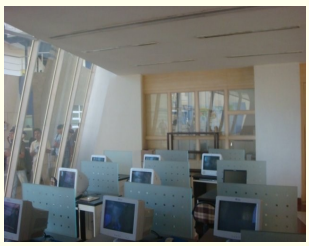
ISSN

Applied Engineering and Technologies

VOLUME 1, ISSUE 1 APRIL-2012

CONTENTS



Published by
Vidyalankar Institute of Technoogy
Wadala, Mumbai, Maharashtra
www.vit.edu.in

VIT

Vidyalankar Institute Of Technology

Vidyalankar Institute of Technology (VIT) is an 'A' grade Engineering degree college approved by the AICTE, the DTE (Maharashtra), and affiliated to the University of Mumbai. Incepted in the year 1999, the Institute has steadily gained recognition and today attracts top talent.

VIT conducts courses in Electronics, Electronics and Telecommunication, Computers, Information Technology and Biomedical Engineering with an average annual intake of 600 students at the undergraduate level. The Institute also conducts Masters in Engineering programs in three disciplines in addition to Masters in Management Studies.

The Institute's mission is to be a leading academic centre that imparts quality education in the fields of Engineering, Technology and Management .The institute aims to facilitate a research environment that is conducive to evolving knowledge and generation and dissemination of new ideas. More information about VIT can be found on www.vit.edu.in.

From the Desk of the Chairman, AICTE

The All India Council for Technical Education encourages all its affiliates to visualize beyond the ordinary in the dissemination of technical education in India. To be in step with our international counterparts, institutes need to focus on application-based pedagogy as well as encourage research activities among faculty and students. Promoting research and fostering strong industry-institute bonds will aid in networking for optimum resource utilization and in sharing best practices.

Technical journals provide intellectual nourishment in engineering academic and professional circles and thereby contribute to creating an environment conducive to research. They help create a research culture in academia and inculcate a habit of expressing ideas in a rational and convincing manner.

Congratulations to Vidyalankar Institute of Technology for coming up with its own technical journal titled '**Applied Engineering and Technologies'.** I am certain, that supported by an astute selection of quality technical research papers, such an initiative will reap rich dividends for the world of academic research and technological development. My best wishes for an enlightening reading experience!

Dr. S.S. Mantha

Foreword

"Provoked by intellect, propelled by values." Guided by this inspiring motto, Vidyalankar Institute of Technology has been taking bold strides ahead in its quest to be a destination for not just budding engineers who can be at par with their global counterparts, but also for research scholars who can push the limits of knowledge beyond existing boundaries.

It is a proud moment indeed for all of us at the Institute to present our very first technical journal titled '**Applied Engineering and Technologies'.** An annual publication, with an issue slated to release every April, the journal will provide a forum for engineering professionals to showcase their research talents and expose them to the use of contemporary tools and the developments in various fields of Engineering. Eminent guest editors and the in-house editorial team comprising highly experienced faculty will ensure that good quality reviewed research papers are included.

The journal, '**Applied Engineering and Technologies'** focuses on applications in the areas of Electronics, Electrical, Telecommunications, Bio-Medical Engineering and Management. The target readers are research students, undergraduate and postgraduate students and practicing upcoming professionals from industry and academia. This will further serve to facilitate their interaction and intellectual exchange of ideas with academia, industry and research personnel and help them to chisel and hone their talents to become better professionals.

VIT has been regularly conducting annual National Conferences, ISTE approved Short Term Training Programs and Technical Workshops over the last three years, which have always generated a buzz, and have witnessed enthusiastic participation from across academia and industry. This initiative takes the Institute one more step forward in realising the dream of being an innovative research-based educational centre, envisaged by its visionary founder Prof. C. S. Deshpande. Through the ideas generated by '**Applied Engineering and Technologies',** we hope to contribute to the thought aptly put forth by Dr. Carl Sagan, "Somewhere, something incredible is waiting to be known..."

Seema Shah

AET - 0001

Information Security System using Multiple Cryptography & Visual Steganography

Atul Oak

Prof. Arun Chavan

atul.oak@vit.edu.in

Vidyalankar Institute of Technology, Wadala

Abstract

In any communication, security is the most important issue in today's world. Lots of data security and data hiding algorithms have been developed in last decade which worked as a motivation for developing a tool that will provide security using cryptography algorithms and a technique called steganography.

Cryptography is the discipline which embodies principles, means and methods for the transformation of data in order to hide its information content, prevent its undetected modification, or prevent its unauthorized use. Cryptography is about communication in the presence of adversaries. A process associated with scrambling plaintext (ordinary text, or clear text) into cipher text (a process called encryption), then back again (known as decryption). The conversion of data into a secret code for protection of privacy using a specific algorithm and a secret key. The original text, or "plaintext", is converted into a coded equivalent called "cipher text" via an encryption algorithm. The cipher text can only be decoded (decrypted) using a predefined secret key.

Steganography is the art and science of writing hidden messages in such a way that no one apart from the intended recipient knows the existence of the message. The outcome of the project is to create a software tool that can effectively hide a message inside image file and encrypting the message. Steganography is a way of protecting information similar to cryptography and watermarking. While watermarking ensures message integrity and cryptography scrambles a message, steganography hides it. The modern steganography can be broken into three categories: pure steganography, secret key steganography and public key steganography. Pure steganography is hiding where no information other than the hiding technique is required as this is sufficient knowledge to be able to retrieve the hidden messages. Other two categories secret key and public key steganography rely on the passing of a key without which the hidden information cannot successfully be extracted.

Using steganography a message is transmitted inside some sort of cover in such a way that a third party looking at the cover is not aware that the hidden message even exist. Project will focus on using color images as a cover.

Problem Statement

In today's information age, information sharing and transfer has increased exponentially. The threat of an intruder accessing secret information always exists in data communication. Cryptography and Steganography are most widely used techniques to overcome this concern. Neither of them alone is secure enough for sharing information over an unsecure communication channel and is vulnerable to intruder attack.

There is need of highly secure system to transfer information over any communication media minimizing the threat of intrusion. In this project an advanced system of encryption data that combines the features of cryptography, steganography along with optional file splitting. This system will be more secure than any other these techniques alone. Visual steganography is one of the most secure forms of steganography available today. It is most commonly implemented in image files. Embedding data into image changes its color frequencies in a predictable way. To overcome this predictability the concept of multiple cryptography is proposed where data will be encrypted into a cipher and cipher will be hidden into multimedia image file in encrypted format. different cryptographic algorithms are used to achieve data encryption and visual steganography algorithm will be used to hide encrypted data. Alteast 3 encryption algorithms will be provided form which one will be selected by user during run time. Additional security in the form of password

validation will be provided so that only authenticated user will be able to access he system. System will be implemented on transmitter & receiver terminal for secure information exchange between the transmitter and receiver for data communication.

Proposed Information Security System based on multiple cryptography & image steganography

A GUI based software application which provides end user the choice of cryptography algorithm & performs the visual steganography.

Developing GUI

The system is a GUI based software system, with facility of menu accessible with keyboard. The GUI will have two main parts the transmitter part & receiver part.

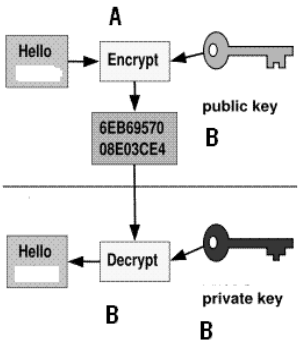
Transmitter will be responsible for encoding of data by encryption of data with cryptography algorithms and further putting encrypted data inside the image.

Receiver part is responsible for extracting data from an image and further decoding of data by decryption of data with cryptography algorithms.

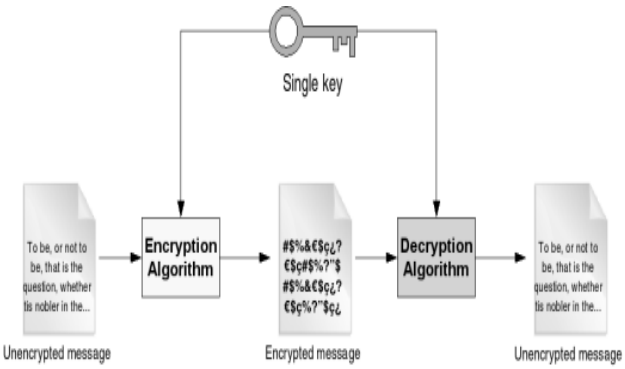
Multiple Cryptographic algorithms – Encryption & Decryption

Symmetric-key cryptography refers to encryption methods in which both the sender and receiver share the same key (or, less commonly, in which their keys are different, but related in an easily computable way). This was the only kind of encryption publicly known until 1976. The encryption key is trivially related to the decryption key, in that they may be identical or there is a simple transform to go between the two keys. The keys, in practice, represent a shared secret between two or more parties that can be used to maintain a private information link.

Asymmetric cryptography, also known as public key cryptography, is a form of cryptography in which a user has a pair of cryptographic keys - a **public key** and a **private key**. The private key is kept secret, while the public key may be widely distributed. The keys are related mathematically, but the private key cannot be practically derived from the public key. A message encrypted with the public key can only be decrypted with the corresponding private key.



In cryptography, a stream cipher is a symmetric cipher in which the plaintext digits are encrypted one at a time, and in which the transformation of successive digits varies during the encryption. An alternative name is a state cipher, as the encryption of each digit is dependent on the current state. In practice, the digits are typically single bits or bytes.



Stream ciphers can be viewed as approximating the action of a theoretically unbreakable cipher, the one-time pad (OTP), sometimes known as the Vernam cipher. A one-time pad uses a *key stream* of completely random digits, a stream cipher uses pseudorandom key stream which is combined with plaintext similar to Vernam cipher. Stream ciphers typically execute at a higher speed than block ciphers and have lower hardware complexity. To be secure, the period of the key stream, that is, the number of digits output before the stream repeats itself, needs to be sufficiently large.

Block ciphers operate on large blocks of digits with a fixed, unvarying transformation. Typically block size of 64 to 128 bits is used. Block stream technique is widely used technique because security provision compared to stream cipher is better. It uses permutation and substitution technique to generate cipher text.

User will be provided with the choice of at least 3 different cryptographic algorithms like triple DES, RC4 etc for encryption or decryption of data.

Visual Steganography

The most common steganography method in audio and image files employ some type of least significant bit substitution or overwriting. The least significant bit term comes from the numeric significance of the bits in a byte. The high-order or most significant bit is the one with the highest arithmetic value (i.e., 2^7=128), whereas the low-order or least significant bit is the one with the lowest arithmetic value (i.e., 2^0=1).

Least significant bit substitution can be used to overwrite legitimate RGB color encodings or palette pointers in GIF and BMP files, coefficients in JPEG files, and pulse code modulation levels in audio files.

Least significant bit substitution is a simple, albeit common, technique for steganography. Its use, however, is not necessarily as simplistic as the method sounds. Only the most naive steganography software would merely overwrite every least significant bit with hidden data. Almost all use some sort of means to randomize the actual bits in the carrier file that are modified. This is one of the factors that make steganography detection so difficult

User Validation

Software system is password protected by user authentication between transmitter & receiver for enhancing the security of the system

Application Areas

This method can be used to increase the security on web based applications. The user will be asked to provide the secret key and the password can be compared from image files using a key. it can be used as advancement over the existing option to input the security phrase in various web based applications. In the case of a secret message being transferred the information can be kept inside a multimedia data which will be the normal cipher which had to be transferred in the normal way. Video files and image streams can also be used to transmit data.

Reference

Book References

- Programming in Java – complete reference
- Cryptography And Network Security Principle And Practice - William Stalling
- Cryptography And Network Security - Atul Kahate

IEEE Papers for project idea

- IEEE Paper on Visual Cryptographic steganography in images 2010
- IEEE Paper on A LSB Steganography Detection Algorithm
- IEEE Paper on New Image Steganography Technique

Web References/Journal References

- B.R. Elbert, Private Telecommunication Networks, Artech House, US, 1989.
- *Telecommunications Management: Network Security*, The National Computer Centre Limited, UK, 1992
- K.H. Rosen, *Elementary Number Theory and its Applications*, 4th Edition, Addison Wesley / Longman, 1999.
- *ISO Dictionary of Computer Science: The Standardized Vocabulary* (23882), ISO, 1997.
- F. Botto, *Dictionary of e-Business*, Wiley (UK), 2000.
- H.M. Deitel, P.J. Deitel, K. Steinbuhler, *e-Business and e-Commerce for Managers*, Prentice-Hall (USA), 2001

AET - 0002

MSA Array Fed High Gain Antenna Using Parasitic Patches on a Superstrate Layer

Rajashree Thakare[1], Shishir J. Digamber[1], Rajiv Kumar Gupta[1]

Electronics and Telecommunication Engg. Dept., Terna C.O.E , Nerul, Navi Mumbai

[1]rajashreeb03@gmail.com,[1]shishir.jagtapd@gmail.com, [1]rajivmind@gmail.com

Abstract

This paper proposes a microstrip antenna array fed high gain antenna using parasitic patches on a superstrate layer for wireless applications. The antenna structure consists of a 2 × 2 microstrip antenna (MSA) array which feeds array of square parasitic patches fabricated on a low cost FR4 superstrate. The patches on superstrate are suspended in air at about λo/2. The metal plated MSA array is fed using corporate microstrip line through a 50 Ω coaxial probe. Spacing between patches in MSA array feed is λ_0. MSA array without superstrate provides 16.0 dB gain but with significant -12 dB side lobes. Side lobes decrease to -15 dB due to superstrate layer. 19.2 dB gain with SLL < -15 dB is obtained when 5x5 square parasitic patches are fabricated on a 1.6 mm thick FR4 superstrate layer. The structure is designed and VSWR < 2 is obtained over 5.725 – 5.875 GHz, ISM frequency band. The antenna provides gain variation of < 1 dB, more than 85 % efficiency over 5.725-5.875 GHz. The proposed structure is suitable for satellite and terrestrial communications.

Introduction

Microstrip antennas (MSA) offer many attractive features such as low weight, small size, ease of fabrication, ease of integration with Microwave Integrated Circuits (MIC) and can be made conformal to host surface. However, they suffer from low gain, narrow bandwidth, low efficiency, and low power handling capability. Broadband techniques have been reported using electromagnetic coupling or stacking the patches [1].

High Gain antennas are realized by line fed antenna arrays or reflectarrays [2]. Line-fed microstrip antenna arrays are planar but have the disadvantages of low efficiency due to line losses and higher cross-polar radiation due to the feed-line network. Reflectarray antennas have been proposed [2-4]. Reflectarrays avoid the feed-line network and can be made flat or conformal. The feed antenna of the reflectarray is located in its radiation aperture which results into aperture blockage. Also, the design of the reflectarray is highly involved and its efficiency is low due to dielectric losses.

Gain enhancement techniques based on Fabry-Perot Cavity (FPC) have been considered to increase broad side directivity. A partially reflecting surface (PRS) formed by single or multiple dielectric layers or a periodic screen at integral multiple of λ/2 above a ground plane is used to increase directivity. The gain of PRS antenna depends on the reflection coefficient of PRS and feed antenna [5-9].

High gain microstrip array using a superstrate layer is proposed but it has the disadvantage of large inter-element spacing and low side lobe level (SLL) [10].Three dimensional efficient directive antenna arrays fed in space using a single feed patch is proposed in [11]. The resulting array is planar and since the feed antenna is located behind the array, there is no aperture blockage but the structure has large thickness, more inter-element spacing and low SLL for small size arrays.

MSA fed high gain antennas using parasitic patches on a superstrate have been reported. These antennas offer high efficiency, low side lobe level and avoid feed network, but these antennas have narrow bandwidth [12-13].

Here gain improvement using MSA array feed and an array of parasitic patches is proposed. The proposed antenna consists of a 2x2 microstrip antenna array which feeds an array of square parasitic patches printed on a FR4 superstrate and positioned at $\lambda_0/2$ from the microstrip antenna. The antenna with 5 X 5 square parasitic patch on finite ground provides more than 85 % efficiency, side lobe level <-15 dB and front to back lobe ratio of more than 20 dB with an associated gain of 19.2 dB. The VSWR is < 2 over 5.725 – 5.875 GHz frequency band.

The following sections deal with the antenna geometry, design theory and simulation results. Radiation pattern and impedance variation of antenna structures on infinite and finite ground plane are also described.

1. Antenna Geometry and Design Theory

A broadside directive radiation pattern results when the distance between the ground plane and PRS causes the waves emanating from PRS in phase in normal direction. If reflection coefficient of the PRS is $\rho e^{j\psi}$ and f (α) is the normalized field pattern of feed antenna, then normalized electric field E and power S at an angle α to the normal are given by [2]

$$|E| = \sqrt{\frac{1-\rho^2}{1+\rho^2-2\rho\cos\phi}} f(\alpha) \quad (1)$$

$$S = \frac{1-\rho^2}{1+\rho^2-2\rho\cos\phi} f^2(\alpha) \quad (2)$$

Where, ϕ is the phase difference between waves emanating from PRS. For the waves emanating from PRS to be in phase in normal direction, resonant distance L between ground plane and PRS is given by [2]

$$L_r = (\frac{\psi_0}{360} - 0.5)\frac{\lambda}{2} + N\frac{\lambda}{2} \quad (3)$$

where ψ0 is phase angle of reflection coefficient of the PRS in degree and N=0, 1, 2, 3 etc.

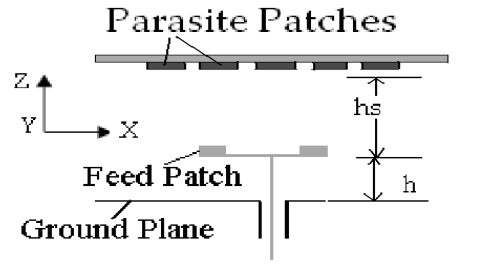
Gain can be increased by using array of parasitic elements on a superstrate layer. High gain broadside radiation can be achieved if the elements are fed in phase. The parasitic elements in an array are fed from the radiating field of microstrip antenna [12-13]. However design of this antenna is tedious as dimensions of different parasitic patch are to be optimised to achieve high gain. Since the parasitic patches are positioned at different location and at different distance from feed patch. Hence feed to each element involves (a) amplitude tapering and (b) phase delay

Beside the amplitude tapering due to distance, there is additional amplitude tapering due to the radiation pattern of microstrip antenna. The amplitude tapering results in decrease in gain but it improves side lobe level.

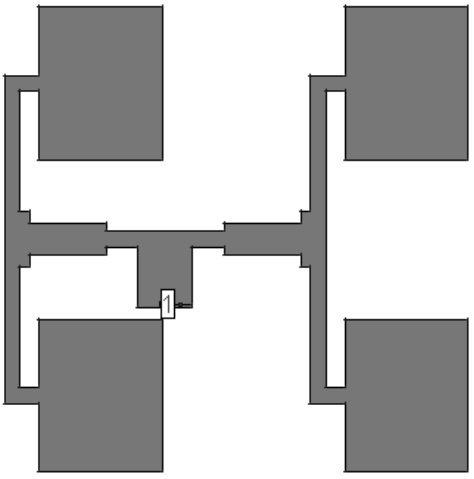
The phase delay in feed to different elements located at different position is compensated by detuning or decreasing the length of an element corresponding to the feed delay so that parasitic elements radiate in phase resulting in directive broadside radiation pattern. However, parasitic patches in the array, which are far from feed patch, receive less feed amplitude. Due to this mutual coupling effect of these elements decreases and they contribute less in radiation. Therefore, MSA array fed high gain antenna is proposed.

A MSA fed high gain antenna using a superstrate layer give rise to a directive beam. Therefore in an array MSA patches can be located at a distance more than λ_0 without any grating lobe. Beside this superstrate helps in reducing side lobe level and cross polarization.

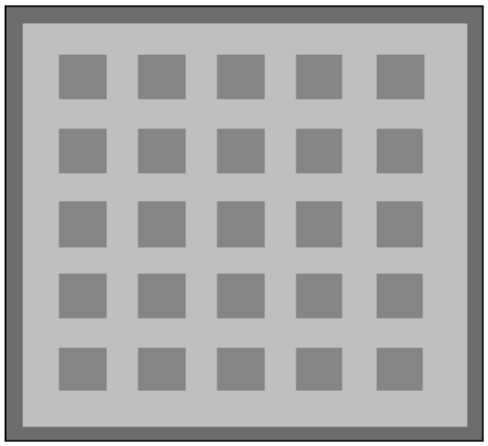
The geometry of the proposed antenna structure is shown in Fig. 1. The MSA array feed consists of corporate microstrip line feed and 2x2 MSA array. The MSA array feed structure is shown in Fig. 1 (c). The feed structure is fabricated using 0.5 mm thick copper plate which is placed at a height h = 2 mm from the ground plane. The square parasitic patches are located at a height 'hs' from the feed patch and fabricated on the bottom side of FR4 superstrate of thickness 1.59 mm. Relative permittivity and loss tangent of this superstrate is 4.4 and 0.02 respectively. The superstrate also acts as a radome to the antenna. To achieve high efficiency air is used as a dielectric medium between feed patch and ground plane and also between superstrate and feed patch. MSA array is fed through a coaxial probe of 50 Ω. The antenna is designed to operate over 5.725 – 5.875 GHz ISM band. All dimensions mentioned here are in mm only. The structures have symmetry about the center and parasitic patches at same distance from the centre have same dimension in E or H plane. The antenna design and optimization have been carried out using commercial IE3D software [18].



(a) Side view



(b) Top view of MSA array feed



(b) Top view of parasitic patches on a superstrate layer

Fig. 1 Geometry of antenna structure

2. Analysis on Infinite Ground Plane

Initially, a metal plated MSA on infinite ground plane with spacing h =2 mm to operate over 5.725-5.875 GHz, ISM band is designed. MSA provides gain of 9.5 dBi. Then a FR4 superstrate layer is placed above it. Gain improves to 11.6 dB Now 2x2 MSA array with

corporate feed is designed and optimised over 5.725-5.875 GHz. The gain improves to 16 dB. However there are 2 grating lobes -4 dB below main lobes. Gain increases and side lobe level or grating lobe level decreases when a superstrate layer is placed on at $\lambda_0/2$ from ground plane. Gain increases to 16.4 dB with -15 dB SLL. The structure is termed as MSA0. 3x3 square parasitic patch array (SPPA) are placed on a superstrate layer. The structure is optimized. The optimum dimensions are h=2, hs=25.9, E1=17 and S1=25.9. VSWR< 2 over 5.7-5.95 GHz and 16.4 dB gain are obtained. Now 5x5 square parasitic patches are placed on the superstrate layer and the structure is optimized. VSWR< 2 over 5.7-5.875 GHz and antenna gain of 19.4 dB is obtained. The optimum dimensions are h=2, hs=25.9, E1=E2 =E3=E4=17, S1=S2=S3=25.9. Impedance variation of MSA0, 3x3 and 5x5 SPPA are shown in Fig. 2. Gain variation of these structures is shown in Fig. 3.

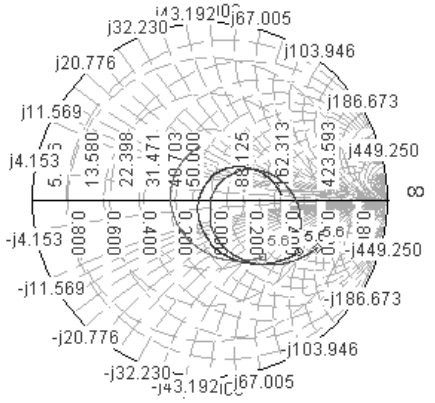


Fig. 2. Impedance variations vs. frequency (MSA0, 2x2, 4x4)

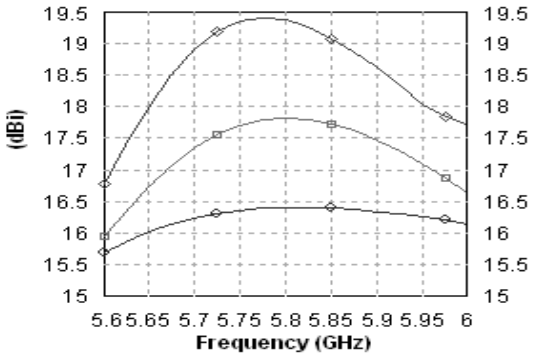
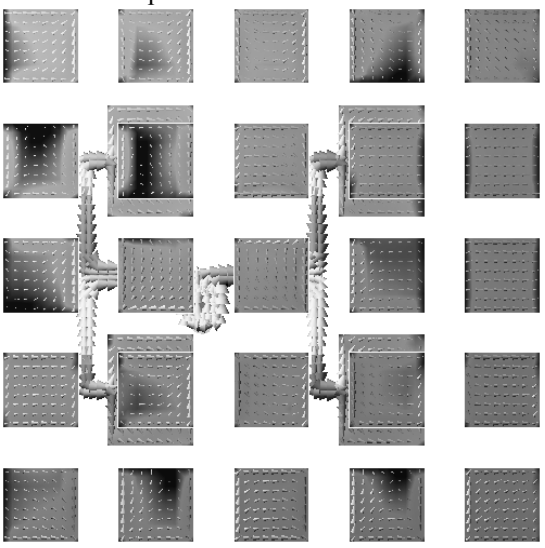


Fig. 3. Gain variations vs. frequency (MSA0, 2x2, 4x4)

Fig. 4 shows average and vector current distribution at the feed and parasitic patches at 5.8 GHz. The current distribution shows that the amplitude of current induced in parasitic patches are nearly in phase and decrease as its distance from feed element increases. The superstrate affects the phase and amplitude distribution of fields. The phase distributions of the fields with a superstrate are observed to be more uniform than one without the superstrate. The superstrate has a focusing or phase smoothening effect and thus increases the effective aperture area, resulting in gain improvement [12-13].

3. Antenna Design on Finite Ground Plane

The MSA array fed 5x5 SPPA structure is redesigned on finite ground plane of size 150mm x 150 mm. The VSWR is < 2 over 5.725 – 5.875 GHz frequency band as shown in Fig. 5 The antenna provides 19.2 dB gain with < 1 dB gain variation over 5.725-5.875 GHz, WLAN band. There is little radiation pattern variation over the entire 5.725-6.4 GHz band. Gain variations of structures on finite and infinite ground are shown in Fig. 6. It is observed that gain increases slightly with finite ground and HPBW decreases. It is due to constructive interference between radiated and reflected waves at particular dimensions of finite ground. The antenna offer more than 85% antenna efficiency as shown in Fig. 7. Radiation patterns on infinite and finite ground are shown in Fig. 8. Radiation patterns are symmetrical in broadside direction. There is little variation in radiation patterns. SLL is < -20 dB and F/B is about 20 dB with < -23 dB cross polarization.



(a) 5.8GHz

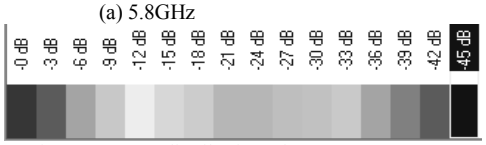


Fig. 4. Current distribution of 4x4 SPPA structure

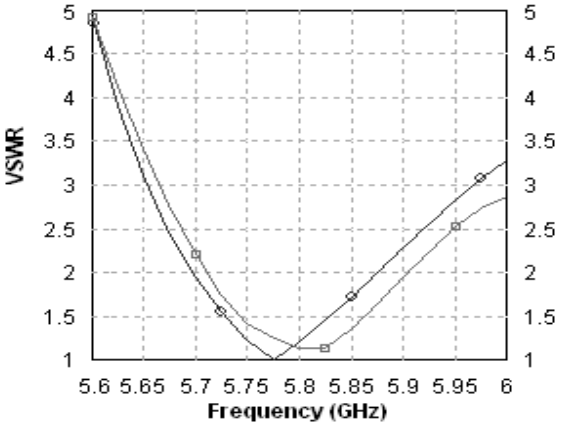


Fig. 5. VSWR vs. frequency (Infinite, Finite Ground)

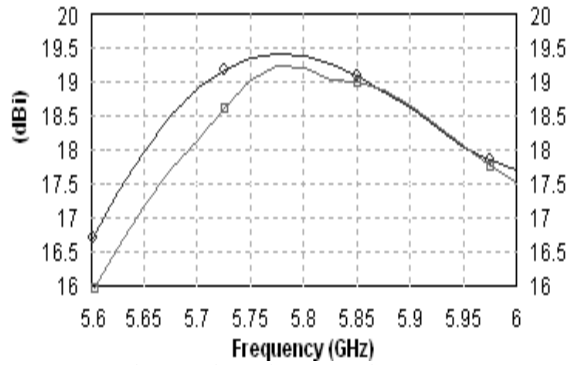


Fig. 6. Gain vs. frequency of 5x5 SPPA
(Infinite, Finite)

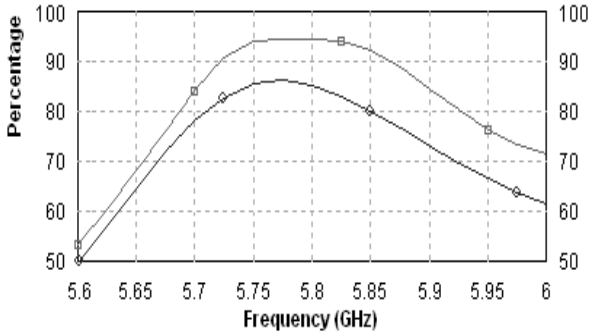
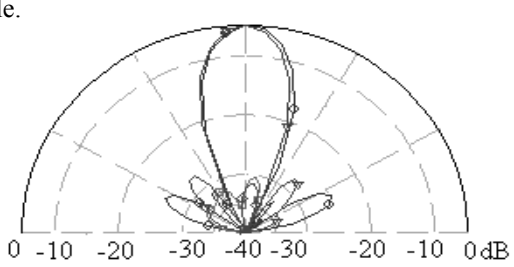


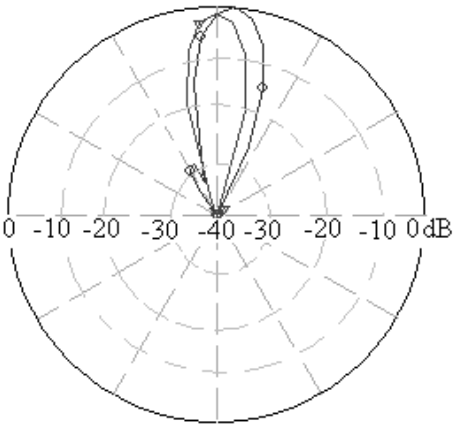
Fig. 7. Antenna efficiency vs. frequency of 5x5 SPPA
(Infinite, Finite)

4. Conclusion

An efficient, high gain, easy-to-fabricate MSA array fed antenna having low SLL and high F/B is proposed. MSA array is placed in a FPC to enhance gain. The MSA array dimension and spacing, parasitic patch dimensions and spacing between parasitic patches, MSA array height and FPC height are the determining factor in improving gain of antenna. The proposed structure is suitable for satellite as well as terrestrial communications and can be embedded into the host vehicle.



(i) 5.8 GHz
(a) Infinite ground plane



(i) 5.8 GHz
(b) Finite ground plane
(Eθ EΦ at Φ = 0° and
Eθ EΦ at Φ = 90°)

Fig. 8. Radiation patterns of 5x5 SPPA antenna

5. References

[1] G. Kumar and K P. Ray, Broadband Microstrip Antennas, Norwood, MA Artech house, 2003.

[2] D.M. Pozar, S.D.Targonski, and H. Syrigos, Design of millimeter wave microstrip reflectarrays", IEEE Trans. Antennas Propagat., vol. AP-45, no.2, pp.287-295, Feb. 1997.

[3] R. D. Javor, X.D. Wu, and K. Chang, "Design and performance of a microstrip reflectarray antenna", IEEE Trans. Antennas Propagat., vol. AP- 43, no.9, pp.932-939, Sept. 1995.

[4] J. Huang, and R. J. Pogorzelski, "A Ka band microstrip reflectarray with elements having variable rotation angles", IEEE Trans. Antennas Propagat., vol. AP46, no.5, pp.650-656, May 1998.

[5] G. V. Trentini, Partially reflecting sheet arrays, *IRE Trans. Antennas Propag.* 4, 1956, pp. 666–671.

[6] A. P. Feresidis and J. C. Vardaxoglou, High gain planar antenna using optimized partially reflective surfaces, *IEE Proc. Microw. Antennas Propag* 148, 2001, pp. 345–350.

[7] Renato Gardelli, Matteo Albani, and Filippo Capolino, Array thinning by using antennas in a Fabry–Perot Cavity for gain enhancement, *IEEE Trans. Antennas Propag* AP- 54, 2006, pp. 1979–1990.

[8] Antonije R. Djordjević and Alenka G. Zajić, Optimization of resonant cavity antenna, European Conference on Antennas and Propagation, 2006.

[9] E.A. Parker, "The gentleman's guide to frequency selective surfaces", *17th Q.M.W. Antenna Symposium,* London, April 1991.

[10] W. Choi, Y.H. Cho, C. Pyo and J. Choi, High Gain Microstrip Patch Array Antenna using a Superstrate Layer, ETRI journal,Vol. 25, no.5, Oct. 2003.

[11] P.N.Chine and Girish Kumar, "Three Dimensional, Efficient, Directive Microstrip Antenna Arrays," IEEE *Int. Symposium Antenna and Propagation.* Washington DC., July 2005.

[12] R. K. Gupta and J. Mukherjee, Low cost efficient high gain antenna using array of parasitic patches on a superstrate layer, *Microw. Opt. Technol. Lett.* 51, 2009, pp. 733– 739.

[13] R. K. Gupta and J. Mukherjee, Effect of superstrate material on a high gain antenna using array of parasitic patches, *Microw. Opt. Technol. Lett.* 52, 2010, pp. 82– 88.

[14] Zhi-Chen Ge, Wen-Xun Zhang, Zhen-Guo Liu,Ying-Ying Gu, Broadband and High gain printed antennas constructed from Fabry- Perot resonator structure using EBG or FSS cover, *Microw. Opt. Technol. Lett.*, 48, 2006, pp. 1272–1274.

[15] H. Legay and L. Shafai, A new stacked microstrip antenna with large bandwidth and high gain, *Proc. IEEE AP-S Int. Symp.*, 1993, pp. 948–951.

[16] Egashira S., Nishiyama E., Stacked microstrip antenna with wide bandwidth and high gain, *IEEE Trans. Antennas Propag,* 44, 1996, pp. 1533-1534.

[17] Lee R.Q., Lee K.F., Experimental study of two layer electromagnetically coupled rectangular patch antenna, *IEEE Trans. Antennas Propag.*, 38, 1990, pp. 1298-1302.

[18] IE3D release 12.0, Zeland software Inc., Fremont, CA., USA, 2006.

AET - 0003

Performance Analysis of Polarization Effect for Orthogonal and Random State in WDM Systems

Chaya.S[1] Lecturer
Department of Electronics and Telecommunication
MGM's College of Engineering and Technology
Navi Mumbai, India
[1] *chaya.ravindra@gmail.com*

Savita R. Bhosale[2] HOD
Department of Electronics and Telecommunication
MGM's College of Engineering and Technology
Navi Mumbai, India
[2] *svtbhosale@yahoo.co.in*

Abstract

Nonlinear interaction between signal channels may result in significant performance degradation in dense wavelength-division-multiplexing (WDM) transmission systems operated at high bit rates. In this paper, we report that the nonlinear crosstalk for systems with high spectral efficiency can be suppressed if WDM channels are launched with orthogonal relative states of polarization.In this architecture the data is send by wdm techniques from transmitting end & the effect of polarization seen on channel spacing is 50Ghz and they are generated in groups by odd and even channels by PBRS generator.All the even channels before being multiplexed with odd channels are passed through the polaization shifter which rotates the polarization shifter by Orthogonal and Random Polarized state.After multiplexing the signal is Launched into a fiber & then is de-multiplexed and sent to 8 receiver followed by BER Tester,Eye Diagram to measure channel performance for given polaization state difference between adjacent channels.For different polarization state Orthogonal and Random Polarized state.

Keywords PBRS; WDM; Eye Diagram; Nonlinear Interaction; Quality-Factor; Orthogonal State, Random State

Introduction

The main advantage of the optical fiber communications are the high speed, large capacity and high reliability by the use of the broadband of the optical fiber. So to be able to take the full advantage of the speed in optical fibers one of the basics concepts in fiber optic communication is the idea of allowing several users to transmit data simultaneously over the Since the first wires were laid for telegraphs in the 1800's, the drive has been to increase the amount of information that can be sent in a given interval. In the early years of telegraphs, telephones, and other telecommunications, the simple and obvious solution was to add more lines of communication. The increased cost of wire-laying and maintenance quickly built up however, and a new answer to the problem had to be invented. The answer was multiplexing, in which more than one signal is sent over the same line

1. Types of Multiplexing Techniques

1.2 Time Division Multiplexing

In TDM, the transmission capacity of a communications channel is logically divided into time frames of equal duration. Each time frame is further divided into a set of n time slots. This scheme by itself cannot hope to utilize the available bandwidth because it is limited by the speed of the time multiplexing and demultiplexing components

1.3 Wavelength Division Multiplexing:

First WDM systems only combined two signals. Modern systems can handle up to 160 signals and can thus expand a basic 10 Gbps fiber system to a theoretical total capacity of
over 1.6 Tbps over a single fiber pair. WDM systems are popular with telecommunications companies because they allow them to expand the capacity of the network without laying more fiber. By using WDM and optical amplifiers, they can accommodate several generations of technology development in their optical infrastructure without having to overhaul the backbone network. Capacity of a given link can be expanded by simply upgrading the multiplexers and demultiplexer at each end. This is often done by using optical-to-electrical-to-optical (O/E/O) translation at the very edge of the transport network, thus permitting interoperation with existing equipment with optical interfaces. Most WDM systems operate on single mode fiber optical cables, which have a core diameter of 9 µm. Certain forms of WDM can also be used in multimode fiber cables (also known as premises cables) which have core diameters of 50 or 62.5 µm Early WDM systems were expensive and complicated to run.
However, recent standardization and better understanding of the dynamics of WDM systems have made WDM less expensive to deploy.

In a simple WDM system (Figure), each laser must emit light at a different wavelength, with all the lasers' light multiplexed together onto a single optical fiber. After being

transmitted through a high-bandwidth optical fiber, the combined optical signals must be demultiplexed at the receiving end by distributing the total optical power to each output port and then requiring that each receiver selectively recover only one wavelength by using a tunable optical filter. Each laser is modulated at a given speed, and the total aggregate capacity being transmitted along the high-bandwidth fiber is the sum total of the bit rates of the individual lasers. An example of the system capacity enhancement is the situation in which ten 2.5-Gbps signals can be transmitted on one fiber, producing a system capacity of 25 Gbps. This wavelength-parallelism circumvents the problem of typical optoelectronic devices, which do not have bandwidths exceeding a few gigahertzes unless they are exotic and expensive. The speed requirements for the individual optoelectronic components are, therefore, relaxed, even though a significant amount of total fiber bandwidth is still being utilized

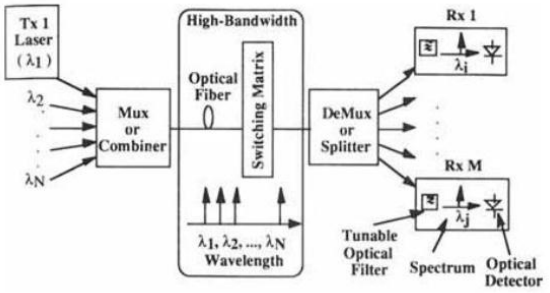


Figure 1.Simple Block Diagram of WDM

The concept of wavelength demultiplexing using an optical filter is illustrated in Figure 2. In the figure, four channels are input to an optical filter that has a no ideal transmission filtering function. The filter transmission peak is centered over the desired channel, in this case, l3, thereby transmitting that channel and blocking all other channels. Because of the non-ideal filter transmission function, some optical energy of the neighboring channels leaks through the filter causing inter-channel, inter-wavelength cross-talk. This cross-talk has the effect of reducing the selected signal's contrast ratio and can be minimized by increasing the spectral separation between channels. Although there is no set definition, a non-standardized convention exists for defining optical WDM as encompassing a system for which the channel spacing is approximately 10 nm.

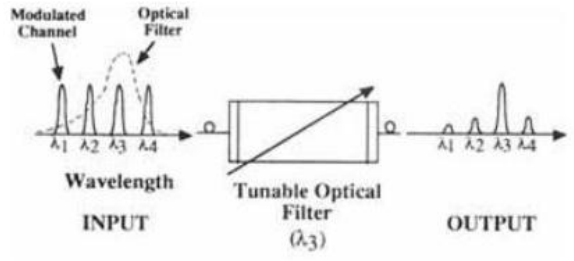


Figure 2 Optical WDM channels being demultiplexed by an optical amplifier

Self-Phase Modulation and Cross-Phase Modulation

The nonlinearities discussed in this section and the next all owe their origin to the fact that the index of refraction of an optical
fiber varies nonlinearly with signal power

$$n = n_{\text{linear}} + \overline{n}_2\left(\frac{P}{A_{\text{eff}}}\right)$$

where $\overline{n}_2$ is the nonlinear index coefficient (3.2×10^{16} cm^2/W for silica fiber), n_{linear} is the linear index of refraction, P is the optical power, and A_{eff} is the cross-sectional mode area.

Since the local refractive index is a function of the optical intensity of a propagating signal, a nonrectangular-shaped optical pulse will experience a varying refractive index depending on the optical power at each temporal location. As we know, the speed of an optical wave within a medium is dependent on the refractive index. Therefore, the varying refractive index will then cause the different intensities to propagate at different speeds along the fiber. Thus, optical power fluctuations are converted to phase fluctuations. This phase shift causes the pulse to temporally disperse in the fiber and limits transmission distance and signal speed.

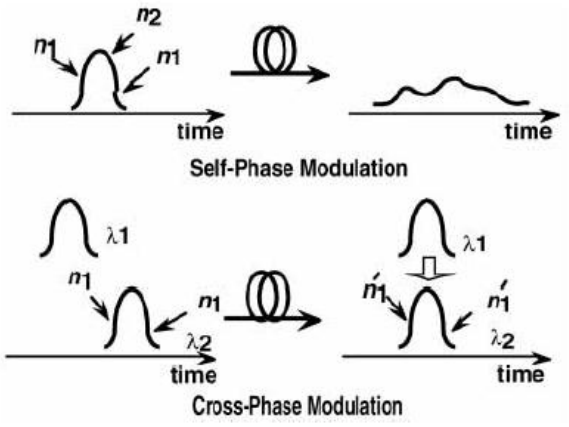


Figure 3. Pulse broadening due to SPM and XPM.

This effect for a single optical pulse is known as self-phase modulation (SPM) and will distort a transmitted optical pulse as shown in Figure 3 Note that both temporal and spectral broadening result from this nonlinearity.

To mitigate the effects of crosstalk in WDM networks, the following techniques have been proposed:

- **Architecture dilation**. Purposely introducing fiber delays (on the order of a bit time) between different crosstalk paths decorrelates the bit pattern of the main signal from the interfering signals and places some of the crosstalk power in the "0" bits of the main signal instead of the "1" bits.
- **Low-coherence light sources**. Using *light-emitting diodes* (LEDs) or *chirped distributed feedback*

lasers (DFBs) with coherence times less than a bit time can reduce coherent crosstalk, but the impact of dispersion would become more critical

- **Polarizatio scrambling or modulation.** Polarization scrambling reduces the effect of coherent crosstalk, since interference between the crosstalk and signal decreases when their polarization states are not matched
- **Phase modulation**. Modulating the phase of the signal at a rate greater than the bit rate averages out the crosstalk and improves performance, since signal degradation depends on the relative phase between the signal and crosstalk

I. CIRCUIT DIAGRAM

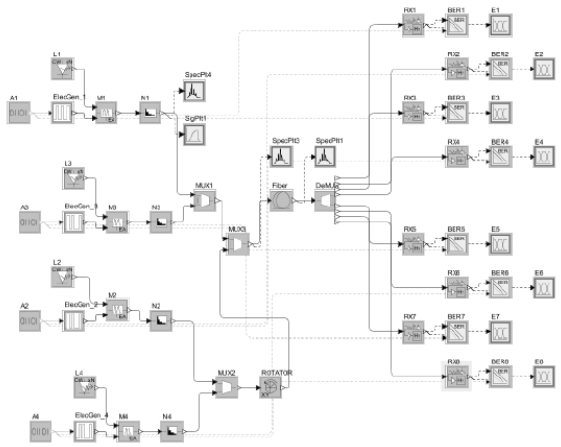


Figure 4: Simulation setup for polarization dependence studies

The simulation setup for showing the effect of polarization by changing the fiber length and polarization angle on WDM is shown in figure 2. The continuous wave laser is used to create the carrier signal. In this setup, four users are taken in account whose wavelengths have a specific difference i.e. spacing between them. The wavelength of first user is kept at 1537.4GHZ. The wavelengths of next users are set as the spacing of 50 GHZ. The data source is used to generate the random input data bit sequence at the rate of 10 Gbps. The light signal modulates the input data. The modulator is driven by the modulator driver which decides the input data format. The input data format used here is NRZ Rectangular. The modulated data from odd channel users is combined using a multiplexer and the modulated data from even channel users is multiplexed and sent to polarization rotator. After that the output of MUX from odd channels and polarization rotator is combined by multiplexer and is sent over different fiber lengths as 75 km,85 km and 45km All the attenuation, dispersion and non linear effects are activated. At the receiver, the signal is demultiplexed and sent to 8 receivers followed by BER Tester to measure channel performance (BER and Q-factor) for given polarization state difference between adjacent channels. Initially all channels have the same polarization state. A BER Tester is attached at the output of receiver to examine the BER and Q-factor of input signal.

2. Results and Discussions

Using simulation setup, the value of BER, Q-factor, eye diagrams, input optical spectrum of odd and even channels are measured. Optical scope measures the input and output wavelength spectrums. BER and Q-factor is measured at the receiver output by using a BER Tester. Eye diagram is seen by using an eye diagram analyzer. Here following points are discussed for one odd channel and one even channel for different length of fiber and different channel spacing at random polarization Figure 5 shows the eye diagrams for the even and odd channels. The eye opening in odd channels is better than even channel. In Polarization State for Fiber Length of 75 km, the polarization angle is scanned from 0 to 180 degrees with 5 degrees step and Q-factor is measured versus polarization angle. Figure 4 shows results for one odd (chanel1) and **Figure 5** for one even channel (chanel2).As the polarization angle varies from 0-90 degree, BER will increase and Qfactor will be reduced as shown in fig 3.4. At 90 degree, BER is minimum and Q-factor is maximum. If polarization angle is increased further, BER will start increasing and Q-factor will start decreasing as shown in **fig 3.4**. It is also observed that Q-factor is more in case of odd channel at zero polarization angle

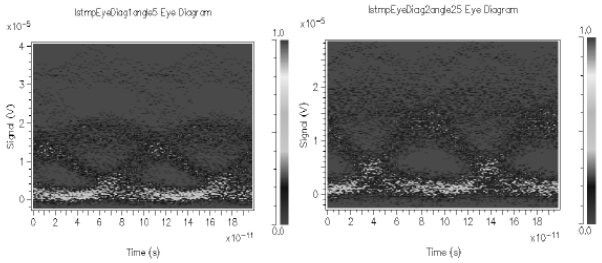


Figure 5: Eye diagrams of odd and even channels

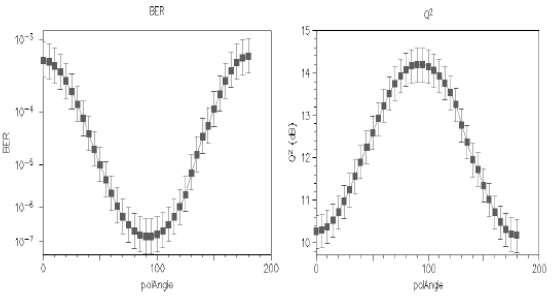


Figure 6: BER and Q-factor versus polarization angle for Odd channel (channel-1)

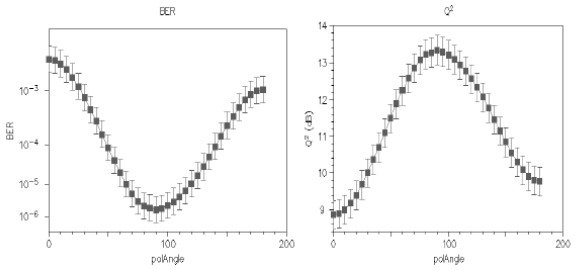


Figure 7.BER and Q-factor versus polarization angle for even channel (channel-2)

Estimation of BER and Q-factor

Length of Fiber (in km)	Channel number	Polarization Angle					
		0 degree		90 degree		180 degree	
		BER	Q2 dB	BER	Q2 dB	BER	Q2 dB
45	Chann-1	2.065e-318	31.62	2.8256e-312	31.540	00	63.00
	Chann-6	8.16e-238	30.34	1.0421e-266	30.849	8.1034e-239	30.365
75	Chann-1	1.3e-08	14.90	1.23e-09	15.511	1.1593e-08	14.943
	Chann-6	1.8e-08	14.81	5.5e-09	15.139	2.5e-08	14.729
85	Chann-3	5.7568e-05	11.72	7.104e-05	11.606	5.9e-05	11.701
	Chann-6	2.4e-04	10.85	1.4209e-04	11.196	2.8713e-04	17.40

Table: BER and Q-factor observation at different length of fiber at even channel (un-polarized channel) and odd channel (polarized channels).

3. Conclusion

Performance analysis of polarization effect in WDM system for different values of fiber length and polarization angle is presented. The comparison of polarization effect at various values of fiber length and polarization revealed that as we increase the length of the filter, the bit error rate will increase and eye opening will also decrease and the Quality-Factor will be reduced. In both even and odd channels, the Quality-Factor is minimal for polarization angles equal to 0 or 180 degrees, i.e. when all channels have parallel polarization states; and Quality Factor has maximum at 90 degrees, i.e. when adjacent channels polarization state is orthogonal to each other. The BER has minimum value at 90 degree, i.e. when adjacent channels polarization state is orthogonal to each other. It is also observed the spectrums of even and odd channels During this simulation, it is observed that at 90 degree polarization angle, minimum BER and maximum Quality-Factor can be achieved. If the effect of polarization is studied at different fiber lengths, as the length of fiber increases the BER also increases but Quality-Factor decreases. This result holds that the polarization angle is independent of the length of fiber, i.e. for any length of fiber the effect of polarization is minimum at 90 degree. Using this, the receiver model can be improved using realistic filter shapes and to account for noise re-polarization during transmission. The communications industry is at the onset of new expansion of WDM technology necessary to meet the new demand for bandwidth.

4. References

[1] Tomoaki Ohtsuki and Iwao Sasase, ¯Optical Synchronous CDMA, Encyclopedia of Telecommunications. Editor: John Proakis, Wiley, 2002.

[2] Don Warren and Justin Moore, ¯Multiplexing in Fiber Optic Connections., Summer Ventures in Science and Mathematics, 2001

[3] Diptish Dey, ¯Theory towards an all optical WDM slotted ring MAN with support for optical multicasting.,Ph.D. Thesis, University of Twente, June 2003, available at http:/www.tup.utwente.nl/.

[4] "Photonic Networks- Advances in Optical Communications" Written by Giancarlo Prati (Ed.)

[5] "Optical Fiber Communication Systems" Written by Leonid Kazovsky, Sergio Benedetto & Alan Wilner Permission was granted to use figures from this book.

[6] Bergano, N.S. and C.R. Davidson ¯ Wavelength division multiplexing in long haul transmission systems. Journal of Lightwave technology, Vol.14, No.6, 1996, pp. 1299-1308.

[7] KEETON, S., et al. ¯ Enabling next generation optical networks with forward error correction. National Fiber Optic Engineers Conference, 2001, pp. 54-59.

[8] ITU-T Recommendation G.694.2, ¯Spectral grids for WDM applications: CWDM Wavelength grid., June 2002.

[9] Jane M. Simmons, AT&T Labs – Research, 100 Schulz Drive, Red Bank, NJ 07701, Architectural Advantages of WDM Technology in Access Networks.

[10] T. Ivan Lima Efficient Computation of Outage Probabilities Due to Polarization Effects in a WDM System Using a Reduced Stokes Model and Importance Sampling IEEE photonics technology letters, vol. 15, no. 1, January 2003.

AET – 0004

Remote Monitoring System Based on Embedded Web Server

Sneha Mane [*1], Alka Khade[*2], Kanchan Gorde[*3]

[1] *Student, ME(ELX), Terna Engineering College, nerul, Navi Mumbai.*
[2] *Professor, Terna Engineering College, nerul, Navi Mumbai.*
[3] *Professor, Terna Engineering College, nerul, Navi Mumbai.*
[1]*snehamane1986@yahoo.com* [2] *khadealka@gmail.com* [3] *gordekanchan@yahoo.co.in*

Abstract

This is a guide to designing and programming embedded systems to communicate in local Ethernet networks and on the Internet. Ethernet is the networking technology used in many offices and homes to enable computers to communicate and share resources. Many Ethernet networks also connect to a router that provides access to the Internet.

For many years, embedded systems and Ethernet networks existed in separate worlds. Ethernet was available only to desktop computers and other large computers. Embedded systems that needed to exchange information with other computers were limited to interfaces with low speed, limited range, or lack of standard application protocols.

But developments in technology and the marketplace now make it possible for embedded systems to communicate in local Ethernet networks as well as on the Internet. Network communications can make an embedded system more powerful and easier to monitor and control. An embedded system can host a Web site, send and receive e-mail, upload and download files, and exchange information of any kind with other computers connected via a network interface.

Keywords— Embedded internet, Web server, monitoring system, embedded devices.

1. Introduction

With the success of the Internet, the TCP/IP protocol suite has become a global standard for communication. TCP/IP is the underlying protocol used for web page transfers, e-mail transmissions, file transfers, and peer-to- peer networking over the Internet. For embedded systems, being able to run native TCP/IP makes it possible to connect the system directly to an intranet or even the global Internet. Embedded devices with full TCP/IP support will be first-class network citizens, thus being able to fully communicate with other hosts in the network.

2. Background Overview

The demand for Internet-connected products is growing. According to International Data Corporation, the industry analyst group, the market for Internet-connected goods will be worth around $170.8 billion by 2012. More and more the Internet is seen as the most cost-effective way of remotely monitoring and controlling embedded systems. With the availability of standards -based embedded enabling technology at low cost the entry level for companies looking to gain benefit from Internet -connected technology has been significantly lowered.

Fig.1 Network interface card

Fig.2 RJ45 Connector

I. APPLICATION AREAS

While the often-cited refrigerator that reorders the milk when it runs low is likely remain pure fantasy for a while at least, many more applications providing much greater added value are beginning to be realized.

In particular, three market areas are providing the bulk of the emerging applications. Above figure shows where to expect most application activity…

1) Home appliances
2) Automated Plant facilities
3) Commercial Security systems

While Internet enabled appliances in the home, such as video door phones, Web TV, interactive toys, intelligent lighting, refrigerators and microwave ovens will gain the most "visibility", it is the commercial surveillance, access and control security systems and industrial remote monitoring and control systems where most value will be gained.

Embedded systems are generally located remotely from the people that service them. Monitoring their operation, whether to collect data, check performance or upgrade application software can be a costly and time-consuming process. Traditionally, this has been done through manual inspection or through the implementation of a very costly proprietary network for remote access.

The ability to remotely manage a system or device via the Internet offers several benefits. A device can trigger an alarm when operation thresholds are approached. This warning means that service technicians need only make calls to devices that require attention and perform the necessary remedial action required to correct the situation before greater damage occurs.

Embedded Internet devices can also collect statistics for inventory (for automatic restocking) and performance data for comparing the performance of one device with another.

3. Why TCP/IP?

Why has TCP/IP become the de facto standard for Internet communications? TCP/IP is a very well proven architecture. A large number of users are very familiar with it and it is supported by a lot of existing tools. Significantly TCP/IP is an open standard; its specification is free to whoever wishes to use it and being open is not linked to any vendor.

It is a universal protocol available on a wide range of platforms and is used throughout the world on a range of physical networks. Add to this the fact that it is both easy to set-up and start-up, provides low cost and reliable communications, offers a dynamic routing capability and a remote network and equipment management capability.

4. The Embedded TCP/IP

The Internet is essentially a massive web of powerful interconnected networks that has virtually unlimited processing capability and storage capacity to handle the billions of messages that pass through it each day. Implementing TCP/IP on standard network nodes has little or no impact in terms of resource overhead, CPU power and memory allocation. This is a far cry from designers trying to Internet-ready consumer or industrial products. Here the implementation of the TCP/IP stack is very sensitive, both in cost and space terms. Often the designer has limited processing power at his disposal and only a meager few Kbytes of Flash RAM and ROM available in which to implement the TCP/IP protocols.

The use of additional modules that take care of the TCP/IP stack are usually out of the question – either they cost too much or take up too much space to be viable. The only realistic approach is that of an embedded TCP/IP implementation. This can be done either in software or hardware depending on the functionality required and the design environment available.

Either way, it is highly user configurable and negates the need for an additional external TCP/IP module.

II. The Working Flow

The followings are the various steps for the working flow of above proposed system…

The system will be consisting of the following major sections...

AR M 7 Processor,
The Network Interface Card,
LAN Connection through RJ45,
Relays for Device Switching,
TCP/IP Protocol for Embedded Systems,
HTTP Protocol for Web Server Application,
HTML Based Web Page Design.

The controller will continuously monitor the various physical parameters of the system.

The values will be updated inside the web page of the controller.

Whenever user sends a browsing request from internet or local LAN; it will be forwarded.

User can also control various relays just by sending predefined commands from the browser itself.

5. The Proposed System

5.1 Block Diagram

The Block Diagram of the system is attached behind.

5.2 Explanations of Blocks

The following are the brief explanations of the working principle of the various major blocks or sections used in the system…

1) *Power Supply*: This unit will supply the various voltage requirements of each unit. This will be consists of transformer, rectifier, filter and regulator. The rectifier used here will be Bridge Rectifier. It will convert 230VAC into desired 5V/12V DC.

2) *ARM7 Processor:* This unit is the heart of the complete system. It is actually responsible for all the process being executed. It will monitor & control all the peripheral devices or components connected in the system. In short we can say that the complete intelligence of the project resides in the software code embedded in the Microcontroller. The code will be written in Embedded C and will be burned or programmed into the code memory using a programmer.

3) *ADC 8-bit*: This unit is one of most important unit in embedded system which is inbuilt in ARM7 to understand various analog parameter incoming from transducers. The job of this section is to convert analog input signals (voltages) into its equivalent digital (decimal) value.

4) *555 Timer:* The 555 monolithic timing circuit is a highly stable controller capable of producing accurate time delays, or oscillation. Here we are using it in Astable Multivibrator mode for generating clock pulses. The frequency depends upon the external register connected to the IC.

This unit requires +5VDC for it proper operation.

5) *Relay Driver:* As microcontroller cannot supply more current to driver high current sinking device; we will use relay driver circuit to drive the relays. We will use ULN2803 IC for this purpose. It has in built 8 Darlington Pairs to drive 8 channels each of 300mA. Also it can bear up to 50V.

This unit requires +12VDC for it proper operation.

6) *Relay:* A relay is a simple electromechanical switch made up of an electromagnet and a set of contacts. Here we are using SPST (Single Pole, Single Throw) Type Relay. It will be used to switch ON OR OFF the electrical path between two contacts.

This unit requires +12VDC for it proper operation.

7) *Temperature Sensor LM35:* The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 does not require any external calibration or trimming to provide typical accuracies. This is 3 leg IC that directly gives analog output.

This unit requires +5VDC for it proper operation.

8) *Humidity Sensor*: This sensor will be used to sense the environmental moisture content in percentage. This will give analog output which will be fed to the ADC unit for digital conversion. The output is linear to the humidity level.

This unit requires +5VDC for it proper operation.

A. Technology & Programming Languages

As microcontrollers are the core of these days digital circuit design in industry, this system uses it for the centralized operation and digital processing. The technology used here is embedded technology which is the future of today's modern electronics.

The followings are the various Programming Languages & Technologies that are going to be used in the proposed system…

Embedded Technology,
ARM7 Processor,
Embedded C - Keil Compiler,
Eagle Software for PCB Designing,

B. Project Development Methodology or Steps

The following will be development steps so as to achieve the working Prototype Model of the above proposed system…

Defining the Problem,
Understanding the Need & Usability in industry and society (Market Analysis),
Developing Block Diagram,
Designing Circuits of individual blocks,
Testing circuits in LAB & Finalizing,
Developing PCB on PC,
Getting the PCB printed from market,
Soldering the components,
Performing various Basic Experiments to test the PCBs,
Developing Flowchart for the entire process,
Writing actual Software Program,
Compilation & Burning,
Testing and Debugging,
Finally Running the system and,
Documentation.

6. Scope & Applications

Only the imagination can limit the applications of the above proposed system. Though the following are some examples…

- The Remote controller kit is ideal for the simplest home automation applications, such as power control. Here the user can turn on lights, switch on fans; turn on an electric oven while sitting at a PC in the office

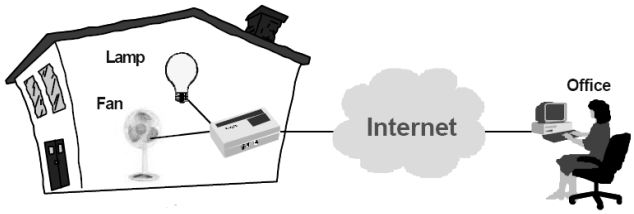


Fig. 3 A simple application allowing remote control of lighting and other power circuits in the home

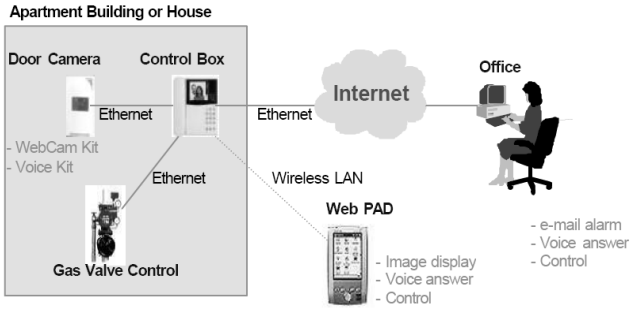


Fig. 4 Combining the voice and webcam kits to provide a higher level of home automation

The intelligent vending machine is also an excellent application example. The majority of vending machines in the world are maintained and replenished to set schedules – every few days, once a week. If the contents of a particular machine reach a certain level, the delivery

service company is alerted and stocks can be quickly replenished. This kind of "Just-in-time" approach provides a significant improvement service for the users of the machine. Similarly, if a fault occurs on a machine, the server can alert the maintenance company who can send an engineer immediately to the site and rectify the problem.

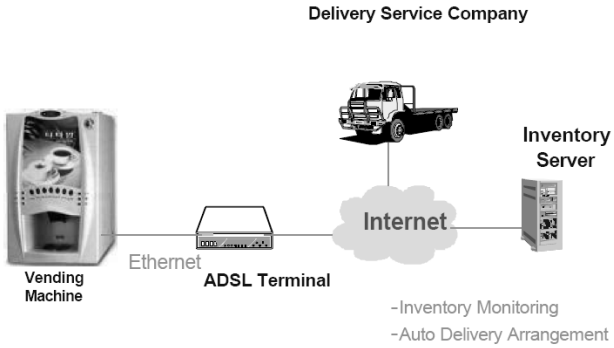


Fig. 5 The intelligent vending machine

Other areas of use include:

Metering and data gathering.

Remote maintenance and diagnostics.

Internet text TV – converting an existing CRT TV into an Internet enabled one without having to change the motherboard.

LCD display systems – for example a real-time message service at a railway station.

Intelligent buildings – connecting all air conditioners to a central controller.

7. Conclusion

The market for Internet-ready products has been hampered by the lack of low-cost enabling technology solutions that would allow designers to achieve realistic Internet our project remove these restraints, providing the means to easily connect any embedded Internet application to various physical networks such as PSTN, GPRS, LAN and serial links. An extensive range of development and application boards provides a choice of unique hardware or software implementations of the TCP/IP protocol stack needed to establish Internet communications.

By the realization of the above proposed system one can learn many aspects of a digital electronics circuit. This will give the complete knowledge of designing microcontroller based systems.

References

[1] Andrew S. Tanenbaum, *Computer Networks*, 4th Edition.

[2] Guangjie Han, Mo Guan, Hai Zhao, "EWS: Providing Internet Connectivity for non-PC Devices", *Proceedings of 2004 IEEE International Conference on Networking, Sensing and Control*, Taipei, Taiwan, March, 2004, pp. 349–354.

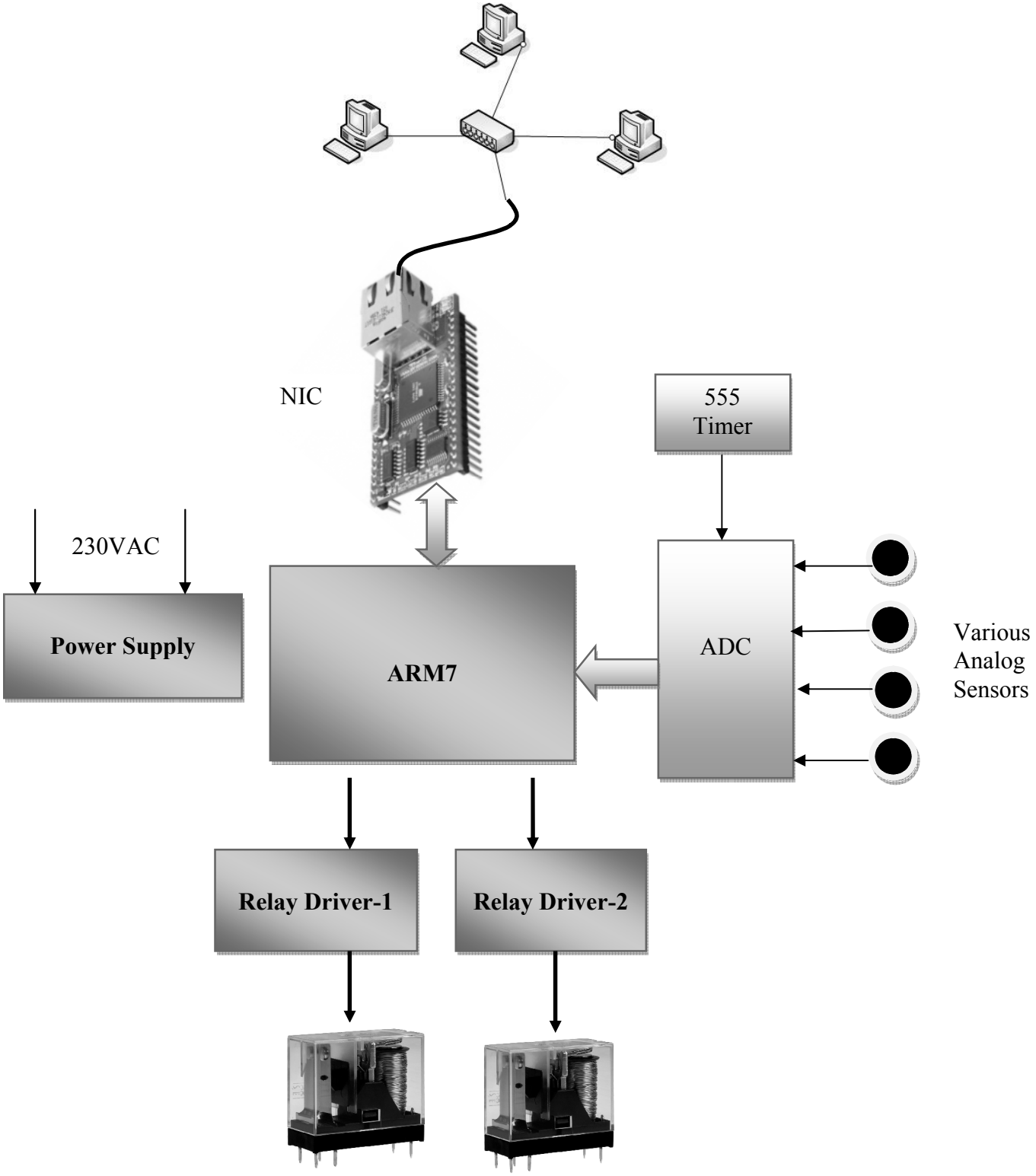
[3] Mo Guan, Guangjie Han, Hai Zhao, "The Embedded Internet Technology Based on a Real-Time Kernel for non-PC Devices", *Proceedings of 2004 IEEE International Conference on Networking, Sensing and Control*, Taipei, Taiwan, March, 2004, pp. 343–348.

[4] N. Ishizumi, K. Saisho, and A. Fukuda, "A design of flash memory file system for embedded systems", Proceedings of Systems and Computers, Japan, 2004, pp. 91–100.

[5] Behrouz A.Forouzan, Sophia Chung Fengan, "TCP/IP Protocol Suite", Beijing: Tsinghua University Press, 2000.

[6] The IEEE website. [Online]. Available: http://www.ieee.org/

THE SYSTEM BLOCK DIAGRAM



AET - 0005

Solutions to Minimize Radiation Hazards from Mobile Phones

Saritha L R
Assistant Professor,
Department of Information technology,
SIES GST, Nerul,
Navi-Mumbai, India.
sarithalr@gmail.com

Abstract

Mobile phones use electromagnetic waves that are propagated through space to carry information. Mobile phone electromagnetic radiation can result in thermal and non-thermal effects. Studies show that exposure to the electromagnetic wave for a certain period of time will leads to health problem such as headaches, or even worse, brain cancer. There are two sources of RF exposure from the mobile phone system: base station antennas and the mobile phone or handset. Exposure from the base station antennas is continuous but very low, irradiates the whole body and exposes an entire community. The radiation from the cellular phone, which is in close proximity to the user, is of special interest for this matter. This paper proposes a new handover mechanism for cellular networks, aiming at minimal emission from mobile phones. The proposed handover mechanism creates a new bidding procedure aiming at minimal uplink transmission power and hence minimal exposure to radiation. Devices such as Bluetooth headset and earphone are also used to study either this equipment are effective to reduce the effect of thermal radiation toward human head or not.

Index Terms*— Low radiation cellular, Green Communications, Handover, MIMO systems, electromagnetic radiation, mobile phone, Bluetooth*

1. Introduction

Mobile communication is currently the fastest growing communication system in the telecommunication industry. Due to increased number of user using the mobile phone, the concern is now focusing on the electromagnetic wave produced by the mobile phone itself. Electromagnetic radiation can be classified into ionizing and non-ionizing radiation. Ionizing radiation is the radiation with high energy which will remove tightly bound between electrons and atoms resulted tissue damage while non-ionizing radiation is the radiation that has enough energy to vibrate the atoms and molecule but do not remove the electrons in the molecule. This radiation is mainly occurred at low frequency range. Mobile phone is designed with low power transceiver in order to transmit voice and data to a few kilo meters to where the base station is located. When a call is established, the mobile phone will sends radio signals to the closest radio base station antennas which in turn are connected to a mobile switch. The power transmitted from a mobile is dependent on the received coverage level from the base station. Signal strength from the base station varied depending on the distance of mobile phone from the base station. When a mobile phone is near to the base station, the signal strength is higher and vice versa. Mobile phones and base stations are designed to transmit the lowest amount of power as required to sustain a call in order to minimize the possibility of interference to the system if excessive power is used. Radio frequency used to communicate by mobile phone has the ability to penetrate through semi-solid substances like meat, and living tissue to a distance proportional to its power density. It also can cause dielectric heating effect or thermal effect. Thermal effects are the temperature rise in the body cause of energy absorption from oscillating electric fields or electromagnetic radiation. Thermal radiation also induced when mobile phone is used to make a call or receive a call for a long period of time. Thermal radiation is generated when heat from the movement of charged particles within atoms of the mobile phone's case is converted to electromagnetic radiation and related to the Specific Absorption Rate (SAR) where it is defined as the rate of RF power absorbed per unit mass by any part of the body. SAR values are dependent on the separation distance of the body and the mobile phones. The nearer the distances of the radiation source to the human head, the higher the SAR values.

2. Specific Absorption Rate (SAR)

SAR is the time rate of energy absorption per gram of tissue from non-ionizing electromagnetic radiation. The term SAR distribution is used to indicate the pattern of SAR inside the body. Figure 1 shows the SAR distribution towards human head when using mobile phone.

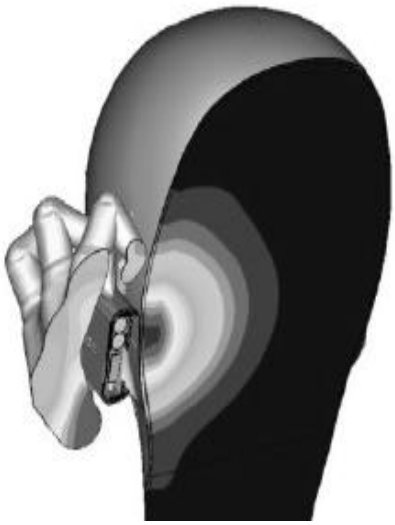


Figure 1: SAR distributions towards human head when using mobile phone. [1]

The computed total power absorbed by head tissues is P*abs*=0.795W with only mean SAR values over tissue balls are used in mobile phone norms. SAR values are dependent on the separation distance of the body and the mobile phones. As the distance of the body and mobile phones is closed, the SAR values will be higher and vice versa. Using mobile phones with low SAR values and making call at high reception field strength which permitting low transmission power can reduce the exposure to the high intensity radiation.

$$SAR = \sigma \frac{|E|^2}{2\rho} = c\frac{\Delta T}{\Delta t}[W/kg]$$

σ is the conductivity of tissue simulant (s/cm), $|E|2$ is the electric field strength (V2/cm2), ρ is the density of tissue simulant (g/cm3), c is the specific heat capacity of tissue simulant (J/g/0C) and ΔT is the change in temperature when exposed for time change of Δt.

3. Thermal and Non-thermal radiations

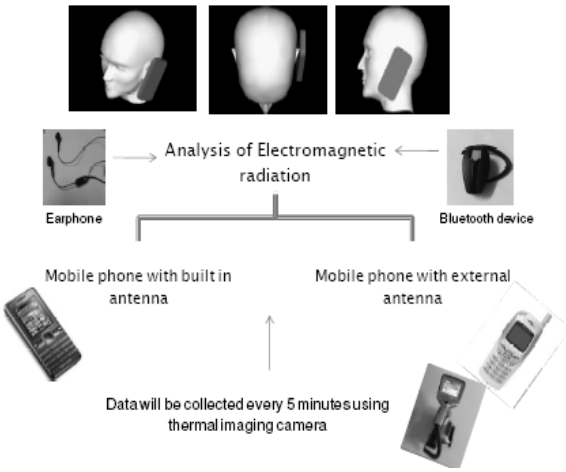
RF radiation emitted from mobile phone has effects on human health which can be categorized as thermal, non-thermal, genotoxical, increase probability of getting brain tumour and non-specific symptoms. Non-specific complaints had been made by mobile phone users such as symptoms like headaches, earaches, blurring of vision, short term memory loss, numbing, itchy, burning sensations, bad sleep, electromagnetic hypersensitivity exhaustion and anxiety when using mobile phone. Researchers had found that symptoms such as headache, fatigue, and difficulty in concentration were more common in people with higher exposures to RF radiation. Electromagnetic hypersensitivity happens in some users of mobile phone who reported feel several unspecific symptoms such as burning and itchy in the skin of the head, exhaustion, sleep disturbances, dizziness, loss of mental attention, reaction times and short term memory loss, headaches, depression, heart palpitations, and disturbances of the digestive system.

Thermal effect is a direct result of heating resulted from a measurable temperature increase which is beyond the body's normal thermoregulatory process. The heating effect occurs in the exposed biological material such as tissue and cells due to the heating of such material. When using a mobile phone, most of the heating effect will occur at the surface of the head then causing the skin temperature to increase by a fraction of a degree. When the tissue temperature is increasing, the brain's blood circulation easily disposes of excess heat by instantaneously increasing local blood flow. However, the cornea of the eye does not have this temperature regulation mechanism. Tissues at some parts of the human head are more sensitive to damage due to increases in temperature. Nerve fibre is one part of human head which is sensitive to temperature increase because of poor vasculature structure. Non thermal effects resulted from a direct interaction between the RF radiation and the organism and can be carried away by thermoregulatory process. This effect could be reinterpreted as a normal cellular response to an increase in temperature.

4. Reducing Electromagnetic Radiation from Mobile Phone towards Human body

4.1. Using Bluetooth Headset and Earphone

Bluetooth headset and earphone are devices used for mobile phone hands free purposes. Bluetooth headset is a device using Bluetooth technology where Bluetooth frequency is used to connect to the mobile phone to let mobile phone user listen and talk in conversation hands freely. Earphone is a wired device which plug in to the mobile phone to provide mobile phone user talk hand-freely.



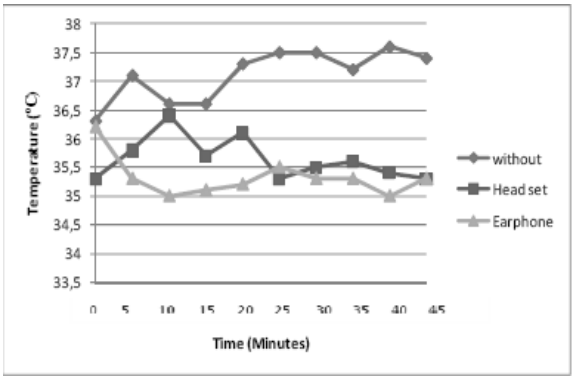


Figure 3: comparison of thermal radiation without and with the used of headset and earphone using mobile phone operating at 1800MHz[1]

4.2. Green Handover

Green Handover is a new handover mechanism that minimizes radiation from mobile devices. The evolution of wireless technology and specifically the advent of multiple inputs multiple output (MIMO) systems provide an opportunity in this aspect. Localized and distributed MIMO systems may be leveraged to significantly reduce radiation from mobile phones. For example, when connected to a mobile phone, a base station (BS) equipped with multiple antennas may employ receive beam forming (RxBF) in order to suppress interference and significantly enhance the uplink (UL). The increase in UL quality in turn allows for a similar decrease in the UL transmission power and respective exposure to radiation. However, in common systems, even when such a BS is nearby, in many cases the mobile phone would prefer another BS requiring higher UL power and radiation over it. This is because the criterion for handover in common cellular systems is based on the received downlink (DL) signal strength or signal quality. This handover criterion is simple and makes sense when the UL and DL are balanced. This is not the case in MIMO systems. For example, many BSs employing MIMO techniques receive with all antennas, but transmit from only one or two. Things become even more significant when receive only devices, such as Green Antennas, are deployed in the proximity of the mobile. This means that the measured DL quality may be a poor indicator for the expected UL quality and required transmit power.

The new scheme, dubbed Green Handover, suggests establishing connectivity with the BS requiring *minimal UL transmission power*. A key point in this concept is providing the mobile with sufficient information. This information is used by the mobile to estimate the expected UL transmission power.

In orthogonal frequency division multiplexing (OFDM) MIMO based current handover mechanisms (such as LTE and WiMAX), soft handover is not employed and each mobile phone is served by a single BS. In such systems, the main criterion for choosing a BS for establishing a connection and handover is the received DL signal strength or signal quality. Signal to noise ratio (SNR) or signal to interference and noise ratio (SINR) are common measures for the DL signal quality. Obviously, the DL signal quality is not the only criterion in the handover process. For example, when the UL transmit power is high (e.g., above 20dBm), and/or when the UL packet error rate is not sufficient, the BS may initiate a handover process. However, once initiated, the criterion for choosing the target BS is DL signal quality (not the minimal UL transmit power).

Therefore, in current handover mechanism, when the mobile recognizes multiple target BSs, it chooses the BS it receives best. This does not necessarily mean the chosen BS is the one which receives the mobile at best quality. In other words, it is not necessarily the one which requires minimal UL transmission power and respective exposure to radiation. This is especially true in case the BSs employ multiple antennas. With multiple antennas, a large variety of transmission and reception schemes is available. Each scheme exploits the MIMO channel differently which often results in significantly different link quality.

In order to minimize the radiation emitted from mobiles, a new handover mechanism should be sought. Green Handover is a handover mechanism that chooses among the recognized target BSs (with sufficient DL) the one that requires minimal UL transmission power. The Green Handover mechanism requires additional information, besides the DL signal quality, in order to estimate the expected required UL transmission power.

A handover process usually begins with the mobile searching for potential target BSs. At this point the target BSs may not be aware of the searching mobile or the search process. Thus, the most straight forward means to provide the searching mobile with information respective to the expected UL transmission power is through *broadcast messages* of the target BSs. Broadcast messages may include, for example, the number of receive antennas employed by the BS and the noise and interference levels at the BS antennas. Thus, knowledge of the number of receiver antennas at the BS and the noise and interference levels may not suffice. In order to accurately estimate the expected UL transmission power, the BS may further broadcast information respective to the MIMO modes employed (e.g., MRC, UL SDMA with several UEs, RxBF). Moreover, the BS may broadcast the MIMO detection algorithm or some other indication of the UL decoding performance. In order to make things simpler and clearer for the mobile, the BS may broadcast a table depicting the expected UL transmission power in various scenarios (voice call, data uploading with different capacities) respective to the DL signal strength or signal quality. This way, together with the measured DL signal, the mobile may be able to estimate the expected UL transmission power. In case of distributed MIMO and especially in the case of Green Antennas, the broadcasting methods discussed above provide a loose estimate for the expected UL

transmission power. This is because the broadcast information cannot capture the proximity of the mobile to receive only devices such as Green Antennas. In such cases, a more accurate approach to estimate the expected UL power includes the transmission of an UL *test signal*. Note that the transmission of such test signals requires a dialog between the searching mobile and the potential target BSs. When coordinated multipoint (CoMP) reception is employed, multiple neighbouring BSs may receive the transmission of mobiles in their coverage and eliminate the need for the transmission of UL test signals.

Green Antennas receive the UL signals of mobiles in their proximity with high quality and forward the information to a single or multiple BSs via wire line. As Green Antennas do not transmit they do not affect the DL signal received by the mobiles. Thus, a mobile phone may receive Cell A with best quality, whereas Cell B may receive the mobile at better quality than Cell A, and hence Cell B requires minimal emission from the mobile phone. The new handover mechanism uses this concept and chooses, among neighbouring cells with sufficient downlink, the cell for which the emission from the mobile phone is minimized.

5. Conclusions

Although the effect of thermal radiation is very low to lead to the possibility of having brain cancer, but it might cause other non-specific symptoms such as headache, heating, fuzziness, itchy for long-term period. Devices such as Bluetooth headset and earphone are used to study either this equipment are effective to reduce the effect of thermal radiation toward human head or not. By using Bluetooth headset and earphone device when talking via mobile phone, the result shows lower radiation since direct radiations from the mobile phone antenna was reduced. Proposed Green Handover minimizes the UL transmission power and respective exposure to radiation. Green Handover chooses, among the recognized target BSs, the one BS that requires minimal UL transmission power. This process requires additional information, beside the DL signal quality, in order to estimate the expected required UL transmission power. One of the more interesting aspects of Green Handover is the ability to create bidding procedures in which the operators bid for the minimal UL transmission power and radiation. Including UL transmission power as an additional parameter could provide an interesting solution for radiation aware users.

6. References

[1] Dayang Azra Awang Mat, Franky Kho, Annie Joseph, Kuryati Kipli, Shafrida Sahrani, Kasumawati Lias & Ade Syaheda Wani Marzuki, " The Effect of Headset and Earphone on Reducing Electromagnetic Radiation from Mobile Phone toward Human Head", 2009

[2] Doron Ezri, Shimi Shilo, "Green Handover - a New Handover Mechanism that Minimizes Radiation from Mobile Devices", 2010 IEEE 26-th Convention of Electrical and Electronics Engineers in Israel.

[3] Jong Tze Kim and Awangku Abdul Rahman, " Microwave Exposure Levels in the Vicinity of Cellular Network Tower",2004 RF and microwave conference, October 5 - *6*, Subang, Selangor, Malaysia.

[4] R.Seetharaman,G.S.Uthayakumar,N.Gurusamy and N.Kumaravel, " Mobile Phone Usage and Cancer", Department of Electronics and Communication Engineering College of Engineering, Anna University, Chennai, India, 2008

[5] Okonigene R.E., "Siting f G Base Station Antenna And Its Health Consequences", 2010 Seventh International Conference on Information Technology.

[6] Kasumawati Lias, Dayang Azra Awang Mat, Kuryati Kipli, Ade Syaheda Wani Marzuki, " Human Health Implication of 900MHz and 1800MHz Mobile Phones", Proceedings of the 2009 IEEE 9th Malaysia International Conference on Communications 15 -17 December 2009 Kuala Lumpur Malaysia.

AET - 0006

Image Retrieval based on Integrated Colour and Texture Feature

Rashmi Ramesh Adatkar *Dr. R G Karandikar*
rashmi.adatkar@gmail.com *rgkarandikar@rediffmail.com*
K J Somaiya College of Engineering, Vidyavihar, Mumbai-77

Abstract

The growth of digital image and video archives is increasing the need for tools that effectively filter and efficiently search through large amounts of visual data. Content Based Image Retrieval (CBIR) systems are used for automatic indexing, searching, retrieving and browsing of image databases. Color and texture are the important features used in CBIR systems. This paper presents the comparison of color and texture feature extraction. The results are also verified integrating both the features. The results presented are by using standard data.

Keywords- Content-Based Image Retrieval (CBIR), feature extraction

1. Introduction

In CBIR systems [1-3], images are automatically indexed by extracting their features. A feature is a characteristic that can capture a certain visual property of an image either globally for the entire image or locally for regions or objects [5]. Color, texture and shape are commonly used features in CBIR systems. A key function in any CBIR system is the feature extraction. Mapping the image pixels into the feature space is termed as feature extraction. Extracted features are used to represent images for searching, indexing and browsing images in an image database. Use of feature space is more efficient in terms of storage and computation. Most of the CBIR systems represent the feature space as a feature vector. Once the features are represented as a vector it can be used to determine the similarity between images [6]. In retrieval stage, query image is also represented as a feature vector and the similarity between the query vector and stored feature vectors is computed [7]. The similarity measure is used to determine the distance between the query image and stored images. After that images are ranked according to the Euclidean distance and retrieved.

In this paper images are represented by color and texture descriptor For color moments RGB and HSV are considered as descriptors and for texture, the image is decomposed into eight-orientation.

2. Feature Computation

There are several color and texture models in use. In this paper the RBG and HSV color model and gabor wavelet transform is used.

A) Color Features

Color is an important feature for image representation as it is invariant with respect to scaling, translation and rotation of an image. Color space, color quantification and similarity measurements are the key components of color feature extraction. The mean, variance and standard deviation of an image are known as color moments [9]. Following equations define the mean, variance and standard deviation of an image of size *n* X *m*.

$$\text{Mean}=\sum_{i=1}^{n}\sum_{j=1}^{m} x_{ij} / mn \qquad \text{.....(1)}$$

$$\text{Variance}=\frac{1}{nm}\sum_{i=1}^{n}\sum_{j=1}^{m}(X_{ij}-mean)^{2} \qquad \text{.....(2)}$$

Stddev= $\sqrt{\text{var}iance}$, where X_{ij} is the pixel value of the ith row and jth column

B) Texture Features

The notion of texture generally refers to the presence of a spatial pattern that has some properties of homogeneity [8]. For texture feature extraction, the Gabor wavelet transform, was implemented. Directional features are extracted to capture image texture information. The Gabor function, in Fourier domain, is given by $G(u,v)=\exp\{-\frac{1}{2}(\frac{u^2}{\sigma_u^2}+\frac{v^2}{\sigma_v^2})\}$ where σ_u and σ_v are the bandwidths of the filter. The Gabor wavelet transform dilates and rotates the two-dimensional Gabor function. The image is then convolved with each of the obtained gabor function.

To obtain a Gabor filter bank with *L* orientations and *S* scales, the Gabor function is rotated and dilated as follows:

$$G_{mn}(x,y) = a^{-m}G(x,y), \quad \text{..... (3)}$$

where $x = a^{-m}(x\cos\theta + y\sin\theta)$, and $y = a^{-m}(-x\sin\theta + y\cos\theta)$

$\theta = \frac{n\pi}{L}, n = 1,2,.....L$ and m=0, 1,.S-1.

The simulations were performed in MATLAB. For color feature extraction, the RGB and HSV space moments were calculated. For texture feature extraction, the transform parameters were set to perform an eight-orientation decomposition of the image.

3. Results

	COLOUR FEATURE VECTORS FOR DATABASE											
	RED		GREEN		BLUE		HUE		SATURATION		VALUE	
IMAGES	mean	std_dev	mean	std_dev	mean	std_dev	mean	std_dev	mean	std_dev	mean	std_dev
img1	174.1869	60.6898	81.8479	45.886	17.2913	34.7875	0.0697	0.0284	0.8925	0.1533	174.2461	60.7653
img2	83.3022	72.1092	37.8804	25.4451	41.8324	22.6705	0.6254	0.3861	0.4353	0.2265	84.9609	71.0457
img3	89.7366	64.9565	36.8986	26.5195	24.525	12.2024	0.2949	0.3659	0.5794	0.2644	90.1841	64.415
img4	141.3967	96.9741	107.1435	90.6856	104.7821	90.3586	0.2011	0.3539	0.3139	0.2771	141.5948	96.9966
img5	131.243	74.2627	72.6791	48.8853	74.9273	31.7305	0.6484	0.3634	0.4871	0.2062	135.3293	71.5232
img6	95.3045	73.268	63.1689	51.0222	35.6137	29.1511	0.0921	0.056	0.6034	0.171	95.484	73.0686
img7	169.0388	63.0922	110.8468	63.0265	61.9275	44.5659	0.0881	0.128	0.6668	0.1751	169.056	63.0619
img8	93.7492	67.6105	35.4809	31.7362	38.2858	19.9686	0.7634	0.3643	0.616	0.159	93.7978	67.5653
img9	137.5565	48.9852	82.7064	43.0871	100.7912	66.2025	0.509	0.3843	0.5462	0.2118	154.854	52.3516
img10	212.23	75.1689	201.1196	91.8147	198.8444	93.2394	0.2543	0.3422	0.1521	0.295	214.6117	72.1017
img11	222.1933	57.5344	192.368	100.8761	187.4147	104.4802	0.1382	0.2874	0.2492	0.3934	223.0663	56.9551
img12	60.3145	80.2169	26.3368	42.8192	26.6348	37.4966	0.3631	0.3943	0.5267	0.4197	61.8663	80.1614
img13	163.2867	53.6348	146.2496	70.3731	146.729	69.7328	0.1432	0.3163	0.1191	0.2974	163.8012	53.2995
img14	120.7148	78.2221	33.125	43.4831	35.3788	34.7843	0.6289	0.3881	0.8279	0.2027	126.8318	74.0805
img15	43.7139	58.6508	19.3281	29.9229	9.5744	17.3991	0.3371	0.3683	0.7198	0.3634	46.9102	58.9596
img16	96.4272	72.3818	35.4782	33.8557	33.9124	32.6973	0.4452	0.4285	0.6003	0.3086	97.6685	71.2544
img17	121.1721	59.4032	71.7296	57.183	77.7807	43.6843	0.6342	0.3436	0.5374	0.2944	129.8415	56.5677

	COLOUR FEATURE VECTOR OF QUERRY IMAGE											
	RED		GREEN		BLUE		HUE		SATURATION		VALUE	
IMAGES	mean	std_dev	mean	std_dev	mean	std_dev	mean	std_dev	mean	std_dev	mean	std_dev
Querry	43.7139	58.6508	19.3281	29.9229	9.5744	17.3991	0.3371	0.3683	0.7198	0.3634	46.9102	58.9596

1a: Color Feature vector

	TEXTURE FEATURE VECTORS FOR DATABASE IMAGES							
	45DEG		90 DEG		135		180	
IMAGES	mean	std_dev	mean	std_dev	mean	std_dev	mean	std_dev
img1	6.879	9.087	28.192	22.275	137.250	73.397	25.865	15.914
img2	4.369	6.526	17.135	19.474	69.329	53.104	15.167	14.284
img3	2.351	5.409	11.304	10.303	68.366	50.328	13.606	13.723
img4	10.786	23.196	32.973	38.778	158.146	131.334	34.956	35.162
img5	3.735	4.479	19.325	15.426	121.002	73.272	22.724	17.193
img6	4.608	4.953	17.149	16.785	93.550	74.742	21.149	18.422
img7	7.276	9.739	32.169	30.178	176.023	97.561	33.665	22.539
img8	1.798	2.483	11.038	9.224	70.854	55.166	13.169	11.604
img9	5.925	9.196	24.995	18.628	137.805	68.874	27.313	16.639
img10	18.170	29.154	62.852	62.124	276.647	129.683	62.941	44.052
img11	8.299	11.125	49.452	33.531	273.700	132.442	51.320	28.102
img12	10.583	18.892	24.661	48.386	51.171	63.696	21.979	37.081
img13	16.908	21.766	49.052	45.650	203.556	97.749	42.176	29.085
img14	7.303	10.373	25.776	34.050	80.862	54.276	21.809	24.184
img15	6.235	12.061	17.912	32.326	37.060	45.142	13.494	21.972
img16	5.576	8.369	21.629	25.553	73.628	53.553	19.202	18.855
img17	8.909	11.661	28.707	29.323	116.522	65.116	28.866	27.485

	TEXTURE FEATURE VECTOR for QUERRY IMAGE							
	45DEG		90 DEG		135		180	
IMAGES	mean	std_dev	mean	std_dev	mean	std_dev	mean	std_dev
Querry	6.235	12.0607	17.9118	32.3261	37.0598	45.1422	13.4935	21.9717

2a: Texture Feature Vector

Calculated Feature vectors from the database

	COLOUR FEATURE VECTORS												TEXTURE FEATURE VECTORS							
	RED		GREEN		BLUE		HUE		SATURATION		VALUE		45DEG		90 DEG		135		180	
IMAGES	mean	std_dev	mean	std_dev	mean	std_dev	mean	std_dev	mean	std_dev	mean	std_dev	mean	std_dev	mean	std_dev	mean	std_dev	mean	std_dev
img1	174.187	60.690	81.848	45.886	17.291	34.788	0.070	0.028	0.893	0.153	174.246	60.765	6.879	9.087	28.192	22.275	137.251	73.397	25.865	15.914
img2	83.302	72.109	37.880	25.445	41.832	22.671	0.625	0.386	0.435	0.227	84.961	71.046	4.369	6.526	17.135	19.474	69.329	53.104	15.167	14.284
img3	89.737	64.957	36.899	26.520	24.525	12.202	0.295	0.366	0.579	0.264	90.184	64.415	2.351	5.409	11.304	10.303	68.366	50.328	13.606	13.723
img4	141.397	96.974	107.144	90.686	104.782	90.359	0.201	0.354	0.314	0.277	141.595	96.997	10.786	23.196	32.973	38.778	158.146	131.334	34.956	35.162
img5	131.243	74.263	72.679	48.885	74.927	31.731	0.648	0.363	0.487	0.206	135.329	71.523	3.735	4.479	19.325	15.426	121.002	73.272	22.724	17.193
img6	95.305	73.268	63.169	51.022	35.614	29.151	0.092	0.056	0.603	0.171	95.484	73.069	4.608	4.953	17.149	16.785	93.550	74.742	21.149	18.422
img7	169.039	63.092	110.847	63.027	61.928	44.566	0.088	0.128	0.667	0.175	169.056	63.062	7.276	9.739	32.169	30.178	176.023	97.561	33.665	22.539
img8	93.749	67.611	35.481	31.736	38.286	19.969	0.763	0.364	0.616	0.159	93.798	67.565	1.798	2.483	11.038	9.224	70.854	55.166	13.169	11.604
img9	137.557	48.985	82.706	43.087	100.791	66.203	0.509	0.384	0.546	0.212	154.854	52.352	5.925	9.196	24.995	18.628	137.805	68.874	27.313	16.639
img10	212.230	75.169	201.120	91.815	198.844	93.239	0.254	0.342	0.152	0.295	214.612	72.102	18.170	29.154	62.852	62.124	276.647	129.683	62.941	44.052
img11	222.193	57.534	192.368	100.876	187.415	104.480	0.138	0.287	0.249	0.393	223.066	56.955	8.299	11.125	49.452	33.531	273.700	132.442	51.320	28.102
img12	60.315	80.217	26.337	42.819	26.635	37.497	0.363	0.394	0.527	0.420	61.866	80.161	10.583	18.892	24.661	48.386	51.171	63.696	21.979	37.081
img13	163.287	53.635	146.250	70.373	146.729	69.733	0.143	0.316	0.119	0.297	163.801	53.300	16.908	21.766	49.052	45.650	203.556	97.749	42.176	29.085
img14	120.715	78.222	33.125	43.483	35.379	34.784	0.629	0.388	0.828	0.203	126.832	74.081	7.303	10.373	25.776	34.050	80.862	54.276	21.809	24.184
img15	43.714	58.651	19.328	29.923	9.574	17.399	0.337	0.368	0.720	0.363	46.910	58.960	6.235	12.061	17.912	32.326	37.060	45.142	13.494	21.972
img16	96.427	72.382	35.478	33.856	33.912	32.697	0.445	0.429	0.600	0.309	97.669	71.254	5.576	8.369	21.629	25.553	73.628	53.553	19.202	18.855
img17	121.172	59.403	71.730	57.183	77.781	43.684	0.634	0.344	0.537	0.294	129.842	56.568	8.909	11.661	28.707	29.323	116.522	65.116	28.866	27.485

Calculated Feature vectors for Querry Image

	COLOUR FEATURE VECTORS												TEXTURE FEATURE VECTORS							
Querry	RED		GREEN		BLUE		HUE		SATURATION		VALUE		45DEG		90 DEG		135		180	
image	43.714	58.651	19.328	29.923	9.5744	17.399	0.3371	0.3683	0.7198	0.3634	46.91	58.96	6.2346	12.061	17.912	32.326	37.06	45.142	13.494	21.972

3a: Combined Feature Vectors

Similarity measurements Value	Position of Image in database
0.000	15
48.211	12
68.052	3
69.102	2
77.147	8
82.447	16
92.829	6
119.460	14
147.363	17
153.504	5
188.382	9
194.347	1
208.837	7
217.288	4
259.450	13
367.996	10
370.242	11

(1b)

Similarity measurements Value	Position of Image in database
0.000	15
34.824	12
36.966	2
39.039	16
40.780	3
45.194	8
46.314	14
66.587	6
84.337	17
91.087	5
105.728	9
106.030	1
150.599	7
152.114	4
180.878	13
257.079	11
266.127	10

(2b)

Similarity measurements Value	Position of Image in database
0.000	15
59.473	12
78.368	2
79.335	3
89.410	8
91.222	16
114.241	6
128.124	14
169.790	17
178.494	5
216.024	9
221.389	1
257.474	7
265.241	4
316.277	13
450.742	11
454.142	10

(3b)

1b: Similarity measurement and Image ranking for color feature extraction
2b: Similarity measurement and Image ranking for Texture feature extraction
3b: Similarity measurement and Image ranking for combined feature extraction

First the mean and standard deviations of database images are calculated and stored in a database. Then it is compared with the mean and standard deviation of the query image. The Euclidean distance metrics is used to measure the similarity between the query image and the database images. Least the value of similarity measurement determines its more relevance to the query image. Table 1a, 2a and 3a gives the values of the calculated vectors for only color , only texture and combination of color and texture vectors extraction respectively. Table 1b, 2b and 3b gives the values of similarity measurements and the position of the relevant image in the database. The integration of color and texture feature would help us to calculate the recall and the precision rate used to determine the retrieval efficiency for an image retrieval system.

4. Conclusions

The main contribution of this work is a comprehensive comparison of color and texture feature extraction techniques for CBIR. The RGB and HSV space and the Gabor wavelet transform were found to yield the good color and texture retrieval results, respectively. In future work, methods for combining color and Texture features would be explored, in addition to incorporating user-feedback into the system. Another issue that needs to be addressed is the issue of distance measures between feature vectors. Euclidean distance was used in this case because of its simplicity and interpretability, but it would be valuable to evaluate other distance measures and their effect on retrieval performance.

References

[1] Chang S.K., and Hsu A. (1992), "Image information systems: where do we go from here*?" IEEE Trans. On Knowledge andData Engineering*, Vol. 5, No. 5, pp. 431-442.

[2] Tamura, H. and Yokoya N. (1984), "Image database systems: A survey," *Pattern Recognition*, Vol. 17, No. 1, pp. 29-43.

[3] Zachary J. M., Jr. and Sitharama S. I. Content Based Image Retrieval Systems, Journal of the American Society for Information Science and Technology, 2001.

[4] Goodrum A. A. (2000), Image Information Retrieval: An overview of Current Research.

[5] Smulders A.M.W., Worring M., Santini, A. S., Gupta, and R. Jain (2000), "Content-based image retrieval at the end of the early years," *IEEE Transaction on Pattern Analysis and Machine Intelligence*, Vol.22, No. 12, pp. 1349-1380.

[6] Faloutsos C. et. al. (1994), "Efficient and effective querying by image content, *"Journal of intelligent information systems*, Vol.3, pp.231-262.

[7] Rui Y. and Huang T. S (1997), Image retrieval: Past, Present, and Future, Journal of Visual Communication and Image Representation.

[8] J. Han and K. Ma, "Fuzzy Color Histogram and Its Use in Color Image Retrieval",*IEEE Trans. On Image Processing*, vol. 11, pp. 944 – 952, Aug. 2002.

[9] Hu M.K. (1962), Visual pattern recognition by moment invariants, computer methods in image analysis. *IRE Transactions on Information Theory*, Vol. 8.

AET - 0007

Performance Enhancement of Selfish Node in Vehicular Adhoc Network

Nandita Khobragade
M. E. EXTC Semester III
K. J. Somaiya COE,
Vidyavihar, Mumbai
nandita_nn@yahoo.co.in

Bharti Singh
Professor (EXTC Department)
K.J.Somaiya COE,
Vidyavihar, Mumbai
bhartialoksingh@yahoo.co.in

Abstract

In Vehicular adhoc network each node forward the bundle of message to the other node whenever they are within transmission range. Unfortunately, some nodes may be reluctant to forward the bundles that is not directly beneficial to it. Practical Incentive protocol is a protocol used to address the selfishness problem in Vehicular adhoc network by attaching some incentive on the bundle which is not only attractive but also fair to all participating nodes. Hence, performance enhancement of selfish node in Vehicular adhoc network is done by increasing its delivery ratio and average delay through incentive policy.

1. Introduction

Vehicular adhoc network[1] is basically a Delay tolerant network[2] characterized by the lack of intermittent connectivity i.e. no end to end path between source and destination, long or variable delay, asymmetric data rates and high error rates. When two vehicles are within transmission range e.g. 300 meters, they can exchange bundles, hence they follows a store and forward method. But, in order to conserve power, buffer and computing resources, a selfish node will not forward the bundles to other node, degrading effectiveness of network. The practical incentive protocol[3] is used to address the selfishness problem of the network, hence it attach some incentive in the bundle. Credits and reputation value is allocated to each node based on the level of cooperation while forwarding the packets.

The remainder of this paper is organized as follows. In Section II, we discussed selfishness problem in vehicular network. In section III, we formalize selfish node model. Then we present the Pi protocol in Section IV, followed by the incentive strategy and performance evaluation in section V and Section VI, respectively Finally, we draw the conclusions in Section VII.

2. Selfishness Problem

Routing in vehicular adhoc network relies on vehicular nodes to forward packets for each other, the routing performance (e.g., the number of packets delivered to their destinations) depends on if nodes are willing to forward for others. In the real world, most people are socially selfish. As being social, they are willing to forward packets for others with whom they have social ties such as family members and friends even at the cost of their own resources. Also, they give different preferences to those with social ties i.e., they will provide better service to those with stronger ties than to those with weaker ties, especially when there are resource constraints. As being selfish, they are unwilling to forward packets for those with whom they have no social ties in order to save their own storage and power resources. For convenience, the above social and selfish behaviour will be referred to as social selfishness. However, there exists few nodes, which do not forward packets for anyone else in order to conserve its own resources; such selfishness is called individual selfishness[5]. In this paper, our main aim is to address individual selfishness of the node and selfish nodes are stimulated to forward packets for all other nodes to maintain high performance.

3. Selfish Node Model

In vehicular DTNs, each vehicle is equipped with On Board Unit (OBU) communication device, which allows different vehicles to communicate with each other based on the 802.11p protocol. Note that the 802.11p physical layer offers different bitrates, ranging from 3 to 27 Mbps, from which OBU devices can choose. Therefore, when two vehicles are within the transmission range, e.g., 300 meters, they can exchange bundles. In general, a vehicle is almost resource unlimited, while the equipped OBU communication device is considered resource-constrained, i.e., buffer and computation power constraints. Therefore, there

may exist many selfish nodes in the networks. In order to conserve buffer space, these selfish nodes may be very reluctant in the cooperation that is not directly beneficial to them. As a result, the selfishness would be against the goal of the vehicular DTN to cooperatively deliver a bundle from its source S to the destination D. Therefore, the cooperation probability of a selfish node can be modelled as follows [3]:

$$Pc = \alpha Ps + (1 - \alpha)Pu = \alpha Ps + 1 - \alpha \quad (1)$$

where $0 \leq \alpha \leq 1$ is the selfish factor, $Ps < 1$ is the cooperation probability under selfish condition, i.e., $Ps = 0.01$, while $Pu = 1$ denotes the unselfish cooperation probability. Clearly, if $\alpha = 0$, a node is unselfish, i.e., it is always willing to help with forwarding with probability $Pc = 1$. On the, if $\alpha = 1$, the node is selfish, the cooperation probability is just $Pc = Ps = 0.01$. Therefore, the smaller the selfish factor α, the better the cooperation in vehicular network.

4. Practical Incentive Protocol

Practical incentive (Pi) protocol is to address the selfishness problem in Vehicular adhoc network. In this protocol, when the source node sends a bundle, it doesn't set a routing path in advance, but only need to attach some incentive on the bundle. Then, the selfish nodes on the road could be stimulated to help with forwarding the bundle to improve the delivery ratio and reduce the average delay of the whole network[3].

This protocol is a fair incentive model in which selfish nodes are stimulated to help forward bundles with credit-based incentive as well as reputation-based incentive. In the reward model, to achieve fairness, if and only if the bundles arrive at the destination node, the intermediate forwarding nodes can get credits from the source node. Furthermore, for the failure of bundle forwarding, those intermediate forwarding nodes still can get good reputation values from a trusted authority (TA). Therefore, with this stimulation, the packet delivery performance of Vehicular adhoc network can be improved[3].

5. Incentive Strategy

To achieve the following objectives, the following hybrid incentive strategy is adopted[3].

There exists a trusted authority (TA) in the system. Although it does not participate in bundle forwarding, TA performs trusted fair credit and reputation clearance for vehicular nodes. Therefore, before joining the network, each node should register itself to the TA and obtain its personal credit account (PCA) and personal reputation account (PRA) in the initialization phase. Later, when a node has an available fast connection to the TA, it can report to the TA for credit and/or reputation clearance. For example, in the vehicular network, a vehicle can communicate with TA for clearance when it makes contact with some Roadside Units (RSUs). For each node, PCA stores its credits, while PRA records its dynamic reputation value as follows: Let RIP(n-1) be the node's reputation value at time Tn-1.Then, the new reputation value RIP(n) at time Tn is formulated as $RIP(n) = e^{-\lambda Ti} . RIP(n-1) + CTi$, where $Ti = Tn - Tn\text{-}1$, λ is the rate at which the reputation value would decrease, and CTi denotes the reputation cumulative function, which is the summation of new gained reputation values in the time period Ti.

It is not mandatory for the intermediate node to forward bundles. All intermediate nodes in the network can self-determine whether or not to participate in bundle forwarding. However, once an intermediate node participates in forwarding bundle, it can get the credits from the source node as well as reputation values from the TA.

If the bundle doesn't arrive at the destination node, the source node won't need to pay credits. However, those intermediate nodes that helped to forward can still get good reputation values from the TA. Based on the above reputation calculation, if no new reputation value is gained in Ti i.e. CTi = 0, then $RIP(n) = e^{-\lambda T} . RIP(n-1)$ will decrease with time.

In the incentive model, the following reward calculation is exercised, once an intermediate node Ni helped forward a bundle for Disi distance, it can get a reward

Rewardi = Disi.CIP + Disi.RIP , if bundle arrives at the destination;

Disi.RIP, otherwise (2)

where CIP is a unit incentive credit provided by the source S, RIP is a fixed unit reputation value defined by the TA for optimizing the network. Assume that CF is the unit resource cost used for forwarding. We define the gaining factor of DTN node Ni as

$$\zeta i = (Disi.CIP - Disi.CF) / Disi.CF$$
$$= CIP - CF / CF \quad (3)$$

and redefine the cooperation probability of Ni with reputation value RIP as

$$Pc = \begin{cases} 1, & \text{if } RIP < Rth \\ & \text{elseif } RIP \geq Rth \\ 1, & \alpha i - \zeta i \leq 0; \\ (\alpha i - \zeta i)Ps + 1 - (\alpha i - \zeta i), & \alpha i - \zeta i > 0. \\ & \text{end if} \end{cases} \quad (4)$$

Then, with the cooperation probability Pc, the node Ni is interested in helping forward the bundle. Note that, when $RIP \geq Rth$, different intermediate nodes may have different initial selfish factor α. Therefore, to guarantee the success of stimulation on all intermediate nodes, the source S can choose a large CIP (i.e., large gaining factor ζ) in its incentive policy such that each αi-ζi can be minimal. In addition, since Rewardi is a linear increase function of distance in Eq. (2), the longer the distance, the more the Reward Therefore, the intermediate node is willing to forward the bundle as long as possible.

6. Performance Evaluation

In this section the performance of the proposed

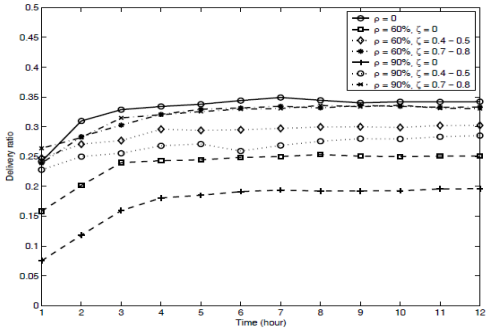


Fig1 : Delivery ratio w.r.t selfish ratio and gaining factor

Pi protocol is studied with reference to [3] The performance metrics used in the evaluation are 1) the delivery ratio, which is the fraction of generated messages that are correctly delivered to the final destination within a given time period; 2) the average delay, which is defined as the average time between when a message is generated at some source and when it is successfully delivered to its destination. Both delivery ratio and average delay can be used to examine.

In the simulations, total n vehicular nodes with a transmission deployed in an area to simulate a sparse vehicular network. In vehicular DTNs, the performance of bundle forwarding is highly contingent upon the mobility of vehicles. Since vehicles are usually driven along the roads in a city, it is assumed that each node follows the shortest path map based movement routing. Let, ρ = the number of selfish nodes / the total number of nodes be the selfish ratio (SR) among these nodes, which usually is a variable based on how many nodes that behave selfishly in the network. Once a node is selfish, then according to Eq. (4), it may refuse to forward the bundle packets if the gaining factor ζ is less than its selfish factor α when RIP $\geq$ Rth.

However, with some incentives, i.e., the gaining factor ζ in Eq. (4) is increased, the selfish node may faithfully forward. Note that, in the simulation, $RIP < Rth$ is not considered. The reason is that, when RIP < Rth, the selfish nodes will faithfully forward the bundles, which is equivalent to lowering the selfish ratio ρ in the simulation.

It is shown if in fig 1, delivery ratio with different incentive policies and under different selfish ratio. It can be seen that delivery ratio with no incentive is very low, especially when selfish ratio is 90%. In this condition, when a forwarding node seeks a next forwarding node at some location but only meets selfish nodes who are not willing to forward, the bundle message has to be dropped, since the next hop is not immediately available due to the selfishness. Therefore, the larger the selfish ratio, the more the dropping events take place and the lower the delivery ratio. On the other hand, when the network is stimulated with some incentive, the delivery ratio will increase. Because different selfish node has different selfish factor, the same incentive can't satisfy all selfish nodes. Therefore, there still exists a small fraction of selfish nodes. Intuitively, when the incentive is higher, the fraction of selfish nodes becomes smaller and delivery ratio is improved.

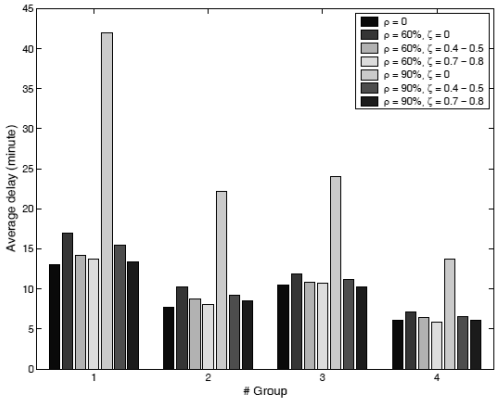


Fig2 : Average delay w.r.t selfish ratio and gaining factor

Similarly, fig 2 shows the average delay with different incentive policies and under different selfish ratio. From the figure, it can be seen that, higher the selfish ratio ρ, the longer the average delay. However, when the network is stimulated with some incentive, the average delay will decrease quickly.

7. Conclusion

In this paper, it is shown that there exists selfish node in the vehicular adhoc network which does not forward the packets which degrade the overall performance of the network. The performance of the network is enhanced by using the practical incentive protocol. It is shown that when incentives are given to the selfish node, the average delay and delivery ratio are improved.

References

[1] R. Lu, X. Lin, H. Zhu, P.-H. Ho, and X. Shen, "ECPP: efficient conditional privacy preservation protocol for secure vehicular communications," in Proc. 27th Conf. Computer Commun. (INFOCOM 2008), Phoenix, AZ, USA, Apr. 2008, pp. 1229-1237.

[2] K. Fall, "A delay tolerant networking architecture for challenged Internet,"in Proc. 2003 Conf. Applications,Technol.,Architectures,Protocols,Com puter Commun., SIGCOMM '03, Karlsruhe, Germany, 2003, pp.27-34.

[3] Rongxing Lu, Xiaodong Lin, Haojin Zhu,Xuemin Shen, Preiss B., "Pi: A Practical Incentive Protocol for Delay Tolerant Networks " IEEE Trans. Wireless Commun.,vol.9,pp.1483-1493,2010

[4] A. Panagakis, A. Vaios, and I. Stavrakakis, "On the effects of cooperation in DTNs," in Proc. 2nd International Conf. Commun. Syst. Software aMiddleware, COMSWARE 2007, 2007, pp. 1-6.

[5] Qinghua Li, Wei Gao, Sencun Zhu, Guohong Cao, "A routing protocol for socially selfish delay tolerant networks," in Proc 2010 INFOCOM, San Diego, CA, March 2010,pp.1-9

AET - 0008

Smart Agriculture Model using Sensor Networks with Context- aware Grid Computing

Aparna Kadam
ME student, TEC
aparnakadam1111@gmail.com

K.T.V. Reddy
Principal, PVPP's COE
ktvreddy@gmail.com

Alka Khade
TEC Mumbai
khadealka@gmail.com

Abstract

Agriculture is currently the biggest industry in India. It has a key role in the socioeconomic growth of the country. In a country like India, where the economy is mainly based on agriculture and the climatic conditions are isotropic, we need to make full use of agricultural resources. The continuous increasing demand of the food requires the rapid improvement in food production technology. This paper proposes a system for automation of the agricultural methods by integrating emerging technologies such as context-aware computing, grid computing and sensor/ actuator network so as to implement more efficient methods which otherwise follow traditional approaches. Context aware systems are concerned with the acquisition of context (e.g. using sensors to judge the current state, the abstraction and understanding of context (e.g. matching a measured sensor parameters against the required values for particular crop & conditions), and application behavior based on the recognized context (e.g. triggering actions based on context). Agricultural land is graphically distributed in nature and so to monitor and control it the one need to share the available resources which may be distributed all over the place. This requirement makes Grid computing the best candidate. This will overcome the limitation of real time data collection, decision making for the distributed agriculture lands making the network energy efficient. Sensor networks will be used to sense the physical attributes of the surroundings for monitoring variations and current situation in the area of irrigation, plant monitoring, pesticide spraying, fertilizer usage etc. They can also be utilized to monitor air temperature, humidity, ambient light, soil moisture and temperature that will be helpful in analyzing the current state of farms.

1. Introduction

Agriculture faces many challenges, such as climate change, water shortages, labor shortages due to an aging urbanized population, and increased societal concern about issues such as animal welfare, food safety, and environmental impact. Humanity depends on agriculture and water for survival, so optimal, profitable, and sustainable use of our land and water resources is critical. The continuous increasing demand of the food requires the rapid improvement in food production technology. In a country like India, where the economy is mainly based on agriculture, and the climatic conditions are isotropic, still we are not able to make full use of agricultural resources.

Agriculture may be defined as an integrated system of techniques to control the growth and harvesting of crops. This paper proposes a system for automation of the agricultural methods by integrating context-aware computing, grid computing and sensor/ actuator network so as to implement more efficient agricultural methods which otherwise follow traditional approaches [1]. This involves transforming key agricultural concerns to a context model governed via an I/O channel of sensors and actuators. One novel approach to create context model is through, use of wireless sensors. The grid computing can be utilized for efficient data processing & resource sharing [2] by forming grids of the base station nodes. In our system we propose a context aware model of a typical watering process in agricultural. The context model clearly saves the scarce water resource and it can be the control irrigation system in the farms by monitoring the environmental changes in the parameters such as temperature, humidity & soil moisture, which will be useful to maintain the required state of the field. This has the impact on improved decision making for farmers and this novel approach thus can provide solution to solve many other problems like fertilization, pesticide spraying and early detection of various crop specific issues.

IRRIGATION is an essential practice in many agricultural cropping systems. Self-propelled center pivot and linear-move irrigation systems generally apply water quite uniformly however substantial variations in soil properties and water availability exist across most fields. In these cases, the ability to apply site-specific irrigation management to match spatially and temporally variable conditions can increase application efficiencies, reduce environmental impacts, and even improve yields.

2. Integration of Technologies

The development of a distributed in-field sensor-based site-specific irrigation system offers the potential to increase yield and quality while saving water, by the seamless integration of sensor networks, grid computing & context computing. But it can be a challenging task of integrating these technologies[1]. Fig 1. presents the integration of three technologies and their resultant new concepts.

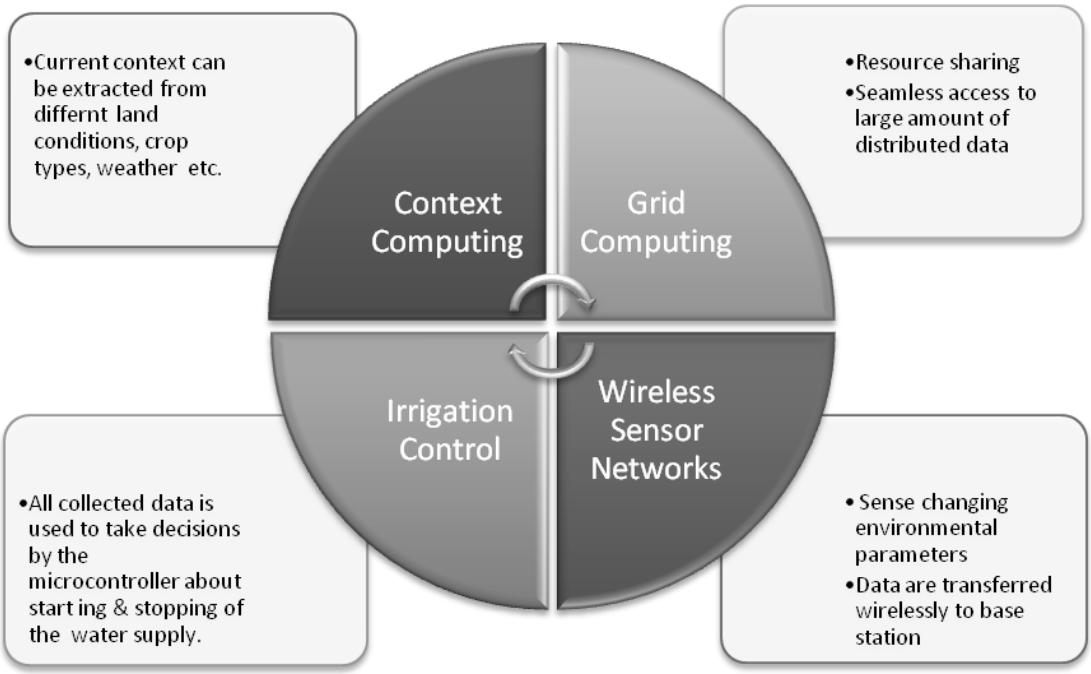


Fig1. Integration of Technologies

2.1 Context Computing

The ability of smart devices and smart applications to identify current operating conditions or context and adapt their behavior on the basis of the context is termed as context awareness. The context information is a set of parameters defining the surrounding situation that emerge in the moment. Once the information based on the context has been gathered, then the challenge is to use it in more effective way. In the Ontology based models the Ontologies represent a description of the concepts and relationships. In the field of agriculture, one need to consider many different operating parameters and their relations, hence this is the most suitable type of model for irrigation management. The important part of context computing, reasoning the gathered context information can be done on this basis. It also enables the system to deal with the changing conditions of environmental parameters, land, water requirements & crop type.

2.2 Grid Computing

Grid computing is about bringing resources together. There are two main objectives of the grid first, the vast amount of data collected by the sensors can be processed, analyzed, and stored using the computational and data storage resources of the grid. Second, the sensors can be efficiently shared by different users and applications under flexible usage scenarios. The results can in turn be used to optimize the operation of the sensors, or influence the operation of actuators to change the environment. Thus, sensor grids are well suited for adaptive and pervasive computing applications.

2.3 Wireless Sensor Networks

It has become a popular technique to incorporate WSNs in the applications that need interaction between user & the physical world. They allow the physical environment to be measured at high resolutions, and greatly increase the quantity and quality of real-world data and information for applications [3]. Since the land under cultivation is distributed over large geographical area, resource sharing becomes necessary. Because of deployment of such wireless sensor devices, WSNs acquire substantial data acquisition & processing capability.

2.4 Irrigation Control

Water is undoubtedly the main element for all irrigation activities, worldwide. Particularly in India, an unpredictable monsoon coupled with an increasing demand for food production has induced an imperative need for irrigation options. Drip irrigation is a water-saving technology which enables slow and regular application of water directly to the roots of the plants through a network of economically designed plastic pipes and low discharge emitters [4]. It maximizes crop productivity through increase in the crop yield and also the area for cultivation, and protects the environment through conserving soil, water and fertilizer resources, thus increasing the farmer income. Irrigation can be automated by using a central controller.

3. Materials and Methods

A conceptual system layout of distributed in-field WSN & grid of base station nodes along with the server node having context awareness is illustrated in Fig.2. Before having an automatic irrigation system installed land owners are needed to conceptualize and map out a landscape design plan. This map will determine the amount of water each zone will need. It is often best to understand proper plant care in order to categorize which plants are drought-resistant and which ones need

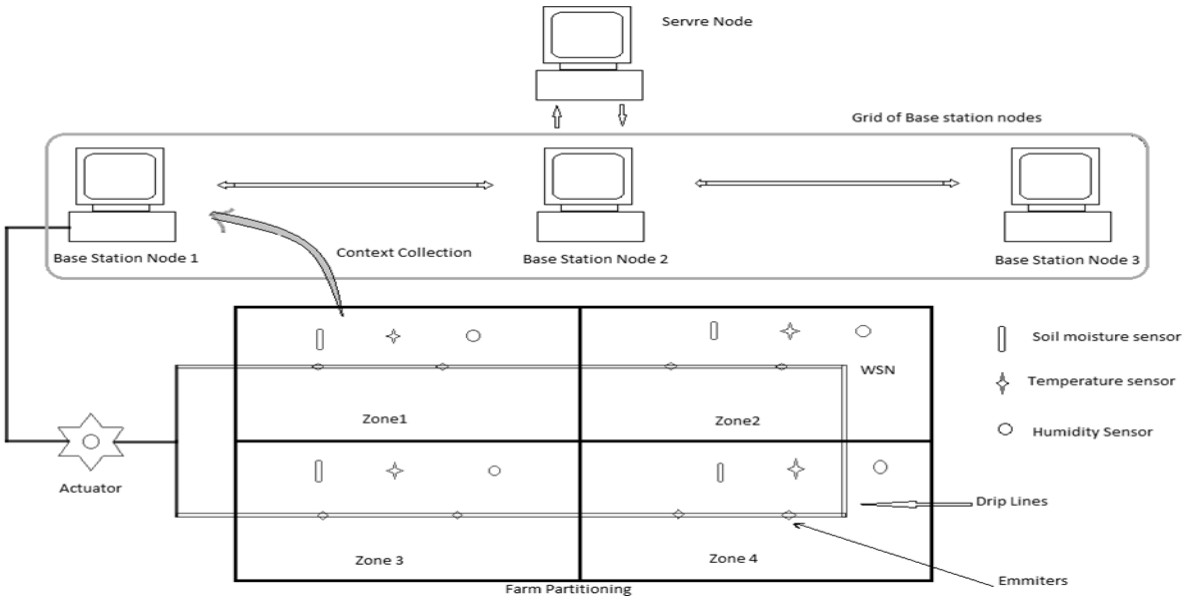


Fig2. System Model

more water. Plants that have similar needs should typically be strategically planted together in order to achieve optimum plant health and water conservation. Different sensors for measurement of temperature, soil moisture, humidity are placed in each zone. For soil moisture measurement, the gypsum sensor can be used. It absorbs the water and provides a decent range of resistance and moisture measurement. Rain detector can also be accommodated along with other sensors for presenting rainfall data information. The collected data is then processed, analyzed and stored at the base station node by the controller (ARM controller LPC2148). The other inputs to the server are system model (that specifies the structure of the grid model), system mode (which is selected depending upon the type of crop & surrounding conditions), & system database (that specifies the required parameter values selected as per the context algorithm). The database is designed in SQL Server, & grid nodes carry out data processing by embedded C language.

Context algorithm & GUI can be implemented in .net. All base station nodes are wirelessly connected to each other to form a grid using Zig Bee standard. These data values from sensors depend on type of crop, different seasonal patterns & previously sampled values. Drip irrigation is the slow, even application of low pressure water to soil and plants using plastic tubing, called drip tape, placed directly in the plants' root zone. Emitters are evenly spaced along the tape's length to allow the water to drip into the crop root zone. This method allows for very little evaporation and zero runoff, saves water by directing it more precisely, reduces the transmission of pathogens, and wets less of the soil surface, thus producing fewer weeds.

4. Context Awareness Algorithm

Context computing is a critical tool for measuring and understanding the complex coupled dynamics of natural systems.

4.1 Climate

It is necessary to consider the duration of crop and thus how many & which of the seasons it encounters e.g. Sugar cane is a long duration crop and thus it encounters all the seasons viz., rainy, winter and summer during its life cycle. Principle climatic components that control crop growth, yield and quality are temperature, light and moisture availability. The "ideal" climate for maximum production of crop must be determined.

4.1.1 Rainfall

A total rainfall range that will be adequate for the crop must be known. Rainfall requirements during the active growth period, intervals when high rainfall is not desirable & its effect on the crop must be taken into account.

4.1.2 Temperature

Growth is closely related to temperature. Optimum temperature for initial growth is generally 32° to 38°c. Rust incidence is high when the minimum temperatures are drastically reduced.

4.1.3 Relative humidity

High humidity (80-85%) favours rapid crop elongation during grand growth period. A moderate value of 45-65% coupled with limited water supply is favorable during the ripening phase.

4.1.4 Sunlight

Plants are sun loving quantities. They grow well in areas receiving solar energy in sufficient quantity.

4.2 Pests & diseases

The damage caused by Pests & diseases to crops is well known that are dependent on certain predisposing weather conditions. The farmer has to contend with the ravaging effects of locust swarms & diseases. Reduction in the losses caused by Pests & diseases by timely & effective control measures will considerably add to food production in the country. Irrigation and fertilization should be managed together to optimize efficiency. Chemigation through drip systems efficiently deposits chemicals in the root zone of the receiving plants. Because of its precision of application, chemigation can be safer and use less material than spray applications.

4.3 Field Irrigation Schedule

The goal of an efficient irrigation scheduling program is to "provide knowledge on correct time and optimum quantity of water application to optimize crop yields with maximum water use efficiency and at the same time ensure minimum damage to the soil". Thus, irrigation scheduling is the decision of when and how much water to apply to a cropped field[5]. Its purpose is to maximize irrigation efficiencies by applying the exact amount of water needed to replenish the soil moisture to the desired level.

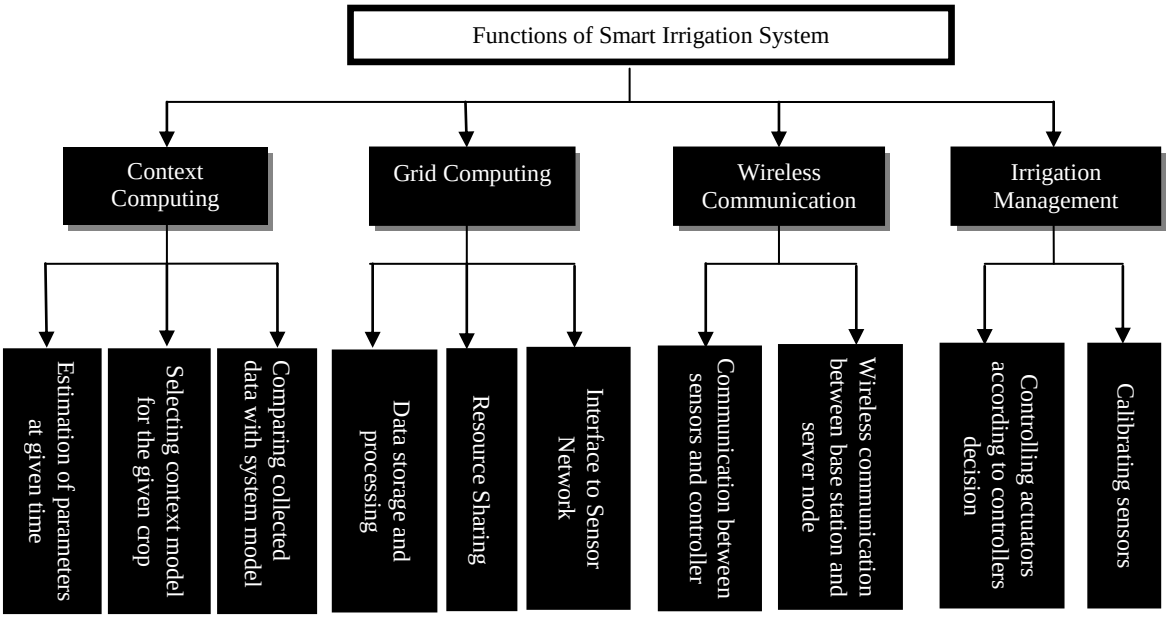


Fig 3. Software Model of the system

4.4 Irrigation water Management:

Different crops have different climatic requirements, as well as the other factors responsible for controlling the growth varies from plant to plant, & hence their irrigation requirements. The amount of water required to compensate the evapotranspiration loss from the cropped field. Crop water requirement refers to the amount of water that needs to be supplied, while crop evapotranspiration refers to the amount of water that is lost in evaporation + transpiration[6]. The irrigation water basically represents the difference between the crop water requirement and effective precipitation. The irrigation water requirement also includes additional water for leaching of salts and to compensate for non-uniformity of water application. Adequate soil moisture throughout the crop-growing season is important for obtaining maximum yields because crop growth is directly proportional to the water transpired.

During each irrigation, the wetting pattern needs to effectively rewet the root zone. The first irrigation of the season establishes the wetting pattern and can be longer than subsequent irrigations. Expanding a wetting pattern beyond this initial boundary can require an excessive amount of water. Once we select the proper duration for the initial irrigation, subsequent irrigation sets should maintain the previously established wetting pattern.

5. System Software And Control Strategy

5.1 User Interface:

The user interface is designed with .net framework in C# language, which is a tool package of virtual instrument. The system functions are following as Fig.3

5.2 Irrigation control algorithm:

Since soil-plant-air is a complicated objective, diverse factors, such as soil texture, compaction and species, may significantly impact on the water infiltration into the field. Here control is based on feedback strategy, which includes soil moisture sensor, error operation unit, logical decision and actuator. In order to get precision irrigation, for the logical decision, this algorithm is

opted. In order to improve control accuracy, three-input and one output fuzzy control model is constructed. Soil water contents and their change ratio, temperature and humidity are regarded as input factors, while valve turning on time is regarded as the output factor.
Soil water contents and their change ratio can be divided into different ranges: negative-large, negative-middle, negative-little, middle, positive-little, positive-middle, and positive-large. Electromagnetic valve turning on is controlled by the control algorithm according to soil water contents and their change ratio & remaining parameters.

6. Conclusion

Water is undoubtedly the most important part for all irrigation activities, worldwide. Particularly in India, an unpredictable monsoon coupled with an increasing demand for food production has induced an imperative need for irrigation options. Context awareness can improve productivity by increasing situational awareness of the state of the field. Grid computing uses its standards-based approach for the coordinated sharing of distributed and heterogeneous resources to solve large-scale problems. This paper used a concept of a promising low-cost wireless solution for an in-field WSN and remote control of precision irrigation using context aware algorithm with grid computing technique. Drip irrigation permits greater control and precision of irrigation timing and the amount of water applied. This flexibility to manage a schedule based on root zone soil water tension, thus precisely matching crop needs, may be the greatest advantage of drip irrigation.

7. References

[1] Aqeel-ur-Rehman, Zubair A. Shaikh, Noor A. Shaikh and 1Noman Islam, "An Integrated Framework to Develop Context-Aware Sensor Grid for Agriculture", Australian Journal of Basic and Applied Sciences, 4(5): 922-931, 2010.

[2] Hock Beng Lim, Yong Meng Teo, Protik Mukherjee, Vinh The Lam,Weng Fai Wong Simon See "Sensor Grid: Integration ofWireless Sensor Networks and the Grid", IEEE conference on Local Computer Networks 2005.

[3] Yunseop (James) Kim, *Member, IEEE*, Robert G. Evans, and William M. Iversen, "Remote Sensing and Control of an Irrigation System Using a Distributed Wireless Sensor Network", IEEE transaction on Instrumentation & Measurement, Volume 57, No.7, June2008.

[4] Anthony D. Wood, John A. Stankovic, Gilles Virone, Leo Selavo, Zhimin He, Qiuhua Cao, Thao Doan, Yafeng Wu, Lei Fang, and Radu Stoleru, University of Virginia, **"***Context-Aware Wireless Sensor Networks for Assisted Living and Residential Monitoring", IEEE Network, July/August 2008.*

[5] Clemmens, A.J. 1990. Feedback Control for Surface Irrigation Management. *In*:Visions of the Future. ASAE Publication 04-90. American Society of Agricultural Engineers, St. Joseph, Michigan, pp. 255-260.

[6] Fangmeier, D.D., Garrot, D.J., Mancino,C.F. and S.H. Husman. 1990. Automated Irrigation Systems Using Plant and Soil Sensors. *In*: Visions of the Future. ASAE Publication 04-90. American Society of Agricultural Engineers, St. Joseph, Michigan, pp. 533-537.

AET - 0009

Integration of Embedded System with Different Technology: RFID Tweeter

Mausami R.Desai[1], Research Scholar (M.E.E.C.)
S. S Engineering College, Bhavnagar
mausami09@gmail.com

Prof.K.R.Trivedi[2], Associate Professor
S.S. Engineering College, Bhavnagar,
krtrivedi@gmail.com

Abstract

RFID is used in many applications like identification of objects, tracking of objects etc .Most of the RFID prototypes are used for identification and tracking. This paper describes a prototype which is combination of RFID reader and embedded system. This paper addresses the use of current RFID technology for authentication in social networking using embedded system. This prototype can be expanded for so many applications which are related to social networking. It is a simple example of Internet of Things.

1. Introduction

Microcontroller based embedded system can be used for so many applications. It provides analog and digital o/p as well as it also provides Ethernet connectivity . Here these features are used for social networking .Now a days social networking become essential part of our life. With the help of social networking we can send messages to a person or a group of persons. It is easily approachable for conveying messages. This prototype is also simple example of Internet of Things. Internet of things is future internet which is foreseen as worldwide network of interconnected objects, uniquely addressable based on standard communication protocol. Internet of Things is simply integration of number of emerging technologies like identification and tracking (RFID/NFC/Barcode), sensor network, embedded technology and nano technology. This work includes the concept of embedded intelligence and for this purpose it uses embedded technology and RFID.

2. Hardware Section

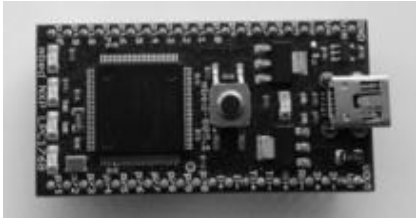
The prototype used here is divided in two parts.

A. RFID Section: This is a technology that uses silicon chip embedded on tags to transmit radio waves. These tags aim identify products, assets, medical records. A tag may contain information about the product or people. RFID tag is a uniquely identifiable object that can be embedded to any physical body. RFID consists of small microchips that contain unique Id embedded within it. A RFID system always made up of two components :

(i) The transponder which is located on the object to be identified.
(ii) The detector which is used to read the tag.

There are so many tags available. Here we are going to use 125 Htz tags and reader for authentication.

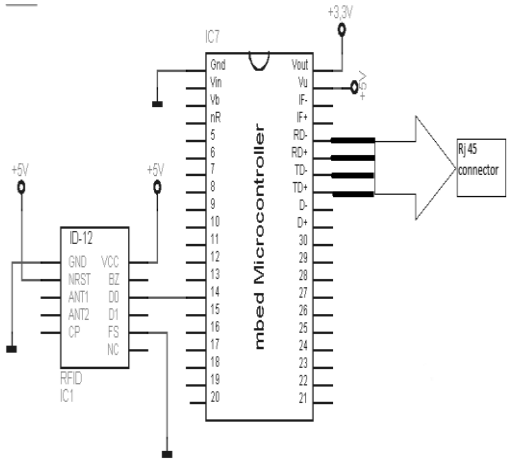
B. Embedded Section : There are so many options are available for this section. But mbed is unique from all other examples. mbed provide cloud based programmable microcontroller. One important thing is that with mbed there is no need to install anything. It provide online C/C++ complier mbed is having high level abstraction library. It is having reusable library. It has standard object oriented API .So that mbed has less low level programming. It can be used without knowing MCU details. This device can be used for any kind of operating device like window, Linux, Mac operating system etc. There is no need to install specific driver for specific operating device.



There is no need to install anything. mbed is USB plug and play devices. As we connect with computer it works as USB pen drive .we can directly copy and paste data. The small low-cost mbed module contains an NXP LPC1768 SOC processor. The new LCP1768 contains an ARM Cortex M3 processor, 64K RAM memory, a 512K Flash memory, a network controller, and a wide range of I/O interfaces such as USB, SPI, I2C,GPIO, ADC, DAC, RS232,

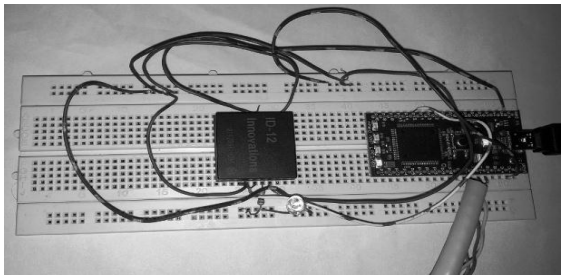
3. Experimental Setup

This prototype can be designed using mbed and RFID reader ID 12. The system is working under software control. RFID reader ID 12 is connected to mbed with serial receive line. With the help of this pin RFID tag Id can be received by mbed. The RFID reader module reads tags and send the ID as 1600-8N1 serial stream.

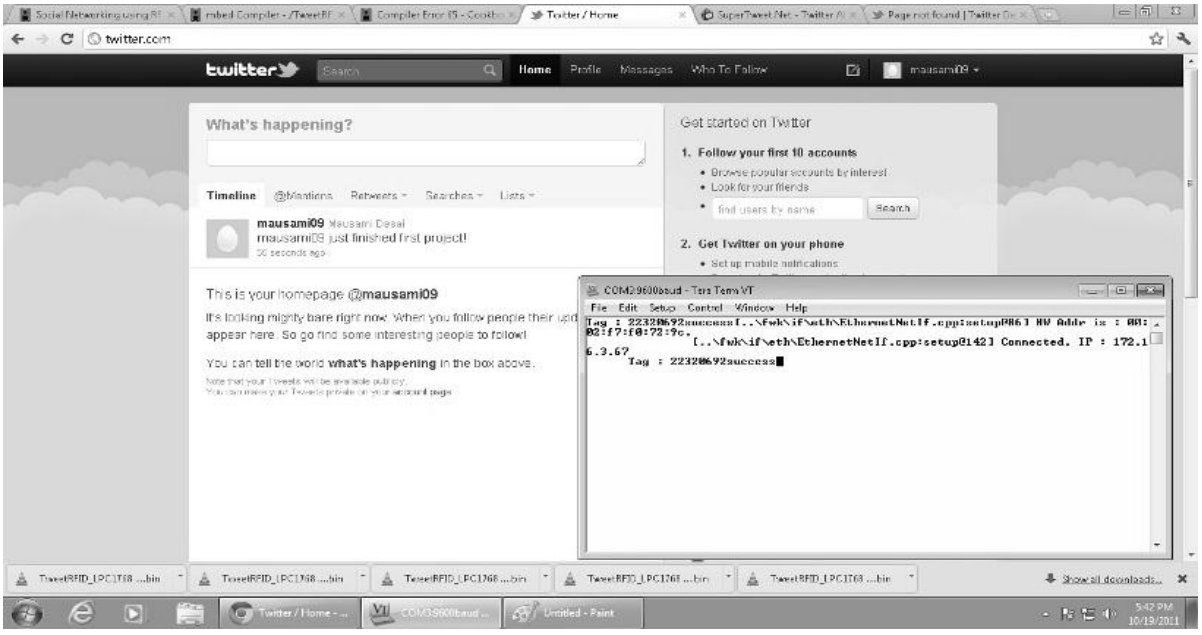


This tag ID is associated with user using software. This mbed is connected with compiler using USB. It is connected with Ethernet. For that purpose four pins RD+, RD-, TD + and TD- using RJ 45 connecter. At here we use twitter as social networking site. For using twitter account is requires user id and password. In this prototype we are using an api supertweet.net which use basic qauth authentication. It sends the tweets without password of tweeter account.

4. Result



The figure above shows the real setup of the mbed connected to RFID reader with wires. Figure given below is the snapshot of the twitter page showing tweet generated with the experimental set up used. It shows that idea of IOT has worked successfully.



5. Conclusion

This system is simple prototype which is designed only for 3 users but it can be extended for number of people. There are so many applications where we can use the same. For example it can be used for attendance system which may be combination of this prototype and database. At present we are working on different applications with the help of sensors.

:

6. References

[1] Mbed Handbook [Online]. Available:http://mbed.org/handbook/Homepage
[2] www.supertweet.net
[3] http://sourceforge.jp/projects/ttssh2/releases/
[4] id-innovations.com/httpdocs/
[5] www.wikipedia.com
[6] Simon Ford, Rapid Prototyping for Microcontrollers,[Online].Available http://mbed.org/media/press/mbed_whitepaper.pdf

AET - 0010

Audio Watermarking for Copyright Protection

Mrs. Madhura Amey Pednekar
M.E. Electronics
K.J.Somaiya College of Engg.Mumbai

Abstract

Watermarking bring a variety of very important techniques how to hide important information in an undetectable and irremovable way in audio and video data. Audio Watermarking is a technique that hides copyright information into the digital audio signal.Digital audio watermarking scheme is used for both copyright protection and content authentication. In this paper, fragile and robust watermarking techniques are used for content authentication and for copyright protection. New proposed algorithm based on LSB technique and DWT as well as security key is created by using chaotic sequence to get better SNR, transparency.

1. Introduction

One of the most important property of (digital) information is that it is in principle very easy to produce and distribute unlimited number of its copies. This might undermine the music, film, book and software industries and therefore it brings a variety of important problems concerning the protection of the intellectual and production rights that badly need to be solved. The fact that an unlimited number of perfect copies of text, audio and video data can be illegally produced and distributed requires to study ways of embedding copyright information and serial numbers in audio and video data. Watermarking bring a variety of very important techniques how to hide important information in an undetectable and irremovable way in audio and video data. Watermarking is the main part of the fast developing area of information hiding. The rapid growth of Internet and digital multimedia has made the authority and integrity of audio information more and more important issues. It is done by hiding data (information) within digital audio, images and video files. Watermarking is the process that embeds data called a watermark tag or label into a multimedia object it may contain information such as copyright, license, tracking and authorship etc. To protect digital works against illegal use and tampering, most of existing watermarking schemes are designed for either copyright protection [1] or content integrity authentication. However, in some application domains, one might wish to embed several watermarks in the same signal to accomplish different goals. If both purposes are fulfilled simultaneously, multiple watermarks scheme are required. For example, both robust and fragile watermarks are embedded for copyright protection and content authentication.

A digital watermark is either a visible or invisible mark placed on an signal that later can be detected and used as copyright infringement.

In general watermarking techniques are classified either by the embedding or detection process.Any watermarking method consists of two parts. The embedder with the watermark, Signal generation and decoder.

All of the developed algorithms take advantage of the perceptual properties
Of the human auditory system (HAS) in order to add a watermark into a host signal in a perceptually transparent manner.

Embedding additional information into audio sequences is a more tedious task than that of images, due to dynamic supremacy of the HAS over human visual system.

Most of the existing watermarking schemes are designed for either copyright protection or content integrity.

However, in some application domains, one might wish to embed several watermarks in the same signal to accomplish different goals. For example, the owner might desire to use one watermark to convey ownership information, use a second watermark to verify content integrity, and use a third watermark to convey a caption.

Watermarking Techniques used for Ownership Protection, proof of ownership, authentication and tampering detection, fingerprinting.

In this paper, section 2 contains different watermarking techniques, section 3 and 4 explain Fragile and robust watermarking algorithm techniques, and section 5 explain new proposed algorithm. Section 6 has given simulation results.

2. Watermark Techniques

Amplitude Modulation: - In this system, slight variations in the amplitude of the original host signal are introduced according to the watermark to be embedded. Varying the amplitude of the host signal by a few percent produces inaudible variations resulting in a watermarked signal which sounds identical to the original host file.

Hidden binary watermark can be easily destroyed. Time domain watermarking has a higher payload (number of bits hidden in a slice of audio signal represented as bps) compared to watermarking schemes of other domain, however, since the Embedding process performed directly on the original host audio signal (or selected blocks of the audio signal) requires a great number of threshold values to be defined.

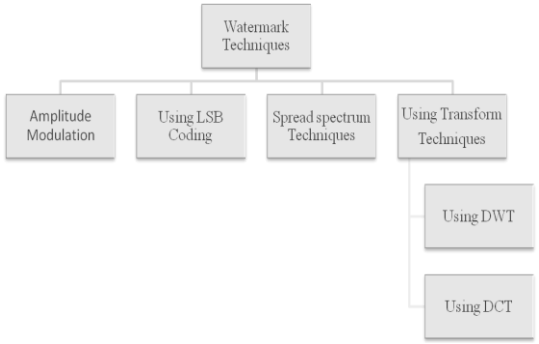


Fig.1 Classification of watermark techniques

Time domain methods are vulnerable against attacks like resampling, low pass filtering and compressing. This means that the hidden watermark can be easily destroyed since attacks based on common signal processing procedures can easily change the threshold values that are required for correct extracting the watermark from a watermarked audio signal.

LSB coding technique, Substitute the least significant bit of each selected bit (pixel) with the watermark bits. It is old technique which is not very robust against attacks Spread Spectrum is a general technique for embedding watermarks that can be implemented in any transform domain or in the time domain. The watermark is added to the full spread of whatever domain is being used and as such with a pseudo random mark and appropriate scaling it .Using DWT; the decomposition process can be performed in different levels. The more the levels are, the more accurate DWT in terms of the frequency and the time is obtained. In other words, since in higher levels of DWT, the frequency ranges of the sub-band become narrower, signal can be represented in detail with more precise frequencies. DWT, which is faster than of the other transforms and also it is reasonably robust against compressing attacks such as mp3, however, since DWT directly modifies the transform coefficients, some distinguishable artifacts can be induced in the low energy regions of the host audio signal. In audio watermarking applications, DCT embeds the digital watermark into the coefficients obtained from the transform using the quantization techniques. This approach has a high SNR since the digital watermark bits are inserted in the high energy sections of the host audio signal resulting in a very clear watermarked sound. Moreover, DCT is robust against resampling and low pass filtering attacks. However, it is vulnerable to compressing attacks such as mp3 since in the heart of every audio compressing algorithm an energy compressing transform such as DCT can be found. To improve the performance and the robustness of the audio watermarking technology it is possible to combine two or more of the previously described methods. The combined technique shows high SNR. This means that the quality of the watermarked audio is well preserved and the hidden watermark bits are inaudible. This technique is robust against the compressing attack like mp3 [3].

A multipurpose watermarking method which could protect copyright and realize tampering localization

Simultaneously by embedding two watermarking algorithm

- Fragile Watermarking
- Robust Watermarking

3. Fragile watermarking

In many multimedia applications, there is a need to authenticate a source that has been subjected to potential tampering

Attacks. This application is called Content authentication. Watermarking is among the emerging fields that are used in Content Authentication.

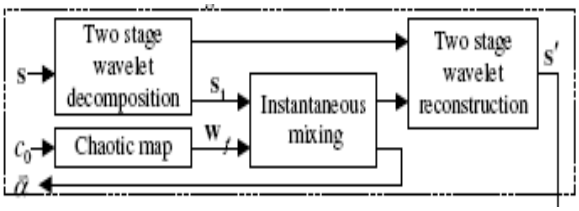


Fig 2. Fragile watermark embedder

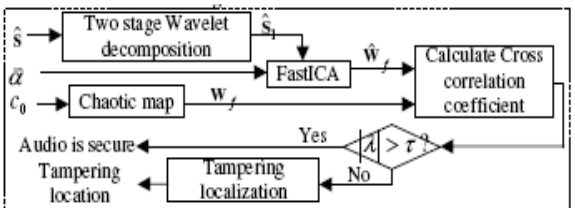


Fig 3.Fragile watermark Decoder

Fragile watermarking is mostly used for Content Authentication. In Fragile watermarking embedder,watermarked embedded audio file will created using DWT and chaotic map. Chaotic sequence is random sequence created as per chaotic equationThis chaotic sequence is used to generate watermark signal .First Audio file is going through the process of two stage decomposition getting DWT coefficients. These coefficients are mixing with watermark sequence using instantaneous Matrix, getting watermarked audio file and Security key. At decoder side, Watermarked audio file is received with security key. Using security key , estimate the watermark from watermarked audio file and chaotic sequence .Estimated watermark is compare

with actual watermark and get cross correlation factor to check tampering is available or not.

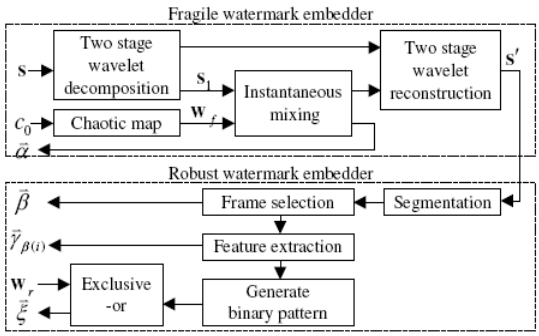


Fig.4 Robust Watermark Embedder

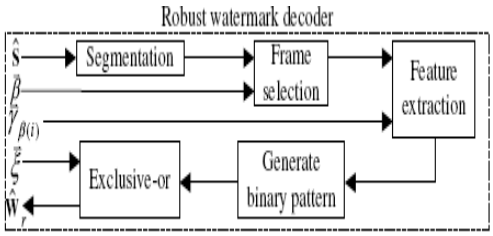


Fig.5 Robust Watermark Decoder

4. Robust Watermarking

Robust Watermarking is used for copyright protection because it is provide security keys which is unique identification code of authorized dealer which is created by using robust algorithm. Watermarked audio file from fragile embedder received at robust encoder, and Binary image is used as robust watermark. This robust watermark is embedded with coefficients from DWT and DCT create security keys which are used at decoder side to extract watermark. Estimated watermark is compared with actual watermark and find out SNR(signal to noise ratio),BER (Bit error rate),NC(Normalized cross correlation) for checking of robustness ,transparency and detect ability of system.

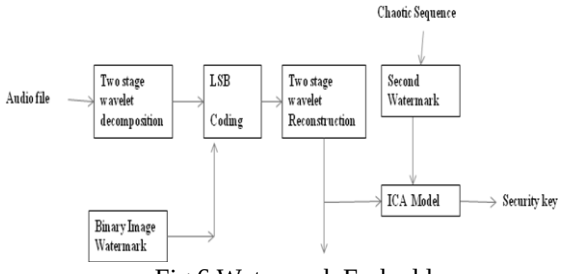


Fig.6 Watermark Embedder

Watermarked audio file

5. New Proposed Algorithm

Audio file is going through two stage wavelet decomposition. Decomposed coefficients are embedded with binary image watermark using LSB coding technique to get embedded file. Embedded file is reconstructed again to get watermarked audio file. This watermarked audio file combine with second watermark which is created by chaotic sequence using ICA model. After mixing of it we get security key which is used at decoder side to detect estimated watermark. Calculate SNR between actual watermark and estimated watermark.

6. Simulation Result and Analysis

For fragile watermarking

A chaotic sequence was embedded in the host audio (.wav) as fragile watermark, respectively. Haar wavelet basis was used . The values of other parameters were:

$p = 3$, $q = 2$, $c0 = 0.3$, $l = 512$, $h = 3$, $L1 = 1024$,$L2 = 4$, $a11 = 0.99$, $a12 = 0.01$, $a21 = 0.98$, $a22 = 0.02$, $\tau = 0.9$.

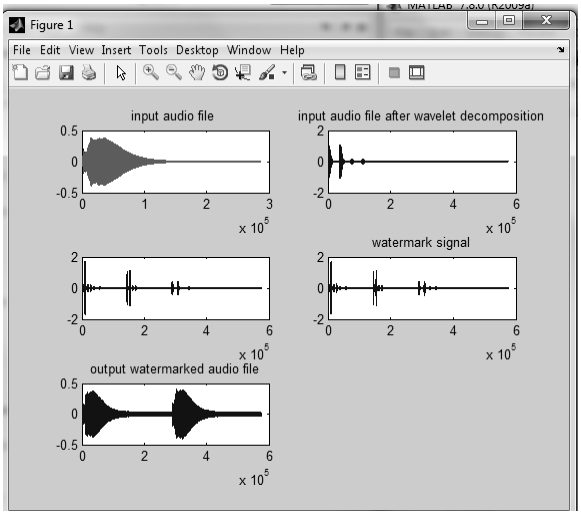


Fig.7 Fragile watermark embedded output

After simulation of fragile watermarking algorithm, we get watermarked audio file (7) using mentioned values of parameters .Fragile watermark detected output is indicated ,contains actual watermark and estimated watermark (8).

$$SNR(\mathbf{s},\mathbf{s}') = 10\log_{10}\frac{\sum_{n=0}^{L_s-1} s^2(n)}{\sum_{n=0}^{L_s-1}[s(n)-s'(n)]^2} \quad (1)$$

$$NC(\mathbf{w}_r,\hat{\mathbf{w}}_r) = \frac{\sum_{n=0}^{MN-1} w_r(n)\hat{w}_r(n)}{\sqrt{\sum_{n=0}^{MN-1} w_r^2(n)}\sqrt{\sum_{n=0}^{MN-1} \hat{w}_r^2(n)}} \quad (2)$$

Transparency Test:

In transparency test ,SNR(Eq.(1)) between original audio and watermarked audio for the different audio files are checked. This method is achieves better transparency, given in table 1.

For robust watermarking

At embedder side watermarked audio file received from fragile embedder is going through the robust embedder to create two security keys which is find out estimated

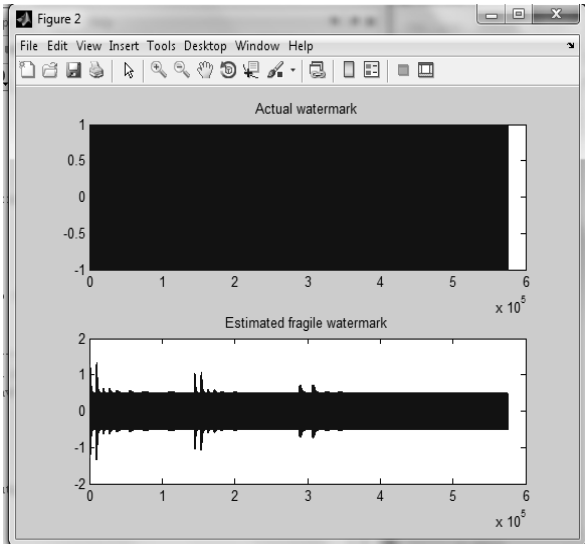


Fig.8 Fragile watermark detector output

Audio File	SNR (DB)
Test1.wav	19.7183
Test2.wav	24.8867
Test3.wav	27.8282
Test4.wav	23.3514
Test5.wav	20.3112

Table 1

Watermark which should be match with the actual watermark. If NC =1(Eq.(2)) then estimated watermark and actual is the same ,as shown in (9) and (10).

For new proposed algorithm

At embedder side, watermarked audio file and security key will get. Both are generated in different way ,so SNR and transparency between watermarked audio and actual audio is better. Results are shown in (11)

This method will give better transparency and SNR as compared to fragile and robust ,proved in table 2.

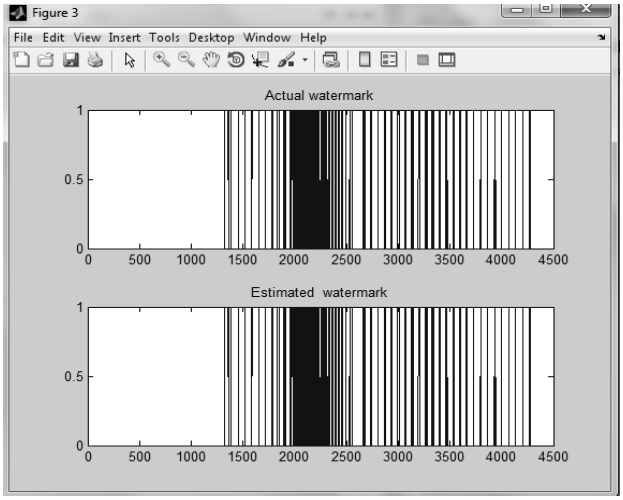


Fig.9 Robust Watermark Detector output(NC=1)

Audio File	SNR (DB) For Fragile	SNR(DB) For New Proposed Algorithm
Test1.wav	19.7183	35.2703
Test2.wav	24.8867	34.0883
Test3.wav	27.8282	29.5698
Test4.wav	23.3514	29.8560
Test5.wav	20.3112	32.1245

Table 2

7. Conclusion

Watermarking technique is used for copyright protection and for content authentication. Fragile and robust are two multipurpose techniques which are used for the content authentication and for copyright protection respectively. Simulation results demonstrate the effectiveness of our algorithm in terms of transparency, robustness, detection reliability. New proposed algorithm gives better transparency and SNR

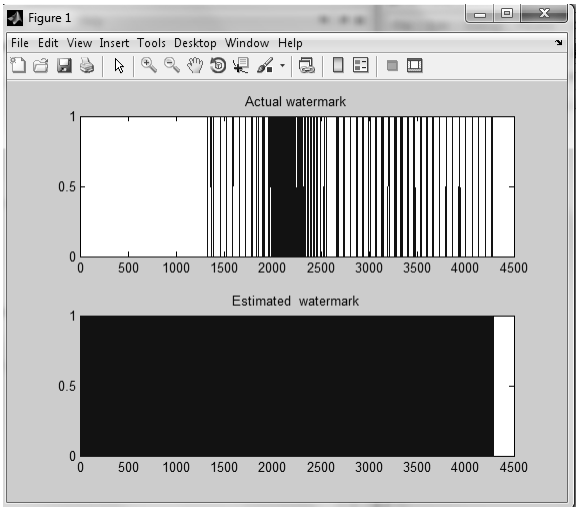


Fig.10 Robust Detector Output (NC=0.3549)

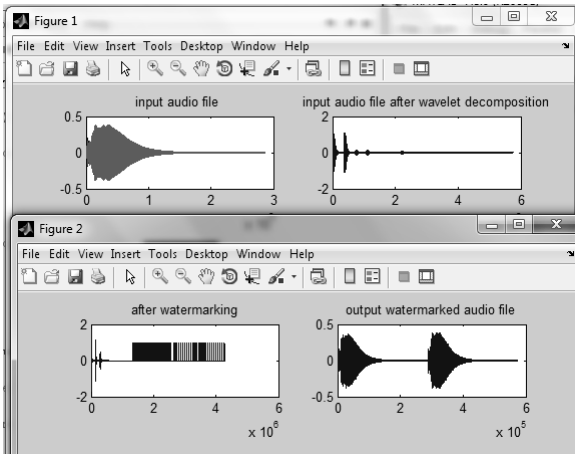


Fig.11 New proposed algorithm Output

8. References

[1] Multipurpose Audio Watermarking Scheme for Copyright protection and Content Authentication NING *Chen*, *Jie Zhu* Department of Electronic Engineering, Shanghai Jiaotong University, Shanghai 200240, China.

[2] Elec 484 Final Project: Audio Watermarking JARED VAWTER - 0021099 , IAN WOOD – 0023047

[3] Algorithm for Audio Watermarking and Stegnography ,*JIC* Department of Electrical and Information Engineering, Information Processing Laboratory,University of Oulu,OULU 2004

[4] A New Approach to Audio Watermarking Using Discrete Wavelet and Cosine Transforms Hooman Nikmehr, Sina Tayefeh Hashemy

[5] M.Q. Fan and H.X. Wang, "A Novel Multipurpose Watermarking Scheme for Copyright Protection and Content Authentication", *2nd Workshop on Digital Media and its Application in Museum & Heritage*, Chongqing, China, 2007,pp. 19-24

[6] Hyvärinen, "Fast and Robust Fixed-point Algorithms for Independent Component Analysis", *IEEE Trans. Neural Networks*, vol. 10, no. 3, pp. 626-634, 1999.

AET - 0011

Light Detection and Ranging

Anjum Shafi Mujawar

Department of Electronics and Communication Engineering
Vidyalankar Polytechnic,Wadala
Anjum.mujawar@vpt.edu.in

Abstract

Light Detection and Ranging (LIDAR) have recently become the technologies of choice in mass production of Digital Elevation Models (DEMs), Digital Terrain Models (DTMs), and Triangulated Irregular Networks (TINs), referred to generically hereafter as DEMs. This paper presents lessons learned from LIDAR projects to date in various states. It addresses opportunities presented by LIDAR for generating DEMs as articulated by various user groups in the National Height Modernization Study. Finally, it summarizes actions required by the remote sensing community to establish LIDAR as standard tools, with established standards, for generating digital elevation data for the new millennium.

1. INTRODUCTION

LIDAR (Light Detection and Ranging) is an optical remote sensing technology that measures properties of scattered light to find range and/or other information of a distant target. The prevalent method to determine distance to an object or surface is to use laser pulses. Like the similar radar technology, which uses radio waves, the range to an object is determined by measuring the time delay between transmission of a pulse and detection of the reflected signal. LIDAR technology has application geometrics, archaeology, geography, geology, geomorphol ogy, seismology, forestry, remote sensing and atmospheric physics.[1] Applications of LIDAR include ALSM (Airborne Laser Swath Mapping), laser altimetry or LIDAR Contour Mapping. The acronym LADAR (Laser Detection and Ranging) is often used in military contexts. The term laser radar is also in use but is misleading because it uses laser light and not the radio waves that are the basis of conventional radar.

2. GENERAL DESCRIPTION

The primary difference between LIDAR and RADAR is LIDAR uses much shorter wavelengths of the electromagnetic spectrum, typically in the ultraviolet, visible, or near infrared range. In general it is possible to image a feature or object only about the same size as the wavelength, or larger. Thus LIDAR is highly sensitive to aerosols and cloud particles and has many applications in atmospheric research and meteorology.

An object needs to produce a dielectric discontinuity to reflect the transmitted wave. At radar (microwave or radio) frequencies, a metallic object produces a significant reflection. However non-metallic objects, such as rain and rocks produce weaker reflections and some materials may produce no detectable reflection at all, meaning some objects or features are effectively invisible at radar frequencies. This is especially true for very small objects (such as single molecules and aerosols).

Lasers provide one solution to these problems. The beam densities and coherency are excellent. Moreover the wavelengths are much smaller than can be achieved with radio systems, and range from about 10 micrometers to the UV (ca. 250 nm). At such wavelengths, the waves are "reflected" very well from small objects. This type of reflection is called backscattering. Different types of scattering are used for different LIDAR applications, most common are Rayleigh scattering, Mie scattering and Raman scattering as well as fluorescence. Based on different kinds of backscattering, the LIDAR can be accordingly called Rayleigh LIDAR, Mie LIDAR, Raman LIDAR and Na/Fe/K Fluorescence LIDAR and so on. The wavelengths are ideal for making measurements of smoke and other airborne particles (aerosols), clouds, and air molecules.

A laser typically has a very narrow beam which allows the mapping of physical features with very high resolution compared with radar. In addition, many chemical compounds interact more strongly at visible wavelengths than at microwaves, resulting in a stronger image of these materials. Suitable combinations of lasers can allow for remote mapping of atmospheric contents by looking for wavelength-dependent changes in the intensity of the returned signal.

LIDAR has been used extensively for atmospheric research and meteorology. With the deployment of the GPS in the 1980s precision positioning of aircraft became possible. GPS based surveying technology has made airborne surveying and mapping

applications possible and practical. Many have been developed, using downward-looking LIDAR instruments mounted in aircraft or satellites. A recent example is the NASA Experimental Advanced Research LIDAR.

A basic LIDAR system involves a laser range finder reflected by a rotating mirror (top). The laser is scanned around the scene being digitized, in one or two dimensions (middle), gathering distance measurements at specified angle intervals (bottom).

In general there are two kinds of LIDAR detection schema: "incoherent" or direct energy detection (which is principally an amplitude measurement) and Coherent detection (which is best for Doppler, or phase sensitive measurements). Coherent systems generally use Optical heterodyne detection which being more sensitive than direct detection allows them to operate a much lower power but at the expense of more complex transceiver requirements.

In both coherent and incoherent LIDAR, there are two types of pulse models: MICROPULSE LIDAR systems and high energy systems. Micropulse systems have developed as a result of the ever increasing amount of computer power available combined with advances in laser technology. They use considerably less energy in the laser, typically on the order of one microjoule, and are often "eye-safe," meaning they can be used without safety precautions. High-power systems are common in atmospheric research, where they are widely used for measuring many atmospheric parameters: the height, layering and densities of clouds, cloud particle properties (extinction coefficient, backscatter coefficient, depolarization), temperature, pressure, wind, humidity, trace gas concentration (ozone, methane, nitrous oxide, etc.).

On a functional level, LiDAR is typically defined as the integration of three technologies into a single system capable of acquiring data to produce accurate digital elevation models (DEMs). These technologies are lasers, the Global Positioning System (GPS), and inertial navigation systems (INS). Combined, they allow the positioning of the footprint of a laser beam as it hits an object, to a high degree of accuracy. Lasers themselves are very accurate in their ranging capabilities, and can provide distances accurate to a few centimeters. The accuracy limitations of LiDAR systems are due primarily to the GPS and IMU (Inertial Measurement Unit) components. As advancements in commercially available GPS and IMUs occur, it is becoming possible to obtain a high degree of accuracy using LiDAR from moving platforms such as aircraft.ALiDAR system combines a single narrow-beam laser with a receiver system. The laser produces an optical pulse that is transmitted, reflected off an object, and returned to the receiver. The receiver accurately measures the travel time of the pulse from its start to its return. With the pulse travelling at the speed of light, the receiver senses the return pulse before the next pulse is sent out. Since the speed of light is known, the travel time can be converted to a range measurement. Combining the laser range, laser scan angle, laser position from GPS, and laser orientation from INS, accurate x, y, z ground coordinates can be calculated for each laser pulse.

Laser emission rates can be anywhere from a few pulses per second to tens of thousands of pulses per second. Thus, large volumes of points are collected. For example, a laser emitting pulses at 10,000 times per second will record 600,000 points every minute. Typical raw laser point spacing on the ground ranges from 2 to 4 meters.

Some LiDAR systems can record “multiple returns” from the same pulse. In such systems the beam may hit leaves at the top of tree canopy, while part of the beam travels further and may hit more leaves or branches. Some of the beam is then likely to hit the ground and be reflected back, ending up with a set of recorded “multiple returns” each having an x, y, z position. This feature can be advantageous when the application calls for elevations for not only the ground, but for tree or building heights. As surface types and characteristics vary and change the laser beam’s reflectivity, then the ability of the LiDAR to record the return signals changes. For example, a laser used for topographic applications will not penetrate water, and in fact records very little data even for the surface of the body of water. Where the application calls for a laser to penetrate water to determine x, y, z positions of undersea features, then a slightly different variation of LiDAR technology is used

3. COMPONENTS

There are several major components to a LIDAR system:

1. Laser — 600-1000 nm lasers are most common for non-scientific applications. They are inexpensive but since they can be focused and easily absorbed by the eye the maximum power is limited by the need to make them eye-safe. Eye-safety is often a requirement for most applications. A common alternative 1550 nm lasers are eye-safe at much higher power levels since this wavelength is not focused by the eye, but the detector technology is less advanced and so these wavelengths are generally used at longer ranges and lower accuracies. They are also used for military applications as 1550 nm is not visible in night vision goggles unlike the shorter 1000 nm infrared laser. Airborne topographic mapping LIDARS generally use 1064 nm diode pumped YAG lasers, while bathymetric systems generally use 532 nm frequency doubled diode pumped YAG lasers because 532 nm penetrates water with much less attenuation than does 1064 nm. Laser settings include the laser repetition rate (which controls the data collection speed). Pulse length is generally an attribute of the laser cavity length, the number of passes required through the gain material (YAG, YLF, etc.), and Q-switch speed. Better target resolution is achieved

with shorter pulses, provided the LIDAR receiver detectors and electronics have sufficient bandwidth.

2. Scanner and optics — How fast images can be developed is also affected by the speed at which it can be scanned into the system. There are several options to scan the azimuth and elevation, including dual oscillating plane mirrors, a combination with a polygon mirror, a dual axis scanner. Optic choices affect the angular resolution and range that can be detected. A hole mirror or a beam splitter are options to collect a return signal.

3. Photodetector and receiver electronics — two main photodetector technologies are used in lidars: solid state photodetectors, such as silicon avalanche photodiodes, or photomultipliers. The sensitivity of the receiver is another parameter that has to be balanced in a LIDAR design.

4. Position and navigation systems — LIDAR sensors that are mounted on mobile platforms such as airplanes or satellites require instrumentation to determine the absolute position and orientation of the sensor. Such devices generally include a Global Positioning System receiver and an Inertial Measurement Unit (IMU).

4. APPLICATIONS

Fig1:LIDAR System

This LIDAR-equipped mobile robot uses its LIDAR to construct a map and avoid obstacles.

Other than those applications listed above, there are a wide variety of applications of LIDAR, as often mentioned in Dataset programs.

ARCHAEOLOGY

LIDAR has many applications in the field of archaeology including aiding in the planning of field campaigns, mapping features beneath forest canopy, and providing an overview of broad, continuous features that may be indistinguishable on the ground. LIDAR can also provide archaeologists with the ability to create high-resolution digital elevation models (DEMs) of archaeological sites that can reveal micro-topography that are otherwise hidden by vegetation. LIDAR-derived products can be easily integrated into a Geographic Information System (GIS) for analysis and interpretation. For example at Fort Beausejour - Fort Cumberland National Historic Site, Canada, previously undiscovered archaeological features have been mapped that are related to the siege of the Fort in 1755. Features that could not be distinguished on the ground or through aerial photography were identified by overlaying hill shades of the DEM created with artificial illumination from various angles.

With LIDAR the ability to produce high-resolution datasets quickly and relatively cheaply can be an advantage. Beyond efficiency, its ability to penetrate forest canopy has led to the discovery of features that were not distinguishable through traditional geo-spatial methods and are difficult to reach through field surveys.

METEOROLOGY AND ATMOSPHERIC ENVIRONMENT

The first LIDARs were used for studies of atmospheric composition, structure, clouds, and aerosols. Initially based on ruby lasers, LIDARs for meteorological applications were constructed shortly after the invention of the laser and represent one of the first applications of laser technology.

Elastic backscatter LIDAR is the simplest type of LIDAR and is typically used for studies of aerosols and clouds. The backscattered wavelength is identical to the transmitted wavelength, and the magnitude of the received signal at a given range depends on the backscatter coefficient of scatterers at that range and the extinction coefficients of the scatterers along the path to that range. The extinction coefficient is typically the quantity of interest.

Differential Absorption LIDAR (DIAL) is used for range-resolved measurements of a particular gas in the atmosphere, such as ozone, carbon dioxide, or water vapor. The LIDAR transmits two wavelengths: an "on-line" wavelength that is absorbed by the gas of interest and an off-line wavelength that is not absorbed. The differential absorption between the two wavelengths is a measure of the concentration of the gas as a function of range. DIAL LIDARs are essentially dual-wavelength elastic backscatter LIDARS.

Raman LIDAR is also used for measuring the concentration of atmospheric gases, but can also be used to retrieve aerosol parameters as well. Raman LIDAR exploits inelastic scattering to single out the gas of interest from all other atmospheric constituents. A small portion of the energy of the transmitted light is deposited in the gas during the scattering process, which shifts the scattered light to a longer wavelength by an amount that is unique to the species of interest. The higher the concentration of the gas, the stronger the magnitude of the backscattered signal.

Doppler LIDAR is used to measure wind speed along the beam by measuring the frequency shift of the backscattered light. Scanning LIDARs, such as NASA's HARLIE LIDAR, have been used to measure atmospheric wind velocity in a large three dimensional cone. ESA's wind mission ADM-Aeolus will be equipped with a Doppler LIDAR system in order to provide global measurements of vertical wind profiles. A Doppler LIDAR system was used in the 2008 Summer Olympics to measure wind fields during the yacht competition.[6] Doppler LIDAR systems are also now beginning to be successfully applied in the renewable energy sector to acquire wind speed, turbulence, wind veer and wind shear data. Both pulsed and continuous wave systems are being used. Pulsed systems using signal timing to obtain vertical distance resolution, whereas continuous wave systems rely on detector focusing.

GEOLOGY

In geology and seismology a combination of aircraft-based LIDAR and GPS have evolved into an important tool for detecting faults and measuring uplift. The output of the two technologies can produce extremely accurate elevation models for terrain that can even measure ground elevation through trees. This combination was used most famously to find the location of the Seattle in Washington, USA.[8] This combination is also being used to measure uplift at Mt. St. Helens by using data from before and after the 2004 uplift.[9] Airborne LIDAR systems monitor glaciers and have the ability to detect subtle amounts of growth or decline. A satellite based system is NASA's ICESat which includes a LIDAR system for this purpose. NASA's Airborne Topographic Mapper is also used extensively to monitor glaciers and perform coastal change analysis.

PHYSICS AND ASTRONOMY

A worldwide network of observatories uses lidars to measure the distance to reflectors placed on the moon, allowing the moon's position to be measured with mm precision and tests of general relativity to be done. MOLA, the Mars Orbiting Laser Altimeter, used a LIDAR instrument in a Mars-orbiting satellite (the NASA Mars Global Surveyor) to produce a spectacularly precise global topographic survey of the red planet.
In September, 2008, NASA's Phoenix Lander used LIDAR to detect snow in the atmosphere of Mars.

In atmospheric physics, LIDAR is used as a remote detection instrument to measure densities of certain constituents of the middle and upper atmosphere, such as potassium, sodium, or molecular nitrogen and oxygen. These measurements can be used to calculate temperatures. LIDAR can also be used to measure wind speed and to provide information about vertical distribution of the aerosol particles.

BIOLOGY AND CONSERVATION

LIDAR has also found many applications in forestry. Canopy heights, biomass measurements, and leaf area can all be studied using airborne LIDAR systems. Similarly, LIDAR is also used by many industries, including Energy and Railroad, and the Department of Transportation as a faster way of surveying. Topographic maps can also be generated readily from LIDAR, including for recreational use such as in the production of orienteering maps.

In oceanography, LIDAR is used for estimation of phytoplankton fluorescence and generally biomass in the surface layers of the ocean. Another application is airborne LIDAR bathymetry of sea areas too shallow for hydrographic vessels.

In addition, the Save-the-Redwoods League is undertaking a project to map the tall redwoods on California's northern coast. LIDAR allows research scientists to not only measure the height of previously unmapped trees but to determine the biodiversity of the redwood forest.

5. LIDAR DATA

What can you do with LIDAR?

Measure distance

- Measure speed
- Measure rotation
- Measure chemical composition and concentration

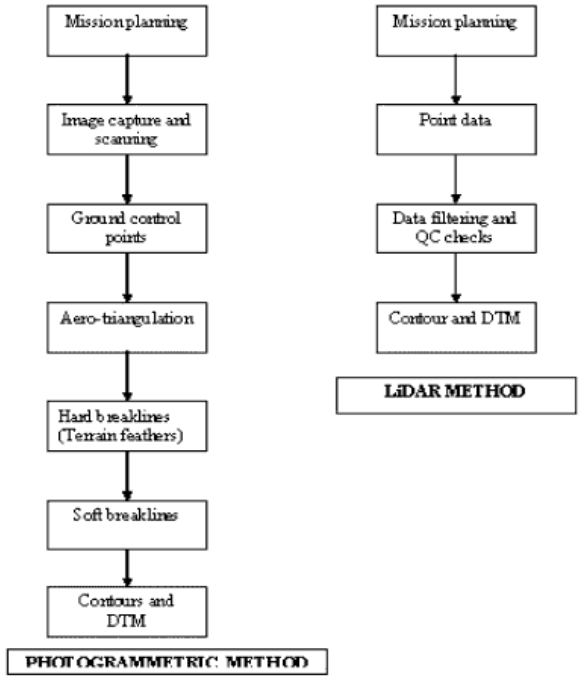
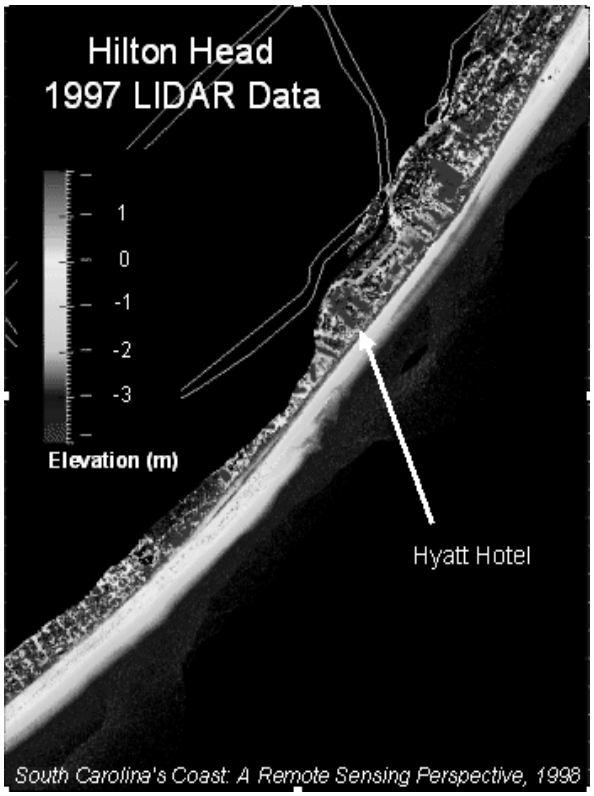


Fig 2: Comparison of various steps involved in DTM generation, Photogrammetry vs. LIDAR

WHAT ARE LIDAR DATA?



Light Detection and Ranging (LIDAR) is a remote sensing system used to collect topographic data. This technology is being used by the National Oceanic and Atmospheric Administration (NOAA) and NASA scientists to document topographic changes along shorelines. These data are collected with aircraft-mounted lasers capable of recording elevation measurements at a rate of 2,000 to 5,000 pulses per second and have a vertical precision of 15 centimeters (6 inches). After a baseline data set has been created, follow-up flights can be used to detect shoreline changes.

HOW LIDAR DATA ARE COLLECTED ?

For the South Carolina project, a LIDAR sensor was mounted on-board a NOAA DeHavilland Twin Otter aircraft pictured below. Once in flight, the aircraft travels over the beach at approximately 60 meters per second. During the flight, the LIDAR sensor pulses a narrow, high frequency laser beam toward the earth through a port opening in the bottom of the aircraft's fuselage. The LIDAR sensor records the time difference between the emission of the laser beam and the return of the reflected laser signal to the aircraft.

The LIDAR transceiver is rigidly fastened to the aircraft and does not move. However, a scan mirror assembly is mounted beneath the transceiver. A 45-degree folding mirror reflects the laser pulses onto a moving mirror which directs the laser pulses to the earth.

The reflected laser light from the ground follows the reverse optical path and is directed into a small Cassegrainian telescope. The moving mirror produces a conical sampling pattern beneath the aircraft over a 30-degree wide swath, thus permitting the collection of topographic information over a strip approximately 300 meters (about 1000 feet) in width from the nominal 600 meter (2000 feet) data collection altitude.

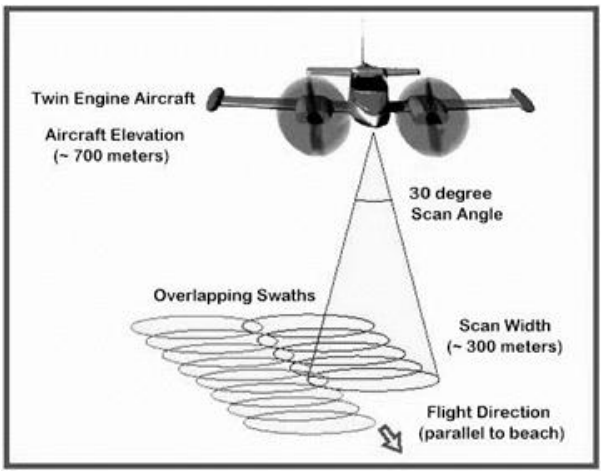


Fig 4: Illustration of How the LIDAR Sensing Instrument Captures Elevation Points.

The LIDAR instruments only collect elevation data. To make these data spatially relevant, the positions of the data points must be known. A high-precision global positioning system (GPS) antenna is mounted on the upper aircraft fuselage. As the LIDAR sensor collects data points, the location of the data are simultaneously recorded by the GPS sensor. After the flight, the data are downloaded and processed using specially designed computer software. The end product is accurate, geographically registered longitude, latitude, and elevation (x, y, z) positions for every data point. These "x, y, z" data points allow the generation of a digital elevation model (DEM) of the ground surface.

LIDAR data sets on this CD-ROM cover an area from the low water line to the landward base of the sand dunes. Flights are planned to maximize the number of elevation points collected at the lowest tide for the largest area possible. The aircraft flight path is always parallel to the beach. Four passes are flown over each section of the beach. Two of these passes are flown so the center of the swath is over the sand/water interface. The other two passes are flown over the center of the sand/development interface.

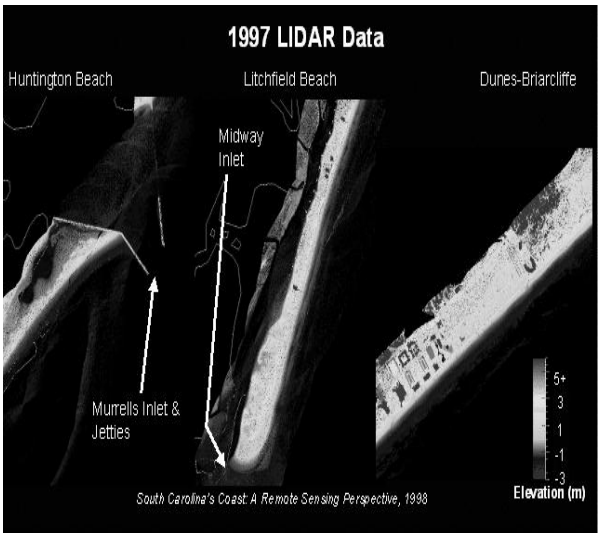
Flights generally last four hours. Weather conditions must be monitored. The flights cannot be flown during times of rain or fog as the water vapor in the air could cause the laser beams to scatter and give a false reading. Additionally, the plane cannot fly during times of high winds as the returned laser pulse will not be recorded correctly.

6. INTERPRETING LIDAR ELEVATION MAPS

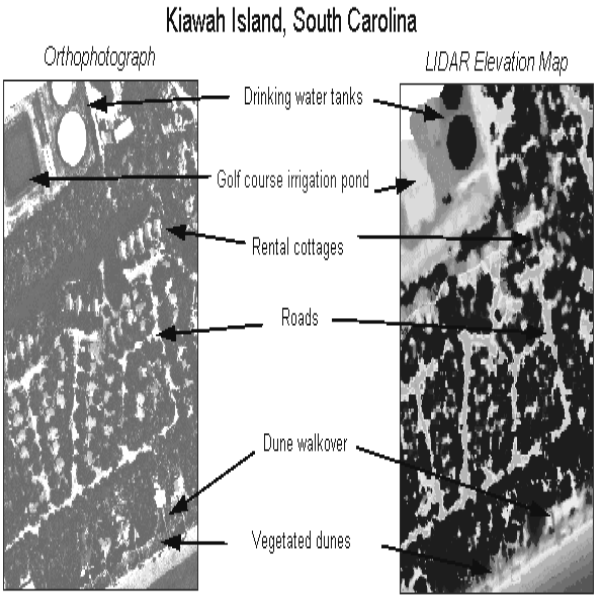
In remote sensing, false color images such as LIDAR elevation maps are common. They serve as an effective means for visualizing data. The term "false color" refers to the fact that these images are not photographs. Rather, they are digital images in which each image pixel represents a data point that is colored according to its value. The purpose of this section is to aid users in interpreting false color images.

LIDAR beach mapping data are composed of elevation measurements of the beach surface and are acquired through aerial topographic surveys. The file format used to capture and store LIDAR data is a simple text file and referred to as "x,y,z," where x is longitude, y is latitude, and z is elevation. Using the elevation "points," LIDAR data may be used to create detailed topographic beach maps.

In the three images shown below, the legend in the bottom right corner of the image has a range of numbers from -3 meters to +5 meters. The numbers indicate the relationship between the colors on the legend and the elevations depicted on the map. For example, in the Huntington Beach map, the deep blue color represents land approximately at sea level or zero elevation. The cyan (light blue) features, like the jetty, represent elevations around 1 meter, or about 3 feet above sea level.



LIDAR data become easier to interpret when examined in conjunction with additional data such as aerial photography. In the example below a LIDAR elevation map is compared with an orthophotograph. This small area on Kiawah Island provides a variety of interesting features. Comparing the orthophoto to the LIDAR data it becomes easier to identify features such as houses, roads, the vegetated dune area, and irrigation ponds.



Comparing Features Found in an Orthophotograph to LIDAR Data

Along the South Carolina coast, beach features tend to be less than 5 meters (16 feet). As a result, the scale of the color bar was chosen to highlight relatively narrow variations in elevation. This legend can be readily viewed in the PDF maps located in the pdf/islands directory on this CD-ROM. Additionally, this legend has been provided for use in Arc View and is located at: data/LIDAR/avelev.shp.

In this second example, an additional vector base map was overlaid on both the orthophoto and LIDAR elevation map. The base map, created in 1993, includes digitized building footprints, dune walkovers, and roads. A detailed base map can assist in confirming features detected by LIDAR elevation measurements. For example, when houses are surrounded by tall vegetation, LIDAR elevation data do not distinguish between roof top and tree top. Without the vector base map, it would be very difficult to determine boundaries between roofs and trees. Often ancillary data do not provide sufficient detail or are not available. In these cases, the user must obtain ground reference information using either local knowledge or by visiting the area to accurately confirm landmarks.

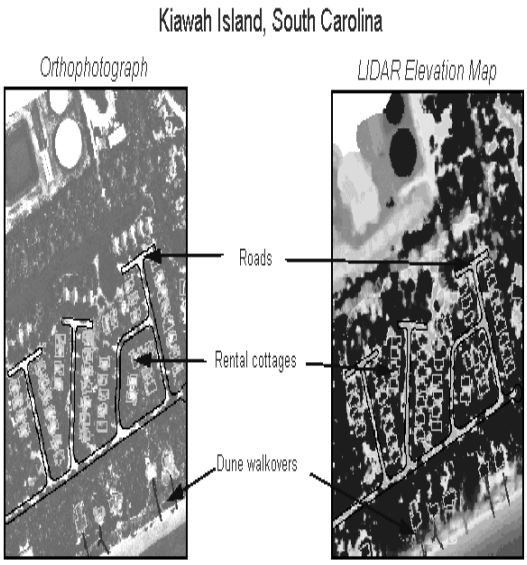


Fig7:Example of How Vector Data Can be Useful in Identifying Features in LIDAR Data

Users can also view LIDAR data by creating a plot or profile of the data. In the profile below the beach features including the dune crest, beach face, and the water line can be identified. Users that have the add-on Arc View Spatial Analyst module can use the LIDAR Data Handler Extension, provided on this CD-ROM, to create similar profiles.

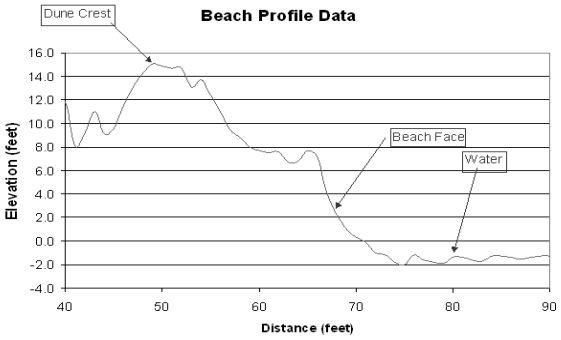


Fig 8:LIDAR Data Viewed as a Profile

7. APPLICATIONS EXAMPLES

FLOOD RISK MAPPING

LiDAR surveys are one of the quickest and most accurate methods to produce a DEM. Using the LiDAR derived DEM, hydrologists are able to predict flood extents and plan mitigation and remediation strategies. The reliability of flood risk mapping and hydrological models is dependent on the accuracy of the terrain elevation data used. This is especially true for modeling in areas of little terrain relief. For example, in a flat river basin such as the Red River in Manitoba and North Dakota, a slight increase in water level can flood a large area. This may mean that many communities would be affected by a rise in water level. In areas with more relief, the accuracy of the DEM is not as critical, but knowledge of slope and aspect can aid considerably in predicting water volumes and flow characteristics.

The following is an excerpt from the IJC's final report "Living with the Red", and is based on the results of LiDAR surveys done in the region:

"The Task Force found that current mapping of high risk areas was not adequate for modeling and analysis of flood risk, or for the consideration of flood protection options. Among other things, the Task Force produced high-resolution digital elevation data for the lower Pembina River and for the area south of the Winnipeg Floodway, and analyzed data collection technologies. Through these efforts, the Task Force found that airborne laser mapping can be a fast, reliable, and cost-effective method of obtaining three-dimensional data suitable for the creation of a digital elevation models (DEM)."

Flood risk mapping.

8. CONCLUSIONS:

LiDAR mapping is a maturing technology, and applications are still being identified and developed as end-users begin to work with the data. There are on-going initiatives to identify areas where the technology allows value-added products to be generated or where it offers significant cost reductions over traditional survey methods.

There are a number of conclusions to be drawn from the information presented herein. These deal with LiDAR technology itself, the impact of the technology on the survey and mapping industry, and the societal and economic benefits that accrue through its use. They have been presented below in point form, in no particular order.

1. LiDAR is an enabling technology. Primarily, it has allowed data to be collected that was difficult or impossible to obtain prior to its introduction. This is especially true in the forest industry and utility corridor arena, where it has been very difficult and expensive to get elevation models using ground-based GPS, conventional survey and/or photogram metric techniques.

2. LiDAR is an enhancing technology. For applications where a more precise DEM is required, such as engineering and road design and flood plain mapping, LiDAR is able to provide much more information than can be acquired by virtually any other means — at least within economic reason.

3. LiDAR has revolutionized the survey and mapping world. In practical terms, hydrographic LiDAR has been a viable survey tool since the early 1980s. With the advent of a full constellation of GPS in the early 1990s, hydrographic LiDAR has taken a giant leap forward in being able to provide accurate data for difficult survey operations. Topographic LiDAR has evolved from a relative physics experiment to a useable and reliable survey tool, all since the mid 1990s. Now that the technological "chasm" is virtually crossed, and more people are buying into LiDAR, the survey and mapping industry is racing to meet the demand for services. This includes the industry's ability to properly acquire, process and quality control the data.

4. LiDAR has empowered clients. The speed with which data can be collected, and the relative speed at which it can be processed compared to any other technology, has given clients the power to demand products more quickly. In many cases, time saved on surveying and mapping translates into huge downstream economic gains.

5. LiDAR saves clients money. For many projects, especially those where DEMs are required for heavily vegetated areas, LiDAR can greatly reduce survey time and effort. This translates directly into cost savings for clients.

6. LiDAR offers flexibility. Although it can be said of data collected via other methods, data collected by LiDAR is extremely versatile. It can be used for anything from power line detection to DEM generation in a second growth forest. This is due to the tremendous point density achieved from LiDAR, its accuracy, and its ability to penetrate to the ground through foliage in vegetated areas.

7. LiDAR is unobtrusive and environmentally friendly. Unlike ground survey techniques, airborne LiDAR can be flown over areas where access is limited, impossible, or undesirable. Apart from the need to validate the

8. LiDAR with ground truthing, it is not necessary to send pervasive ground crews to conduct intense survey operations. LiDAR surveying can also avoid unnecessary tree cutting and other practices that can harm the environment.

In conclusion, it is hoped that this paper will have provided an insight into the possibilities of LiDAR, and will elicit discussion regarding the use of LiDAR to conduct mapping projects. Given the versatility of the technology, and its maturation, it seems logical that any strategic plan or project should at least consider its use. If required, more information can be obtained by contacting TerraPoint.

8. REFERENCES

[1] Cracknell, Arthur P.; Hayes, Ladson (2007) [1991], Introduction to Remote Sensing (2 ed.), London: Taylor and Francis, ISBN 0849392551, OCLC 70765252

[2] Experimental Advanced Research Lidar', NASA.org. Retrieved 8 August 2007.

[3] EID; crater beneath canopy

[4] Thomas D. Wilkerson, Geary K. Schwemmer, and Bruce M. Gentry. Lidar Profiling of Aerosols, Clouds, and Winds by Doppler and Non-Doppler Methods, NASA International H2O Project (2002).

[5] Earth Explorers: ADM-Aeolus', ESA.org (European Space Agency, 6 June 2007). Retrieved 8 August 2007.

[6] Doppler lidar gives Olympic sailors the edge', Optics.org (3 July, 2008). Retrieved 8 July 2008.

[7] a b Strauss C. E. M., "Synthetic-array heterodyne detection: a single-element detector acts as an array", Opt. Lett. 19, 1609-1611 (1994)

[8] Tom Paulson. 'LIDAR shows where earthquake risks are highest, Seattle Post (Wednesday, April 18, 2001).

[9] Mount Saint Helens Lidar Data', Washington State Geospatial Data Archive (September 13, 2006). Retrieved 8 August 2007.

[10] Airborne Topographic Mapper', NASA.gov. Retrieved 8 August 2007.

[11] NASA. 'NASA Mars Lander Sees Falling Snow, Soil Data Suggest Liquid Past' NASA.gov (29 September 2008). Retrieved 9 November 2008.

[12] CW Gowers. ' Focus On : Lidar-Thomson Scattering Diagnostic on JET' JET.EFDA.org (undated). Retrieved 8 August 2007.

AET - 0012

Efficient Routing Protocol for Establishing Stable Links in MANET

R. Bhuvaneswari , *Asst. Professor*
EXTC, Saraswati College of Engineering, Kharghar
bhuvanasraj@gmail.com

Dr.M.Viswanathan, *Sr. Dy.Director, FCRI*
m.viswanathan@fcriindia.com

Abstract

Energy in mobile adhoc networks is of much important. Similarly shortest path from source to destination is also important for routing. To address these issues a routing protocol is proposed which gives an optimum between these issues. Channel aware adhoc on-demand multipath distance vector (CAOMDV) is proposed to overcome the issue of energy and shortest path in a single routing protocol. This protocol helps in updating the routing table with both the node route list and their corresponding energies. As this is a multipath protocol, it shifts the route without further overhead, delay and loss of packets. Simulation results shows that CAOMDV performs well compared to ad-hoc on-demand multipath distance vector (AOMDV) routing protocol even after introducing energy related fields in CAOMDV.

Keywords- Power aware adhoc on-demand multipath distance vector, residual energy, shortest path, system lifetime, traffic anticipation

1. Introduction

A mobile, ad hoc network is an autonomous system of mobile hosts connected by wireless links. There is no static infrastructure such as base station. If two hosts are not within radio range, all message communication between them must pass through one or more intermediate hosts that double as routers. The hosts are free to move around randomly, thus hanging the network topology dynamically. Thus routing protocols must be adaptive and able to maintain routes in spite of the changing network connectivity. Such networks are very useful in military and other tactical applications such as emergency rescue or exploration missions, where cellular infrastructure is unavailable or unreliable. Commercial applications are also likely where there is a need for ubiquitous communication services without the presence or use of a fixed infrastructure. Examples include home-area wireless networking, on-the-fly conferencing applications, networking intelligent devices or sensors, communication between mobile robots, etc.

Almost all mobile devices are supported by battery powers, so the energy-efficient issue is one of the most important design issues in MANET. Solutions to the energy-efficient issue in MANET can generally be categorized as follows:

1) Low-Power Mode, in which mobile devices can support low-power sleeping mode. The main research challenges in low-power mode are that at what time mobile node can turn to sleeping mode, and at what time it should wake up. Corresponding issues are addressed in [1], [2], [3] and etc; 2) Transmission Power Control: In wireless communication, transmission power has strong impact on transmission range, bit error rate and inter-radio interference, which are typically contradicting factors. By adjusting its transmission power, mobile node can select its immediate neighbors from others, thus the network topology can be controlled in this way. How to determine transmission power of each node so as to determine the best network topology has been addressed in [4], [5], [6] and etc; 3) Power-Aware Routing: Other than the common shortest-hop routing protocols, such as DSDV [7], AODV [8], DSR [9], and etc, power-aware routing protocols take various power metrics or cost functions into account in route selection. S. Singh, M. Woo, and C. S. Raghavendra proposed five different metrics along with their impacts on the performance in [10]. J.H. Chang and L. Tassiulas presented a routing algorithm for static MANET in [12], which aims to maximize system lifetime by balancing the energy consumption. I. Stojmenovic and X. Lin proposed a new power-cost metric based on the combination of both node's lifetime and distance based power metrics in [12]. In this paper, we present a power-aware on-demand routing protocol called PAAOMDV with the objective to maximize the system lifetime of MANET, which is defined as the time once some node uses up its energy for the first time. The main ideas of PAAOMDV include: 1) traffic anticipation, i.e. the source is able to anticipate the traffic of the request; 2) energy reservation, i.e. the node on the route should make the energy reservation for the request according to the anticipated traffic; 3) energy threshold, i.e. a node could participate in route discovery only when its logical residual energy, which is defined as the physical residual energy subtracting all reserved energy, is greater than the energy returned by a threshold function; 4) a new path cost function is used in route selection which takes both shortest-hop and maximum lifetime into consideration.

2. Related Work

We propose a power-aware routing protocol which extends the Ad-hoc On-Demand Multipath Distance Vector (AOMDV) routing protocol [13]. We call it CAOMDV. AOMDV is, itself, an extension of the Ad-hoc On-Demand Distance Vector (AODV) routing protocol [14]. In this section we review the details of these two predecessor protocols that are useful to our discussion in this paper.

2.1 AODV

AODV is a single-path, on-demand routing protocol. When a source node, n_s, generates a packet for a particular destination node, n_d, it broadcasts a route request (RREQ) packet. The RREQ contains the following fields:

<source IP address,
source sequence number,
broadcast ID,
destination IP address,
destination sequence number,
hop-count>

where the source and destination IP addresses remain constant for the lifetime of the network, source sequence number is a monotonically increasing indicator of packet "freshness", destination sequence number is the last known sequence number for n_d at ns and hop-count is initialized to zero and incremented at each intermediate node which processes the RREQ. A RREQ is uniquely identified by the combination of source sequence number and broadcast ID. An intermediate node only processes a RREQ if it has not received a previous copy of it. If an intermediate node has a route to n_d with destination sequence number at least that in the RREQ, it returns a route reply (RREP) packet, updated with the information that it has. If not, it records the following information:
source IP address, source sequence number, broadcast ID, destination IP address and expiration time for reverse path route entry, and forwards the RREQ to its neighbors. Like the RREQ, a RREP is only processed on first sighting and is discarded unless it has a greater destination sequence number than the previous RREP or the same destination sequence number but a smaller hop-count. The RREP packet contains the following fields:

<source IP address,
destination IP address,
destination sequence number,
hop-count,
route expiration time>

The route expiration time is the time after which the route is considered to have expired and a new route discovery process must be undertaken. ns sends packets via the first path it hears about. If it receives a later RREP which has either fresher information or a shorter hop-count, it swaps to that, discarding the original route information. When an active route link breaks, a route error (RERR) packet, with sequence number incremented from the corresponding RREP and hop-count of ∞, is sent by the upstream node of the broken link to n_s. Upon receipt of a RERR, ns initiates a new route discovery process if it still has packets to send to n_d. Nodes also periodically send "hello" messages to neighboring nodes to maintain knowledge of local connectivity.

2.2 AODV

The key distinguishing feature of AOMDV over AODV is that it provides multiple paths to n_d. These paths are loop-free and mutually link-disjoint. AOMDV uses the notion of advertised hop-count to maintain multiple paths with the same destination sequence number. In both AODV and AOMDV, receipt of a RREQ initiates a node route table entry in preparation for receipt of a returning RREP. In AODV the routing table entry contains the fields:

<destination IP address,
destination sequence number,
next-hop IP address,
hop-count,
entry expiration time>

where entry expiration time gives the time after which, if a corresponding RREP has not been received, the entry is discarded. In AOMDV the routing table entry is slightly modified to allow for maintenance of multiple entries and multiple loop-free paths. Firstly, advertised hop-count replaces hop-count and advertised hop-count is the maximum over all paths from the current node to n_d, so only one value is advertised from that node for a given destination sequence number. Secondly, next-hop IP address is replaced by a list of all next-hop nodes and corresponding hop-counts of the saved paths to n_d from that node, as follows:

<destination IP address,
destination sequence number,
advertised hop-count,
route list: {(next hop IP 1, hop-count 1),
(next hop IP 2, hop-count 2), . . .},
entry expiration time>

To obtain link-disjoint paths in AOMDV n_d can reply to multiple copies of a given RREQ, as long as they arrive via different neighbors.

3. Channel-Aware On-Demand Routing Protocol for MANET

In this section, we first present an overview of CAOMDV followed by some definitions in CAOMDV. Then the main ideas of CAOMDV will be presented in

detail. Finally, the protocol optimization and brief analysis will be presented.

3.1 Overview of Channel Aware AOMDV

There are 3 basic assumptions in CAOMDV:
1. Each mobile node is able to read its own physical residual energy;
2. Each mobile node knows its transmission power, based on which it could estimate the energy consumption of sending a packet;
3. The source node of a request is capable of anticipating the number of the packets to be transmitted.

The traffic of a request in some network applications can be anticipated easily and accurately. For example, when a user wants to copy a shared file from another, the traffic of the request is equal to the length of the file. However in some real-time applications, it is difficult to anticipate the traffic accurately. In these cases, the traffic could be anticipated approximately based on the historical experience or statistic. And improving the performance of CAOMDV in the cases of inaccurate traffic anticipation will be one of our future works. CAOMDV works in a similar manner with DSR [9], a well-known on-demand routing protocol. In both CAOMDV and DSR, mobile nodes only maintain the routes to the active destinations, and a route discovery process is needed for every new destination. Although DSR is a shortest-hop routing, it is close to a minimum-total energy- consumed routing in the case that each node is with approximately same transmission power. The objective of CAOMDV is to maximize the system lifetime of MANET. But as a routing protocol, CAOMDV also should guarantee the delivery rate, i.e. maximize the number of packets correctly delivered. To maximize both the system lifetime and delivery rate, CAOMDV must try to balance the energy consumption in the whole network. The main improvements of CAOMDV over DSR are that:

1)The intermediate nodes on the route make energy reservation based on the traffic anticipation made by the source, thus each node knows not only its physical residual energy, but also the expected energy possibly to be consumed in the future, and hence it will report its energy status more accurately. For example, in this way the node with high physical residual energy but already on some routes will be not preferred in route selection;

2)As mentioned above, CAOMDV could take both shortest-hop and maximum-lifetime into consideration in route selection based on the precise energy status reported by intermediate nodes;

3)CAOMDV applies an energy threshold function in route discovery for first filtering out the nodes with low logical residual energy, and second reducing the broadcast operations in route discovery. From the global viewpoint of a MANET, the energy threshold function aims to guide all nodes consuming their energy approximately synchronously. The node that consumes its energy too fast will be protected from routing while others will be encouraged. In this way, the energy consumption will be balanced in the whole network.

3.2 Definitions of Channel Aware in Routing

We'll make the following definitions before presenting PAAOMDV in detail.

1. Node Lifetime and System Lifetime N = {1, 2, … , n} is the node set of MANET, while n is the node number;
NLT(i) = the time when node i uses up it energy;
System Lifetime(N) = min{NLT (i) | i N};

2. Physical Residual Energy Ei(t) and Logical Residual Energy $LE_i(t)$
$E_i(t)$ = the physical residual energy of node i at time t;
$LE_i(t) = E_i(t) - \Sigma$(Reserved Energy of node i at time t);

3.3 Ideas in CAOMDV

In CAOMDV, each node should maintain an Energy Reservation Table (ERT) instead of the route cache in the common on-demand protocols. Each item in ERT is mapped to a route passing this node, and records the corresponding energy reserved. The entries of an item in ERT are Request ID, Source ID
Destination ID, Amount of Energy Reserved, Last Operation Time, Route, and their functions will be presented in detail below.
The basic operations of CAOMDV include route discovery, packet forwarding and route maintenance.

3.3.1 Route Discovery

Route discovery in PAAOMDV is an enhanced version of route discovery in AOMDV, incorporating energy fields for choosing energy efficient path. The duration, E, of a path is defined as the minimum residual energy over all of its links,

$$E \triangleq \min_{1 \le h \le H} residual\ energy_h \qquad (1)$$

where h is link number, and H is number of links/hops in the path. The energy, E, is also recorded in the RREQ, updated, as necessary, at each intermediate node. Thus, all information required for calculating the residual energy is available via the RREQs, minimizing added complexity. Similarly to the way the longest hop path is advertised for each node in AOMDV to allow for the worst case at each node, in PAAOMDV the minimum E over all paths between a given node, n_i, and n_d, is used as part of the cost function in path selection. That is,

$$E_{min}^{i,d} \triangleq \min_{C \in path\_list_i^d} E_C \qquad (2)$$

where $path\_list^d_i$ is the list of all saved paths between nodes n_i and n_d. The route discovery update algorithm in

PAAOMDV is a slight modification of that of AOMDV. If a RREQ or RREP for n_d at ni, from a neighbor node, n_j , has a higher destination sequence number or shorter hop-count than the existing route for n_d at n_i, the route update criterion in PAAOMDV is the same as that in AOMDV.

However, if the RREQ or RREP has a destination sequence number and hop-count equal to the existing route at n_i but with a greater E_i, E_{min}, the list of paths to n_d in n_i's routing

Table 1: Comparison of routing table entry structures in AOMDV and PAAOMDV.

AOMDV routing table	CAOMDV routing table
Destination IP address	Destination IP address
Destination sequence number	Destination sequence number
Advertised hop count	Advertised hop count
Path list{(next hop IP 1, hop count 1),(next hop IP 2, hop count 2),……..}	E_{min}
	Path list{(next hop IP 1, hop count 1,E1), (next hop IP 2, hop count 2, E2),……..}
Expiration time out	Expiration time out

table is updated. So, in PAAOMDV, path selection is based on E_i, E_{min} as well as destination sequence number and advertised hop count. The routing table structures for each path entry in AOMDV and PAAOMDV are shown in Table1.

3.3.2 Packet Forwarding

Once the route has been established, the source starts sending the data packets to the destination. After the node on the route forwards a data packet, it will update the corresponding item in the routing table by firstly subtracting the amount of energy just consumed from the amount of energy reserved.

3.3.3 Route Maintenance

When a node finds an error in forwarding a data packet, it will initiate a route error packet (RERR) and send it back to the source. Each node that receives the RERR packet would remove the corresponding item from routing table and switch to alternate path. For the nodes that could not receive the RERR packet on the route, expiration time out is used to switch from that path to other.

4. Simulation Model

The simulation platform is ns-2 [15] which is a discrete event simulator. The simulation scenario is a common used 1000m*1000m physical area. The max node speed is 10 m/s with 100 nodes investigated. Each node is with the same transmission power. The initial energy of all nodes is set as 1. Each simulation run lasts for 100 seconds.

4.1 Simulation Results

Throughput is based on the number of packets and is compared between CAOMDV and AOMDV. Results from Fig. 1 shows that CAOMDV is better than AOMDV based on Packet Received Ratio. Average end to end delay is based on the source to destination delay and is compared between CAOMDV and AOMDV. Results from Fig. 2 shows that CAOMDV is better than AOMDV. This is because of the routing updates taking place for every path and switches the path when there is problem in other.

Table 2: Simulation parameters

No. Of nodes	100
Area size	1000*1000
Simulation time	100 seconds
Mobility model	Random way point
Mac	802.11
Radio range	250m
Traffic source	CBR
Packet size	512

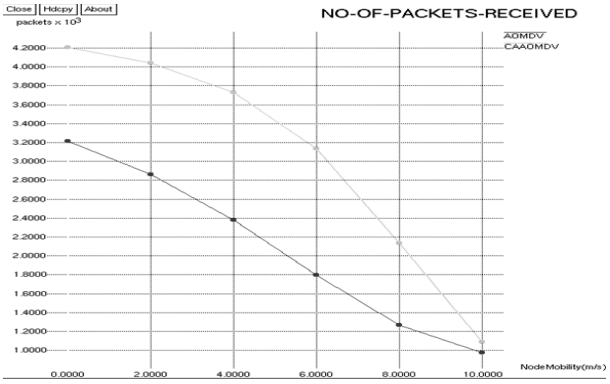


Fig. 1 Packet received comparison.

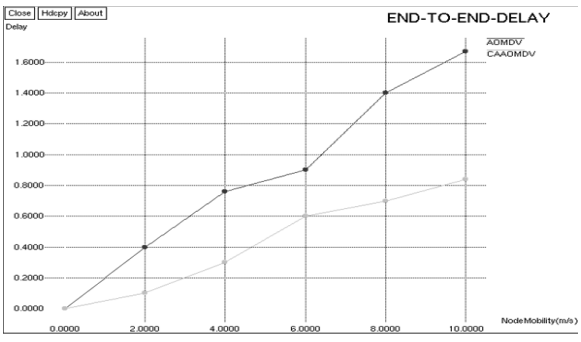


Fig. 2 End to End delay comparison.

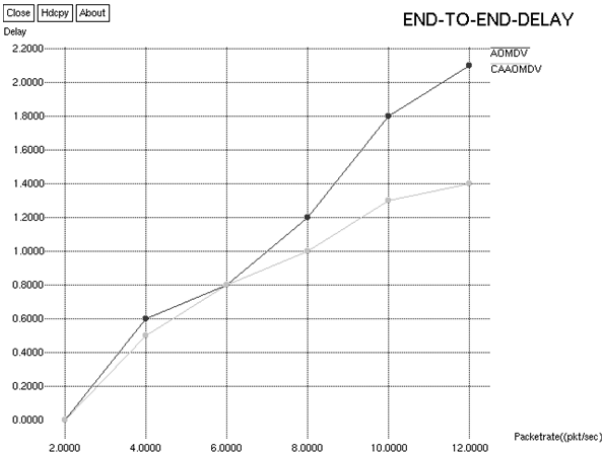


Fig. 3 Delay comparisons.

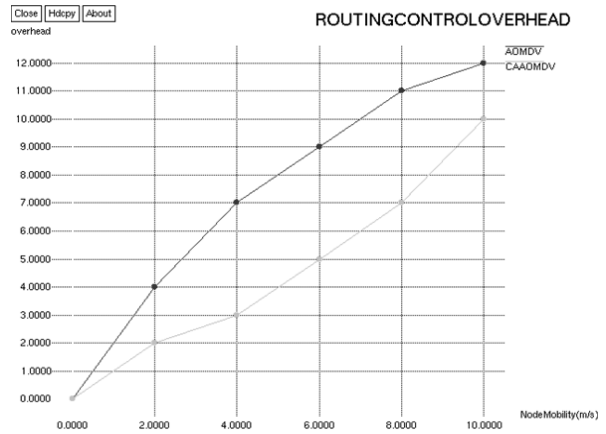


Fig. 4 Routing overhead comparisons.

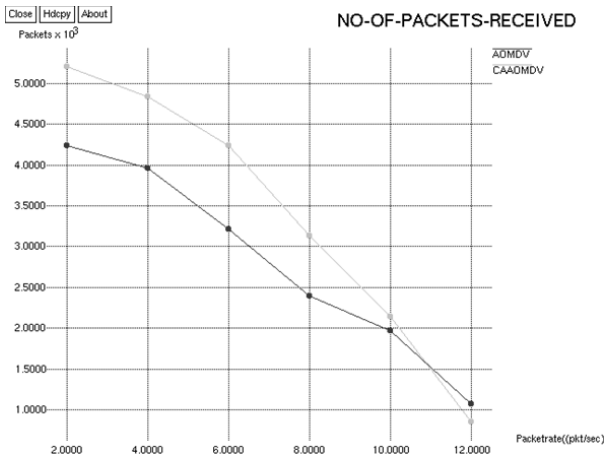


Fig. 5 Packet Received Ratio comparisons.

Fig. 3 shows End to end delay comparison for CAOMDV and AOMDV. End to End delay is less for CAOMDV because of updates which the routing table holds.

Fig. 4 shows the Rouiting overhead during progress of simulation. This gives a better performance for CAOMDV over AOMDV.

Packet Received Vs Packet rate is compared between CAOMDV and AOMDV. Fig. 5 shows that CAOMDV has more packets receiving ratio than AOMDV.

5. Conclusion

In this paper, channel awareness is introduced in AOMDV so that shortest path along with maximum energy is established. Hence, based on the simulation results CAOMDV has better packet received ratio, end to end delay and routing overhead than AOMDV. CAOMDV controls routing with efficient energy. This power awareness can be established to other routing protocols in future.

6. References

[1] S. Singh and C. S. Raghavendra, "Power Efficient MAC Protocol for Mul-tihop Radio Networks", Proc. of IEEE International Personal, Indoor and Mobile Radio Communications Conference, July 1998, pp. 153–157.

[2] C. F. Chiasserini and R. R. Rao, "A Distributed Power Management Policy for Wireless Ad Hoc Networks", IEEE Wireless Communication and Networking Conference, 2000, pp. 1209–1213.

[3] J. R. Lorch and A. J. Smith, "Software Strategies for Portable Computer Energy Management", IEEE Personal Communications, Jun 1998, pp. 60–73.

[4] L. Hu, "Topology Control for Multihop Packet Radio Networks", IEEE Transactions on Communications, Oct 1993, vol. 41, pp. 1474–1481.

[5] R. Ramanathan and R. Rosales-Hain, "Topology Control of Multihop Wireless Networks using Transmit Power Adjustment", Proc. of IEEE Infocom, Tel Aviv, Israel, March 2000, pp. 404–413.

[6] R. Wattenhofer, L. Li, P. Bahl, and Y. M. Wang, "Distributed Topology Control for Power Efficient Operation in Multihop Wireless Ad Hoc Net-works", Proc. of IEEE Infocom, Anchorage, Alaska, April 2001, pp. 1388–1397.

[7] C.E. Perkins and P. Bhagwat, "Highly Dynamic Destination-Sequenced Distance-Vector Routing (DSDV) for Mobile Computers", Proc. of ACM SIGCOMM, London, U.K., 1994, pp. 234-244.

[8] C. E. Perkins and E. M. Royer, "Ad-hoc On-Demand Distance Vector Routing", Proc. of 2nd IEEE Workshop on Mobile Computing Systems and Applications, New Orleans, LA, 1999, pp. 90-100.

[9] D. B. Johnson and D. A. Maltz, "Dynamic Source Routing in Ad-Hoc Wireless Networks", Mobile Computing, ed. T. Imielinski and H. Korth, Kluwer Academic Publishers, 1996, Chapter 5, pp. 153-181.

[10] S. Singh, M. Woo, and C. S. Raghavendra, "Power-Aware Routing in Mobile Ad Hoc Networks", Proc. Of the International Conference on Mobile Computing and Networking, Dallas, Texas, October 1998, pp. 181–190.

[11] J.H. Chang and L. Tassiulas, "Routing for maximum system lifetime in wireless ad-hoc networks", Proc. 37th

Annual Allerton Conf. on Communication, Control, and Computing, Monticello, IL, Sept. 1999, pp. 22--31.

[12] I. Stojmenovic and X. Lin, "Power-aware Localized Routing in Wireless Networks", Proc. of IEEE International Parallel and Distributed Processing Symposium, Cancum, Mexico, 2000, pp. 371–376.

[13] M. K. Marina and S. R. Das, "On-demand Multipath Distance Vector Routing in ad hoc networks," ICNP, pp. 14–23, Nov 2001.

[14] C. E. Perkins and E. M. Royer, "Ad-hoc on-demand distance vector routing," WMCSA, pp. 90–100, Feb 1999.

[15] "ns-2 Network Simulator", obtain via http://www.isi.edu/nsnam/ns/.

Brief Resume of Mrs. R. Bhuvaneswari, Asst.Prof.

Ph.D., Course work completed and received Confirmation. Thesis work preparation in progress.

Passed Full time M.E, Degree with first class in Applied Electronics from Government of College of Engineering, Bharathiyar University, Coimbatore, Tamil Nadu.

Passed B.E., Degree in Electronics and Communication Engineering from Government of College of Engineering, Bharathiyar University, Coimbatore, Tamil Nadu.

Expertise in delivering excellence in the field of 'Electronics & Communication Engineering' backed up with 16 + years of teaching experience in various Engineering Colleges in Chennai and Navi Mumbai.

Presented paper on "A New Approach for Maximizing Node Energy in MANET" in Anna University Coimbatore in 2011.

Attended Work shop on Computer networks and Security conducted by Dr. Bhaskaran, IIT Mumbai at College of Engineering, Pune during January 2010.

Attended National Conference on Embedded Control, Computing and Communication--NCECCube 2007 at I2IT Pune, on 18-21, September, 2007.

Participated on SAN, MOODLE workshop at CDAC,Kharghar,Navi Mumbai in 2007

Participated in the Course on "The Women's Leadership Program" at College of Engineering, Anna University, Guindy on 14th &15th November 2003.

Attended International Conference/Tutorial on "Wireless Communication Networks" at SSN College of Engineering on June 27-29, 2003.

Coordinated for ISO Certification and NBA accreditation for SSN Institution, Chennai.

Participated in the Seminar on "Automotive Electronics "Organized by Indian Society for Technical Education, at IIT Campus, Chennai-36.

Successfully completed 6 months Computer Programme on C, C + at Anna University, Chennai, in Association with DC Elcot Software Ltd.

AET - 0013

Antenna Design for 2G & 3G Mobile Phones

Nikhil Sakpal
Department of EXTC
VIT,Mumbai

Dhirendra Sharma
Department of EXTC
VIT,Mumbai

Ruchir Nerurkar
Depatment of EXTC
VIT,Mumbai

Niteesh Jayant
Department of EXTC
VIT,Mumbai

Abstract-

Dual-band operation, reduce size, bandwidth optimization are major concern in the design of mobile antenna.This Paper is mainly used to evaluate the properties of the Helical chip antenna .An internal antenna was designed for mobile phone, the frequency of which is chosen in such a way that it will cover both the frequency bands for 2G and 3G mobile communications. When mobile phones are taken into account, parameters like phone style, weight, design style are considered. Form Factor refers to process of measuring these parameters to describe the physical structure of the mobile phones. Hence in his paper we are focusing on designing an internal antenna for covering 2G and 3G bands for the mobile phones with its size even smaller than the form factors of normal mobile phones. 3G mobile phones are bulky in size compared to 2G phones as they possess more complicate chipsets, a bigger LCD display and more than 1 camera sensor. Due to which, they altogether take up a huge amount of PCB space.Therefore, the biggest advantage of this project paper is that we are reducing the size of the antennas inside the mobile phones to make them smaller in size and operates on two resonant frequency. Gain , s-parameter was measured by using network analyzer as we are using helical antennas for implementing our project. The helical antenna was lighter in weight ,reduce in size as compared to micro-strip path antennas.

I. INTRODUCTION

The advance of communication technology gives birth to a lot of mobile communication standards now a days. Standards still keep improving and emerging. Multi-Band operations become one of the standard features that now a days a mobile phone possesses. Thus, Equipping with a multi-band antenna is a necessity for our ongoing life. Therefore on the other hand, chip antenna was proposed to provide a compact antenna solution for wireless applications.

We have Combined helical chip antenna(s) with a suitable shaped and sized metal patch(s) to form a dual-band monopole antenna. The frequency of is chosen in such a way that it will cover both the frequency bands for 2G and 3G mobile communications and resonat occurs at this frequency.

Mobile communication has stepped into its Third Generation (3G) today. Before 3G becoming popular, sophisticated networks of the Second Generation (2G) has been built and run for the years. Among all the standards of 2G, Global system for Mobile communication is the most popular which is used to launch 3G standards smoothly. The PIFA typically consists of a rectangular planar element located above ground plane, a short circuiting plate or pin, and a feeding mechanism for the planar element.The Inverted F antenna is a variant of the monopole where the top section has been folded down so as to be parallel with the ground plane.

This is done to reduce the height of the antenna, while maintaining a resonant trace length. This parallel section introduces capacitance to the input impedance of the antenna, which is compensated by implementing a short-circuit stub. The stub's end is connected to the ground plane.PIFA antennas are less efficient. In PIFA form factors like size, weight & design style are of great concern. One method of reducing PIFA size is simply by shortening the antenna. However, this approach affects the impedance at the antenna terminals such that the radiation resistance becomes reactive as well.PIFA uses 30% of PCB area.These disadvantages of PIFA are overcome CHIP antennas.One such type of Antenna is Helical chip antenna as shown in fig :1

Advantages of chip antennas are:

Compatible with higher Generations,Reduce production cost of mobile phone,Reduces the size of antenna,Reduce the weight of antenna,Operating frequency bands: GSM900,GSM1800 & UMTS bands,Low profile antenna,Better performance in higher band frequencies, Increases gain of antenna.

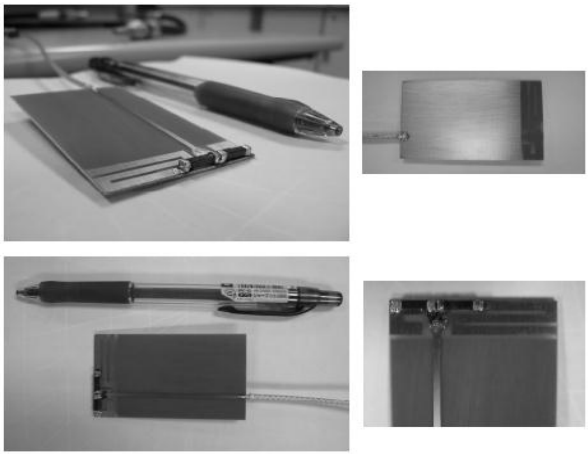


Fig 1: Helical chip antenna

II.ANTENNA DESIGN CONFIGURATION

It was proposed to make use of the low-profile of chip antenna to design an antenna which is suitable for mobile communications while the proposed antenna has to satisfy following requirements:

1. Operating frequencies should cover both 2G (GSM) and 3G bands (UMTS)
2. No bigger than 40 × 10 × 5 mm
3. Easy to be implemented on PCB
4. Capable of radiate in all directions

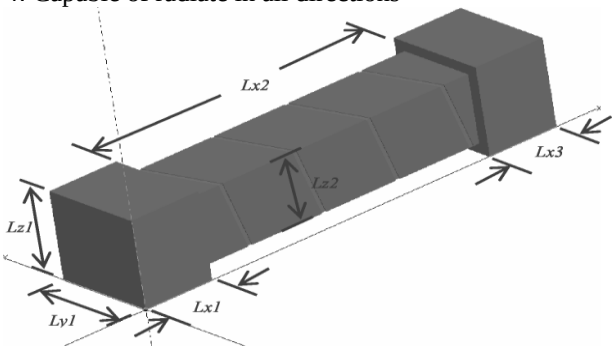


Fig2:Dimensions of computer model of the chip antenna

Table 1:List of lengths of edges of the chip antenna

Length (mm)	**Length (mm)**	**Length (mm)**
Lx1 =1.6	*Ly1*= 2.2	*Lz1*= 2.2
Lx2= 6.8	*Ly2*= 1.7	*Lz2*= 1.7
Lx3= 1.6	*Ly3*= 2.2	*Lz3*= 2.2

Table 2:Material settings of the chip antenna

	Ceramic Material Metal coating	***Material Metal coating***
Relative Permittivity (Dielectric Constant)	9	1
Relative Permeability	1	1
Conductivity	0	∞
Electric Loss Tangent	0.004	0
Magnetic Loss Tangent	0	0

Other parameters were:
i. Dimension of dielectric of the PCB : 20 × 30 × 0.9 mm
ii. Dimension of the ground plan : 10 × 30 × 0.02 mm
iii. Microstrip feeding patch : 2 × 0.1 × 0.02 mm
iv. Radiation Box : 60 × 80 × 21.8 mm
v.PCB material : FR4

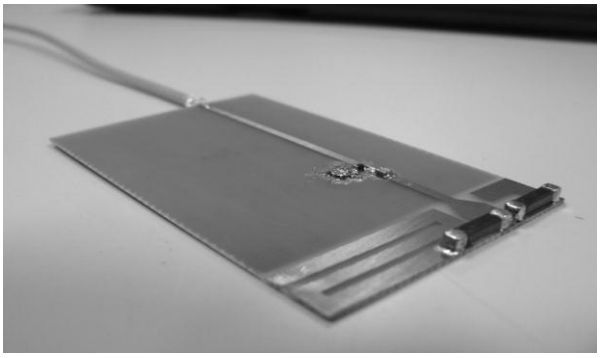


Fig: 3

The design started with investigation on a *helical chip antenna* m and design of radiating metal patch to obtain the desired resonant frequency of 900 Mhz and 1800 Mhzwhich was followed by computer simulation. Then, prototypes were made when simulation results were optimum , the above design was made with the matching network as shown in Fig:3.The matching network is shown in fig:3

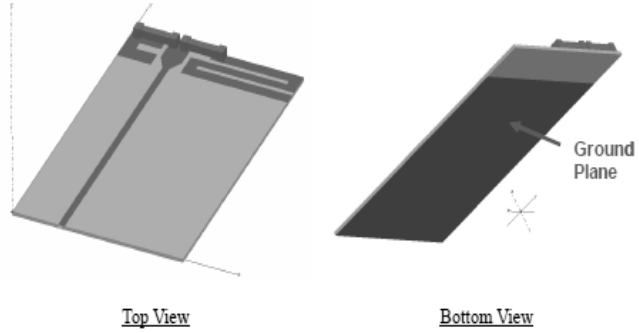


Fig 4a: Antenna outlook

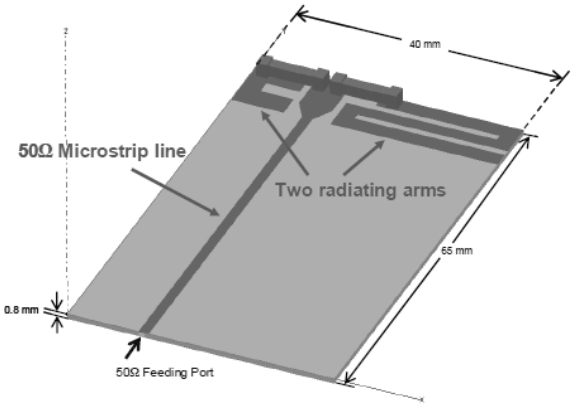


Fig 4b: Antenna outlook

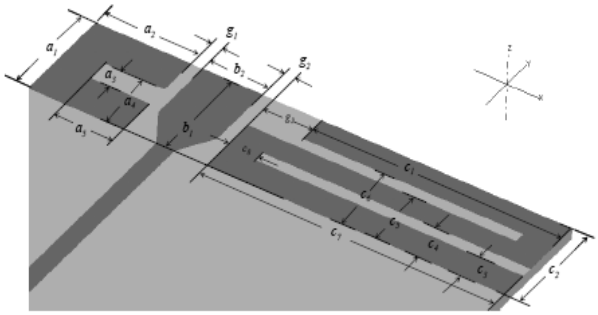
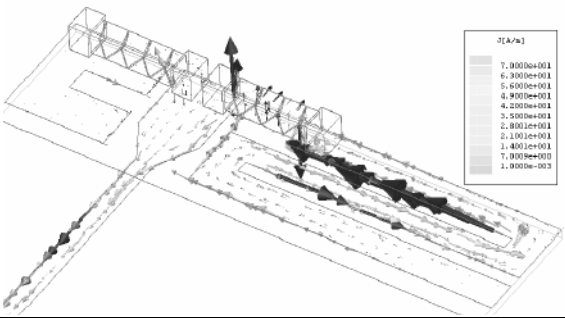


Fig 5: Dimension of antenna module

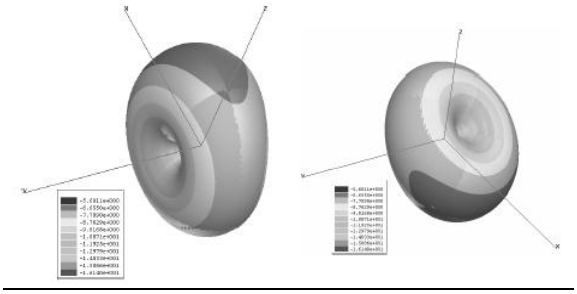
Table 3: Dimension values

	Length (mm)		Length (mm)		Length (mm)		Length (mm)
a_1	9	b_1	9	c_4	3.5	g_1	1
a_2	8	b_2	5	c_5	5.5	g_2	1
a_3	2	c_1	21	c_6	6.5	g_3	4
a_4	4.5	c_2	9	c_7	25		
a_5	5	c_3	2.5	c_8	2.5		

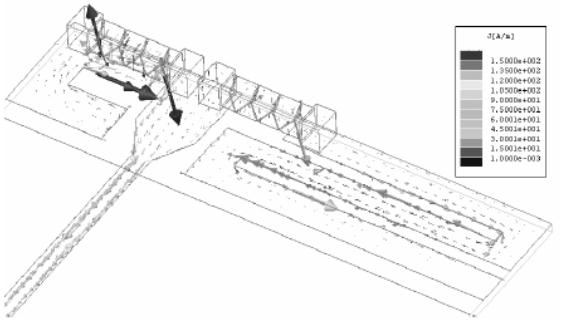
A.Current distribution in radiating arms



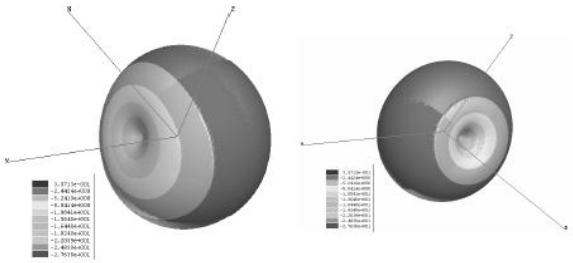
Current dritubution(vector) at frequency 0.9 GHz



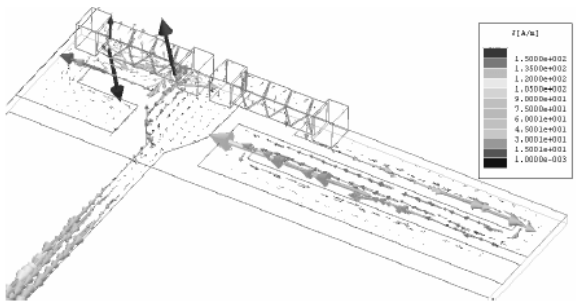
Gain pattern at frequency 0.9 GHz



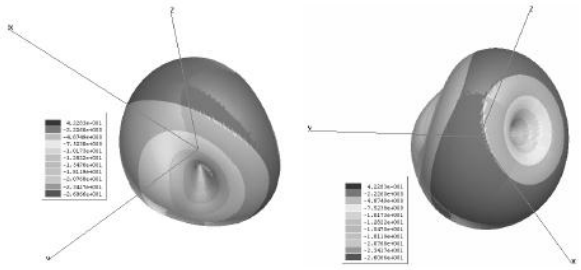
Current dritubution(vector) at frequency 1.75 GHz



Gain pattern at frequency 1.75 GHz



Current dritubution(vector) at frequency 2.15 GHz



Gain pattern at frequency 2.15 GHz

Table 4: Gain and efficiency

Freq. (GHz)	0.9	1.75	2.15
Antenna Efficiency	0.6844	0.8533	0.7365
Antenna Gain (dBi)	-5.6014	1.68394	0.42104

B.Matching circuit

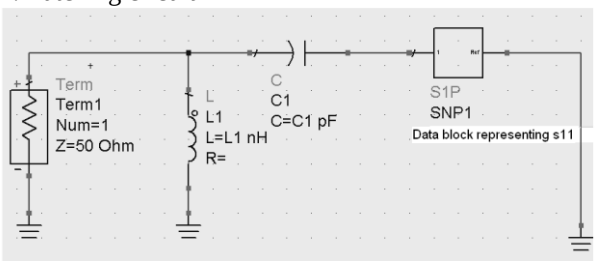
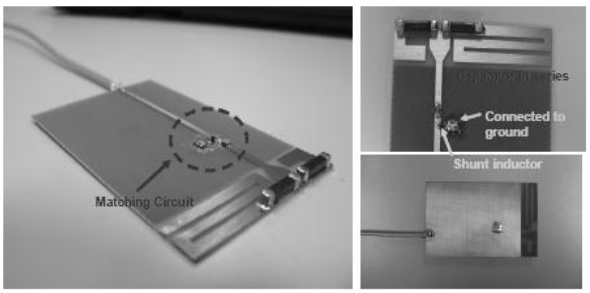


Fig 3: Matching circuit

For small antenna, |*S11*| is usually smaller than -6dB. Here, -8dB was chosen for higher-band frequencies. However, it was observed that, by keeping |*S11*| less than -6dB at higher-band,
|*S11*| at lower-band could never meet -5dB. Therefore, "below -4dB" and "below -8dB" were chosen as the optimization goals for lower-band and higher-band frequencies respectively.
|*S11*| value of extreme low frequencies (897.5MHz) could never achieve the goal of "below -4dB", so a minor modification on optimization goals was made. Finally, we resulted in this combination of values: **C1 = 5.4pF and L1 = 18nH**. See above Fig.



Finally, measurement and comparison and improvements were done before completion.

Table 5: Comparison of matched and unmatched antenna

Freq. (GHz)	Maximum Antenna Gain from Measurement [3]			
	b11_v5_blue		b11_v5_blue_match	
0.920	**0.666 dBi**	y-z (H)	-7.77 dBi	y-z (V)
1.795	-10.01 dBi	x-y (V)	**0.502 dBi**	x-z (V)
1.920	NIL		**0.456 dBi**	x-y (H)
2.035	0.802 dBi	x-y (H)	**0.976 dBi**	x-y (H)

Comparison on Max. Antenna Gain between b11_v5_blue and b11_v5_blue_

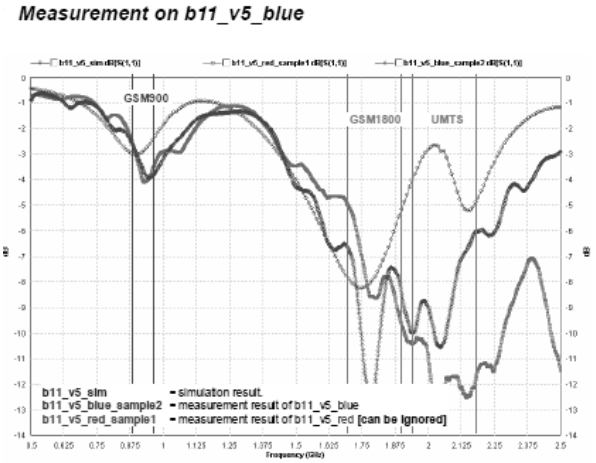
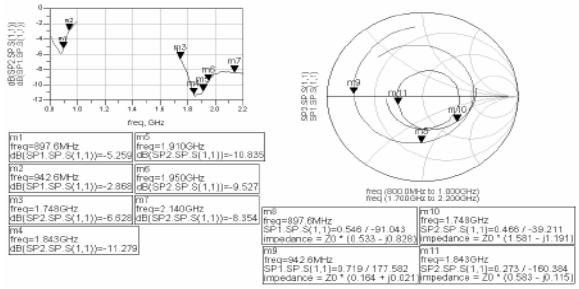


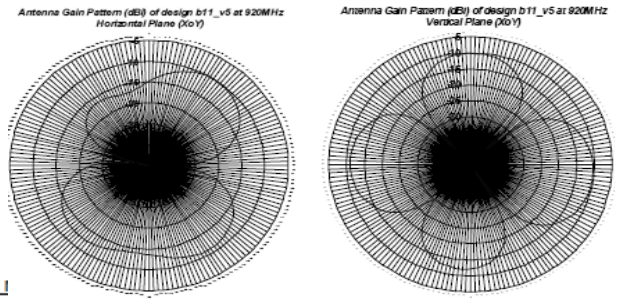
Fig 4: s11 parameter measurement values



S_{11} of b11_v5_blue_match (C1 = 5.5pF and L1 = 8.2nH)

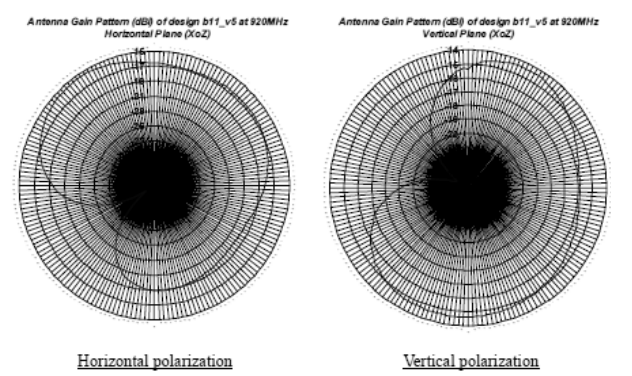
Performance of *S11* at lower-band frequency was improved by matching. Because this matching topology only favours single-band frequency, when we just concentrate on improving performance at one frequency band, the other must be deteriorated. Therefore, it is also necessary to cope with all operating bands at the sametime when designing a matching circuit. (Please refer Fig. Overall antenna gain is enhanced by matching as well. However, a drop of antenna gain was found at 0.92 GHz. |*S21*| plot (Fig. 6.18) of the matching circuit shows that less power can get transmitted at lower-band frequency. This is because the shunt inductor cannot effectively block RF power from shorting to ground. This loss accounts for the drop of antenna gain at lower-band frequency.

C. Radiation pattern

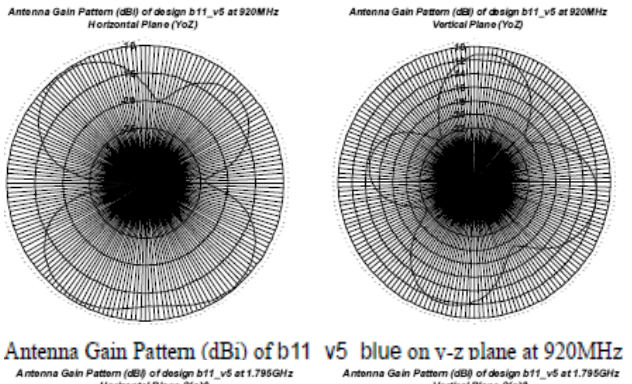


Horizontal polarization Vertical polarization

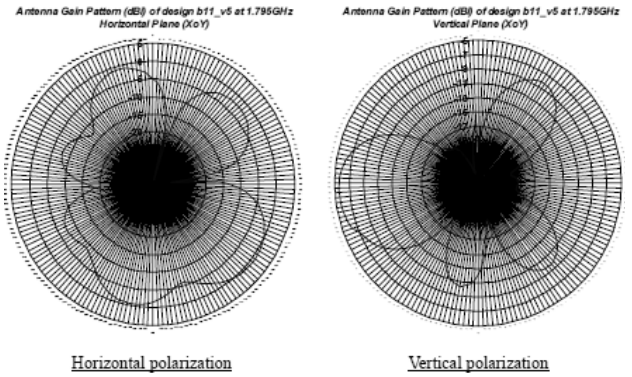
Antenna Gain Pattern (dBi) of b11_v5_blue on x-y plane at 920MHz



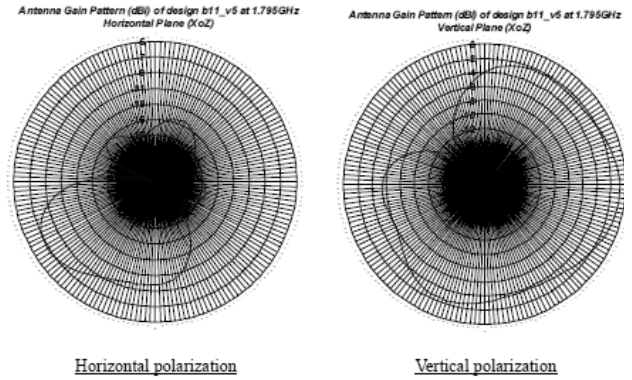
Antenna Gain Pattern (dBi) of b11_v5_blue on x-z plane at 920MHz



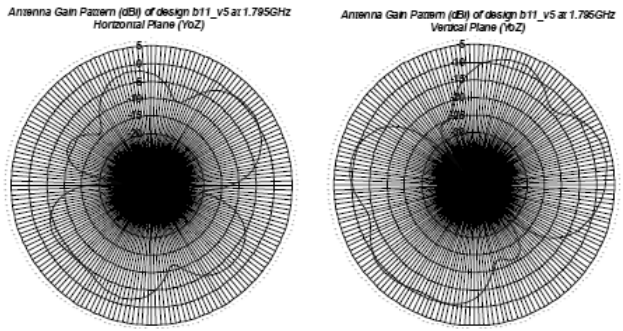
Antenna Gain Pattern (dBi) of b11_v5_blue on y-z plane at 920MHz



Antenna Gain Pattern (dBi) of b11_v5_blue on x-y plane at 1.795GHz



Antenna Gain Pattern (dBi) of b11_v5_blue on x-z plane at 1.795GHz



Antenna Gain Pattern (dBi) of b11_v5_blue on y-z plane at 1.795GHz

Table 6: Maximum antenna gain from measurements

Freq.	Max. Gain	Plane	Polarization
920 MHz	0.666 dBi	y-z	horizontal
1.795 GHz	-10.01 dBi	x-y	vertical
2.035 GHz	0.802 dBi	x-y	horizontal

Acknowledgment:
We would wish to thanks Professor Santosh Jatpap for guidance
and encouragement.Prof. Pravin Patil for teaching us Microwave
subject.Prof. Prathamesh and lab assitance for helping in the lab works.

CONCLUSION

Dual-band operation and reduce size and weight was achieved.
Critical factors affecting characteristics a helical chip antenna have been investigated. They are the width of the metal track (**track_width**), gap between tracks (**track_gap**)
and number of turns of the track (**N**). The proposed design is integrated with *Model* , but the performance at lower-band is still far poorer than acceptable.
Redesigning the metal patch in *Model* is necessary.It is believed that the proposed design performs like a resonator. Research can go on by constructing a mathematical model for it. With this, further analysis can be done.

REFERENCE

[1] Prof. Phan Anh, "Antenna Theory and Technique", Science and Technical Press, Hanoi 2000.
[2] W. H. Cantrell, and W. A. Davis, "Amplitude modulator utilizing a high-Q class-E DC-DC converter," 2003IEEE MTT-S Int. Microwave Symp. Dig., vol. 3, pp. 1721-1724, June 2003.
[3] David M. Pozar, Microwave Engineering, John Wiley & Sons, INC, Second Edition .
[4] Ludwig ,RF Circuit design,Pearson edition

AET - 0014

Separation of foreground & background objects in image processing

[1]Dr. T.C.Manjunath, *B.E., M.E., Ph.D. (IIT Bombay), Member IEEE & Fellow IETE*
[2] Dr. Kottur N Vijaya kumar, *B.E., M.E., Ph.D. (Mumbai Univ.)*
[3] Mrs. Suhasini V.K., *B.Sc., M.C.A. (Ph.D.-SNDT Women's Univ., Mumbai)*

[1]Principal, HKBK College of Engg., S.No. 22 / 1, Nagawara, Arabic College Post, B'lore-45, Karnataka
Email : manjuiitb@yahoo.com

[2] Professor & Head, Mechanical Engg, Sinhagad Institute of Technology, Lonavala, Maharashtra
Email : kotturvijaykumar@gmail.com Mob : +91 9869363683

[3]Research Scholar, SNDT Women's University, Mumbai
[3]Associate Professor, MCA Dept.,
Bharatiya Vidyapeeth's Institute of Management & Information Technology (BIMIT), CBD Belapur, Navi Mumbai, Maharashtra.
Email : suhasini.kottur@gmail.com Mob : 9987102369 9869380620

Abstract

This paper features an efficient method of performing the shape analysis of objects in a binary image using a technique called as the moments. Using these moments, we can compute the centroid, moment of inertia, principal angle, orientation of the captured objects in the image. The simulation results show the effectiveness of the developed method.

Index Terms — Moments, Invariance, Centroid, Moment of Inertia, Principal angle, Orientation, Binary image, Gray scale image.

INTRODUCTION

SHAPE analysis is a method of finding the shape of irregular objects using two types of descriptors called as the line descriptors and the area descriptors and is used when the objects are not polyhedral objects. For example, circles, spheres, ellipses, boundaries, curves, arcs, objects of irregular shapes. There are two methods of performing the shape analysis of objects. viz., line descriptors & the area descriptors. Line descriptors are used to find out the length of the irregular boundary or curvature of an irregular object in a digital image in terms of pixels.

Area descriptors are used to find out the shape of the irregular object and its characteristic properties such as area, moments, central moments, centre of gravity (centroid), moment of inertia and the orientation of the object w.r.t. (x , y) axis of the image. The area descriptors are defined as the descriptors which are based on the analysis of the points enclosed by the boundary and are used to characterize the shape of the foreground region R in a image. In this paper, we discuss about the shape analysis concept of the captured objects in a 2 D image using moments [1].

The theory of moments provides an interesting method of describing the properties of an object in terms of its area, position and orientation parameters. The idea of moments was borrowed from the science of physics. In this paper, we discuss about a method of computing the features of objects in a 2D image.

The paper is organized as follows. A brief introduction about the shape analysis of objects was presented in the previous paragraphs. In section 2, a brief introduction about the foreground & background region in an image is dealt with. Shape analysis using moments is described briefly in section 3. Section 4 deals with the analytical / mathematical treatment of a simulation example. Section 5 shows the simulation results. Conclusions are presented in section 6 followed by the references.

FOREGROUND REGION AND BACKGROUND REGION IN A BINARY IMAGE

Consider a binary image B (k , j) as shown in Fig. 1 which is obtained by the segmentation / thresholding / binarization of a digital image or a gray scale image I (k , j). Foreground is represented by 1's & background is represented by 0's. There was a circular object with a hole inside [2]. First, it was captured by a camera, digitized & then binarized. B (k , j) is the binary representation of the object with the hole inside & is as shown in the Fig. 1.

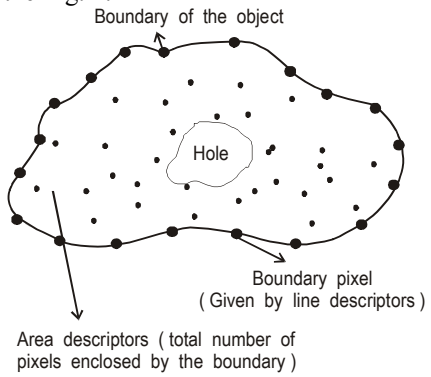


Fig. 1 : 2D representation of a elliptical object in a image

A region R in a binary image is defined as a set of connected pixels as shown in Fig. 2, which are having the same gray level attribute. R is a connected set, i.e., for each pair of pixels in R, there is at least one path, which connects the pair. Foreground region is one connected set and background region forms another connected set. This makes sure that there are no breaks in the part. Since R is a connected set, R is a single part (with no breaks). Connected in the sense, there is a neighboring pixel, which is having the same gray scale value as the pixel considered. R can also have a hole in it. Now, we have to compute the shape of the alphabet O. In order to compute the shape of the alphabet O, we consider only the foreground region and the background region is neglected [3].

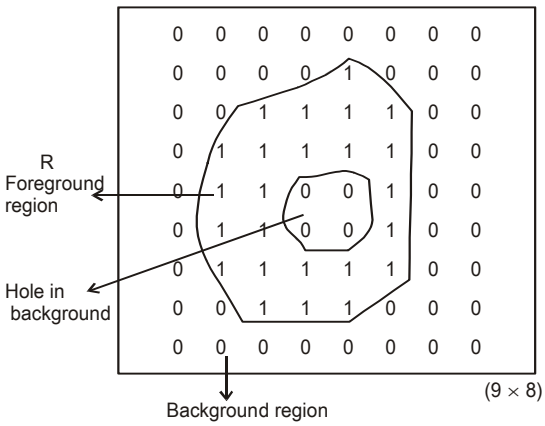


Fig. 2 : A foreground region R in an binary image ; White - 1 (Foreground), Black - 0 (Background pixel)

SHAPE ANALYSIS USING MOMENTS

To analyze and characterize the shape of the given foreground region R, we compute some numbers. These numbers are called as the moments of the foreground region R. Moments gives the characteristic features of the objects such as the shape, area, centroid, moment of inertia and the orientation of the object in the image. There are four types of moments, viz., lower order moments, central moments, normalized central moments & the principal angle [4].

Moments are defined as the sequence of numbers which are used to characterize the shape of any object OR the sum of products of the row value **x** raised to the power k and column value **y** raised to the power j in R.

$$m_{kj} \sum_{\text{row , column } \in R} \text{row}^{\,k}\ \text{column}^{\,j} \qquad (1)$$

$$\overset{\Delta}{=} \sum_{x,\, y \in R} x^k y^j \quad ; \quad k \geq 0 \,;\, j \geq 0 \qquad (2)$$

x and y : Row and column values of the pixel in the foreground region R.

Order of the moment = Sum of the powers = (k + j).

In calculation of moments, consider only the foreground pixels and ignore the background pixels.

Lower Order Moments : Ordinary Moments, m_{kj}

Geometric meanings and physical significance of the LOM could be explained as follows. Let $\{m_{kj}\}$ be the ordinary moments of the foreground region R of a binary image B (k , j), A being the area of the foreground region R and $\{ x_c , y_c\}$ be the position of the centroid of the region R. Then [2], [5],

$$Area = A = m_{00}$$

$$x_c = \frac{m_{10}}{m_{00}}$$

$$y_c = \frac{m_{01}}{m_{00}} \qquad (3)$$

$$(x_c, y_c) = Centroid = \left\{ \frac{m_{10}}{m_{00}}, \frac{m_{01}}{m_{00}} \right\}$$

- Zeroth order moment m_{00} gives the area of the foreground region R or the count of the total number of pixels in the region R or it is the measure of the size of the region R.
- m_{10} gives the first order moment (lower order) along x-axis.
- m_{01} gives the first order moment (lower order) along y-axis.
- m_{20} gives the second order moment (lower order) along x-axis.
- m_{02} gives the second order moment (lower order) along y-axis.

- m_{11} gives the product moment.
- m_{22} gives the product moment.
- Normalize the first order moments with the zeroth order moments, i.e., divide the first order moments with the zeroth order moments $\frac{m_{10}}{m_{00}}, \frac{m_{01}}{m_{00}}$. This gives the centroid of the foreground region R.

The physical significance of lower order moments is, they just give the area and the centroid of the foreground region R.

Central Moments of a Foreground Region R, μ_{kj}

The geometric meanings and physical significance of central moments can be explained as follows. Central moments are called so because they are obtained using the centroid (x_c , y_c). The central moments of foreground region R are nothing but the ordinary moments m_{kj} of the foreground region R, but, translated by an amount equal to the centroid so that the centroid (x_c , y_c) now coincides with the origin, as a result of which the first order central moments are equal to zero and are invariant to translations of the foreground region R (i.e., $\mu_{10} = \mu_{01} = 0$). Let (x_c, y_c) be the centroid of a region R and let (x, y) be the row and column of a pixel p in R. The central moments μ_{kj} of R are given by

$$\mu_{kj} = \sum_{(x,y)\in R} (x - x_c)^k (y - y_c)^j \quad ; (k, j) \geq 0 \qquad (4)$$

The physical significance of the central moments are, they just give the area and the moment of inertia and they are invariant to translations, but are variant to scale changes and rotations [2], [6].

- Lower order central moments (Zeroth), μ_{00} is the same as m_{00} ; i.e., gives the area of the region R or the size of the region, i.e., the number of pixel counts [16].
- Lower order central moments (First), μ_{10} : gives the first order central moment along x-axis = 0 (since centroid coincides with origin) & μ_{01} : gives the first order central moment along y-axis = 0 (since centroid coincides with origin).

During the calculation of the moments, each point (x , y) is shifted by an amount equal to the distance of the centroid from the origin ; so finally over the sum, the centroid coincides with the coordinate origin. Any translations of the region R are negated because of this shifting process. Since, central moments are invariant to translations, the first order central moments μ_{01} and μ_{10} are always = 0. Invariancy to translations means ; in the image, if the object is translated along x or y-axis the properties of the object remains the same. The second order central moments could be explained as follows :

- μ_{20} :Gives the second order central moment along x-axis. Gives the Moment of Inertia [M I] of the foreground region R about the x-axis.
- μ_{02} : Gives the second order central moment along y-axis. Gives the Moment of Inertia [M I] of the foreground region R about the y-axis.
- The x and y-axes pass through the centroid of the region R.
- μ_{11} is a product moment as it involves finding the product of ($x - x_c$) & ($y - y_c$) raised to a power after which, the products are summed to give μ_{11}.
- μ_{22} is another product moment which is not of any physical significance [15].

Normalized Central Moments, v_{kj}

The geometric meanings and physical significance can be explained as follows. Central moments are further normalized to produce another type of moments, called as the normalized central moments, which are invariant to scale changes of the foreground region R, in addition to translation invariance. If μ_{kj} are the central moments of region R and v_{kj}, then the normalized central moments v_{kj} of R are given by [2]

$$v_{kj} = \frac{\mu_{kj}}{\mu_{00}^{(k+j+2)/2}} \quad ; (k, j) \geq 0 \qquad (5)$$

This property of invariancy to scale changes occurs because the area of the region R is scaled down by the factor of $\frac{(k+j+2)}{2}$. Invariancy to scale changes means ; in the image, if the object is zoomed in or zoomed out, the properties of the object remains the same.

- v_{00} : Zeroth order NCM = 1, from this, we can come to a conclusion that the NCM are invariant to scale changes of R.
- v_{10} and v_{01} : First order NCM along x and y-axis = 0, since they are invariant to translations.
- v_{20} and v_{02} : Second order NCM along x and y-axis.
- v_{11} and v_{22} : Product moments, not of any physical significance.

The physical significance of NCM's are they are invariant to scale changes, in addition to translation invariance, but variant to rotations [7].

Principal Angle: Orientation or Inclination of the Region, ϕ

Lower order moments m_{kj}, central moments μ_{kj} and normalized central moments v_{kj}, characterize the region R and are invariant to translations and scaling of R, but are variant to rotations of the foreground region R.

Invariancy to rotations of R can also be obtained by finding the principal angle ϕ and is a measure of the orientation of the region R. The principal angle ϕ can be expressed in terms of the second order central moments and so does not involve additional calculations.

The physical significance of principal angle is ; it is invariant to rotations of the foreground region and gives the orientation of the foreground region R in the binary image. Invariancy to rotations means ; in the image, if the object is rotated by any amount, then, the properties of the object remains the same [8].

The physical interpretation of the principal angle ϕ is as follows. Draw a line L (β) through the centroid (x_c, y_c) of R at angle of β with the x-axis. The moment of inertia of R about the line L(β) depends on the angle β. Go on varying the angle β as shown in the Fig. 3.

At one point, the MI of the object will be minimum. The angle at which the moment of inertia I_R of region R is minimized is called the principal angle of R and is nothing but ϕ which is equal to β. It follows that the principal angle is well defined for an elongated object, but it becomes ambiguous when the object approaches a circular shape [9].

Principal angle ϕ of the foreground region R is defined as the angle at which the moment of inertia I_R of region R is minimized. Mathematically, it is given by the formula [2]

$$\phi = \frac{1}{2} a\tan 2\left(2\mu_{11}, \mu_{20} - \mu_{02}\right) = \frac{1}{2}\tan^{-1}\left(\frac{2\mu_{11}}{\mu_{20} - \mu_{02}}\right) \quad (6)$$

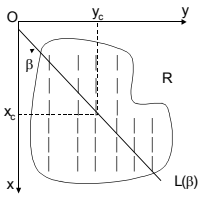


Fig. 3 : Principal angle of a region R

Invariant Moments

Now, we know the centroid of R and the principal angle of R, i.e., ϕ. If we translate R by an amount = ($-x_c$, $-y_c$), then the centroid coincides with the origin. Rotate R by an angle of −ϕ (clockwise) ; then, the principal angle becomes zero. Now, if we take the moments of the region R, it will be seen that these moments are invariant to translations, rotations and scale changes [14]. The normalized moments of the resulting region will then be invariant to translations, rotations and scale changes of R. Such moments are called as invariant moments. Invariant moms are defined as the moments, which are invariant to translations, scale changes and rotations of the foreground region R [10].

Eccentricity

It is the maximum chord length along the principal axes or major axis of object divided by the minimum chord length, which is perpendicular to chord length. The maximum chord length or major diameter D of an object O is defined as

$$\text{Eccentricity} = \frac{\text{Maxmimum chord length}}{\text{Minimum chord length}} \quad (7)$$

$$D = \max_{i,j}\sqrt{\left(x_j - x_i\right)^2 + \left(y_j - y_i\right)^2} \quad (8)$$

where $p_i = (x_i , y_i)$ and $p_j = (x_j , y_j)$ are the pixels in the boundary of the object O.

$$\text{Thinness} = \frac{\left(\text{Perimeter}\right)^2}{2}$$

$$\text{Roundness} = \frac{\left(x_c^{\,2} + y_c^{\,2}\right)^2}{A} \quad (9)$$

SIMULATION EXAMPLE

(ANALYTICAL CALCULATION)

In this section, we consider a zig-zag object was captured by the camera, digitized, segmented & binarized and stored in the memory of the computer as shown in Fig. 4. It is necessary for us to compute the shape of the objects using the methods discussed in the previous section. A brief analytical / mathematical treatment to the problem considered is dealt with in this section. The following computations can be seen as below [11].

Row k ↓ \ Col j →	1	2	3	4	5	6	7	8
1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	0	1	1	0	1	0	0	0
4	0	0	1	1	1	1	0	0
5	0	0	1	1	1	0	0	0
6	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0

Fig. 4 : An image of size (8 × 8)

$$m_{00} = \sum_{x,\, y \in R} x^0\, y^0 = \text{Area} = 10$$

$$m_{01} = \sum_{x,\, y \in R} x^0\, y^1 = 40$$

$$m_{10} = \sum_{x,\, y \in R} x^1\, y^0$$

$$= 40$$

$$m_{02} = \sum_{x,\, y \in R} x^0\, y^2 = \sum_{x,\, y \in R} y^2$$

$$= 174$$

$$m_{20} = \sum_{x,\, y \in R} x^2\, y^0 = \sum_{x,\, y \in R} x^2$$

$$= 166$$

$$m_{11} = \sum_{x,\, y \in R} x^1\, y^1$$

$$= 162$$

$$m_{22} = \sum_{x,\, y \in R} x^2\, y^2$$

$$= 2968$$

x_c = and

y_c =

Centroid , $(x_c\ y_c) = (4, 4)$

$$\mu_{00} = \sum_{x,\, y \in R} (x-4)^0\, (y-4)^0 = 10$$

$$\mu_{02} = \sum_{x,\, y \in R} (x-4)^0\, (y-4)^2 = 14$$

$$\mu_{20} = \sum_{x,\, y \in R} (x-4)^2\, (y-4)^0$$

$$= 6$$

$$\mu_{11} = \sum_{x,\, y \in R} (x-4)^1\, (y-4)^1$$

$$= 2$$

$$\mu_{22} = \sum_{x,\, y \in R} (x-4)^2\, (y-4)^2$$

$$= 8$$

Calculation of normalized central moments as follows

$$v_{kj} \quad \frac{\mu_{kj}}{\mu_{00}^{(k+j+2)/2}} \; ; \; k \geq 0 \; , \; j \geq 0$$

$$v_{00} = \frac{\mu_{00}}{\mu_{00}^{(0+0+2)/2}} = \frac{\mu_{00}}{\mu_{00}^{1}} = 1$$

$$v_{10} = \frac{\mu_{10}}{\mu_{00}^{(1+0+2)/2}} = \frac{\mu_{10}}{\mu_{00}^{1.5}} = 0$$

$$v_{01} = \frac{\mu_{01}}{\mu_{00}^{(0+1+2)/2}} = \frac{\mu_{01}}{\mu_{00}^{1.5}} = 0$$

$$v_{02} = \frac{\mu_{02}}{\mu_{00}^{(0+2+2)/2}} = \frac{\mu_{02}}{\mu_{00}^{2}} = 0.140$$

$$v_{20} = \frac{\mu_{20}}{\mu_{00}^{(2+0+2)/2}} = \frac{\mu_{20}}{\mu_{00}^{2}} = 0.36$$

$$v_{11} = \frac{\mu_{11}}{\mu_{00}^{(1+1+2)/2}} = \frac{\mu_{11}}{\mu_{00}^{2}} = 0.02$$

$$v_{22} = \frac{\mu_{22}}{\mu_{00}^{(2+2+2)/2}} = \frac{\mu_{22}}{\mu_{00}^{3}} = 0.008$$

Principal angle = ϕ =

=

= 76.72°

All the results are summarized as shown in the table 1. A graphical user interface program was developed in C / C++ language and the code was compiled and run [12]. On running the code, the following screens as shown below appeared, i.e., the inputs & the output screens, which are nothing but the simulation results as shown in the Figs. 5 - 8 respectively [13].

Type	Lower Order Moms m_{kj}	Central Moms μ_{kj}	Normalized Central Moms v_{kj}
Zeroth (0 , 0)	10	10	1
First (1 , 0)	40	0	0
First (0 , 1)	40	0	0
Second (2 , 0)	166	6	0.36
Second (0 , 2)	174	14	0.140
Product (1 , 1)	162	2	0.02
Product (2 , 2)	2968	8	0.008
Centroid (x_c , y_c)	(4 , 4)		
Principal angle ϕ	76. 72°		

Table 1

SIMULATION RESULTS

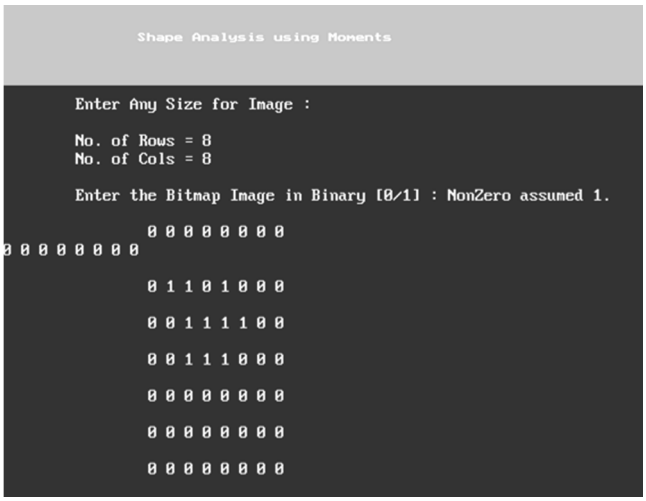


Fig. 5 : Simulation result 1

Fig. 6 : Simulation result 2

Fig. 7 : Simulation result 3

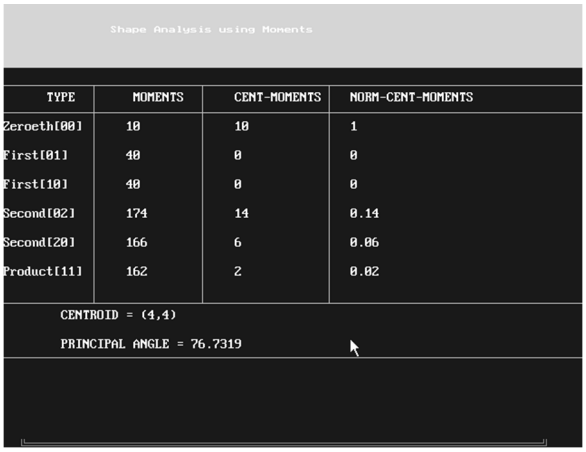


Fig. 8 : Simulation result 4

CONCLUSIONS

A method of computing the moments of a binary image was presented in this paper. The major disadvantage of moments in general is that they are global features rather than local. This makes them not suited for recognizing objects, which are partially obstructed. Moments are inherently location dependent, so some means must be adopted to insure location invariance (like the centroid). The mathematical results & the experimental results / simulated results shows the effectiveness of the developed method [2].

REFERENCES

[1] Craig J, *Introduction to Robotics* : *Mechanics, Dynamics & Control,* Addison Wessely, USA, 1986.
[2] Robert, J. Schilling, *Fundamentals of Robotics - Analysis and Control*, PHI, New Delhi.
[3] Klafter, Thomas and Negin, *Robotic Engineering*, PHI, New Delhi.
[4] Fu, Gonzalez and Lee, *Robotics: Control*, *Sensing*, *Vision and Intelligence*, McGraw Hill.
[5] Groover, Weiss, Nagel and Odrey, *Industrial Robotics*, McGraw Hill.
[6] Ranky, P. G., C. Y. Ho, *Robot Modeling, Control & Applications*, IFS Publishers, Springer, UK.
[7] Crane, Joseph Duffy, *Kinematic Analysis of Robotic Manipulators*, Cambridge Press, UK.
[8] Manjunath, T.C., (2005), *Fundamentals of Robotics*, Fourth edn., Nandu Publishers, Mumbai.
[9] Manjunath, T.C., (2005), *Fast Track to Robotics*, Second edn., Nandu Publishers, Mumbai.
[10] Dhananjay K Teckedath, *Image Processing*, Third edn., Nandu Publishers, Mumbai.
[11] Gonzalvez and Woods, *Digital Image Processing*, Addison Wesseley Publishers.
[12] Anil K Jain, *Digital Image Processing*, Prentice Hall, Englewood Cliffs, New Jersey, USA.
[13] http://www.wikipedia.org
[14] Michael Dipperstein**,** *Run Length Encoding* (*RLE*) *Discussion and Implementation*.
[15] Flusser, J.; Suk, T.; Saic, S., *Recognition of blurred images by the method of moments*, Image Processing, IEEE Transactions.
[16] Bob Bailey, *MSoments in Image Processing*, Nov. 2002.

AET - 0015

Lossless compression in artificial images

[1]Dr. T.C.Manjunath, *B.E., M.E., Ph.D. (IIT Bombay), Member IEEE & Fellow IETE*
[2] Dr. Kottur N Vijaya kumar, *B.E., M.E., Ph.D. (Mumbai Univ.)*
[3] Mrs. Suhasini V.K., *B.Sc., M.C.A. (Ph.D.-SNDT Women's Univ., Mumbai)*

[1]Principal, HKBK College of Engg., S.No. 22 / 1, Nagawara, Arabic College Post, B'lore-45, Karnataka
Email : manjuiitb@yahoo.com

[2] Professor & Head, Mechanical Engg, Sinhagad Institute of Technology, Lonavala, Maharashtra
Email : kotturvijaykumar@gmail.com Mob : +91 9869363683

[3]Research Scholar, SNDT Women's University, Mumbai
[3]Associate Professor, MCA Dept.,
Bharatiya Vidyapeeth's Institute of Management & Information Technology (BIMIT), CBD Belapur, Navi Mumbai, Maharashtra.
Email : suhasini.kottur@gmail.com Mob : 9987102369 9869380

Abstract

This paper features the development of an efficient method of compressing the binary images, i.e., in the form of 0's & 1's. Here, the starting pixel value is taken and the lengths of the subsequent runs are taken into consideration while designing the compression code. The main advantage of this code being saving of a huge amount of memory space, which will lead to the faster transmission rate. The simulation results show the effectiveness of the proposed method.

Index Terms — Run length code, Compression, Memory space, Binary image, Gray scale image.

1. INTRODUCTION

COMPRESSING an image is significantly different than compressing raw binary data. Of course, general-purpose compression programs can be used to compress images, but the result is less than optimal. This is because images have certain statistical properties, which can be exploited by encoders specifically designed for them. Also, some of the finer details in the image can be sacrificed for the sake of saving a little more bandwidth or storage space. This also means that lossy compression techniques can be used in this area. Lossless compression involves with compressing data which, when decompressed, will be an exact replica of the original data. This is the case when binary data such as executables, documents etc. are compressed. They need to be exactly reproduced when decompressed.

On the other hand, images (and music too) need not be reproduced 'exactly'. An approximation of the original image is enough for most purposes, as long as the error between the original and the compressed image is tolerable. Image compression is minimizing the size in bytes of a graphics file without degrading the quality of the image to an unacceptable level. The reduction in file size allows more images to be stored in a given amount of disk or memory space. It also reduces the time required for images to be sent over the internet or downloaded from web pages. Image compression is the application of data compression on digital images. In effect, the objective is to reduce redundancy of the image data in order to be able to store or transmit data in an efficient form. Image compression can be lossy or lossless.

Lossless compression is sometimes preferred for artificial images such as technical drawings, icons or comics. This is because lossy compression methods, especially when used at low bit rates, introduce compression artifacts. Lossless compression methods may also be preferred for high value content, such as medical imaging or image scans made for archival purposes. Lossy methods are especially suitable for natural images such as photos in applications where

minor (sometimes imperceptible) loss of fidelity is acceptable to achieve a substantial reduction in bit rate.

In this paper, we discuss about a method of run length encoding for compression of the binary images. The paper is organized as follows. A brief introduction about the image compression techniques was presented in the previous paragraphs. In section 2, a brief introduction about the storing of images in computers is dealt with. The advantages & disadvantages of high-resolution images along with that of image compression is described in section 3. The next section, i.e., section 4 deals with the types of image compression techniques. Section 5 describes the run length-encoding scheme developed to compress the binary images along with some simulation examples. Section 6 gives the simulation results. The user developed code in C / C++ used for simulation is presented in section 7. Conclusions are presented in section 8 followed by the references.

2. STORING OF IMAGES IN COMPUTERS

Camera converts a 3D physical object into the image of the object. The output of the camera is 2D analog image which is represented by $i (x , y)$. Computer cannot process this analog image. They have to be digitized. The analog image $i (x , y)$ is converted into a digital image (DI) / gray scale image I (k , j) using the A to D conversion. The digital / gray scale image is thresholded to obtain a BI - binary image B (k , j) which consists of foreground objects represented by 1's and background objects represented by 0's. Each 1 or 0 is a pixel or an element of a binary image L (k , j) and can be stored either in 1 bit or in 1 byte. This is how a image is stored in the memory of the computer.

Note that in the memory of the computer or in the CD's or in the DVD's or in the floppy disks or in the hard disks, the images are always stored in the form of 0's and 1's. Storage capacity of the images goes on increasing with the size, brightness, contrast, resolution, colors, whether it is a 2D or a 3D image (hologram), etc. The different methods of storing the pixel values of the binary image are : 1 pixel can be stored in 1 bit or 1 pixel stored in 1 byte.

3. ADVANTAGES AND DISADVANTAGES OF HIGH RESOLUTION IMAGES & THAT OF IMAGE COMPRESSION

High resolution images consume more amount of memory space for storage, take long time to transmit over the communication channels, size of memory consumed is more, good clarity, resolution if very good, retrieval time is increased. Hence, images are often compressed / packed or coded. Images are often compressed in order to reduce the storage capacity. The advantages of image compression being, the memory storage gets reduced by a factor of 8, takes less time to transmit over the communication channels. But the main disadvantage is the retrieval of images takes more time. For example, when we are downloading the images from the Internet, we can see that it takes more time to open because the image is getting decoded.

4. TYPES OF IMAGE COMPRESSION TECHNIQUES

There are various methods of data compression techniques such as the Haufman's coding, Lempel-Zev method of coding, zip / unzip method, winzip, winrar, tar and the Run Length Encoding [RLE]. The different methods of storing the pixel values of the binary image are 1 pixel can be stored in 1 bit or in 1 byte. If 1 pixel is stored in 1 bit, then 8 pixels can be stored in 1 byte, so that the factor of compression is 8. There are different methods for lossless image compression such as

- Run-length encoding - used as default method in PCX and as one of possible in BMP, TGA, TIFF
- Entropy coding
- Adaptive dictionary algorithms such as LZW - used in GIF and TIFF
- Deflation - used in PNG, MNG and TIFF

4.1 RUN LENGTH ENCODING [RLE]

In this section, we deal with the RLE, which is a method of compressing the binary images and uses an encoding scheme in which a RUN is represented by a sequence of pixels having the same value and the length of the run represents the total number of pixels in the sequence. Here, we store the starting value of the pixel and the lengths of the subsequent runs as the binary image is scanned from the left to the right and from the top to the bottom. Hence, we get a coded image or a compressed image.

This run length encoding is a simplest dictionary based data compression technique. Image files frequently contain the same character repeated many times in a row. Images, particularly those having very few gray levels, often contain regions of adjacent pixels, all with the same gray levels. Each row of such images can have long runs of the same gray value. In, such cases, one can store a code specifying the value of the gray level, followed by the length of the run, rather than storing the same value many a times over. As is evident, the run length encoding achieves considerable compaction in images, which have a fairly constant background. The RLE also eliminates the inter-pixel redundancies.

To consider a simulation example, let us have a binary image B (k , j) of size (8 × 10) of 8 rows and 10 columns as shown in Fig. 1, the foreground represented by 1's and the background represented by 0's. Scan the binary image from left to right and from top to bottom using raster-scanning technique. Store the first pixel

value and the length of the subsequent runs as the binary image is scanned from left to right and from the top to bottom using the raster scanning method.

		Column →									n = 10
		1	2	3	4	5	6	7	8	9	10
R	1	0	0	0	0	0	0	0	0	0	0
o	2	0	0	0	0	0	0	0	0	0	0
w	3	0	1	1	1	0	0	0	0	0	0
	4	0	0	0	1	1	1	0	0	0	0
	5	0	0	0	0	0	1	1	1	0	0
	6	0	0	0	0	0	0	0	0	0	0
	7	0	0	0	0	0	0	0	0	0	0
m =	8	0	0	0	0	0	0	0	0	0	0

Fig. 1 : A (8 × 10) binary image

The sequence of storage of the pixel values is shown below in the form of an algorithm as follows.

1st pixel value is 0.
Store 0 in byte 1
The length of Run 1 is $L_{R1} = 0$

There are 21 pixels with value 0
Store 21 in byte 2
The length of Run 2 is $L_{R2} = 21$

There are 3 pixels with value 1
Store 3 in byte 3
The length of Run 3 is $L_{R3} = 3$

There are 9 pixels with value 0
Store 9 in byte 4
The length of Run 4 is $L_{R3} = 9$

There are 3 pixels with value 1
Store 3 in byte 5
The length of Run 5 is $L_{R5} = 3$

There are 9 pixels with value 0
Store 9 in byte 6
The length of Run 6 is $L_{R6} = 9$

There are 3 pixels with value 1
Store 3 in byte 7
The length of Run 7 is $L_{R7} = 3$

There are 32 pixels with value 0
Store 32 in byte 8
The length of Run 8 is $L_{R8} = 32$

Therefore, the sequence of run lengths is given by

$\Gamma = [\ 0\ \ 21\ \ 3\ \ 9\ \ 3\ \ 9\ \ 3\ \ 32\ ]^T$.

i.e., the memory storage = 8 bytes.

If 1 pixel / byte is used to store the given binary image, then memory storage = (8 × 10) = 80 bytes.

If 1 pixel / bit is used to store the given binary image, then memory storage = $\frac{80}{8}$ = 10 bytes.

If Run Length Encoding (R L E) is used, then memory storage = 8 bytes. ∴, % saving in memory space if RLE is used = % S = $\frac{80-8}{8} \times 100 = 90$ %.

1	0	1	0	1	0	1	0
0	1	0	1	0	1	0	1
1	0	1	0	1	0	1	0
0	1	0	1	0	1	0	1
1	0	1	0	1	0	1	0
0	1	0	1	0	1	0	1
1	0	1	0	1	0	1	0
0	1	0	1	0	1	0	1

Fig. 2 : A chess board

0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0

$\Gamma = \{0, 16\}$

1	1	1	1
1	1	1	1
1	1	1	1
1	1	1	1

$\Gamma = \{0, 16\}$

Fig. 3 : Shortest RL code

RLE method of compressing the binary images is not always successful. It depends on the number of 1's and 0's. For ex., when the image has got alternate 1's and 0's, then the RLE fails. It is as good as storing the pixel in 1 byte. For a chess board, the memory storage if RLE is used or 1 pixel / bit is used, then the memory consumed = 64 bytes as shown in Fig. 2. The shortest run length code is an image having all 0's (2 bytes) or an image having all 1's (2 bytes) as shown in Fig. 3. Another disadvantage with the run length code is from the run length code (first value), we cannot know which is the number of zeros or which is number of ones.

Let us consider another simulation example as shown in the Fig. 4. The run length code of the given binary image is Γ = { 0 , 17 , 2 , 1 , 1 , 5 , 4 , 4 , 3 , 27 }^{T}. The storage of Γ requires 10 bytes.

At one byte per number, the number of bytes of storage required to store the (8 × 8) image is 64 .

∴, the percentage saving in memory

$$= \frac{100(64-10)}{64} = 84.4\ \%.$$

		Col j →							
		1	2	3	4	5	6	7	8
	1	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0
Row	3	0	1	1	0	1	0	0	0
k	4	0	0	1	1	1	1	0	0
↓	5	0	0	1	1	1	0	0	0
	6	0	0	0	0	0	0	0	0
	7	0	0	0	0	0	0	0	0
	8	0	0	0	0	0	0	0	0

Fig. 4 : A (8 × 8) binary image

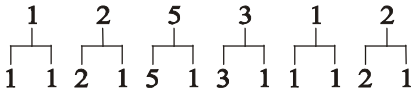


Fig. 5 : A image data

Now, consider performing the RLE on the data shown in the Fig. 5. In RLE, the first value specifies the gray value while the second value specifies the run. Therefore, the RLE code is $\Gamma = [\ 1\ 1\ 2\ 1\ 5\ 1\ 3\ 1\ 1\ 1\ 2\ 1\ ]^T$. The R LE code here is double than that of the original sequence. Hence, RLE should only be used if we have the same character gray value repeated many a times in a row.

5. SIMULATION RESULTS

A graphical user interface program was developed in C / C++ language and many codes was compiled and run. On running the code, the following screens as shown below appeared, i.e., the inputs & the output screens, which are nothing but the simulation results.

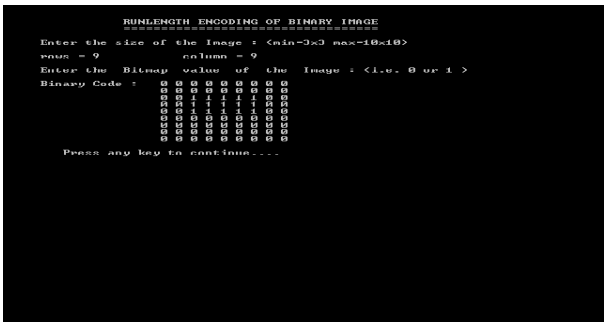


Fig. 6 : Simulation result 1

Fig. 7 : Simulation result 2

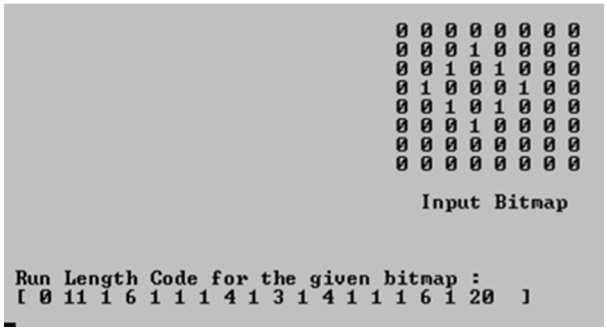


Fig. 8 : Simulation result 3

THE C / C++ CODE FOR COMPILATION

```
// Program to compute the run length encoding of binary
images.

#include<stdio.h>
#include<conio.h>
#include<math.h>
#define MAX 10
#define MIN 3

char d[10][10];
int rln[100];
int no_of_zero,no_of_ones;
int i,j,col,row;
int count=0,flag=0;

// Diplays Title of the program
void header()
{
clrscr();
printf("\n\n\t\trunlength Encoding of Binary Image\n");
printf("\t\t==================================
=");
}

void input()
{
char c;

do{
header();
gotoxy(6,6);
printf("Enter the size of the Image : (min=3x3
max=10x10)");
gotoxy(6,8);
printf("rows = "); scanf("%d",&row);
gotoxy(25,8);
printf("column = ");scanf("%d",&col);
}while(col>MAX || col<MIN || row>MAX || row<MIN);

gotoxy(6,10);
printf("Enter the Bitmap value of the Image : (i.e. 0
or 1 )");
gotoxy(6,12);
printf("Binary Code :");

for(j = 1;j<=row;j++)
for(i = 1;i<=col;i++)
{
d[i][j]=getch();
gotoxy(2*i+20,j+11);
if((d[i][j]!= '1') && (d[i][j]!= '0')){i=i-1;}
else printf("%c",d[i][j]);
}
printf("\n\n\tPress any key to continue....");
getch();
}

void initialise()
{
```

```
rln[0]=0;
count=1;
if(d[1][1]=='0')flag=1;else flag=0;
no_of_zero=0; no_of_ones=0;
rln[0]=d[1][1]-48;  // converting from char -> integer
}

void encode()
{
for(j=1;j<=row;j++)
for(i=1;i<=col;i++)
{

if(d[i][j]=='0')
{
if(flag==0)
{
rln[count]= no_of_ones;
count++;
flag=1;
no_of_zero=0;
}
no_of_zero=no_of_zero+1;
}

if(d[i][j]=='1')
{
if(flag==1)
{
rln[count]= no_of_zero;
count++;
flag=0;
no_of_ones=0;
}
no_of_ones=no_of_ones+1;
}
}

if(flag==0) rln[count]= no_of_ones;
else  rln[count]= no_of_zero;

}

void display()
{
header();
gotoxy(10,6);
printf("Runlength Code:");

gotoxy(10,8);
printf("Tau = {");

for(i=0;i<=count;i++)
{
printf("%d",rln[i]);
if(i!=count)printf(", ");
}
printf("}");

gotoxy(10,10);
printf("Storage of packed binary image  : %d
bytes",col*row/8);
gotoxy(10,12);
printf("Storage of unpacked binary image  : %d
bytes",col*row);
gotoxy(10,14);
printf("Storage of encoded image  : %d bytes",count+1);
printf("\n\n\t Press any key to continue.....");
getch();
}

void main()
{
input();
initialise();
encode();
display();
}
```

6. CONCLUSIONS

A method of compressing the binary images was developed. A GUI in C / C++ was also developed. It was demonstrated that run length encoding is one of the efficient method of compressing the binary images. Of course, it has got some drawbacks. Run-length Encoding, or RLE thus, is a technique used to reduce the size of a repeating string of characters. This repeating string is called a *run*, typically RLE encodes a run of symbols into two bytes, a count and a symbol. RLE can thus compress any type of data regardless of its information content, but the content of data to be compressed affects the compression ratio. RLE cannot achieve high compression ratios compared to other compression methods, but it is easy to implement and is quick to execute. Thus, run-length encoding is supported by most bitmap file formats such as TIFF, BMP and PCX.

7. References

[1] Craig J, *Introduction to Robotics* : *Mechanics, Dynamics & Control,* Addison Wessely, USA, 1986.
[2] Robert, J. Schilling, *Fundamentals of Robotics - Analysis and Control*, PHI, New Delhi.
[3] Klafter, Thomas and Negin, *Robotic Engineering*, PHI, New Delhi.
[4] Fu, Gonzalez and Lee, *Robotics: Control*, *Sensing*, *Vision and Intelligence*, McGraw Hill.
[5] Groover, Weiss, Nagel and Odrey, *Industrial Robotics*, McGraw Hill.
[6] Ranky, P. G., C. Y. Ho, *Robot Modeling, Control & Applications*, IFS Publishers, Springer, UK.
[7] Crane, Joseph Duffy, *Kinematic Analysis of Robotic Manipulators*, Cambridge Press, UK.
[8] Manjunath, T.C., (2005), *Fundamentals of Robotics*, Fourth edn., Nandu Publishers, Mumbai.
[9] Manjunath, T.C., (2005), *Fast Track to Robotics*, Second edn., Nandu Publishers, Mumbai.
[10] Dhananjay K Teckedath, *Image Processing*, Third edn., Nandu Publishers, Mumbai.
[11] Gonzalvez and Woods, *Digital Image Processing*, Addison Wesseley Publishers.
[12] Anil K Jain, *Digital Image Processing*, Prentice Hall, Englewood Cliffs, New Jersey, USA.
[13] http://www.wikipedia.org
[14] Michael Dipperstein**,** Run Length Encoding (RLE) Discussion and Implementation.

AET - 0016

An Efficient Counter Based Scheme of Broadcasting with Adapting RAD In MANETs

Mr.Pramod P.Bhavarthe[1] Mr.D.S.Bade [2] Mr. P.U.Dere[3]

[1]Student, [2] Asst. Professor, VIT, Mumbai [3]Asst. Professor Terna Engg. College Navi Mumbai,

[1]bhavarthe_pramod@rediffmail.com,[2]dattabade@gmail.com,[3]pravinder @rediffmail.com

Abstract-

In mobile ad-hoc networks (MANETs), broadcasting plays a fundamental role, diffusing a message from a given source node to all the other nodes in the network. Flooding is the simplest and commonly used mechanism for broadcasting in MANETs, where each node retransmits every uniquely received message exactly once. Despite its simplicity, it however generates redundant rebroadcast messages which results in high contention and collision in the network, a phenomenon referred to as broadcast storm problem. Pure probabilistic approaches have been proposed to mitigate this problem inherent with flooding, where mobile nodes rebroadcast a message with a probability which can be fixed or computed based on the local density. However, these approaches reduce the number of rebroadcasts at the expense of reach ability. On the other hand, counter-based approaches inhibit a node from broadcasting a packet based on the number of copies of the broadcast packet received by the node within a random access delay time. These schemes achieve better throughput and reach ability, but suffer from relatively longer delay. We are going to implement an efficient counter-based broadcast scheme by adapting its random assessment delay (RAD) that combines the advantages of pure probabilistic and counter-based schemes. Simulation results revealed that this simple adaptation achieves superior performance in terms of saved rebroadcast, end-to-end delay and reach ability.

Keywords — MANETs, Flooding, Broadcast storm problem, Saved-rebroadcast, Reach ability.

I. INTRODUCTION

Mobile Ad hoc Networks (MANETs) are wireless network by autonomous system of mobile nodes that are connected via wireless links without using an existing network infrastructure or centralized administration. The nodes are free to move randomly and act as end points as well as routers to forward packets in a multi-hop environment where all nodes may not be within the transmission range of the source. Scenarios that might benefit from MANETs technology includes rescue/emergency operations in natural or environmental disaster areas, military operations, mobile conference, and home networking [1]. Broadcasting is a means of diffusing a message from source node to all other nodes in the network. It is a fundamental operation in MANETs and is extensively used in route discovery, address resolution, and many other network services in a number of routing protocols. These protocols typically rely on simplistic form of broadcasting called simple flooding, in which each mobile node retransmits every unique received packet exactly once. Although flooding is simple and easy to implement, it often causes unproductive and harmful bandwidth congestion, a phenomenon referred to as the broadcast storm problem [1].Several broadcast schemes have been proposed that mitigate the broadcast storms problem. The performance of these schemes is measured in terms of reach ability, which is the fraction of the total nodes that receive the broadcast messages, the saved-rebroadcast, that is the fraction of the total nodes that does not rebroadcast the messages, and the latency, that is the time between the first and the last instant that the broadcast message is transmitted [3]. These schemes are usually divided into two categories [4]: deterministic schemes and probabilistic schemes.

Deterministic schemes require global topological information of the network and are guaranteed a reach ability of one considering an ideal MAC layer. However, they incur large overhead in terms of time and message complexity for maintaining the global knowledge requirements due to the inherent dynamic topology of MANETs. On the other hand, probabilistic schemes do not require global topological information of the network to make a rebroadcast decision. As such every node is allowed to rebroadcast a message based on a predetermined forwarding probability p. As a consequence, these schemes incur a smaller overhead and demonstrate superior adaptability in dynamic

environment when compared to deterministic schemes [4]. However, they typically sacrifice reach ability as a trade-off against overhead. Among the probabilistic schemes that have been proposed are probability-based and counter based schemes [1].

In probability-based schemes, a mobile node rebroadcasts a message according to certain probability p which can be fixed or computed schemes assume a fixed probability value However; these approaches reduce the number of rebroadcast at the expense of reach ability. In contrast, messages are rebroadcast only when the number of copies of the message received at a node is less than a threshold value in counter-based schemes. This lead to better throughput and reach ability, but suffer from relatively longer delay [3]. To adapt ECS's RAD to congestion levels each node keeps track of the number of packets received per second. We compare this scheme against simple flooding, ECS and counter based scheme. Simulation results shows that this simple modification can achieve better performance in various network situations.

The rest of the paper is organized as follows: In Section 2, we introduce the related work on probabilistic and counter-based broadcasting. The description Efficient Counter Based Scheme (ECS) and its RAD adaptation is presented in Section 3. The performance of the scheme and simulation results are in Section 4. Finally, concluding remarks are presented in Section 5.

II. RELATED WORK

This section includes some research work related to probabilistic and counter-based broadcasting schemes. Probability-based scheme of broadcasting reduced redundant rebroadcast by differentiating the timing of rebroadcast to avoid collision [4]. The scheme is similar to flooding, except that nodes only rebroadcast with a predetermined probability P. Each mobile node is assigned the same forwarding probability regardless of its local topological information. Counter-based scheme is proposed after analyzing the additional coverage of each rebroadcast when receiving n copies of the same packet. An adaptive probabilistic scheme in which probability pfor a node to rebroadcast a packet is determined by the local node density and a fixed value k for the efficiency parameter to achieve the reach ability of the broadcast. However, the critical question thus becomes how to optimally select k, since k is independent of the network topology.

An adaptive counter-based scheme [5] in which each node dynamically adjust its threshold value C based on its number of neighbors. In this scheme fixed threshold C is function of C(n), where n is the number of neighbors of the node. In this approach there should be a neighbor discovery mechanism to estimate the current value of n.

A dynamic probabilistic broadcast scheme [9,10] which is a combination of the probabilistic and counter-based approaches. The scheme is implemented for route discovery process using AODV as base routing protocol [14, 15]. The rebroadcast probability P is dynamically adjusted according to the value of the local packet counter at each mobile node. Therefore, the value of P changes when the node moves to a different neighborhood. To suppress the effect of using packet counter as density estimates, two constant values d and d1 are used to increment or decrement the rebroadcast probability. However, the critical question is how to determine the optimal value of the constants d and d1.

A color based broadcast scheme [13] in which every broadcast message has a color-field, with a rebroadcast condition to be satisfied after expiration of the timer similar to counter-based scheme. A node rebroadcast a message with a new color assigned to its color-field if the number of colors of broadcast messages overheard is less than a color threshold μ. Recently, in an efficient counter-based scheme [6] was proposed which combines the merits of probability based and counter-based algorithms using a rebroadcast probability value of around 0.65 as proposed in [9,10] to yield a better performance in terms of saved-rebroadcast, end-to-end delay and reach ability. In this paper, we are going to implement efficient counter-based scheme by adapting the RAD value to network congestion.

III. RAD ADAPTIVE EFFECTIVE COUNTER BASED BROAD CAST SCHEME

The efficient counter-based scheme that aims to mitigate the broadcast storm problem associated with flooding. The use of ECS for broadcasting enables mobile nodes to make localized rebroadcast decisions on whether or not to rebroadcast a message based on both counter threshold and forwarding probability values. Essentially, this adaptation provides a more efficient broadcast solution in sparse and dense networks. In ECS, a node upon reception of a previously unseen packet initiates a counter *c* that will record the number of times a node receives the same packet. Such a counter is maintained by each node for each broadcast packet. After waiting for a random assessment delay (RAD, which is randomly chosen between 0 and T_{max} seconds), if *c* reaches a predefined threshold *C*, we inhibit the node from this packet rebroadcast. Otherwise, if *c* is less than the predefined threshold, *C,* the packet is rebroadcast with a probability *P* as against automatically rebroadcasting the message in counter-based scheme. The use of a rebroadcast probability stem from the fact that packet counter value does not necessarily correspond to the exact number of neighbors of a node, since some of its neighbors may have suppressed their rebroadcast according to their local rebroadcast probability. Thus, the selection of an optimal forwarding probability is vital to the performance of ECS scheme. Based on [9,10].we are taking 0.5 as rebroadcast probability.

Algorithm: Efficient Counter-Based Scheme

On hearing a broadcast message m at a node X

initialize the counter c = 1;

set and wait for RAD to expire;

for every duplicate message m received within RAD

increment c, c = c +1;

1. if (c < C) (counter threshold-value)
2. {wait for RAD to expires;
3. rebroadcast probability P = P1; }
4. else{ //where P1 = 0.65

stop waiting

Drop the message }

Generate a random number RN over [0, 1]

If RN ≤ P

5. rebroadcast the message;

else

Drop the message.

RAD Adaptation

Essentially, selection of appropriate RAD time can play a vital role in the performance of any broadcast scheme. In original counter-based scheme [8], each node is assigned a fixed constant value T_{max} which is used to determine RAD value at random. Thus, node does not utilize any network information such as congestion or number of neighbors in determining this value. Clearly, higher RAD value is effective in increasing the delivery ratio in a congested network while lower RAD values are needed in non congested network. Adapting RAD in this way maximizes delivery ratio and minimizes end-to-end delay. Congestion can be obtained by increasing the packet size or increasing the packet generation rate or both. We will choose fix the packet size but there will be packet generation rate because broadcast packets, as control type packets, which are generally small in size. Therefore to adapt ECS's RAD T_{max} to congestion levels, each node keeps track of the number packets received per second. If the node is receiving more than 200 packets per second on average (which roughly correlates to a broadcast packet origination rate of 50 packets per second), the node uses a RAD T_{max} time of 0.05 seconds. Otherwise, the node uses a RAD T_{max} time of 0.01 seconds.

IV. PERFORMANCE ANALYSIS

In order to verify the effect of the RAD adaptation, we perform simulation using ns-2 packet level simulator (v.2.29) [8]. We provide a side by side implementation with ECS, counter-based, and flooding, and compare the results against those obtained from the three approaches.

The radio propagation model used in this study is the ns-2 default, which uses characteristic similar to a commercial radio interface, Lucent's Wave LAN card with a 2Mbps bit rate [11,12]. The distributed coordination function (DCF) of the IEEE 802.11 protocol is utilized as MAC layer protocol while model. In a random waypoint mobility model, each node at the beginning of the simulation remains stationary for a pause time seconds, then chooses a random destination and starts moving towards it with a randomly selected speed from a uniform distribution [0, max-speed]. After the node reaches its destination, it again stops for a pause-time interval and chooses a new destination and speed. This cycle repeats until the simulation terminates. Because it takes time for the random way point model to reach a stable distribution of mobile nodes , the modified random waypoint mobility model used take care of this node distribution problem. The simulation is allowed to run for 900 seconds for each simulation scenario. Other simulation parameters that have been used in our project are shown in Table1

TABLE 1. SIMULATION PARAMETERS

Simulation Parameter	**Value**
Simulator	NS-2(V2.29)
Transmission range	250M
Bandwidth	2Mbps
Interface queue length	50
Packet size	512byte
Packet rate	10-80pac./sec
Number of nodes	20,40,……,100
Maximum speed	3m/s

Each data point represents an average of 30 different randomly generated mobility models with 95% confidence interval. We evaluate the broadcast schemes using the following performance metrics:

A. Reach ability (RE): This is the percentage of nodes that received the broadcast message to the total number of nodes in the network

B. Saved Rebroadcast (SRB): This is defined as *(r – t)/r*, where *r* and *t* are the number of nodes that received the broadcast message and the number of nodes that transmitted the message respectively.

C .End-to-end delay: Is the average time difference between the time a data packet is sent by the source node and the time it is successfully received by the destination node.

The analysis is based on the assumptions widely used in literature

1. Nodes are identical
2. All nodes participate fully in the protocol of the network. In particular each participating node should be willing to forward packets to other nodes in the network.
3. Links are bidirectional and no selfishness in the network.
4. Mobile nodes operate in flat squared simulation area.

5. The transmission range is fixed at 250m in all nodes to approximately simulate networks with a multi-hop networks.

Simulation results

First we evaluated the impact of density on the performance of the schemes. First, we evaluated the impact of density by varying the number of nodes within the network area from 20 - 100 nodes using traffic rate of 10 packets/second and 3m/s node speed. We assess the impact of network density on the performance of the different broadcast schemes by varying the number of nodes from 20 to 100 deployed randomly on a fixed area of 1000 x 1000 m2. Figure1 gives the effects of density on the saved rebroadcasts achieved by the four broadcast Schemes The figure shows that RAD adaptive-ECS has superior saved rebroadcast performance than ECS in sparse networks and comparable performance in dense network. This might be due to increase in the number node covered within the network. In sparse network most of the schemes saved less rebroadcast as a result of less connectivity within the network.

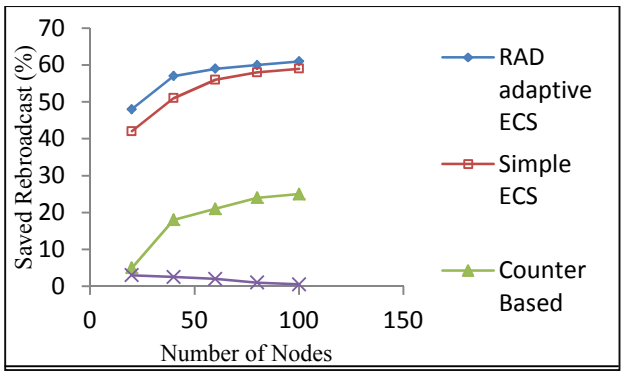


Figure1. Impact of density on saved rebroadcast using 3 m/s node speed and 10 packet/second traffic rates

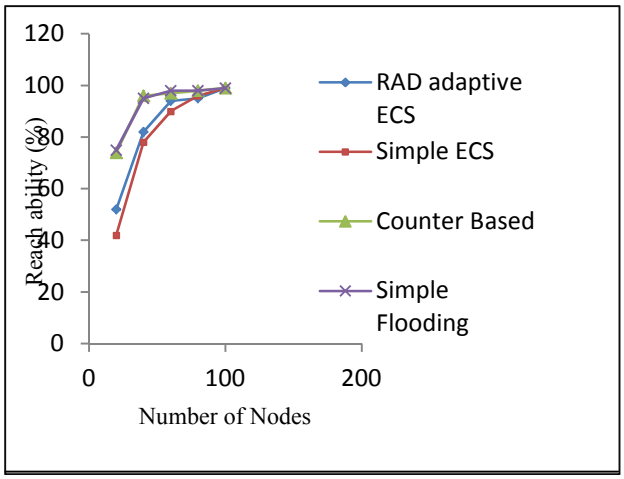


Figure2. Impact of density on reach ability using 3 m/s node speed and 10 packet/second traffic rate

Figure 2 gives the degree of reach ability of the different broadcast schemes. The figure shows the reach ability achieved by the schemes as the node densities increases. The result shows that reach ability increases when network density increases regardless of which scheme is used. The flooding and counter-based algorithms have the best performance. RAD adaptive-ECS has a better reach ability performance than ECS. Figure 3 gives the effect of density on end-to-end delay as network density increases. It shows that the delay is largely affected by network density and thus, increases with increase in density. RAD adaptive-ECS has least end-to-end delay as a result of the RAD adaptation which insures that low RAD values are utilize when network is not congested while high RAD are used when network is congested

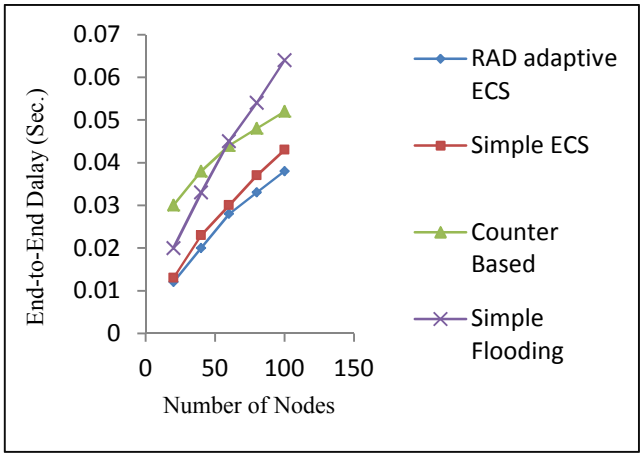


Figure3. Impact of density on end-to-end delay using 3 m/s node speed and 10 packets/second traffic rate

V .CONCLUSIONS

In this paper, the efficient counter-based scheme (ECS) with adaptive RAD was focused as a broadcast scheme for mobile ad hoc networks that reduce the broadcast storm problem associated with flooding. A simple RAD (Random Assessment Delay) adaptation to network congestion has been proposed to improve the original counter-based scheme and ECS. Simulation results show that this simple adaptation minimizes end-to-end delay and maximizes delivery ratio. Thus, achieving superior performance in terms of saved rebroadcast, end-to-end delay and Reach ability.

VI. REFERENCES

[1] S. Ni, Y. Tseng, Y. Chen, and J. Sheu., "The broadcast storm problem in a mobile ad Hoc networks," in *Proceeding of the ACM/IEEE International Conference on Mobile Computing and Networking (MOBICOM)*, 1999, pp. 151-162.

[2] M. D. Colagrosso, "Intelligent broadcasting in mobile ad hoc networks: Three classes of adaptive protocols," *EURASIP Journal on Wireless Communication and Networking*, vol. 2007, pp. Article ID 10216, 16 pages, 2007.

[3] H. Zhang and Z. P. Jiang, "Modeling the performance of analysis of ad hoc broadcasting schemes," *Performance Evaluation*, vol. 63, pp. 1196 - 1215, 2006. 2005.

[4] B. Williams and T. Camp, "Comparison of Broadcasting Techniques for Mobile Ad Hoc Networks," in *Proceeding MOBIHOC*. Lausanne, Switzerland: ACM, 2002, pp. 194-205.

[5] A. Mohammed, M. Ould-Khaoua, L. Mackenzie, and J. Abdulai, "Improving the Performance of Counter-Based broadcast Scheme for Mobile Ad Hoc Networks," in *Proceedings of 2007 IEEE International Conference on Signal Processing and Communications (ICSPC 2007)* Dubai, United Arab Emirates, 2007, pp. 1403 - 1406.

[6] A. Mohammed, M. Ould-Khaoua, and L. Mackenzie, "An Efficient Counter-Based Broadcast Scheme for Mobile Ad Hoc Networks," in *Proceedings of the Fourth European Performance Engineering Workshop (EPEW 2007) Lecture Notes in Computing Science Volume 4748*, K. Wolter, Ed. Berlin, Germany: Springer-Verlag 2007, pp. 275 - 283.

[7] M. Bani-Yassein, M. Ould-Khaoua, L. M. Mackenzie, and S. Papanastasiou, "Improving the performance of probabilistic flooding in MANETs," in *Proceeding of International Workshop on Wireless Ad Hoc Networks*. London, UK, 2005. 2006, pp. 1 - 10.

[8] The Network Simulator ns-2, http://www.isi.edu/nsnam/ns/."

[9] Y.-C. Tseng, S.-Y. Ni, and E.-Y. Shih, "Adaptive approaches to relieving broadcast storms in a wireless multihop ad hoc networks," *IEEE Transaction on Computers,*, vol. 52, pp. 545-557, 2003.

[10] Q. Zhang and D. P. Agrawal, "Dynamic Probabilistic Broadcasting in MANETs," *Journal of Parallel and Distributed Computing*, vol. 65, pp. 220- 233, 2005.

[11] "IEEE802.11 WaveLAN PC Card - User's Guide," pp. A-1

[12] *IEEE standard 802.11-1997, Wireless LAN medium access control (MAC) and physical layer (PHY) specifications*: IEEE, 1997.

[13] A. Keshavarz-Haddad, V. Ribeiro, and R. Riedi, "Color-Based Broadcasting for Ad Hoc Networks," in *Proceeding of the 4th International Symposium on Modeling and Optimization in Mobile, Ad Hoc, and Wireless Network (WIOPT' 06)*. Boston, MA, 2006, pp. 1 - 10.

[14] D. B. Johnson and D. A. Maltz, "Dynamic source routing in ad hoc wireless networks," in *Mobile Computing*, vol. 353, T. Imelinsky and H. Korth, Eds.: Kluwer Academic Publishers, 1996, pp. 153 - 181.

[15] Z. J. Haas, M. R. Pearlman, and P. Samar, "Determining optimal configuration for zone routing protocol," *IEEE Journal on Selected Areas in Communications*, vol. 17, pp. 1395 - 1414, 1999.

AET - 0017

A New Protocol For Rapid Intercommunication By Parallel Interfaced Microcontrollers For Multiple Peripherals.

Amit K. Nerurkar
Department of Computer Engineering,
Vidyalankar Institute of Technology
123amit123@gmail.com

S. A. Patekar
Department of Computer Engineering,
Vidyalankar Institute of Technology
sapatekar@gmail.com

Abstract

In today's embedded world it is highly appreciable to connect as many as devices to the single integrated chip and have a faithful and successful communication. However due to only four ports we can interface maximum of four devices. So to interconnect more devices it's desired to use 8255 programmable peripheral interface or more microcontrollers together. But with this approach the communication between the chips will serial and requires a master slave configuration and hence rate of communication decreases. In this paper we present an alternate configuration for developing communication protocol between microcontrollers which are interfaced in a parallel fashion. In the configuration we will be using a data bus of size 8-bit to transfer data from one controller to the other and 3handshaking signals for synchronization. The proposed confirmation improves the data rate of the system and also enables the system of have a flexible option of devices with varied clocking frequencies.

I. INTRODUCTION

In today's embedded world it is highly necessary to connect as many as devices to the single integrated chip and have a faithful and successful communication. But there are some limitations that need to be adhered due to limitations of ports to single integrated chips. However the current Micro-controller allows only four peripherals [1][2] to get connected. For interfacing more peripherals one has to resort to use micro controller chip [3] or an 8255 [4] programmable peripheral interface chip. The protocol required for such environment is serial synchronous and works on the principle of Master Slave combination.

In this paper we propose interfacing the microcontrollers in parallel and developing the protocol for the same. This system configuration will increase the availability of the ports and makes the system scalable and increases the rate of communication. This has been achieved using 8-bit parallel data lines to transfer the data and 3 bit parallel line for handshaking signal. The protocol designed for such system will not require a master Slave configuration and each controller can communicate or transfer data independently. The system will be multi master system where any controller can communicate with any other controller unlike master slave system where only master can initiate the communication. Since clock is not used for synchronization the clock frequencies of these controllers can may or may not be same but the protocol will work efficiently. Addition and removal of any controller will not affect the protocol. For this protocol the hardware is implemented which contains four microcontrollers interfaced in parallel and four peripherals are interfaced to each microcontroller respectively. The protocol is also tested using a logic analyzer.

II. EXISTING PROTOCOL FOR SERIAL SYNCHRONOUS COMMUNICATION AND BOTTLENECKS THEREOF

The types of interfaces available for communication between microcontrollers can be classifies into two basic categories:

1. Synchronous Interfaces
2. Asynchronous interfaces

A synchronous interface [5] makes use of clock to synchronize the communication between controllers. Whereas, in asynchronous interfacing, the controller makes use of handshaking signals to communicate with each other instead of a common clock.

When using synchronous interfacing, a master-slave configuration is required. Master is the one who

provides the clocking frequency. A master device outputs this clock signal, which is received by all slave devices, to receive and transmit data in synchronization. This is when all the slaves in the system have the same clocking frequency, but if one of them has a different frequency then the efficiency of the system drops down. Hence, only the devices with the same clocking frequency as that of the master can be plugged into the system.

Examples of synchronous protocols are: SPI (Serial Peripheral Interface) [6], I2C (Inter Integrated Circuit) [7]. Both these protocols are serial in nature and hence only bit by bit data can be transferred at a time. This reduces the rate of communication in case of large number of peripherals are present. Since these protocols are synchronous means they use common clock for synchronization. The protocol works with master slave principle in which only master initiates the communication and provides a common clock. Due to this devices should have same clocking frequency as that of master. When it comes to bridging larger distances or connecting external devices, asynchronous interfaces play a dominant role.

III. PROPOSED CONFIGURATOIN AND PROTOCOL

3.1 System Description:

The paper proposes, interfacing four microcontrollers to four devices [8] respectively in parallel fashion. The devices which are interfaced with the controllers are:

1. 16*2 LCD
2. 4*3 Keypad
3. ADC 0808
4. RS 232 (Serial communication to PC)

As shown in fig. 1, the four microcontrollers are connected to each other by a common 8-bit data bus. For synchronization 3-bit handshaking signals are used.

All the circuit boards are designed using eagle software which is a software used for designing the circuit boards. The protocol is programmed in embedded C language using uVision software. The program which is developed is burnt in the all controllers and is not for a specific device.

The data which is to be sent will be sent through the 8 bit data line and synchronization will be through the 3 lines which are SACK (Sender's Acknowledgment), RACK (Receiver's Acknowledgment) and CS(Chip Select), all the above signal are active low signals i.e. they will be activated only when their value is set to 0.

This circuit board is fabricated with above hardware configuration and the developed protocol explained in section 3.2 is then embedded into microcontroller chip.

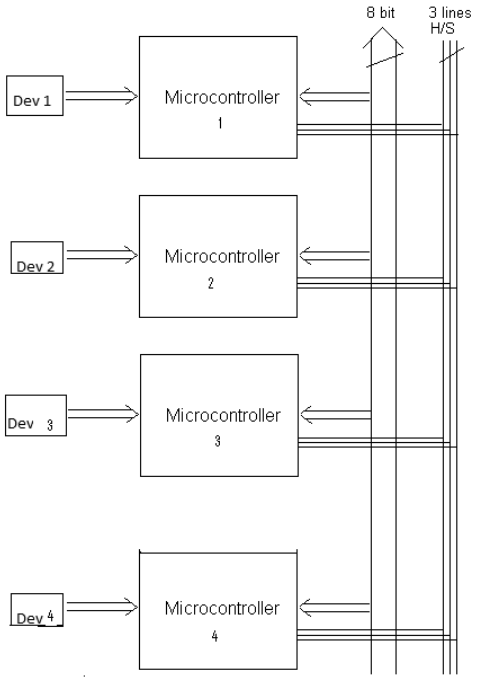


Figure 1 : Interfacing microcontrollers in parallel

3.2 Protocol Description:

The protocol designed for the above configuration is an asynchronous, parallel, non master slave speedy protocol. Whenever the data lines are in use value of CS will be 0 which indicates that data lines are busy that means any controller that wants to send data will sense this CS line, if it is zero that means data line is not free and hence the controller that wants to communicate will wait for some time and then again sense CS line. If CS is 1 that means data lines are free and the controller that wants to communicate acquires the data line by making CS equal to 0. Once the controller acquires the data line, it places data on data line and asserts SACK line by making it zero. This is an indication to all other controllers to go in a listen mode and check data on the data lines, after that the intended receiver replies by making RACK low which is an receiver's acknowledgement, on receiving RACK sender makes SACK high which is an acknowledgement for RACK, after receiving SACK as zero receiver makes RACK as high. The above procedure is called as handshake settlement.

Suppose that ith controller wants to talk to jth controller following procedure is used:

- Check for CS pin which indicates that if communication is already being done by other device
- If CS=0 bus is busy
- If CS=1 bus is free.
- Capture the Bus my making CS =0
- Put Destination address of the controller on to the bus.
- Make SACK =0 indicating Destination address has been sent on bus.
- Wait until Receiver gives Acknowledgement using RACK=0.
- Settle SACK
- Wait for Receiver settlement
- Send Sender's Address on Bus
- Wait for Handshake settlement
- Send Packet length
- Wait for Handshake settlement
- Send all the bytes in the packet & Wait for Handshake settlement
- Release the bus by making CS=1

Suppose that ith controller wants to listen to what jth controller is talking following procedure is used:

- Check for CS pin which indicates that if he Data is present on the Bus or not.
- If CS=0 Data is present
- If CS=1 bus is free
- Wait till CS=0
- Wait till SACK=0
- Check whether Data on Bus= Receiver's address
- Send RACK
- Wait for Handshake settlement i.e. communication started
- Receive the sender's address from the Bus
- Wait for Handshake settlement
- Receive the packet length from the Bus \
- Wait for Handshake settlement
- Receive the packets by executing a for loop (from 1 to packet length)
- Communication completed.

This above protocol is programmed using embedded C language. The code is then compiled using Keil (Cross) compiler [9] and then the code is burnt into the microcontroller chip using the burner.

IV. Testing and Results

The circuit which is fabricated and the protocol which is designed is tested with a HP 56420 logic analyzer [10][11] after the code is burnt into the controller. The sequence of steps explained in section 3.2 is tested with logic analyzer and fig. no. 2 shows the actual procedure of handshake settlement.

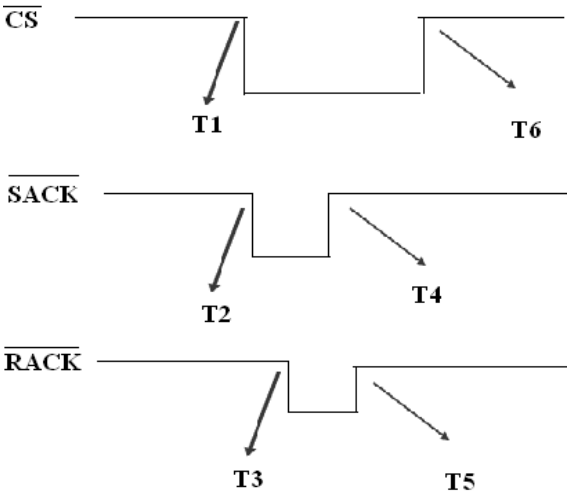


Figure 2: Testing and result of handshake settlement in Logic Analyzer

Initially CS=1 means data bus is free.
Now at time interval T1 CS=0 means some controller has acquired the control on data bus and made CS line low.
Now the sender keeps data on data bus makes SACK low as indicated by time interval T2 so that the receiver should be aware of the availability of the data on data bus.
Once the receiver reads the data, it sends an acknowledgement by making RACK=0 as indicated by time interval T3.
Once receiver receives this, it makes SACK=1 and waits for receiver to respond to this as indicated by time interval T4.
As a response the receiver makes RACK=1 as indicated by time interval T5. This procedure is called as handshake settlement.
Once the controllers finish the message transfer it releases the data bus by making CS=1 as indicated by time interval T6 which is shown in fig. no. 2.
The same set of steps is repeated for the communication between all the controllers.

V. CONCLUSION

A protocol enabling the microcontrollers with multiple peripherals to communicate in parallel speedily has been proposed in this paper. This protocol increases the rate of communication and is asynchronous in nature therefore there is no requirement of the common clock. This protocol overcomes the disadvantages of serial

communication protocols such as only master environment, synchronous communication and serial communication. The protocol which is developed is burnt into the controller chips and is tested using logic analyzer. The results are satisfactory and the system works very efficiently.

REFERENCES

[1] Kenneth Ayala The 8051 microcontroller, Architecture, Programming and Applications
[2] Microcontroller 89C51 Manual. http://www.atmel.com
[3] Interfacing of microcontrollers http://www.bipom.com/applications/ micro_interfacing.pdf
[4] Interfacing microcontroller with 8255. http://www.datasheetarchive.com/ 8255%20interface %20with %208051-datasheet.html
[5] Synchronous Interfaces www.altera.com/literature/an/an433.pdf
[6] SPI http://www.vti.fi/sites/default/files/documents/ tn15_spi_interface_specification.pdf
[7] I2C http://www.i2c-bus.org/
[8] Microcontroller Interfacing with Circuits http://www.scribd.com/doc/4287031/ Interfacing-With- Microcontrollers
[9] Keil Complier http://www.keil.com/c51/
[10] Basics of Logic Analyzer http://en.wikipedia.org/wiki/Logic_analyzer
[11] HP 54620 Logic Analyzer http://www.hpl.hp.com/hpjournal/97apr/ apr97a6.pdf

AET - 0018

RADIO CONTROLLED COMBAT ROBOT

SURYAKANT DAJI PATIL, PROF. PRAVIN ANNADATE
suryakant_patil70@yahoo.com
Vidyalankar Institute Of Technology
Wadala,Mumbai-400037
Mumbai University

Abstract

The objective of this paper is to minimize human casualties in terrorist attack such as 26/11. The combat robot [1] has been designed to tackle such a cruel terror attacks. This robot is radio operated, self- powered, and has all the controls like a normal car. A wireless camera has been installed on it, so that it can monitor enemy remotely when required. It can silently enter into enemy area and send us all the information through its' tiny Camera eyes. This spy robot can be used in star hotels, shopping malls, jewellary show rooms, etc where there can be threat from intruders or terrorists. Since human life is always precious, these robots are the replacement of fighters against terrorist in war areas.

Keywords-Combat Robot; Wireless camera; Terror attack; Radio Operated;Self-Powered; Intruders

I. INTRODUCTION

The global focus on terrorism and security may have geared up following the 9/11 attacks in the USA. The risk of terrorist attack can perhaps never be eliminated, but sensible steps can be taken to reduce the risk. The word "Robot" was first used in a 1921 play titled R.U.R. Rossum's Universal Robots, by Czechoslovakian writer Karel Capek . Robot is a Czech word meaning "worker."

Merriam-Webster defines robot [2] as "a machine that looks like a human being and perform various complex acts; a device that automatically performs complicated, often repetitive tasks; a mechanism guided by automatic controls." ISO describes a robot as "an automatically controlled reprogrammable, multipurpose manipulator programmable in three or more axes, which may be either fixed in place or mobile for use in industrial automation applications".

Yet, all these definitions do give us a rough idea about what comprises a robot, which needs to sense the outside world and act accordingly. There are motors, pulleys, gears, gearbox, levers, chains, and many more mechanical systems, enabling locomotion. There are sound, light, magnetic field and other sensors that help the robot to collect information about its environment. There are Processors powered by powerful software that help the robot make sense environmental data captured and tell it what to do next and also microphones, speakers, displays, etc that help the robot interact with humans.

The main objectives of using robot are

A. Where man dares not venture

Robots have traditionally been put to use in environments that are too hazardous for man.

B. To rescue, pronto!

Robots also work under precarious conditions, for search and rescue after disasters. A host of robots built by the University of South Florida's Centre for robot assisted search and rescue were in action at the world trade centre site within hours after the disaster to delve into the rubble and rescue survivors. Similarly, robots are also put to work in underground mines. A lot of research today is focused on improving rescue functions of robots.

C. We even make them go to war

The faithful robots do not hesitate to tread even the dreaded terrain of battlefields [3]. Their use in Afghanistan and Iraq wars make us wonder if robots have indeed become intelligent! Battle robots of various shapes and sizes were deployed to defuse landmines, search for criminals hiding in caves, search for bombs under cars and in building, for espionage and what not! These robots were controlled by humans.

We aim to develop a model which will be efficiently used to minimize terrorist causality. Being able to achieve reliable long distance communication is an important open area of research to robotics as well as other technology areas. As interest in robotics continues to grow, robots are increasingly being integrated into everyday life. The results of this integration are end-users possessing less and less technical knowledge of the technologies [4].

Currently, the primary mode for robot

communication uses RF. RF is an obvious choice for communication since it allows more information to be transferred at high speed and over long distance. This paper explores the use of readymade RF networks for communication and device control. This eliminates the need of a new infrastructure and detailed technical research.

II. HARDWARE IMPLEMENTATION

The block diagram of the hardware implementation of the entire system is as shown in the Figure 1. This robot is radio operated, self-powered and has all the controls like a normal car. A pair of laser gun has been installed on it, so that it can fire on enemy remotely when required. Wireless camera will send real time video and audio signals, which could be seen on a remote monitor, and action can be taken accordingly.

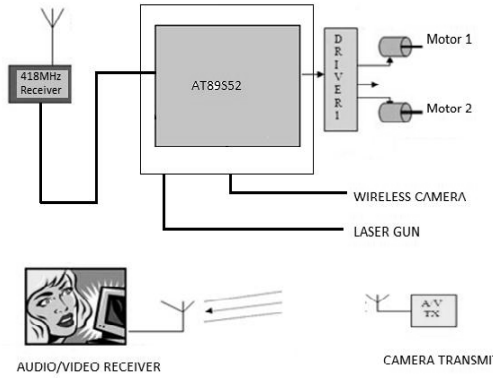


Figure 1: Block Diagram of Intelligent Combat Robot

Heart of our robot is Atmel's AT89S52 [5]. Microcontroller acts as master controller decodes all the commands received from the transmitter and give commands to slave microcontroller. It also acts as Slave microcontroller which is responsible for executing all the commands received from the master and also generating PWM pulses for the speed control. Based on the input codes master will give command to slave microcontroller and robot will behave as follows.

- moves in forward direction
- moves in reverse direction,
- speed controls in both the direction
- it can even turn left or right while moving forward or in reverse direction.
- Instant reverse or forward running without stopping.

A. Transmitting unit

Here a variable frequency oscillator 1 is used for modulating the frequency i.e. to be transmitted and has its output to a high frequency oscillator 2 for generating a carrier wave. The carrier wave is then radiated into space by the antenna. The transmitter module is shown in Figure 2.

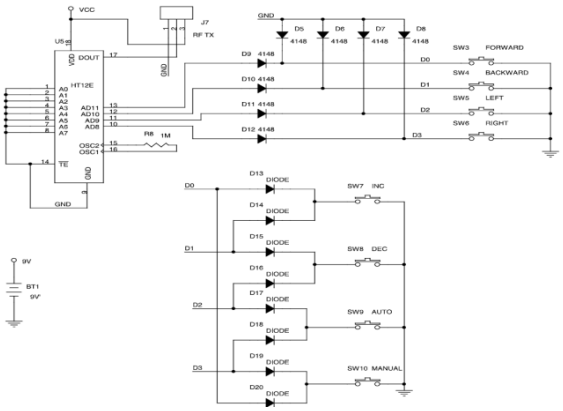


Figure 2: Transmitter Module

B. Receiving Unit

The receiving antenna is connected to a tuned wave detecting circuit for detecting the waves transmitted by transmitter antenna.The output of the tuned wave detecting circuit is connected to amplifier which in turn has its output connected to the input of the high pass frequency as well as the filter to a low pass frequency filter.

The outputs of amplifiers are connected to separate motors and other side of motors are connected to voltage potential .The high pass frequency filter extracts the higher frequency components of the output signals from the amplifier and the low pass frequency filter extracts the lower frequency components of the output signal from the amplifier .The receiver module is shown in Figure 3.

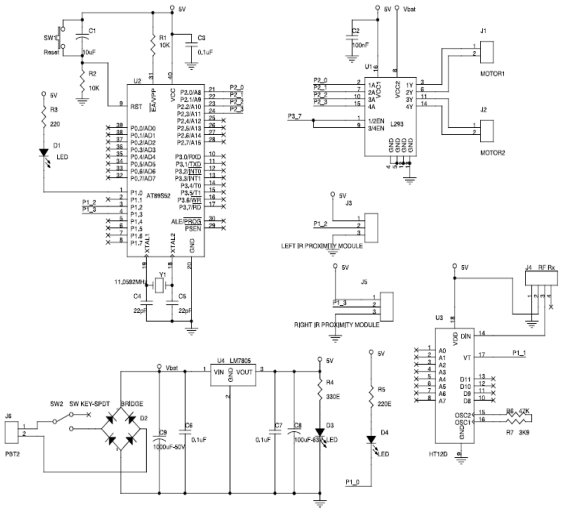


Figure 3: Receiver Module

III. COMPONENTS OR SUBSYSTEMS DESCRIPTION

A. Microcontroller circuit (AT89S52)

It is the heart of the system which controls all the activities of transmitting and receiving. The IC used is AT89S52. The AT89S52 Microcontroller [6] is an 8-bit microcontroller with 8K Bytes of In-System Programming Flash Memory. The device is

manufactured using Atmel's high-density nonvolatile memory technology and is compatible with the industry standard 80C51 instruction set and pin out. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional nonvolatile memory programmer.

By combining a versatile 8-bit CPU with in-system programmable Flash on a monolithic chip, the Atmel AT89S52 is a powerful microcontroller which provides a highly-flexible and cost-effective solution to many embedded control applications. The Idle Mode stops the CPU while allowing the RAM, timer/counters, serial port, and interrupt system to continue functioning. The Power-down mode saves the RAM contents but freezes the oscillator, disabling all other chip functions until the next interrupt or hardware reset.

B. Power supply circuit

The main building block of any electronic system is the power supply to provide required power for their operation and is as shown in the Figure 4. For the microcontroller, keyboard, LCD, RTC, GSM, +5V are required & for driving buzzer +12V is required. The power supply [7] provides regulated output of +5V & non-regulated output of +12V. The three terminals IC7805 meets the requirement of +5V regulated. The secondary voltage from the main transformer is rectified by electronic rectifier & filtered by capacitor. This unregulated DC voltage is supplied to the input pin of regulator IC. The IC used are fixed regulator with internal short circuit current limiting & thermal shutdown capability.

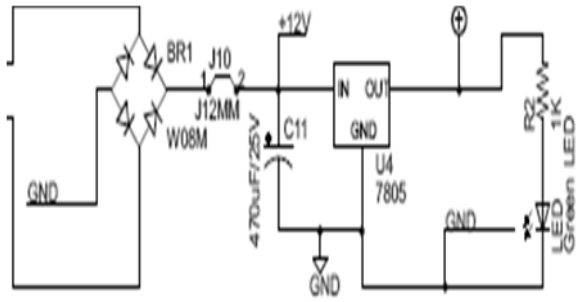


Figure 4: Power Supply Module

C. Decoder HT-12D

The decoders [8] are a series of CMOS LSIs for remote control system applications. They are paired with Holtek 2^{12} series of encoders. For proper operation, a pair of encoder/decoder with the same number of addresses and data format should be chosen.

The decoders receive serial addresses and data from a programmed 2^{12} series of encoders that are transmitted by a carrier using an RF or an IR transmission medium. They compare the serial input data three times continuously with their local addresses. If no error or unmatched codes are found, the input data codes are decoded and then transferred to theoutput pins.

The VT pin also goes high to indicate a valid transmission. The 2^{12} series of decoders are capable of decoding information's that consist of N bits of address and
12_N bits of data. Of this series, the HT12D is arranged to
provide 8 address bits and 4 data bits, and HT12F is used to decode 12 bits of address information

D. Encoder HT-12E

The 2^{12} encoders are a series of CMOS LSIs for remote control system applications. They are capable of encoding information which consists of N address bits and 12_N data bits. Each address/data input can be set to one of the two logic states. The programmed addresses/data are transmitted together with the header bits via an RF or an infrared transmission medium upon receipt of a trigger signal. The capability to select a TE trigger on the HT12E [8] further
enhances the application flexibility of the 2^{12} series of
encoders.

E. DC Motors

For the movement of our robot, we are using DC motors [9]. It is operated by 12V DC power supply. In any electric motor, operation is based on simple electromagnetism. A current carrying conductor generates a magnetic field; when this is then placed in an external magnetic field, it will experience a force proportional to the current in the conductor, and to the strength of the external magnetic field.

F. Motor Driver L293D

The Device is a monolithic integrated high voltage, high current four channel driver designed to accept standard DTL or TTL logic levels and drive inductive loads and switching power transistors. To simplify use as two bridges each pair of channels is equipped with an enable input.

A separate supply input is provided for the logic, allowing operation at a lower voltage and internal clamp diodes are included. This device is suitable for use in switching applications at frequencies up to 5 kHz. The L293D is assembled in a 16 lead plastic package which has 4 center pins connected together and used for heat sinking. The chip is designed to control 2 DC motors. There are 2 Input and 2 output pins for each motor. The behavior of motor for various input is shown in Table 1.

TABLE 1. BEHAVIOR OF MOTORS

Operation	A	B
Stop	Low	Low
Clockwise	Low	High
Anti Clockwise	High	Low
Stop	High	High

G. Transmitter for Laser Gun

The transmitter is constituted by AT90S2323 microcontroller and TLP434 RF transmitter

module at 418MHz. Transmitter is designed for more battery economy and safe transmission of the data.

Block diagram for the transmitter of laser gun is as shown in the Figure 5.

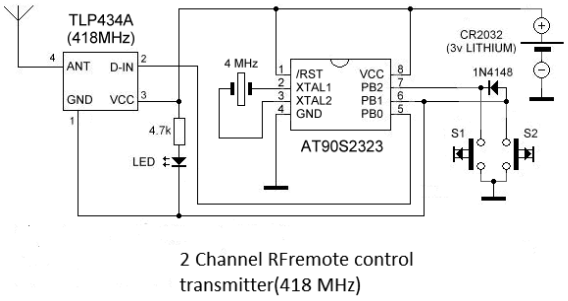


Figure 5: Block Diagram of Transmitter Laser Gun

Here TLP434A is an Ultra-small Trasmitter of range 418MHz with ASK modulation scheme with operating voltage range from 2-12 dc voltage. This IC is usually chained with the encoder IC for example HT12-E. This transmitter is connected to the AT90S2323 10MHz with 2k flash microcontroller. This constitutes a transmitter section of laser gun.

H. Receiver for Laser Gun

The receiver constituted by RF receiver module RLP434A at 418MHz, the microcontroller AT90S2313 [10] and the two relays which can handle any electric (or electronic) device up to 10 Amps (the contacts of my relays are 10Amp at 250Volts). The RLP434A is an RF receiver module with receipt frequency at 418MHz with ASK modulation. There are 2 outputs from this module, the digital, with levels from 0v to VCC (5 volts in our case) and the analog output. Analog output is not used. The transmitter sends 4 bytes with 2400bps 4 times and the receiver RLP-434A collects them and moves them to AT90S2313 to RxD pin, PD0. Block diagram for receiver of the laser gun is depicted in Figure 6.

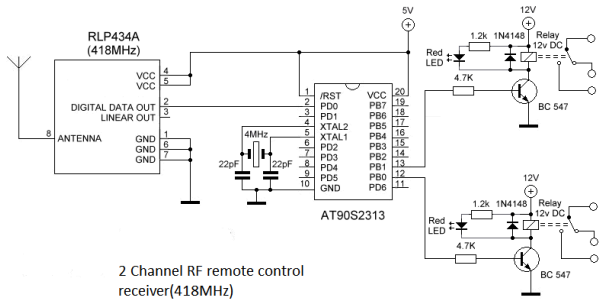


Figure 6: Block Diagram of Receiver Laser Gun

Here RL434A is SAW (surface acoustic wave) based receiver compatible of 418MHz of frequency with operating range from 3.3-6 dc voltage and also it employs ASK modulation. Again as a Tx, here also we have 8-bit microcontroller AT90S2313 with 2k flash memory with 11 pin DIP . All these components will constitute a receiver of laser gun.

I. RF Communication

Radio frequency (RF) is a rate of oscillation in the range of about 3 kHz to 300 GHz, which corresponds to the frequency of radio waves, and the alternating currents which carry radio signals. RF usually refers to electrical rather than mechanical oscillations. The energy in an RF current can radiate off a conductor into space as electromagnetic waves (radio waves); this is the basis of radio technology.

J. JMK AV Receiver with Wireless Camera

It is mini wireless monitoring video camera and wireless receiver set for home and small business surveillance and is used here for demonstration purpose. Simply install the wireless camera in the room where we want to monitor and set the wireless receiver in the next room (up to 15 meters away) and hook it up to a TV or DVR to watch the action or record the footage for the security records.

Here we are placing this wireless camera in the combat robot. Depiction of AV Receiver wireless camera is as shown in Figure 7.

K. TV Capture card

A TV capture card is a computer component that allows television signals to be received by a computer. It is a kind of television tuner. Most TV tuners also function as video capture cards, allowing them to record television programs onto a hard disk. Digital TV tuner card is as shown in the Figure 8.

Figure 7: AV Receiver and Wireless Camera

The card contains a tuner and an analog-to-digital converter along with demodulation and interface logic.

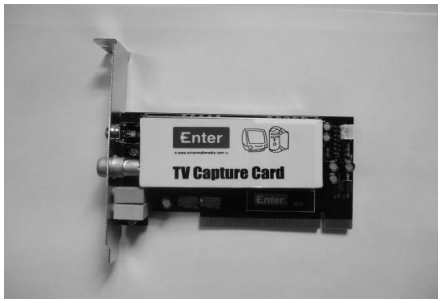


Figure 8: ATI digital TV capture card

L. Remote Controller Decoder SC2272-T4

It can be used for wireless remote control receivers and its features are

- Operating voltage: DC 4~6V.
- Up to 12 tri-state code address pins.
- Up to 6 data pins.
- Toggle control mode.

IV. SOFTWARE IMPLEMENTATION

For the software implementation, we deploy two software packages. First one is the Keil µVision 3.0. second one is the Flash magic simulator. The Keil µVision Debugger accurately simulates on-chip peripherals (I²C, CAN, UART, SPI, Interrupts, I/O Ports, A/D Converter, D/A Converter, and PWM Modules) of 89S52 device.

Simulation helps to understand hardware configurations and avoids time wasted on setup problems. With simulation, we can write and test applications before target hardware is available. The system program written in embedded C [11] using KEIL IDE software will be stored in Microcontroller.

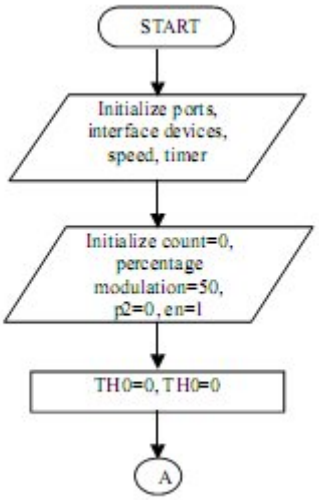
Keil development tools for the Microcontroller Architecture support every level of software developer from the professional applications engineer to the student for learning about embedded software development. The industry-standard Keil C Compilers, Macro Assemblers, Debuggers, Real-time Kernels, Single-board Computers, and Emulators support all 89S52 derivatives. The Keil Development Tools are designed to solve the complex problems facing embedded software developers.

Flash magic is used to dump the code to microcontroller from PC. Flash Magic is a free, powerful, feature-rich Windows application that allows easy programming of Philips FLASH Microcontrollers. Build custom applications for Philips Microcontrollers on the Flash Magic platform! Use it to create custom end-user firmware programming applications, or generate an in-house production line programming tool.

The Flash Memory In-System Programmer is a tool that runs under Windows 95/98/NT4/2K. It allows in-circuit programming of FLASH memories via a serial RS232 link. Computer side software called Flash Magic is executed that accepts the Intel HEX format file generated from compiler Keil to be sent to target microcontroller. It detects the hardware connected to the serial port.

A. Flow charts

The flowcharts depicting the Robot Movement and its Delay are shown in Figure9, 10 and 11.



1) Robot Movement

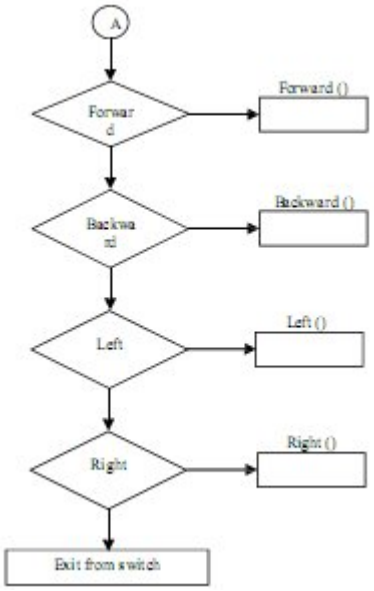


Figure 9: Flowchart For Robot Movement

2) Robot for Particular Movement

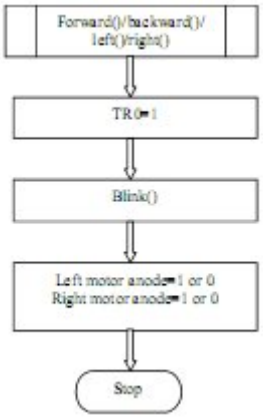


Figure 10: Flowchart For Particular Movement

3) Delay Flowchart

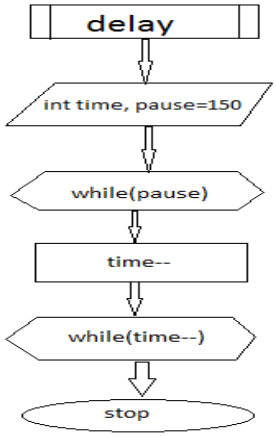


Figure 11: Flowchart For Robot Movement

V. RESULTS AND DISCUSSION

Remote controllers are designed to direct the orientation of robot and to operate the laser gun. Robot keeps on moving in two modes i.e., Manual mode and self-mode. It's brought under user 's control in the case of manual mode. In self-mode, robot starts moving over surface and takes action according to the scenario. To detect the obstacles, we have deployed Infrared sensors (left sensor and right sensor) in the front portion of the module. While moving on the surface, if the left sensor is detected, robot takes back the position for a moment and moves right. If the right sensor is detected, robot gets back and moves left. The front view and top view of designed combat robots are shown in the figures 12 &13.

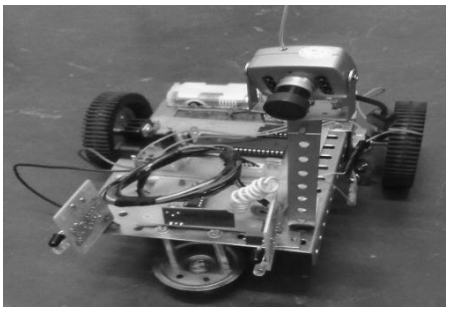


Figure 12: Front view of designed combat robot

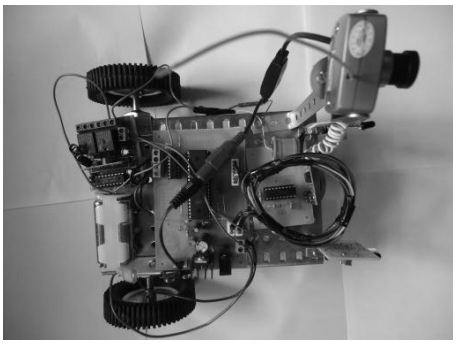


Figure 13: Top view of designed combat robot

VI. APPLICATIONS

- Can be adequately implemented in national defense through military-industrial partnership. It is shown in the figure 14.

Figure 14: Top view of combat robot

- Can be vastly applied in Resorts, borders of noted buildings. It is shown in the figure 15.

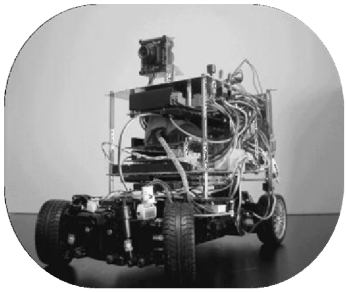


Figure 15: Top view of combat robot

- Installation of combat robots in the stadiums, sacred places, government and non government organizations assures top security.

VII. CONCLUSION

As we all know, these days India is sick off massive terror attacks, bomb explosions at plush resorts. To avoid such disasters TECHNOLOGICAL power must exceed HUMAN power. Human life and time are priceless.

It's our onus to take an initiative to design a model of an apt robot that meets combatant needs. So to avoid terror attacks, to ensure more security at the border and high density areas it's wise to maintain a world class military technology in accordance with combatant needs.

Even every nation needs its own defense system for their integrity and security. In such a way construction of these robots will carry nation's name, fame globally.

REFERENCES

[1] Pete Miles & Tom Carroll, Build Your Own Combat Robot, (2002).

[2] K.S.Fu, R.C.Gonzalez, C.S.G..Lee, Tutorials Robotics.

[3] Asaro,P. How just could a robot war be?, Frontiers in Artificial Intelligence and Applications, 75, 50-64.

[4] S. Y. Harmon & D. W. Gage, "Current Technical Research Issues of Autonomous Robots Employed In Combat", 17th Annual Electronics and Aerospace Confere

[5] www.Atmel.com

[6] Atmel data sheets http://www.keil.com/dd/docs/datashts/atmel/at89s52ds.pdf

[7] Robert L.Boylestad and Louis Nashelsky, "Electronic Devices and Circuit Theory", 8th Edition, 2006

[8] Decoder HT-12D, Encoder12E http://robokits.co.in/shop/index.php?main_page=produc t_info& cPath=14_15&products_id=76>

[9] A. Khamis, M. Pérez Vernet, K. Schilling, "A Remote Experiment On Motor Control Of Mobile Robots", 10thMediterranean Conference on Control and Automation – MED2002.

[10]Receiver for Laser Gun www.alldatasheet.com/datasheet-pdf/pdf/169605/.../RLP434A.htm

AET - 0019

Wireless Patient Monitoring System Using IEEE 802.15.4

Mukulika A. Badge Hardas
Electronics and Telecommunication Vidyalankar Institute of Technology Wadala East, Mumbai, 400037
mlikabdg@gmail.com

Abstract

This paper presents the development of a system for wireless Patient monitoring using ZigBee. The system is intended for home use by patients that are periodically monitored by clinicians and family. Patient monitoring provides clinicians the much needed information about patient's current health status for further treatment.

Nowadays, complex patient monitoring systems offer the possibility of continuously monitoring a multitude of biological signals, analyze them, interpret them and take the appropriate action; or alert clinicians if necessary [1].

A patient would need to be sitting on a bed wired to the devices in order for his vital signs to be monitored. This system measures, records and presents in real-time the electrical activity of the heart while preserving comfort of the patient. The device is built as a low-power, small-sized, low-cost solution suitable for monitoring patient without interfering with the daily activity of a patient. The intention is not to achieve perfect clinical accuracy but the device is able to detect anomalies in the measured data and it also has alerting features. Authorized observers (clinicians or family) can monitor at any moment the state of the patient through the internet.

So this flexible medical service system can enable user get quick and timely medical care unprecedentedly. The application of technical can enable the guardian having more free space, and get effective medical diagnosis at home or office.

Keywords- ZigBee technology; medical monitoring; embedded; ARM; analog-to-digital conversion

I. INTRODUCTION

Currently, because of sudden disease but lose the case of precious life to present to year by year up of trend. Modern medical science also faces new challenge and opportunity and is a hot issue that the modern medical science develops-the movement medical treatment be also more and more valued by people.

This paper presents a system to be used for continuous or periodical remote ECG monitoring of a home alone patient in a stable clinical condition without needing on-the-site medical assistance. This system can measure, record and present in real-time the electrical activity of a patient's heart without the presence of medical staff and while preserving the patient's comfort.

The system is the physiology that is a kind of vs the sufferers or bio-chemical parameter progress continuous, long time, auto, real time monitor, logarithm according to analysis transaction behind carry out many categories to automatically report to the police, the assemble of some medical science instruments of automatic record is the outcome that the electronics, calculator technique, telecommunication technique and living creature examination technique and modern medical science related technique .

The system is divided into two parts: the data acquisition unit and the central unit. The data acquisition unit is a mobile hardware device attached to the patient whose purpose is to collect the ECG signal from the patient and send it to the central unit wirelessly. The central unit consists of a hardware device attached to a PC and a software program running on that PC. The central unit is responsible with gathering the raw ECG data from the data acquisition unit, process analyze and store it, and make it available for viewing over the internet.

Fig.1 presents a graphical overview of the system.

A. The Data Acquisition Unit

The ECG signal is converted into an electrical form using Ag/AgCl electrodes, attached to the patient. This electrical signal is then processed by the analog front-end, presented in Fig. 2, and adapted to a form suitable to be digitized. At this point the signal is converted into a digital form and sent to the central unit. This is achieved using a PIC18 family microcontroller. The major factor taken into consideration when designing the ECG acquisition system is the nature of the ECG signals itself. The useful bandwidth is described as ranging from 0.5 Hz to 35 Hz for monitoring applications and between 0.05 Hz and 150 Hz for diagnosis applications. The ECG signal is extremely weak (up to 2 mV) combined with a variable electrode-skin contact potential in the order of a few hundred mill volts (cause of baseline wander), and a common-mode DC component of up to 1 V. On top of this the signal contains noise from power line interference, muscle movement and respiration.

Because this system is targeted at monitoring rather than clinical analysis of the ECG, the 0.5–35 Hz useful bandwidth was considered.

For such monitoring systems a single lead monitoring is sufficient.

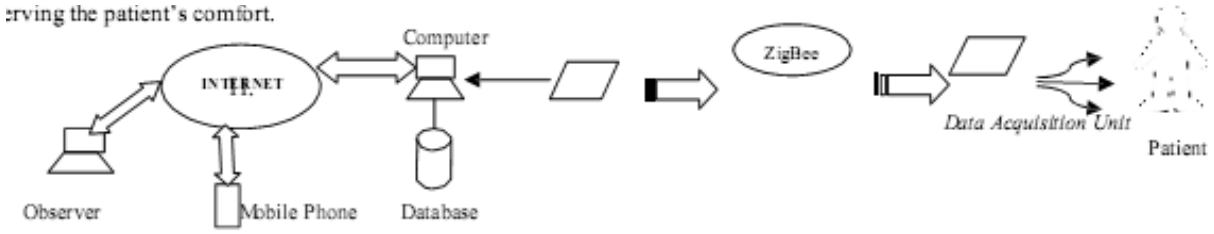


Fig.1. the overview of the monitoring system

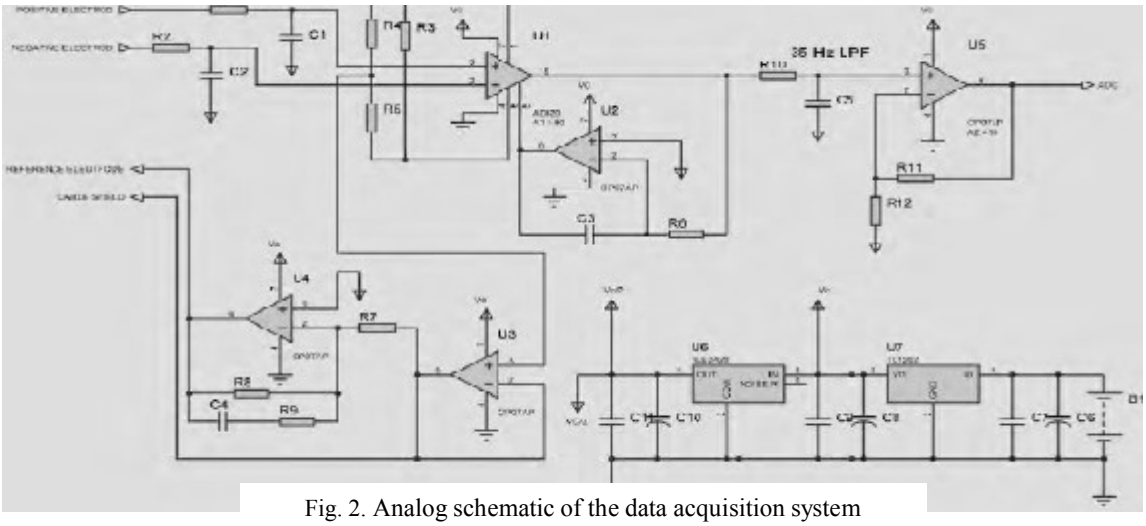


Fig. 2. Analog schematic of the data acquisition system

B. Communication between End Device and the Coordinator

1. ZigBee Introduction

Low power and low complexity were the major factors taken into account when choosing the communication protocol between the data acquisition and the central unit. The device is functioning indoors, so needs a fairly good transmission range (30 m) and without needing of an existing optical path between transceivers, which Bluetooth cannot handle and Wi-Fi would be very resource hungry. Therefore ZigBee was chosen from other technologies.

ZigBee is a set of specifications on top of the IEEE 802.15.4 standard for Low-Rate Wireless Personal Area Networks (LR-WPANs) and was designed to meet the needs of sensor and control devices. Monitoring sensors need to function within a network offering complex topologies, a large number of devices, security and reliability, rather working on high bandwidth. There are a lot of proprietary systems created to meet these requirements but their obvious problem is lack of interoperability [2]. An industry group, the *ZigBee Alliance*, was created to develop standardized applications on top of the 802.15.4 standard. The group is working closely with the *IEEE* to ensure interoperable network for the market.

The 802.15.4 Specification may be used for development of a product for sale only with a membership of the *ZigBee Alliance*. The ZigBee architecture stack is formed of layers.

Each layer provides services to the layer above. The 802.15.4 standard defines the physical (PHY) layer and the media access control (MAC) sub-layer. ZigBee builds on this foundation adding the network layer (NWK) and the application layer framework which consists in the application support sub-layer (APS) and the ZigBee device objects (ZDO). The ZigBee physical layer can operate on three frequency ranges: 869 MHz, 915 MHz, and 2.4 GHz with a bandwidth of 20 kbps, 40 kbps, and 250 kbps, respectively. There are three different types of ZigBee devices**.**

ZigBee coordinator (ZC) is the most capable device, the coordinator forms the root of the network tree and might bridge to other networks. There is exactly one ZigBee coordinator in each network since it is the device that started the network originally. It is able to store information about the network, including acting as the Trust Centre and repository for security keys. ZigBee Router (ZR) can act as an intermediate router, passing data from other devices.

ZigBee End Device (ZED) contains just enough functionality to talk to the parent node (either the coordinator or a router); it cannot relay data from other

devices. This relationship allows the node to be asleep a significant amount of the time thereby giving long battery life. A ZED requires the least amount of memory, and therefore can be less expensive to manufacture than a ZR or ZC.

2. The Central Unit – Coordinator

The Hardware part of the Central unit is responsible with properly gathering the ECG data from the acquisition unit and to send it to the PC software for further processing. This device is built around the PIC18 family microcontroller. It uses a ZigBee transceiver and acts as a ZigBee network coordinator, and together with the end device, it forms a star topology ZigBee network. The communication with the PC is achieved using EIA-232 via the PIC's eUSART and the PC's COM port.

At the beginning the coordinator forms the network and waits for the end devices to join. Because the devices use ZigBee to communicate, the end device can leave and join the network at any time without needing human interaction to reconnect. The end device continuously buffers ECG data in its internal memory, and once every 1.2 seconds sends this data to the coordinator. While de end device is gathering data, the ZigBee transceiver is held in idle mode. The transceiver is woken up just before transmission takes place, and set back in idle mode once the ECG data is sent. This way the transceiver has a lower duty cycle, saving battery power and the ECG data is sent in a acceptable real-time fashion as it is updated once every 1.2 seconds. Once the ECG data reaches the coordinator it is immediately sent to the PC. Here, the Software Processing unit gathers the raw data chunk, and places it in a larger memory buffer in order for it to be properly analyzed and displayed, and also writes it in a database for persistent storage.

3. THE SOFTWARE PROCESSING AND PRESENTING UNIT

The ECG data can be viewed through a secured web application which uses a local web service that communicates with the ZigBee coordinator device. The user can monitor the ECG remotely, save or print data and also set up network configurations, change state of the network end devices. Alarms are sent to the preset users in the system. They can be medical staff, medical centre or family members.

II. D E T A I L S OF IMPLEMENTATION

A. Data Acquisition Unit

This unit was implemented around the instrumentation amplifier AD620 because of its high common mode rejection (> 100 dB), low input bias current (max. 1 nA) and low power consumption (average source current of 1.8 mA).

Because this is a mobile application and thus battery powered, all components need to run at a low voltage. The system can be used with four AAA 1.5 V batteries as a power source. The digital part, the PIC microcontroller runs at 5 V. This voltage is supplied by the TC 1262 LDO voltage regulator. Thus we need to adapt the ±2 mV ECG signal to fit the 0–5 V range. So a total gain of 800 is idle.

As the signal is bipolar we need to process it using a reference voltage in the middle of the 0–5 V range. In order to do this we used the TLE2426 rail splitter to supply a +2.5V potential as a virtual ground reference. When powered at ±2.5 V, the AD620 has a swing of –1.4 V to +1.3 V so a gain of 800 would cause saturation. As a consequence, a gain of 50 was chosen for the first stage.

A Driven-Right-Leg Circuit was also used to minimize common mode interference, and an integrator placed at the reference of the AD620 eliminates any baseline wander by integrating the DC content of the amplified raw ECG signal and sending it back to the reference pin of the AD620.

All that is left at the second stage is to filter out unwanted frequencies and to amplify the signal to reach a total gain of 800. This is achieved using an antialiasing 1 pole low pass filter with a cutoff frequency of 35 Hz, and a non-inverting amplifier with a gain of 16.

The ECG signal is now ready to be digitized. This takes place using the A/D converter of the endpoint microcontroller.

Because our highest useful frequency is 35 Hz, a sampling rate of 100 Hz would be, in theory, sufficient; however a frequency of 200samples/sec is used in practice for more accurate results. The quantization resolution used is 10 bits (the maximum resolution for the PIC18 ADC).

B. Communication Between End Device and Coordinator

Both the end device and coordinator device were implemented using the Microchip PIC18LF4620 microcontroller along with the Microchip MRF24J40 RF transceiver for radio communication. The transceiver is operating in the 2.4 GHz band and uses the SPI data link to communicate with the MCU. The microcontroller of the end device uses the built-in 10-bit A/D convertor to sample the ECG signal.

The communication is based on the Microchip ZigBee- 2006 Residential Stack Protocol. The Microchip Stack is written in C and is designed to run on the PIC microcontrollers [4]. The communication software is written in C using the Microchip's MPLAB Integrated Development Environment and compiled using the MPLAB C18 C compiler. The software uses the SPI interrupts and ZigBee protocol primitives to transfer data between devices. The coordinator keeps an application endpoint for ECG data to receive from the end device. The end device keeps a state endpoint which the coordinator can activate to receive ECG data. The coordinator can trigger an alarm also if the connection is lost.

When functioning in monitoring mode, the end device collects ECG data and sends it to the coordinator without any processing. The maximum payload for each network packet is 101 bytes and the endpoint application is handling the segmentation since the ZigBee protocol stack doesn't offer segmentation.

The typical throughput for transmitting ZigBee APS messages is around 53 kbps [5], and we are gathering 200 samples of 10 bits every second. Since the maximum payload of an APS message without

security is 101 bytes, we can only fit 80 10-bits samples into one message. This means that we can send 0.4 seconds of ECG data with every message. Our implementation will send three messages in one duty cycle; this is equivalent to 1.2 seconds of recorded ECG data. Keeping in mind the 53 kbps average throughput, we can estimate the total transmission time for 1.2 seconds of recorded data is approximately 45 ms, thus a 3.75% duty cycle.

C. Presentation and User Interaction

Communication between the coordinator and the PC is serial sing the EIA-232 protocol. When the coordinator receives a chunk of ECG data it re-sends it via it's eUSART to the PC.

The software is divided into two modules:

a server side component and a client component.

The server is built as a Microsoft WCF service hosted inside a indows service. It is responsible with opening a COM port and continuously listening for incoming data from the coordinator.

When data is received it is time stamped and written to a Microsoft SQL database for persistent storage and also kept in a memory inside a buffer, so that it can be available in real time.

The server is also responsible for the processing of the raw ECG using beat detection and beat classification algorithms. It does this by using a Microsoft .NET wrapper around E.P. Limited's Open Source ECG Analysis library [6].

The WCF service exposes a SOAP endpoint as an interface for web communication. The client is implemented as a Microsoft Silverlight 4 application. It provides the only interface between the user and the system.

This application connects to the WCF service and provides the user with the next functionality:

- Viewing the patient's ECG data in real time;
- Viewing the patient's heart beat;
- Viewing the beat type (either premature ventricular contraction, normal or unknown);
- Viewing some of the standard ECG parameters (RR length, QRSwidth, R amplitude);
- Defining alarms based on heart beat, QRS width, arrhythmias.

One of the most important parts of the processing unit is heart beat detection and heart beat classification for alarming purposes. The QRS-complex is detected using filters and estimating a peak threshold as described in [7]: low pass filter, high pass filter and derivative are combined to create a band pass filter between 5 and 11Hz, a bandwidth which holds most of QRS-complexes; after that a peak threshold algorithm is used which determines QRS complexes from noise [7]. Two consecutive detected beats are compared to detect arrhythmias. Beats can also be classified using an open classification algorithm described in [7].

An alarm list can be created which contains e-mail addresses and phone numbers which will be notified when an alarm has been triggered.

CONCLUSIONS

ZigBee proves to be a suitable technology for developing wireless medical systems due to the low complexity, low power and sufficient data rate; it is an excellent choice for monitoring systems. Also because of practicality and flexibility and extendibility, realize the data transmission in the monitor terminal system and the remote server (hospital data center) of computer net, at the same time the data transmission have been completed in the sensor nodes and monitor system.

The possibility for private and public application standardization offer high interoperability within systems and system components, therefore providing a nice environment to develop this kind of applications. The application of technical can enable the guardian having more free space, and get effective medical diagnosis at home or office.

IV.FUTURE IMPROVEMENTS

The most important future improvement of this system would be extending it to a multi parameter monitoring by adding sensors for other biological signals. The end device available resources allow additional sensors like body temperature sensor, blood pressure sensor, oxymeter or accelerometer to behave as a fall sensor.

The end device could be enhanced to use three leads instead of a single lead. Also, using a single end device leaves us with a lot of bandwidth therefore more end devices could be added in the network in order to increase the number of patients undergoing ECG monitoring. Increasing the number of patients expands the target of this application. With the possibility of extending the network topology and coverage by adding routers and more end devices, the application would suit the needs of a medical/elderly care institution that has to monitor biological signals and whereabouts of the patients within the building or even outdoors.

The ZigBee Alliance is creating open application profiles designated to work within a certain industry [8]. This system can be integrated within the ZigBee Health Care profile in order to achieve interoperability with other medical systems.

REFRENCES

[1] * * *, "ZigBee Wireless Sensor Applications for Health, Wellness and Fitness." ZigBee Alliance, 2009.

[2] P. Kinney, "ZigBee Technology: Wireless Control that Simply Works", *ZigBee Communications Design Conference*, October 2003. [3] M. Galaev, "Home Networking with ZigBee", www.eetimes.com. [4] Microhip PIC18LF4620 Datasheet.

[5] T. Ryan Burchfield and S. Venkatesan, "Maximizing Throughput in ZigBee Wireless Networks through Analysis, Simulations and Implementations".

[6] http://www.eplimited.com/

[7] P. Hamilton, "Open Source ECG Analysis Documentation", E.P. Limited, 2002.

[8] http://www.zigbee.org/Standards/Overview.aspx.

AET - 0020

PJPEG-Progressive JPEG

Amey Gawde,Nandesh Chiplunkar,Geetha Narayanan
amgawde@gmail.com,nandu_05ap@yahoo.co.in
Vidyalankar Institue Of Technology
Wadala,Mumbai-400037
Mumbai University

Abstract

Among the different modes of operation allowed in the current JPEG standard, the sequential and progressive modes are the most widely used. While the sequential JPEG mode yields essentially the same level of compression performance of progressive JPEG depends highly upon the designed encoder structure. This is due the flexibility the standard leaves open in designing progressive JPEG encoders. In this case of PJEG a rate-distortion optimized JPEG compliant progressive encoder is used that produces a sequence of bit scans, ordered in terms of decreasing importance. Here an encoder is used that outperforms a baseline sequential JPEG encoder in terms of compression, significantly medium bit rates, and substantially at low and high bit rates. Moreover, unlike baseline JPEG encoders, this can achieve precise rate/distortion control. Good rate-distortion performance at low bit rates and precise rate control are two highly desired features currently sought for JPEG-2000.

1. INTRODUCTION

Images usually contain so much data that they need to be compressed prior to storage or transmission. JPEG (Joint Photographic Experts Group) is the current standard for compression and decompression of still, continuous tone, monochrome and color images JPEG has four distinct modes of operation: sequential DCT based, progressive DCT-based, lossless, and hierarchical[1].

What is PJPEG?

Progressive image transmission using the progressive JPEG(PJPEG) mode is suitable for interactive image communication applications over bandwidth constrained channels.The least information necessary to represent an image is transmitted with as few bits as possible. Based on the receiver's request, the image is progressively reconstructed in several stages until the desired quality is achieved. While the sequential mode provides partial information of the full image, in the PJPEG mode of operation, one can see a rough approximation of the image after the scan has been decoded, and the image reproduction quality is then gradually improved as more scans are decoded. The PJPEG mode of operation is preferred in many applications [2].

In this paper a new PJPEG complaint encoding algorithm is presented which is rate distortion optimized. The proposed algorithm produces an order sequence of scans that can be used to progressively encode/decode an image, achieving precise rate /distortion control and yielding relatively good compression performance at all bit rates, including the very low bit rate.

2. PJPEG

In the progressive JPEG (PJPEG) mode, each scan in the DCT transformed image corresponds to a few bits of one or more coefficients, and therefore represents a portion of the image being encoded/decoded. The DCT coefficients, each of which contributing differently to improving the image quality, can be divided into many groups or decomposed into bits as specified in the PJPEG mode, such that the reconstructed image quality increases as more group of bits of the DCT coefficients are received and decoded. Two different modes are defined in PJPEG, spectral selection (SS) and successive approximation (SA).These two modes can be independently or combined to provide full progression. In spectral selection, the DCT coefficients in each 8×8 blocks are segmented into frequency bands of variable lengths. Each frequency band is the encoded in one scan. In successive approximation, the precision of DCT coefficients of the 8×8 blocks is reduced by dividing them by a power of two(or shifting right their binary representations) before encoding such coefficients. The received DCT coefficients are decoded and multiplied

by the same power of two(or shifting left their binary representations) before the IDCT operation. The precision of the DCT coefficients is increased by one bit in each of the subsequent scans[3,4].

PJPEG imposes a few constraints n the progressive encoder's structure. The PJPEG design algorithm is as follows;

- The first scan to be encoded/decoded must contain only DC information
- The DC and AC coefficients cannot be encoded into the same scan.
- The coefficient numbers in the same spectral band must be consecutive, i e., their locations can be described by just two points:1)start of band and 2)end of band
- Only the first scan of any DCT coefficient can contain more than one bit, and the subsequent scans must represent only one precision bit at a time.
- Encoding/decoding of a bit of a coefficient requires that the proceeding bits of that coefficient be encoded/decoded in advance.

2.1 JPEG coding algorithm:

The ordering of 64 DCT coefficients in an 8×8 block according to subjective importance is a very difficult task. Moreover, the bit rate usually supported by typical low bandwidth channels is generally so low that only the first few more significant bits of a DCT coefficient can be encoded and transmitted. To remove these problems, all the bits of the 64 DCT coefficients in an 8×8 block are here assigned importance levels that involve the size (i.e., bit rate) of the resulting scan and the scan's contribution to reducing the reconstruction distortion, expressed in terms of the sum of squared errors. More specifically, each bit in a DCT coefficient is assigned a rate-distortion ratio, with numerator the reduction in reconstruction distortion, and denominator the scan's size in bits or bytes. The resulting value is then used to associate with each bit a priority level. Taking into account the general PJPEG encoder structure, the prioritized bits are then grouped subject to the specific PJPEG constraints, achieving high compression efficiency and low computational requirements.

2.1.1 Prioritization of bits:

Assuming 8-bit input precision, each DCT coefficient will have 11-bit precision, 10 bits for magnitude and 1 bit for sign. Excluding the sign bit, an 8×8 DCT coefficient block can be considered as a parallelepiped which contains 8×8×10 or 640 bits. An image consists of a number of these parallelepipeds, whose bits should be encoded. The decoder assumes 8×8×10 parallelepipeds of all "0"s and the "0"s are replaced by the actual values of the bits as they are decoded. Therefore, to quantify the effect of each bit o the quality of the decoded image, the distortion associated with each bit being considered "0" is calculated. When the value of the bit is "0",its associated distortion will be equal to zero regardless of its position, as the decoder has already assumed all the bits to have a "0" value, and decoding a "0" bit will not reduce the reconstruction distortion. In the PJPEG coding mode, each bit of the parallelepiped should be transmitted along with the bits at the same position of all the parallelepipeds in an image. Thus, the overall distortion reduction value should be equal to the sum of the distortion reduction values associated with the bits at the same position in all the parallelepipeds in the image, that is, the overall distortion reduction ΔD,associated with the ith bit is equal to

$$\Delta D_i = \sum_{j=0}^{N} (b_{i,j} 2^{P_r})^2$$

Where i = 1, 2… 640. N is the number of 8 x 8 blocks in the input images, $b_{i,j}$ is the value of the i^{th} bit of the j^{th} parallelepiped and Pr, is the position of the i^{th} bit. Encoding of bits at different locations in the parallelepipeds also results in different scan sizes or bit rates. Thus, a rate distortion and bit rate values, and an appropriate importance measure I_r is then given by,

$$I_r = \frac{\Delta D_i}{\Delta R_t}$$

Where the above variables are the priority value, distortion reduction and scan size (or bit rate increase) associated with the ith bit, respectively. In this manner, those bits that contribute the most distortion reduction while requiring the least number of bits (smallest scan size) are assigned the highest priority values. Based on the priority value defined in the above equation, all the 640 bits in a 8×8 block can be sorted in terms of decreasing order of priority values. Unfortunately, however, the order obtained above cannot be used as is if PJPEG compliance is to be maintained .PJPEG requires that, for a specific bit of a DCT coefficient to be encoded/decoded, all the more significant (in terms of bit position in the binary representation) bits of the subject coefficient be encoded/decoded first. The order of the bits obtained above seldom satisfies this constraint. To devise a coding method which is PJPEG compliant, both the priority values and the above PJPEG syntax constraint should be considered. The priority values associated with the first few bits are very large, as compared to those of the other bits. Such a feature is well suited for low-bandwidth channels, such as those used in wireless applications. By transmitting the bits according to the proposed prioritization method, acceptable reproduction quality is quickly obtained after receiving the first 1-4 bits.

2.1.2 Grouping of Bits:

Encoding the bit planes according to the priority vales of their corresponding bits and the above PJPEG constraint is still not "optimal", as such method does not take into account the PJPEG header and encoding structures. In PJPEG, a header is assigned to each scan, carrying information such as the number of image components and bits in the scan. If each scan contains one single bit plane, the additional header information would be excessive, offsetting most of the compression gain that would have been obtained using such a method. Moreover, encoding/decoding 640 bit planes is not necessarily the most compression efficient method in light of the specific coding methods allowed by PJPEG. Fortunately, PJPEG allows a group of consecutive most significant bits of a coefficient and/or bits at the same position of consecutive co-efficient to be encoded in a single scan.

To determine which bits should be grouped together, we begin by grouping only consecutive bits in the same DC or AC coefficient. First, it is better (in terms f compression efficiency) t combine all the bits of the DC coefficient into one scan. This is partly because 1) the first group of bits is encoded as in baseline JPEG, and 2) all subsequent scans must represent only one bit, which is sent as in for each 8 x 8 block. Another reason is that only a single header is needed when one scan represents all the bits of the DC coefficients. The PSNR increases (for the same bit rate) as more and more bits are grouped, but the rate of increase levels off after grouping 2 – 3 bits. Naturally there is a trade-off between compression and progressiveness, and we therefore select the best balance between the two parameters.

Determining the "best" grouping method for the DC bits is rather simple since there are only 10 possible different cases. Moreover, the same method can be applied independently to the AC coefficients in a straightforward way. However, combining successive approximation with spectral selection, grouping DCT bits can then be performed in two directions, going from most to least significant bits and in the zig-zag direction from the first AC coefficient to the highest frequency AC coefficient. Obviously, the number of possible groupings is very large. In this work, the following method for grouping of the bits is used. First, the number of the most significant bits of each AC coefficient that should be grouped together is determined using the above described method. Whenever the groups containing the most significant bits of consecutive AC coefficients have the same number of bits, the bits of the coefficients are combined to form spectral bands. The rest of the bits of the coefficients which should be sent one bit precision at a time are grouped into spectral bands to the extent PJPEG allows. When two or more bits are grouped, their distortions are added. Using the rate of the grouped bits the priority value representing each spectral band is recalculated. Each group is then encoded into scan, and all the scans are transmitted according to their priority values in several stages. Finally the overall PJPEG transmission algorithm is as follows:

- Calculate the priority values of all the bits of all the DCT coefficients.
- Obtain the best grouping pattern, i.e., the number of the most significant bits combined to form the first group for each coefficient.
- Combine the bits or group of bits as suggested above to form spectral bands.
- Recalculate priority values as required for each scan.
- Order and transmit all the scans according to their priority values in stages.

2.1.3 Rate Control:

Rate control is the ability of coding an image up to a specified rate[6].The main goal here is to seek the best possible image reproduction quality given the user-specified bit rate. Encoders that are baseline JPEG compliant cannot achieve automatic rate control, limiting their usefulness in many important applications. Rate control has thus become a key desired feature of the emerging JPEG-2000 standard.

Despite the various syntax constraints of PJPEG, precise rate control can still be achieved. The PJPEG compliant encoder to maintain high reproduction quality subject to the constraint of a fixed bit rate is as follows:

- The bits of the DCT coefficients are ordered according to their priority values and the PJPEG syntax constraints
- If the scan been coded is the first DC scan or one of the first AC scans, and the size in bits of the encoded image is approaching the desired maximum number of bits, the encoding is interrupted and zeros are assigned to the rest of the bits needed for the subject scan.

PJPEG has very efficient method of encoding a sequence of zeros by using an EOB (End of Band) marker. Provision is available for accommodating the code bits representing the zeros and the required markers, such that the output bit rate never exceeds the desired one. In the later scans of the DC value, the bits are encoded as in[1], and it is thus wasteful to assign zeros, as the bit rate would not be affected. Thus, if the total number of bits required to represent the scan would result in a bit rate that exceeds the desired one, the rate control routine in the encoding process moves to the next first AC scan to satisfy the required rate.

2.2 JPEG 2000

Among the new features provided by JPEG 2000 is the process of transcoding. Transcoding is a process that modifies a JPEG 2000 code stream without decoding

and re-encoding the image. In this process, a JPEG 2000 encoded image can be directly transcoded to an image of lower resolution, quality layer, color component or spatial region without the need to decode and re-encode the whole JPEG 2000 image. Also a received JPEG 2000 image can be transcoded by simply discarding higher order resolutions or quality layers and constructing the image at a lower resolution or at a lower quality. For example, reducing the resolution simply requires extracting a subset of resolution levels. Likewise, reducing the bit rate simply requires extracting a subset of quality layers; the transcoding process is shown in Fig.2.2.1. A detailed study of JPEG 2000 standards is presented in [7].

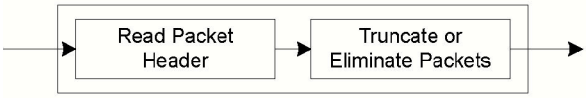


Fig. 2.2.1 Transcoding or down streaming a JPEG 2000 image performed by a Network Transcoder is a very simple operation that only requires truncating or eliminating packets.

Image security is becoming an important demand, mean- while the inherent flexibility of JPEG 2000 has to be preserved. It is highly desirable after generating and securing a JPEG 2000 codestream to allow untrusted transcoders at intermediate network nodes to perform downstreaming of the JPEG 2000 code stream discarding resolutions, quality layers or spatial regions, to match the diverse receivers' capabilities, as shown in Fig. 2.2.2.

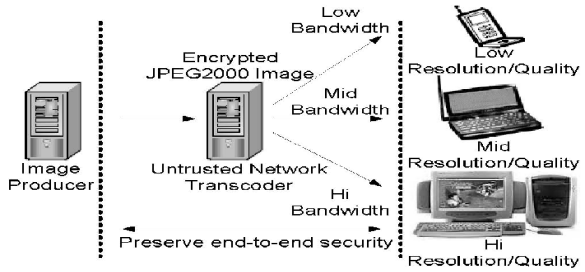


Fig. 2.2.2 Transcoding to match diverse receives' capabilities while preserving end-to-end security. The JPEG 2000 image should be encrypted at the producer side and decrypted only at the receiver side.

This must be done without decrypting the image at intermediate network transcoders and without access to security keys and thus preserving end to end security. It is also important to be able to control the level of access granted to an image viewer, for example, two users receiving the same JPEG 2000 encrypted codestream, one user should be able to decrypt and view the full resolution or quality of the image and the other should be able only to decrypt and view a lower resolution or quality, depending on the decryption key given.

2.2.1 JPSEC:

JPSEC is a very flexible and open framework, it provides a wide range of predefined security service tools in what is called JPSEC normative tools that uses predefined Template protection tools to implement security functions, in the same time, JPSEC also provides an extensible open framework for JPSEC non-normative tools that contain future tools that can be privately developed and defined by the user or registered through a Registration Authority (RA).

JPSEC introduced two new marker segments in the JPEG 2000 code stream to signal security syntax. The SEC marker presented in the Main Header, and an optional INSEC marker that can be inserted anywhere in the bit stream to provide additional or alternative security signaling.

The SEC marker segment supports specifying multiple security tools as well as the Zone of Influence ZOI which the data associated with each protection tool. The INSEC marker segment present in the bit stream itself can be used to give additional or alternative parameter for one of the security tools. The INSEC marker must reference one tool by using its instance index specified in the SEC marker.

The Processing Domain (PD) is used to indicate at which domain the protection method is used. There are four possible domains: Pixel domain, Wavelet coefficient domain, Quantized wavelet coefficient domain, and Codestream domain.

The Granularity Level (GL) is also used to indicate the unit of protection for each protection method. The granularity syntax may define if the unit of protection is a tile, tile-part, component, resolution level, layer, precinct, packet, sub-band, code-block, or a zone identified in ZOI and for each unit whether the header part is protected or not protected.

The Processing Order (PO) defines the processing order used when applying the protection tool to the codestream, there are five processing orders supported: Tile Resolution Layer Component Precinct, Tile Component Precinct Resolution Layer, Tile Layer Resolution Component Precinct, Tile Precinct Component Resolution Layer, and Tile Resolution Precinct Component Layer.

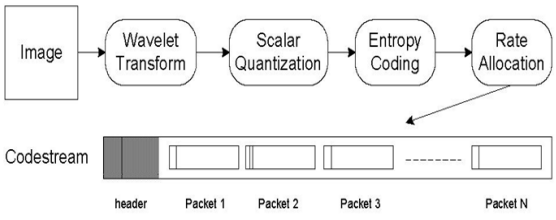


Fig. 2.2.1.1 A JPEG 200 part 1 encoder algorithm typically accomplishes four operations: Wavelet Transform, embedded scalar quantization, entropy coding and code stream building (i.e. rate allocation)

2.2.2 Access Control Methods:

Our proposed methods are applied directly to JPEG 2000 code stream bearing in mind any possible operation such as transcoding (parsing or scaling), especially accessing a JPEG 2000 encoded image at a lower resolution or at a lower quality level, so the PD is set to the Code stream domain. In all our proposed design approaches we will use the Stream cipher template of the Decryption template specified in the JPSEC standard. The applied access control method will be signaled in the SEC marker in the main header marker segment using standard JPSEC signaling.

2.2.2.1 Packet-Based Access Control:

In this approach, GL is set to a single packet. Each individual JPEG 2000 packet is fed to the encryption algorithm and the encrypted data is stored in place of the packet body. Only the packet body is encrypted and the packet header is left unencrypted. The encryption procedure is shown in Fig. 2.2.2.1.1.

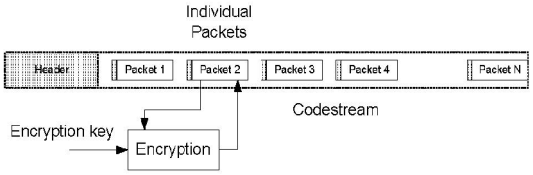


Fig. 2.2.2.1.1 The encryption procedure for Packet-Based Access Control

2.2.2.2 Resolution-Based and Quality-Based Access Control:

This approach considers two special cases when the JPEG 2000 image is ordered in RLCP or RPCL, progression, which is called resolution progression, or when ordered in the LRCP progression, which is called quality progression. For the resolution progression case, each resolution level is represented in the code stream by a contiguous data segment as shown in Fig.2.2.2.2.1, and scaling is carried out by discarding whole resolutions. Thus GL is set to entire resolution level and each entire resolution is fed to the encryption algorithm and the encrypted data is stored in place. Data from each individual resolution level is encrypted using a different encryption key, but those keys are dependent of each other using a hash function. The 256 bits of the encryption key for the highest resolution level is selected arbitrarily, the encryption key for the next lower resolution is the result of hashing the encryption key of the higher resolution level as shown in Fig.2.2.2.2.2. Four different test images with different sizes and color components as, shown in Fig.2.2.2.2.3, were encrypted, transcoded and then the transcoded code streams were successfully decrypted.

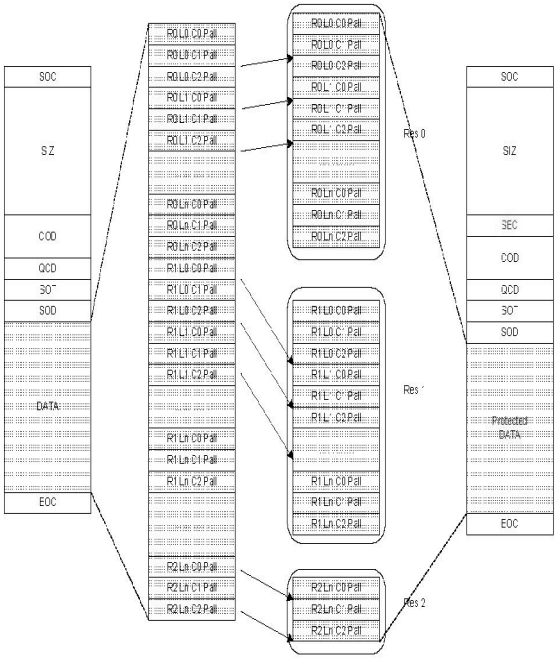


Fig.2.2.2.2.1. The codestream for a JPEG 2000 encoded image having RLCP progression. Resolution levels form contagious blocks of data in the codestream.

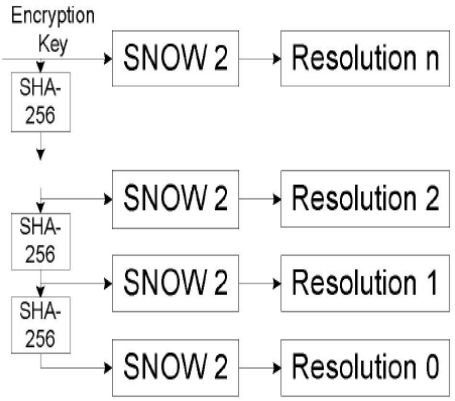


Fig. 2.2.2.2.2. The process of producing encryption keys for individual resolution levels.

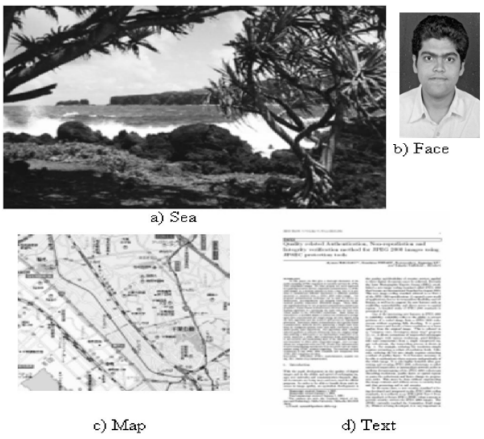


Fig. 2.2.2.2.3. For different test images of different characteristics. a) Sea: 2097 x 1397, b) Face : 187 x 227, c) Map: 600 x 550, and d) Text: 529 x 751 (grayscale)

CONCLUSION:

The progressive mode of JPEG can perform well in many image transmission applications when designed efficiently due to the flexibility that the standard allows in designing PJPEG encoder. A rate-distortion optimized PJPEG encoder is used that generates a sequence of ordered scans. To do this, the bits of the image in DCT domain are ordered based on their priority values. These bits are then grouped based on the design algorithm which provides a good balance between compression efficiency and progressiveness resolution. A PJPEG compliant rate control algorithm by adding a simple control routine to the encoding process. The encoder outperforms baseline JPEG substantially at low and high rates and achieve precise rate-control.

REFERENCES

[1] ISO/IEC, Digital compression and coding of continuous tone still images: requirements and guidelines. International Standard Organization, 1994.

[2] K.R. Rao and J.J. Hwang, Techniques and Standards for Image, Video and Audio Coding. Englewood Cliffs, NJ: Prentice Hall, 1996.

[3] W. Pennebaker and J. Mitchell, JPEG Still Image Compression Standard. New York: Van Nostrand Reinhold, 1993.

[4] G. K. Wallace, “The JPEG still picture compression standard” , Communications of the ACM, vol. 34, pp. 30-44, Apr. 1991.

[5] A. Said and W. A. Pearlman, “A new fast and efficient image codec based on set partitioning in hierarchical trees,” IEEE Transactions on Circuits and Systems for Video Technology, vol. 6, pp. 243-250, June 1996.

[6] T. Chiang and Y. Q. Zhang, “A new rate control scheme using quadratic rate distortion model,” IEEE Transactions on Circuits and Systems for Video Technology, vol. 7, pp. 246-250, Feb. 1997.

[7] D. Taubman and M. Marcellin, "JPEG 2000: Image Compression Fundamentals, Standards and Practice” Kluwer Academic Publishers, 2002.

AET - 0021

IMAGE MATTING

Ruchi Tawani, Samidha kulkarni

Electronics Department,
VIT, Mumbai University
ruchi.tawani@vit.edu.in
Electronics Department,
K.J. Somaiya College of Engineering

Abstract

Matting refers to the problem of accurate foreground estimation in images and videos. From a computer vision perspective, this task is extremely challenging because it is massively ill-posed — at each pixel we must estimate the foreground and the background colors, as well as the foreground opacity ("alpha matte") from a single color measurement. With the recent advances of digital cameras, using matting techniques to create novel composites or facilitate other editing tasks has gained increasing interests from both professionals as well as consumers. In this paper we provide a review that gives a comprehensive review of existing image matting algorithms and systems with some fundamental techniques shared by this image matting algorithms, such as color sampling methods and matting affinities.

1. INTRODUCTION

NATURAL image matting and compositing is of central importance in image and video editing. Mathematically, the observed image Iz ($z = (x, y)$) is modelled as a convex combination of foreground image Fz and background image Bz by using the alpha matte αz

$$Iz = \alpha z Fz + (1 - \alpha z) Bz \qquad (1.1)$$

where αz can be any value in [0,1]. If $\alpha z = 1$ or 0, we call pixel z *definite foreground* or *definite background*, respectively. Otherwise we call pixel z *mixed*.In natural image matting, all quantities on the right hand side of the *compositing equation* (1) are unknown. Thus, for a 3 channel color image, at each pixel there are 3 equations and 7 unknowns.

2. TRIMAP

To properly extract semantically meaningful foreground objects, almost all matting approaches start by having the user segment the input image into three regions: definitely foreground *Rf* , definitely background *Rb* and unknown *Ru*. This three-level pixel map is often referred to as a *trimap*.The trimap is manually specified by the user and it reduces the dimension of the solution space of the matting problem, and leads the matting algorithms to generate user-desired results. This is typically done by iterative nonlinear optimization, alternating the estimation of F and B with that of α. In practice, this means that for good results the unknown regions in the trimap must be as small as possible. As a consequence, trimap-based approaches typically experience difficulty handling images with a significant portion of mixed pixels or when the foreground object has many holes. In such challenging cases a great deal of experience and user interaction may be necessary to construct a trimap that would yield a good matte. Another problem with the trimap interface is that the user cannot directly influence the matte in the most important part of the image: the mixed pixels.

In this paper we present a survey of various image matting techniques like Bayesian, Knockout, Random Walk, Poisson, Closed Form Solution, Iterative Solution, Easy Matting and Robust Matting. Comparitive results about efficiency, memory required, robustness, etc of various techniques is presented here.

3. MATTING TECHNIQUES

BAYESIAN MATTING

Bayesian matting uses a continuously sliding window for neighborhood definition, which marches inward from the foreground and background regions. the

matting problem is formulated in a well-defined Bayesian framework and the matte is solved using the maximum a posteriori (MAP) technique. Mathematically, for an unknown pixel *Iz*, *αz*, *Fz* and *Bz* are estimated by

$$\arg\max P(Fz,Bz,\alpha z|Iz) = \arg\max L(Iz|Fz, Bz,\alpha z) + L(Fz)+L(Bz) + L(\alpha z) \quad (3.1)$$

where $L(\cdot)$ is the log likelihood $L(\cdot) = \log P(\cdot)$.

KNOCKOUT MATTING

The Knockout system will first extrapolate foreground and background colors into the unknown region. For an unknown pixel *I*, its foreground color *Fz* is computed as a weighted sum of nearby known foreground colors, and the weights are proportional to their spatial distances to *I*. The background color *Bz* is first calculated in this way as B_Z, then refined by considering the relative position of *I* and *Fz*, as Finally, *αz* is estimated three times, each in a color channel. For instance, in red channel the alpha is estimated as

$$(r(Iz) - r(Bz)) / (r(Fz) - r(Bz)) \quad (3.2)$$

where $r(\cdot)$ is the red channel value of the color. The final *αz* is then estimated as a weighted sum of these values, where the weight is proportional to the foreground and background difference in the corresponding color channel

POISSON MATTING

Poisson matting models the matte gradient by assuming that intensity changes in the foreground and background are locally smooth. Mathematically, an approximate gradient field of the matte is achieved by taking the partial derivatives on both sides of the matting equation

$$\nabla I_z = (F_z - B_z)\nabla\alpha_z + \alpha_z\nabla F_z + (1 - \alpha_z)\nabla B_z \quad (3.3)$$

RANDOM WALK METHOD

A random walk algorithm is employed to calculate the final alpha values based on the affinity. Given an unknown pixel, its alpha value is set to be the probability that a random walker starting from this location will reach a pixel in the foreground before striking a pixel in the background, when biased to avoid crossing the foreground boundary.These probabilities can be calculated exactly by solving a single system of linear equations.

$$w_{ij} = exp\left(-\frac{\|I_i - I_j\|^2}{\sigma^2}\right) \quad (3.4)$$

This affinity was adopted in the Random Walk matting system with the modification that color distances are not measured in the original RGB space, but in the channels created by using Local Preserving Projections (LPP) techniques.

CLOSED FORM MATTING

A new closed-form solution is used to extracting the alpha matte from a natural image. Here a cost function is derived from local smoothness assumptions on foreground and background colors *F* and *B*, and shows that in the resulting expression it is possible to analytically eliminate *F* and *B*, yielding a quadratic cost function in α. The alpha matte produced by this method is the global optimum of this cost function, which may be obtained by solving a sparse linear system. Since this approach computes α directly and without requiring reliable estimates for *F* and *B*, a surprisingly small amount of user input (such as a sparse set of scribbles) is often sufficient for extracting a high quality matte.

EASY MATTING

In the easy matting system,the energy function to be minimized is defined as:

$$\sum_{z\in\varphi}\left(\frac{1}{N^2}\sum_{i=1}^{N}\sum_{j=1}^{N}\frac{\left\|I_z - \hat{I}_z\right\|^2}{\sigma_z^2} + \lambda\sum_{z\in N(z)}\frac{(\alpha_z - \alpha_v)^2}{\|I_z - I_v\|}\right) \quad (3.5)$$

where *N* is the number of pixels, *N*(*z*), defines a neaighborhood around *z*, and *Iz* is the estimated color given alpha. Both the data term and the neighborhood term are designed in a similar way as in the iterative matting approach,except that no exponential mappings are employed.This greatly simplifies the optimization process since Equation is a quadratic function, thus the energy can be easily minimized by solving a set of linear equations by using conjugate gradient method.Another improvement made in this approach over previous ones is that the weight λ in Equation is dynamically adjusted rather than manually fixed, as

$$\lambda = e^{-(k-\beta)^3} \quad (3.6)$$

where *k* is the iteration count, and β is an pre-defined constant which is set to be 3.4 in the system. The motivation is that users often place scribbles inside foreground and background regions, thus a larger λ value, which indicates an emphasis on the neighborhood term, will encourage the foreground and background regions to smoothly spread out in early iterations. Later on when the foreground and background regions encounter at the object boundary where discontinuity presents, the iteration count has increased so that λ will be small, thus the data term will play a more important role to try to estimate accurate alpha values. This

dynamic weight setting helps the iterative algorithm avoid stepping into bad local minima in early stages.

ROBUST MATTING

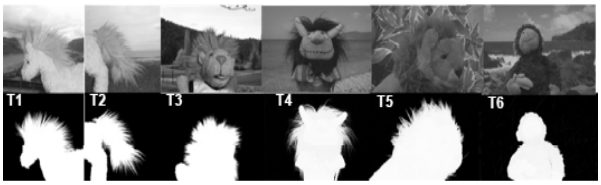
The Robust Matting system combines the optimized color sampling scheme and the matting affinity resulting in a well-balanced system which is capable of generating high quality results while maintaining a reasonable degree of robustness against different user inputs. The energy function to be minimized in this approach is defined as

$$\sum_{z\in\psi}\left[f_z\left(\alpha_z-\hat{\alpha}_z\right)^2+\left(1-\hat{f}_z\right)\left(\alpha_z-\delta(\alpha_z\succ\hat{0.5})\right)^2\right]+\lambda J(\alpha,a,b) \quad (3.7)$$

where $\hat{\alpha}z$ and $\hat{f}z$ are estimated alpha and confidence values in the color sampling step and $J(\alpha, a, b)$ is the neighborhood energy, where the parameters a and b can be analytically eliminated in the optimization process.

PERFORMANCE EVALUATION

A objective and quantitative comparisons among different algorithms is performed, so as to reveal Strengths as well as weaknesses of different methods to give directions to follow for future research.the test images and their mattes are given below.



Each algorithm is applied to each test image using the pre-defined series of trimaps, resulting a series of mattes. These mattes are then compared to the ground-truth and errors are computed in the Mean Squared Error (MSE) sense as *{e1, e2, ...en}*. The minimal MSE value min(*ei*) is then chosen as the measurement of accuracy. The maximum MSE value max(*ei*) is used to measure the robustness of the algorithm against different user inputs.The efficiency of an algorithm is measured as the computational time and memory it takes on each example. These two are hard to measure in a fully objective way since they are closely related to the computational environment.

Table 4.1 shows the Minimal MSE values as the measure of accuracy for all algorithms on the data set along with their ranks. Table 4.2 shows the Maximum MSE values as the measure of robustness for all algorithms on the data set along with their ranks.This study reveals that pure sampling-based approaches usually work well with fine trimaps, but as the trimap becomes coarser, their performance degrades dramatically. For instance, the maximum MSE of Bayesian matting is 7.34 times larger than the minimal MSE it achieves with the finest trimap, indicating that this approach is very sensitive to user input.By combining sampling methods with neighborhood affinities, optimization – based approaches typically achieve a good balance between accuracy and robustness.

ALGORITHMS	RANKS
Bayesian	5.7
Knock-out	3.7
Random walk	7.0
Poisson	7.8
Closed form solution	1.8
Iterative	3.8
Easy mating	4.8
Robust	1.3

Table 4.1 Minimal MSE (representing accuracy) of different algorithms and their ranks.

ALGORITHMS	RANKS
Bayesian	7.0
Knock-out	3.8
Random walk	6.0
Poisson	7.8
Closed form solution	2.7
Iterative	3.3
Easy mating	4.2
Robust	1.2

Table 4.2 Maximal MSE (representing robustness) of different algorithms and their ranks average ranks.

Bayesian	Knock-out	Random Walk	Poisson
130	10	30	22
Closed form	Iterative	Easy Matting	Robust
45	450	46	48

Table 4.3 Memory consumption in Mb. The image size is 1008 × 672 with 19.8% unknown pixels.

	T1	T2	T3	T4	T5	T6
Bayesian	288	408	84	721	85	6
Knockout	2	2	2	2	2	1
Random Walk	2	2	2	3	3	1
Poisson	14	11	9	26	18	4
Closed Form	4	4	4	7	6	3
Iterative	240	300	173	507	250	66
Easy Matting	5	7	2	14	3	1
Robust	5	7	4	14	6	2

Table 4.4 shows the approximate processing time of different algorithms, for each example.

Based on time and memory costs, we label each approach as computationally inexpensive, moderately expensive, or very expensive. Specifically, Knockout and Random Walk matting are labelled as inexpensive given their low requirements on both time and memory. Poisson Matting, Closed-form matting, Robust Matting and Easy Matting are labelled as moderately expensive. Bayesian matting and Iterative matting are labelled as very expensive, since both require significantly large amounts of processing time and memory.

	Closed-form	Robust
T1	$181^{2}:1155^{3}$	$237^{3}:1674^{4}$
T2	$275^{2}:1308^{3}$	$433^{3}:1337^{4}$
T3	$72^{2}:202^{3}$	$83^{3}:476^{4}$
T4	$79^{2}:161^{2}$	$97^{3}:436^{3}$
T5	$112^{2}:3555^{4}$	$142^{3}:2188^{3}$
T6	$48^{2}:1153^{3}$	$65^{4}:329^{4}$
Rank	1.8:2.8	3.2:2.5

Table 4.5 Minimal and Maximal MSE of different algorithms and their ranks for scribble based user input (Format: min(*MSE*)*rank* : max(*MSE*)*rank*). Bottom line shows the average ranks.

Closed Form Solution	Robust Matting
11:48	15:62

Table 4.6 Time (in second) and memory (in Mb) consumption on Example T4 with scribbleset 2(Format: time:memory). The image size is 1008 × 672 with 92.8% unknown pixel

Accuracy vs cost analysis

Each algorithm presents unique characteristics in our tests. Some approaches are fast to compute but cannot generate accurate mattes, and some have the opposite attributes. By jointly considering both accuracy and efficiency, each algorithm can be located in a two dimensional error-cost space, as shown in Figure 4.7. The horizontal axis is error, which measures the accuracy that an algorithm can achieve. The vertical axis is cost, which combines the effort users need to spend on an algorithm to achieve its best possible results, including both labor (how much user input is needed) and computational resources. An ideal (user preferred) matting algorithm should have both small errors and costs, thus is located at the bottom-left corner of the diagram as indicated in red.Recently proposed matting systems are converging in this direction, but there is still considerable room for further improvement, in terms of both accuracy and efficiency.

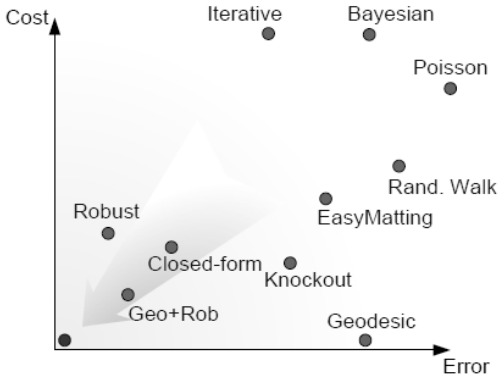


Fig.4.7 Accuracy v.s. Error analysis of existing matting approaches.

CONCLUSIONS

A quantitative and objective evaluation compares the performance of existing matting algorithms, in terms of accuracy, robustness against different user inputs, and computational efficiency. To achieve this a test data set is constructed where each test image is accompanied by a ground-truth matte and a series of predefined trimaps and scribbles as user inputs. Extracted mattes are compared to the ground-truths in the MSE sense as the measure of accuracy and robustness. Computational efficiency is measured by examining the time and memory costs of each algorithm. Both advantages and disadvantages of each algorithm are revealed and addressed in this study, and are summarized in a single Error v.s.Cost figure (Figure 4.7). From the practical stand point of view, an ideal matting algorithm should be able to generate accurate mattes for fairly complicated examples while using the least amounts of user input and computational resources.

References

[1] A. Agarwala, M. Dontcheva, M. Agrawala, S. Drucker, A. Colburn, B. Curless,D. Salesin, and M. Cohen, “Interactive digital photomontage,” in *Proceedings of ACM SIGGRAPH*, pp. 294–302, 2004.

[2] C. CORPORATION, “Knockout user guide,” 2002.

[3] V. Eijkhout, “Overview of iterative linear system solver packages,” Technical Report, University of Tennessee, Knoxville, TN, USA, 1998.

[4] V. Eijkhout, “Overview of iterative linear system solver packages,” Technical Report, University of Tennessee, Knoxville, TN, USA, 1998.

[5] Y.-Y. Chuang, B. Curless, D. H. Salesin, and R. Szeliski, “A bayesian approach to digital matting,” in *Proceedings of IEEE CVPR*, pp. 264–271, 2001.

[6] M. J. Black and P. Anandan, "The robust estimation of multiple motions: Parametric and piecewise-smooth flow fields," *Computer Vision and Image Understanding*, vol. 63, no. 1, pp. 75–104, 1996.

[7] Y. Boykov and G. Funka-Lea, "Graph cuts and efficient n-d image segmentation,"*International Journal of Computer Vision*, vol. 70, no. 2, pp. 109–131, 2006.

[8] W. Briggs, V. Henson, and S. Mccormick, *A Multigrid Tutorial*. Society for Industrial and Applied Mathematics, Philadelphia, 2000.

[9] Y.-Y. Chuang, A. Agarwala, B. Curless, D. Salesin, and R. Szeliski, "Video matting," in *Proceedings of ACM SIGGRAPH*, pp. 243–248, 2002.

AET - 0022

On Inclusion of Hidden View for improved handwritten Character Recognition

#[1]Vijay Patil, #[2]Prof. Dr. S. A. Patekar
Department of Computer Engineering, Vidyalankar Polytechnic, Wadala, Mumbai-37
Department of Computer Engineering,
Vidyalankar Institute of Technology,
Wadala, Mumbai-37
vijay.patil@vpt.edu.in
sapatekar@gmail.com

Abstract

The paper proposes Handwritten Character Recognition method using 2D view and Support Vector Machine (SVM). In this all the character images are Pre-processed (includes Normalization and Noise Removal), which are further used for feature extraction using two dimensional (2D) views. From each character four different views (Top, Bottom, Left, and Right) are obtained called as basic views. All basic views are not able to collect the complete information of character image. The hidden information is capture separately called as extra views. From each view 16 features are extracted and combined to obtain 80 features. These features are used to train SVM to separate different classes of characters. Handwritten Character database is used for training and testing of SVM classifier. Support Vector Machine provides a good recognition result for lower case characters and upper case characters are 82%.

Keywords- 2D view, Extra View, SVM, NN

1. Introduction

Today, many researches have been done to recognize Handwritten characteristics have got million application because in terms of vital link between machine and then communication. Several algorithms have been proposed by many researchers but finding the efficiency of these algorithms is still in the quest. In this paper our approach is not to refine the algorithm but select the best of the algorithm. In this paper the focus is to find out the complete information of the handwritten character. Many feature selection methods are available but very few talk about the structure of the image and none of them talk about the curved character image. The new 2D view feature extraction method is used to gather data from the character image. From this method we get top, bottom, left and right view of the image. All the views formed are not sufficient to reconstruct the image because data from inner part of image is not collected. So the missing data has to be identified and this is done by removing all the views from the original image, the remaining pixels are considered as extra view of the image. The outcome will be the remaining pixels which are not identified by any one of the basic views.

When these features are used to train SVM, which enhanced good results for lower and upper case characters.

2. Implementation Details

Inputs to the system are the character images which have been processed by different stages like preprocessing, feature extraction and classification. In pre-processing, the character image is normalized to a standard size. Feature extraction process gets the two dimensional (2D) views of each image. These feature data is applied to train SVM in training phase. SVM creates structure with this training data can be called as model. Then test character images can be classified in particular classes, depending on their features, by SVM. The block diagram of our HCR system is shown in Fig. 1.

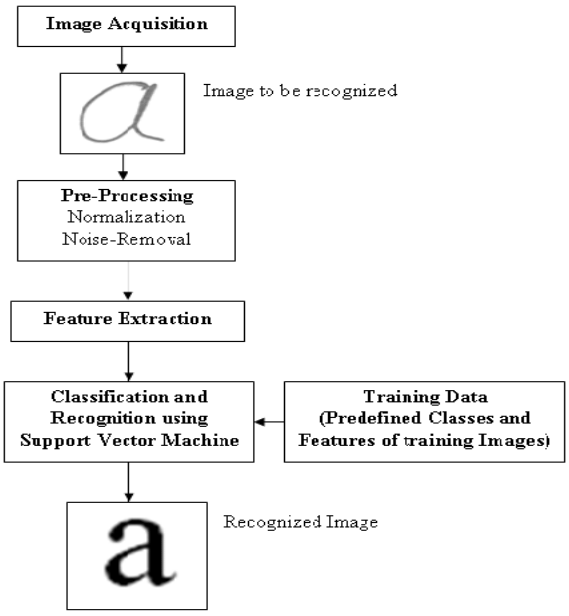


Figure 1: Block diagram of Handwritten Character Recognition System

2.1 Image Acquisition

We will acquire an image to our system as an input. This image should have a specific format, for example, bmp, jpg format. This image can be acquired through the scanner or, digital camera or other digital input devices.

2.2 Preprocessing

After acquiring the image, it will be processed through sequence of preprocessing steps to be ready for the next step. In HCR system, typical preprocessing operations include normalization, smoothing and noise reduction of a digital image so that, algorithms and classification can be made simple and more accurate.

Normalization is to regulate the size, position, and shape of character images, so as to reduce the shape variation between the images of same class. In normalization process all images are converted into fixed size format of 64x64 pixels. Then convert the grayscale image into a binary image. The output image replaces all pixels in the input image with luminance greater than level with the value 1 (white) and replaces all other pixels with the value 0 (black).

Median filtering is applied on normalized images for removal of noise from the image. The objective of noise removal is to remove any unwanted bit patterns, which do not have any significance in the output.

Noise removal reducing noise in an image. For on-line there is no noise to eliminate so no need for the noise removal. In off-line mode, the noise may come from the writing style or from the optical device captures the image.

2.3 Feature Extraction

Feature extraction is an important data gathering step, in which important data of character images are collected. The feature should include all the data with which the original image can be identified. Many available feature selection methods are studies but very few talk about the structure of the image and none of them talk about the curved character image. The new 2D view feature extraction method is applied for HECR system. This method is to get the top, bottom, left, right view of the image. As shown in Figure 2 the views of the image can be found by selecting the pixel from the original image. For selecting the left view start scanning image from top to bottom and each row from left to right. Count all the white pixels until get the first black pixel, then go to next row. Then for selecting the top view start scanning image from left to right and each column from top to bottom. Right view can be achieved by scanning image from top to bottom and each row from right to left. And bottom view achieved by scanning image from left to right, and each column from bottom to top image.

2.3.1 Incorporation of Extra View

All the views (Top, Bottom, Left and Right view) formed are not sufficient to reconstruct the image because data from inner part of image is not collected. The data which is not identified or not collected in the basic views can be obtained by removing the data of basic views from the preprocessed image. This data is considered as extra view of the image. Incorporation of extra view makes handwritten character recognition more effective and accurate.

Figure 2: (a) 2D direction of character image

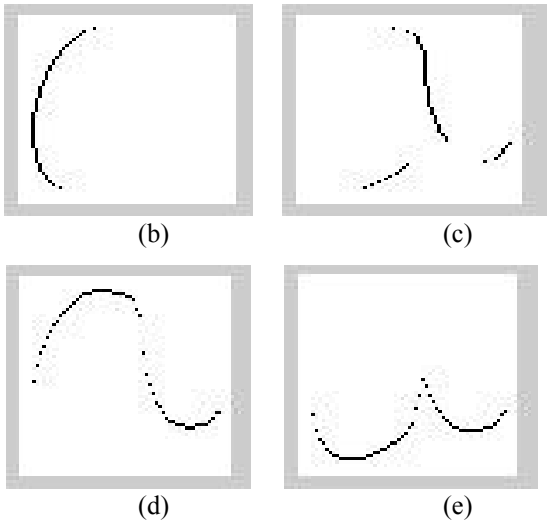
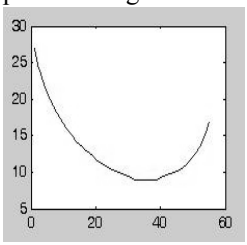


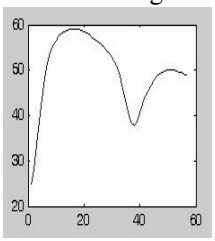
Figure 2: (b) Left view (c) Right View (d) Top View (e) Bottom View

2.4 Smoothing

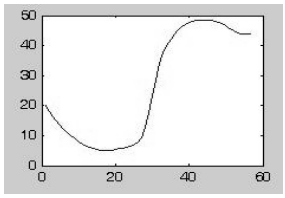
We can use a low pass averaging filter to eliminate the noise. The aim of smoothing is to give a general idea of relatively slow changes of value with little attention paid to the close matching of data values, while curve fitting concentrates on achieving as close a match as possible. Fig. 3 shows the views after smoothing.



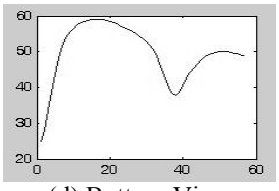
(a) Left View



(b) Right View



(c) Top View

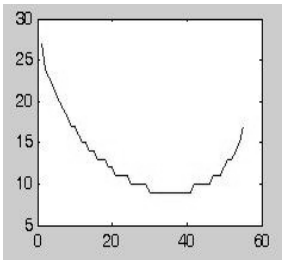


(d) Bottom View

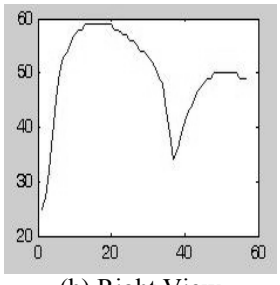
Figure 3: Smoothing of views (a) Left (b) Right (c) Top (d) Bottom

2.5 Interpolation

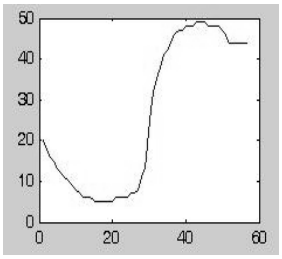
Next step in feature extraction is Interpolation to find the curve which fit the views perfectly. Interpolation is a method of constructing new data points within the range of a discrete set of known data points. For finding the curve fitting to the points in the views collected from the image the cubic interpolation method is used. This method uses four points to find the fine curve at each point so that the curve will be more close to fit all the points in the image views. Fig. 4 shows the views after interpolation.



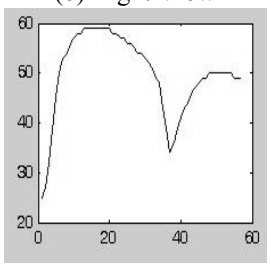
(a) Left View



(b) Right View



(c) Top View

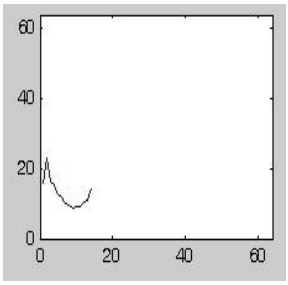


(d) Bottom View

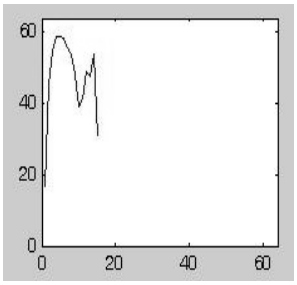
Figure 4: Interpolation of views (a) Left (b) Right (c) Top (d) Bottom

2.6 Sampling

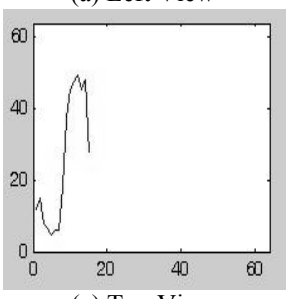
Sampling is an important aspect of data collection. Figure 5 shows sampling effect on all views of character image. All the views are interpolated and made ready for sampling. This process will collect sample data from the curve so that the curve representation will not change and sampled data can represent the same curve as original one. After interpolation we will get 64 points which are now a curve or can be represented as polynomial. This can be represented as the feature set but further it can be reduced by sampling the data with sampling rate 1/4. After sampling the feature data size of every view is 16 points. Finally each character image will have 80 points. These features are easy to interpret, compute and they have good information about the structure of the character.



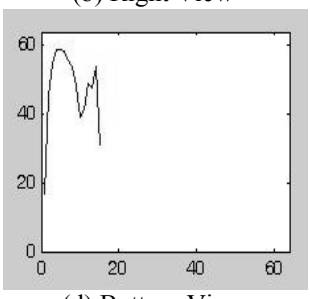
(a) Left View



(b) Right View



(c) Top View



(d) Bottom View

Figure 5: Sampling of views (a) Left (b) Right (c) Top (d) Bottom

2.7 Classification and recognition using support vector machine

The objective of any machine capable of learning is to achieve good generalization performance, given a finite amount of training data, by striking a balance between the goodness of fit attained on a given training dataset and the ability of the machine to achieve error-free recognition on other datasets.

The Support Vector Machine (SVM) can be characterized as a supervised learning algorithm capable of solving linear and non linear classification problems. The principle of an SVM is to map the input data onto a higher dimensional feature space nonlinearly related to the input space and determine a separating hyper plane with maximum margin between the two classes in the feature space. This results in a nonlinear boundary in the input space.

The optimal separating hyper plane can be determined without any computations in the higher dimensional feature space by using kernel functions in the input space. Commonly used kernels include:

Kernel	Function
Linear	$K(x, y) = (x.y)$
Gaussian (Radial basis function)	$K(x, y) = \exp(-\frac{\|x - x_i\|^2}{2\sigma^2})$
Polynomial	$K(x, y) = (x.y)^p$
Tangent Hyperbolic	$K(x, y) = \tanh(x.y - \theta)$

3. Experimental Result

After preprocessing and feature extraction the datasets for SVM are created which include 80 feature points of each character and the respective class label. The training dataset is provided to the SVM to create the structure which can be used for testing. Radial Bases Function (RBF) Kernel is used in the experiments for SVM. The overall performance of recognition rate on the test set for the SVM classifier is shown in Table 1 and Table No. 2. Figure 6 shows the character recognition output of single character.

Table 1: SVM classification accuracy for Lower Case Characters (a-z)

	Training Data set	Testing Data set	Accuracy	Classification
Classes	5	5	23/50	46%
Samples for each class	10	10		
Classes	26	26	34/52	65.38%
Samples for each class	8	2		
Classes	26	26	670/832	80%
Samples for each class	60	32		
Classes	26	26	860/1040	82.69%
Samples for each class	70	40		

Table 2: SVM classification accuracy for Upper Case Characters (A-Z)

	Training Data set	Testing Data set	Accuracy	Classification With EV
Classes	5	5	33/50	66%
Samples for each class	15	10		
Classes	10	10	147/260	56.53%
Samples for each class	25	25		
Classes	26	26	319/520	61.34%
Samples for each class	30	20		
Classes	26	26	532/650	81.78%
Samples for each class	40	25		

Table 3: SVM classification accuracy with EV and normal SVM for special character Q and G

	Training Data set	Testing Data set	Classification with normal SVM	Classification With EV
Classes	1	1	58%	66%
Samples for class Q	40	25		
Classes	1	1	68%	82%
Samples for class G	40	25		

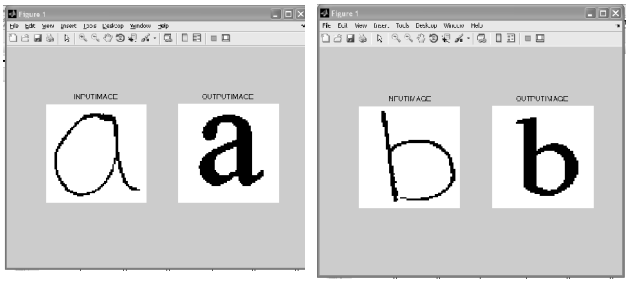


Figure 6: Single Character Recognition result (Lower Case-'a' and 'b')

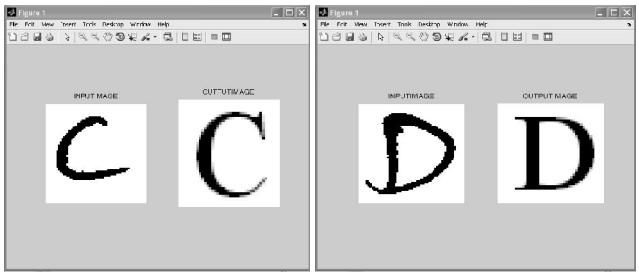


Figure 7: Single Character Recognition result (Upper Case-'C' and 'D')

4. Conclusion

The focus of this paper is on to find hidden information of character which we called as Extra View. Experiments show that these features have good discrimination ability. For training and test sets, the basic views provide 64 features for each character image, which are not sufficient for representing full information of character image completely. Then E-View added to feature extraction to get all most all the features from each character image, which increased the features of each character image to 80 and accuracy of SVM is increased. It can be concluded that features extracted from the character images are well represent the complete input information of character image; the accuracy of character recognition will increased definitely specially for hidden information of characters like Q and G. SVM have been demonstrated superior classification accuracies to neural classifiers in many experiments. Here the paper represent procedure to extract complete information of handwritten character, together with the SVM improves handwritten character recognition. Experiments shows that the by adding extra view improves the accuracy about 20% than the result of normal views.

5. References

[1] Miguel Po-Hsien Wu, "*Handwritten Character Recognition*", The school of Information Technology and Electrical Engineering, University of Queensland, Oct 29, 2003

[2] Nafiz Arica, "*An Offline Character Recognition system for Free Style Handwriting*", thesis of Department of Computer Engg. The Middle East Technical University, Sep-1998

[3] R. Plamondon and S. N. Srihari, "*Online and Offline handwritten recognition: a comprehensive survey*", IEEE Transactions on Pattern Analysis and Machine Intelligence, vol.22. No.1, January 2000.

[4] Wikipedia online, http://en.wikipedia.org/wiki

[5] The odoros Evgenuiu and Massimilliano pontil, "*Statistical Learning Theory: a primer*", 1998

[6] Dewi Nasien, Habibollah Haron, "*Support Vector Machine for English Handwritten Character Recognition*", 2010 Second International Conference on Computing Engineering and Applications

[7] Tutorial Slides by Mingyue Tan, "*Support Vector Machine and its Applications*", The university of British Columbia Nov 26,2004

[8] Vikramaditya Jakkula, "*Tutorial on Support Vector Machine*", School of EECS, Washington State University, Pullman 99164.

[9] Burges C.J., "*Tutorial on support vector Machines for pattern Recognition*", Data mining and Knowledge Discovery, 2,1998, kluwer Academic Piblishers, Boston.

[10] Chin-Wei Hsu, Chih-Chung Chang and Chih-Jen Lin, "*A Guide to Support Vector Classification*", Department of Computer Science, National Taiwan University, Taipei 106, Taiwan, May 19, 2009

[11] Steve R. Gunn, "*Support Vector Machines for Classification and Regression*", Technical Report Faculty of Engineering, Science and Mathematics School of Electronics and Computer Science, 10 May 1998.

[12] Abdul Rahim Ahmad, Christain Viard-Faudin, "*Online Handwriting Recognition using Support Vector Machine*",Proceedings of Second International Conference on Artificial Intelligence in Engineering and Technology, August 3-5, 2004, Kota Kinabalu, Malaysia

[13] Seong Wook Joo, "*Linear Discriminant Function and SVM*"

[14] Max Welling, "*Support Vector Machines*", Department of Computer Science, University of Toronto, Canada

[15] Henok Girma, "*A Tutorial on Support Vector Machine*", Center of Experimental Mechanics, University of Ljubljana, 2009.

[16] Abdul Rahim Ahmad, Marzuki Khalid, Rubiyah Yusof, "*Machine Learning Using Support Vector Machines*"

[17] http://www.google.com search Kernel Trick, Learning from examples

[18] Sami Gazzah and Najoua Ben Amara, "*Neural Networks and Support Vector Machines Classifiers for Writer Identification using Arabic Script*", The International Arab Journal of Information Technology, Vol. 5, No. 1, January 2008.

[19] H. Swethalakshmi, Anitha Jayaraman, V. Srinivasa Chakravarthy, "*Online Handwritten Character Recognition of Devnagari and Telugu Characters using Support Vector Machines*"

[20] Cheng Lin Liu and Hiromichi Fujisawa, "*Classification and Learning Methods for Character Recognition: Advances and Remaining Problems*", National Laboratory of Pattern Recognition, Instt of Automation, Beijing, China

[21] Dhruv Batra, Girish Singhal and Shantanu Choudhary, " *Gabor Filter based Fingerprint Classification using Support Vector Machines*", IEEE India Annual Conference 2004, INDICON 2004.

[22] Nor Amizam Jusoh, Dr. Jasni Md Zain,"*Comparision between Techniques in Feature Extraction*", Proceeding of International conference on Electrical Engineering and Informatics, Instt Teknologi bandung, Indonesia June 17-19, 2007.

[23] Oivind Due Trier, Anil Jain, "*Feature Extraction Methods for Character Recognition –A survey*", Pattern Recognition Society, vol 29, No. 4, 1996

[24] Cheng Lin Liu, "*Handwritten Chinese Character Recognition: Effects of Shape Normalization and Feature Extraction*", National Laboratory of Pattern Recognition (NLPR) Institute of Automation, Chinese Academy of Sciences, Beijing 100080, P. R. China.

[25] Dr. P.Santhi Thilagam, Balaji Bombade, "*Handwritten Kannada Character Recognition system using Support Vector Machine*", International conference on Computer Science and Engineering, Karnataka, 2009.

AET - 0023

Review of Vision Based Car Parking Management Technique

Mohd Ahmed[1], Mandar Sohani[2]

[#]*Faculty MH Saboo Siddik COE, Vidyalankar Institute of Technology, Wadala, Mumbai*

[1]*smaengg@gmail.com*

[2]*mandarsohani@gmail.com*

Abstract

With the rapid increase of cars the need to find available parking space in the most efficient manner, to avoid traffic congestion in a parking area, is becoming a necessity in car park management. Current car park management is dependent on either human personnel keeping track of the available car park spaces or a sensor based system that monitors the availability of each car park space or the overall number of available car park spaces. In both situations, the information available was only the total number of car park spaces available and not the actual location available. In addition, the installation and maintenance cost of a sensor based system is dependent on the number of sensors used in a car park. This paper describes an approach to overcome a situation of monitoring and managing a parking area using a vision based automated parking system. This paper shows a vision based system that is able to detect and indicate the available parking spaces in a car park. One method utilized to detect available car park spaces are based on coordinates to indicate the regions of interest and a car classifier. Other approaches such as background subtraction, color histogram and texture matching approaches are also discussed. The Haar technique shows that the initial work done here has an accuracy that ranges from 90% to 100% for a 4 space car park. The work done indicated that the application of a vision based car park management system would be able to detect and indicate the available car park spaces.

Keywords— *parking space detection, background subtraction, color histogram, texture matching, Haar like features.*

1. Introduction

Parking of cars in a parking area is becoming a difficult task as the number of cars increases while the number of parking spaces is finite. As a result, people would spend a certain amount of time looking for parking space and thus cause a situation where the traffic would be slowed down and cause congestion. The situation of looking for parking space and traffic congestion in parking areas is due to the fact that the information of available parking spaces is not readily available to the people looking for parking spaces. In modern prosperous cities, there is a great need for advanced parking assistant systems to reduce the hustle for the drivers.

Current car park management is dependent on either human personnel keeping track of the available car park spaces or a sensor based system that monitors the availability of each car park space or the overall number of available car park spaces. In both situations, the information available was only the total number of car park spaces available and not the actual location available. In case of sensor based system the cost of installing sensors would increase with the increase in the number of parking bays or areas. This type of system fails when a vehicle takes up more than one spot or when a parking lot has different types of parking spaces. The availability of a vision based parking system would enable the system to be enhanced or scalable with only the utilization of a number of cameras. VBPS can dynamically collect parking information, and provides real-time information service for drivers by the means of on-board guidance system or changeable message board installed on roadside, thus assisting drivers to conveniently and rapidly park.

A vision based system was developed as an alternative to the ordinary system to detect available parking bay locations [2,3,4]. The availability of a vision based parking system would enable the system to be enhanced or scalable with only the utilization of a number of cameras. The method of detecting and locating available parking locations using a vision based system has proven to be robust and cost effective where only a minimal number of cameras are needed [3,4].

The primary purpose of all these paper would be to demonstrate the development of a low cost vision based parking system that can be used to determine the location of available parking locations and provide feedback on the available locations. in computer vision,

including object or scene recognition, solving for 3D structure from multiple images, stereo correspondence, and motion tracking. This paper describes image features that have many properties that make them suitable for matching differing images of an object or scene. The features are invariant to image scaling and rotation, and partially invariant to change in illumination and viewpoint. They are well localized in both the spatial and frequency domains, reducing the probability of disruption by occlusion, clutter, or noise. Large numbers of features can be extracted from typical images with efficient algorithms. In addition, the features are highly distinctive, which allows a single feature to be correctly matched with high probability against a large database of features, providing a basis for object and scene recognition.

2. Literature Survey I

Approach 1:_ Background Subtraction

Background subtraction is a computational vision process of extracting foreground objects in a particular scene. A foreground object can be described as an object of attention which helps in reducing the amount of data to be processed as well as provide important information to the task under consideration. Often, the foreground object can be thought of as a coherently moving object in a scene. We must emphasize the word coherent here because if a person is walking in front of moving leaves, the person forms the foreground object while leaves though having motion associated with them are considered background due to its repetitive behavior. In some cases, distance of the moving object also forms a basis for it to be considered a background, e.g if in a scene one person is close to the camera while there is a person far away in background, in this case the nearby person is considered as foreground while the person far away is ignored due to its small size and the lack of information that it provides. Background subtraction is a class of techniques for segmenting out objects of interest in a scene for applications such as surveillance. Background subtraction is a common method used in image processing.

There are two ways to do background subtraction namely

1. Absolute difference and
2. Thresholded difference.

In the absolute difference method we compute the absolute difference between the two images pixel by pixel and store it in a third image.

For example:

Test Image	Background Image
45 40 35	45 40 35
40 10 10	40 05 05
35 05 05	35 05 05

After Absolute difference

Third Image

0 0 0
0 5 5
0 0 0

In the thresholded difference method the output image is binary. In this method we first compute the absolute difference and only set the output image pixel if the difference is above a certain threshold. By doing this we take into account subtle variations in the background such as lighting changes. In our context the background image is an image of an empty parking lot. We subtract an image with vehicles from the background image using method-2.

In the above example

After thresholded difference

Third Image

0 0 0
0 1 1
0 0 0

The algorithm for the background subtraction method is as follows.

Step-1: Choose the best match background image for the given test image (between night time and daytime background images).

Step-2: For every pixel in the test image, compute the absolute difference with the chosen background image and if the difference lies within a threshold value, consider the pixel as un-occluded and mark it green.

Step-3: Look up the reference image, which has the decision region marked manually on it. The reference lines are drawn in such a way that they only get occluded when there is a car parked in that particular slot.

Step-4: The ratio of green pixels (occluded) to non-occluded one's in the decision area are computed and the one's above the threshold are considered as occupied by a car.

3. Literature Survey II

3.1 Approach 2: Color Histogram Analysis

In image processing and photography, a color istogram is a representation of the distribution of colors in an image. For digital images, a color histogram represents the number of pixels that have colors in each of a fixed list of color ranges, that span the image's color space, the set of all possible colors. Color histograms are flexible constructs that can be built from images in various color spaces, whether RGB, rg chromaticity or any other color space of any dimension. A histogram of an image is produced first by discretization of the colors in the image into a number of bins, and counting the number of image pixels in each bin. For example, a Red–Blue chromaticity histogram can be formed by first normalizing color pixel values by dividing RGB values by R+G+B, then quantizing the normalized R and B coordinates into N bins each. A two-dimensional histogram of Red-Blue chromaticity divides in to four bins (N=4) might yield a histogram that looks like this table:

		Red			
		0-63	64-127	128-191	192-255
blue	0-63	43	78	18	0
	64-127	45	67	33	2
	128-191	127	58	25	8
	192-255	140	47	47	13

Table 2: histogram of Red-Blue chromaticity

The histogram provides a compact summarization of the distribution of data in an image. The color histogram of an image is relatively invariant with translation and rotation about the viewing axis, and varies only slowly with the angle of view.

A. Measurement of Image Similarity (Difference)

To find the optimal histogram matching, we have to have a criterion to judge the performance of the histogram matching normalization. It is straightforward to measure the normalization performance by directly measuring the difference between the histogram matched subject image and the reference image. Yuan *et al.* (1998) and Yang *et al.* (2000) used Euclidean distance as defined by (1), i.e. root-mean-square error (RMSE) to measure this difference, i.e. they used RMSE as a criterion for comparing the performance of the different normalization methods.

$$s_{rk} = \sqrt{\sum_{i=1}^{M}\sum_{j=1}^{N}\left[I_r(i,j,k) - I_{rh}(i,j,k)\right]^2}, \quad \forall k \in \{1,2,\ldots,K\},\ r \in \{1,2,\ldots,L\}$$

In this approach we compute the color histogram for each decision region in the background image and also the test image. We then find the Euclidean distance between these two histograms. If the distance is above a certain threshold we identify the parking space corresponding to this decision. region as empty, otherwise it is occupied. We have computed the histogram using RGB color space which is a 3-d histogram.

4. Literature Survey III

4.1 Approach 3: Texture Matching Approach

Texture provides a very useful cue for retrieving images from a database. Many objects, such as brick walls and tiled roofs, can be recognized based on their distinctive texture patterns. Images containing these ob jects can be identified using texture as the search key. To retrieve images based on texture, it is necessary to devise a matching method that returns a strong match between two texture patterns that are perceived to be similar by human.

Sum of absolute differences (SAD) is a widely used, extremely simple algorithm for measuring the similarity between image blocks. It works by taking the absolute difference between each pixel in the original block and the corresponding pixel in the block being used for comparison.

In this approach we basically take a small patch from the pavement region of the image and try to match it with each parking space region.

4.2 Algorithm

The algorithm for this approach is as follows.

Step-1:Choose a Point on the Pavement region in the foreground image and Choose a 11x11 size pixel patch around it. Find the absolute difference of all the pixels in the parking region with the 11x11 Window and replace the center pixel of the window with the sum of absolute differences.

Step-2: Repeat Step-1 for background image.

Step-3: Find the difference between the foreground and background SAD images.

Step-4: Perform erosions followed by dilations on the image obtained in step-3 twice to remove possible noise that may lead to false classification.

Step-5: Classify the Pixels that are more than the threshold value as occluded(fall under the car occupied region).

Step-6: Look up the reference image which has the parking lot lines marked out in RED color and the rest in black. Perform connected components on the image to assign a unique label to each parking slot.

Step-7: Compute the ratio of occluded pixels to non-occluded one's and if the ratio exceeds threshold value, classify the slots as occupied.

Example to calculate SAD

3x3 size	Test Image
2 5 5	2 7 5 8 6
4 0 7	1 7 4 2 7
7 5 9	8 4 6 8 5

Calculating the SAD values for each of these locations gives the following:

Left	Center	Right	Test Image
0 2 0	5 0 3	3 3 1	2 7 5 8 6
3 7 3	3 4 5	0 2 0	1 20 25 17 7
1 1 3	3 1 1	1 3 4	8 4 6 8 5

For each of these three image patches a SAD value of 20, 25, and 17.

5. Literature Survey IV

5.1 Approach 4: Haar-like features

Haar-like features are digital image features used in object recognition. They owe their name to their intuitive similarity with Haar wavelets and were used in the first real-time face detector. Historically, working with only image intensities (i.e., the RGB pixel values at

each and every pixel of image) made the task of feature calculation computationally expensive. A publication by Papageorgiou. discussed working with an alternate feature set based on Haar wavelets instead of the usual image intensities. Viola and Jones adapted the idea of using Haar wavelets and developed the so called Haar-like features. A Haar-like feature considers adjacent rectangular regions at a specific location in a detection window, sums up the pixel intensities in these regions and calculates the difference between them. This difference is then used to categorize subsections of an image. For example, let us say we have an image database with human faces. It is a common observation that among all faces the region of the eyes is darker than the region of the cheeks. Therefore a common haar feature for face detection is a set of two adjacent rectangles that lie above the eye and the cheek region. The position of these rectangles is defined relative to a detection window that acts like a bounding box to the target object (the face in this case).

In the detection phase of the Viola–Jones object detection framework, a window of the target size is moved over the input image, and for each subsection of the image the Haar-like feature is calculated. This difference is then compared to a learned threshold that separates non-objects from objects. Because such a Haar-like feature is only a weak learner or classifier (its detection quality is slightly better than random guessing) a large number of Haar-like features are necessary to describe an object with sufficient accuracy. In the Viola–Jones object detection framework, the Haar-like features are therefore organized in something called a *classifier cascade* to form a strong learner or classifier. The Haar-like features are illustrated as follows in Figure 1, Figure 2 and Figure 3.

Fig 1: Edge Feature

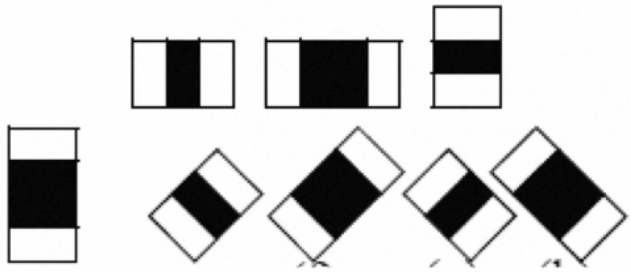


Fig 2: Line Feature

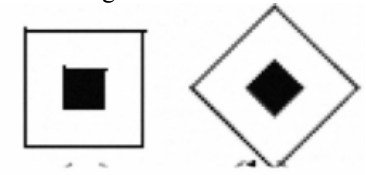


Fig 3: Center Surround Feature

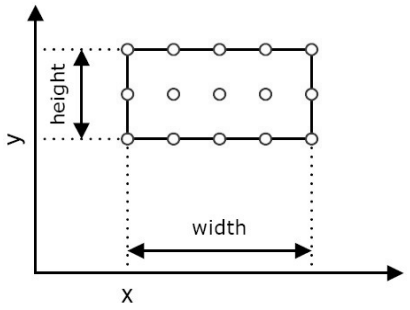
In this paper, Haar-like features were used in the detection of features detected in input videos to determine the presence of a car within a parking bay. Haar-like features use the changes in contrast values between adjacent groups of pixels rather than actual pixel values to determine common Haar features within an image [5]. The primary purpose of using Haar-like features would be for easier classification rather than raw pixel values as the Haar-like features are done in windows of 24x24 pixels [6]. The Haar-like features are typically used to determine the information of a region rather than the raw pixel values. From the utilization of a group of Haar-like features, the determination of features and computed values are used as input into a decision tree classifier for identification. Some of the Haar-like features available for purpose of determining the information range from edge features, line features and center surround features [6].

5.2 Object Detection Using Haar-like Features

The basis of object identification in this paper was based on the utilization of Haar-like features. The tool for object classification was developed in an open source library called Open Computer Vision Library (OpenCV) [5]. The OpenCV library provides us a greatly interesting demonstration for a face detection. Furthermore, it provides us programs (or functions) that they used to train classifiers for their face detection system, called HaarTraining, so that we can create our own object classifiers using these functions. It is interesting. In order to train the object classification algorithm, two sets of images are required to train the classifier. One set of input images would be images that contain the object to be detected, which can be called as positive images, and another set of images that do not contain the object, that are called negative images. Negative samples are taken from arbitrary images. These images must not contain object representations. Negative samples are passed through background description file. It is a text file in which each text line contains the filename (relative to the directory of the description file) of negative sample image. Note that the negative samples and sample images are also called background samples or background samples images. In the training of the classifier, the location of the object within the positive image including the height and width of the object need to be specified.

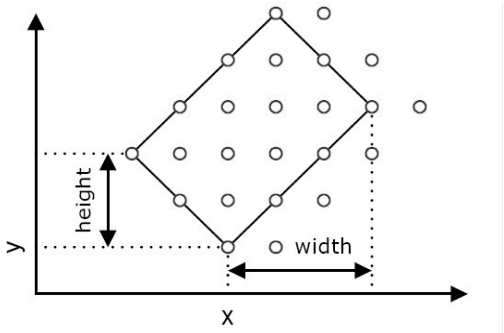
The object detector described in [Viola99] and [Lein02] is based on Haar classifiers. Each classifier uses k rectangular areas (Haar features) to make decision if the region of the image looks like the predefined image or not. Figure “Types of Haar Features” shows different types of Haar features.

4.3 Representing Haar Features



Haar feature defined by IppiRect structure
x=2, y=3, width=5, height=3 (15 pixels)

Fig a.



Tilted Haar feature defined by IppiRect structure
x=4, y=1, width=4, height=3 (24 pixels)

Fig b.

Fig 4: Representing Haar Features

When the classifier K_t is applied to the pixel (i, j) of the image A, it yields the value val1(t) if

$$\sum_{i=1}^{k}\left(w_1 \cdot \sum_{u=i+R_1y}^{R_1y+R_1height-1}\sum_{v=j+R_1yx}^{R_1y+R_1width-1} A_{uv}\right) < norm(i,j)\cdot threshold(t)$$

and *val2(t)* otherwise. Here w_l is a feature weight, *norm(i, j)* is the norm factor (generally the standard deviation on the rectangle containing all features), *threshold(t)*, *val1(t)* and *val2(t)* are parameters of the classifier. For fast computation the integral representation of an image is used. Haar classifiers are organized in sequences called *stages* (*classification stages*). The stage value is the sum of its classifier values. During feature detecting stages are consequently applied to the region of the image until the stage value becomes less than the threshold value or all stages are passed.

6. Comparative Study

It is clear from the above findings that the color histogram analysis approach has performed poorly. One of the reasons for this is that when the color of the car closely matches that of the pavement this method fails. Many of the test set images had several cars which were close in color to the pavement. Also the modified texture matching method that we proposed has fared better than the other two presumably because of the window technique we use which kind of smoothens the effect of any noise. We also notice that the overall performance of any of the three methods does not exceed 70% which shows the difficulty of the problem. The decision region as we have shown in some of the images is very small and hence the decision statistic obtained from it is not very reliable.

The different algorithms have been run over a test set of 12 images which included 193 parking slots in all. The success rate (which is calculated as the percentage of total number of parking slots correctly classified) for each method is as shown below.

S.No	Method	Success Rate
1	Background Subtraction	63.21%
2	Color Histogram Analysis	59.06%
3	Modified Texture Matching	69.99%

Table 1: Testing Result

The results from testing the car classifier by using Haar like feature indicated that the object or car classifier is able to detect cars accurately 271 times out of 300 attempts that gave
90.33% accuracy and false or wrong detection rate of 9.66%. Figure 5 shows the testing of the car classifier.

Total readings	1 car		2 car		3car	
	Correct	False	Correct	False	Correct	False
30	30	0	28	2	27	3
	100%	0	93.3%	6.7%	90%	10%

Table 2: Testing Result

The testing was done using model cars and a sample of 4 parking spaces. From Table 1, the accuracy of the Vision based parking system was found to be 100%, 93.3% and 90% when detecting 1, 2 and 3 cars respectively. The results indicate that as the number of cars increases, the accuracy of detection reduces. The drop of accuracy was due to the type of camera used which in this project was a web camera. The web camera used in this paper had limited resolution and inaccurate lighting correction.

7. Conclusion

It is clear from the above findings that the color histogram analysis approach has performed poorly. One of the reasons for this is that when the color of the car closely matches that of the pavement this method fails. Many of the test set images had several cars which were close in color to the pavement. Also the modified texture matching method that we proposed has fared better than the other two presumably because of the window technique we use which kind of smoothens the effect of any noise. We also notice that the overall performance of any of the three methods does not exceed 70% which shows the difficulty of the problem. The decision region as we have shown in some of the images is very small and hence the decision statistic obtained from it is not very reliable. The camera angle plays an important role

in the success of all these algorithms. Future work possible in this area is to automatically draw the decision regions given a set of training images. Also use of multiple cameras and motion can make the system more robust and reliable hence we will look to explore these options in the future.

The results obtained from the testing by using Haar like features on model cars and car parks, it indicates that the probability of the utilization of a camera or vision based system to monitor car parks is feasible. This is seen in the results that indicate the accuracy in determining the presence of a car in a parking bay or the information that can be provided on the location of the available parking bays. The development of the vision based car park system shows the feasibility of utilizing simple cameras such as web cameras to monitor car parks. However, the utilization of such cameras has indicated some weaknesses in terms of the accuracy of the detection due to the limitations of the camera.

References

[1] V.W. S. Tang, Y. Zheng, and J. Cao, "An Intelligent Car Park Management System based on Wireless Sensor Networks," Proceedings of the 1st International Symposium on Pervasive Computing and Applications, pp. 65-70, Aug 2006.

[2] Sheng-Fuu Lin , Yung-Yao Chen , "A vision-based parking lot management system"., 2006 IEEE Conference on Systems, Man, and Cybernetics. Peter. C, pp. 2897-902, Oct. 2006.

[3] Q.Wu, C. Huang, S. yuWang, W. chen Chiu, and T. Chen. Robust parking space detection considering interspace correlation. In Proceedings of IEEE International Conference on Multimedia and Expo, pages 659-662, 2007.

[4] N. True. Vacant parking space detection in static images. University of California, San Diego, 2007.

[5] Phillip Ian Wilson , John Fernandez, Facial feature detection using Haar classifiers, Journal of Computing Sciences in Colleges, v.21 n.4, p.127-133, April 2006.

[6] Rainer Lienhart and Jochen Maydt. An Extended Set of Haar-like Features for Rapid Object Detection. IEEE ICIP 2002, Vol. I, pp. 900-903, Sep. 2002.

[7] Vision-Based Automated Parking System 10th International Conference on Information Science, Signal Processing and their Applications (ISSPA 2010)

AET - 0024

Information Security Using Wireless Devices

Sanjeev Dwivedi
Vidyalankar Institute of Technology
Wadala(E), Mumbai
sanjeev.dwivedi@rediffmail.com

Abstract

Wireless devices like laptops are prone to theft and loss due to their small size and the characteristics of their common usage environment, because laptops allow users to work while they are away from their desk. Unfortunately, this is also where the information in these devices is, most at risk. Existing schemes for securing data either do not protect information in the device after it is stolen or require bothersome re-authentication. We provide a secure scheme which protects the sensitive data of the user in these devices. We solve the problem existing systems with Transient Authentication, in which a small hardware token (Mobile Phone) continuously authenticates the user's presence over a short-range, wireless link. When the user departs, the token and device lose contact and the device secures itself. We show how to leverage this authentication framework to secure sensitive and confidential data on laptop. We implemented this system and the results were outstanding.

Keywords: Authentication, Bluetooth, Mobile computing.

1. Introduction

Powerful and affordable laptops have brought users to an unprecedented level of convenience and flexibility. Laptops let users work anywhere, anytime. Unfortunately, physical security is a major problem for these devices. Since they are designed for mobile use, they are often exposed in public places such as airports, coffee houses, and taxis, where they are vulnerable to theft or loss. Along with the value of lost hardware, users are worried about the exposure of sensitive information. People store vast amounts of personal and confidential data on their laptops and the loss of a device may lead to the exposure of bank credentials

In presently available schemes the sensitive data in laptops can be protected by using various encryption methods, but the challenge in securing the sensitive and confidential data is not encrypting it but authenticating the current user. The device must obtain the correct evidence of the user's identity and authority before granting access to data. This evidence could be in the form of a password, a smart card inserted into a reader, or biometric data from a fingerprint or iris scanner. But, how often must an authentication should take place by the user? Current systems require users to re-authenticate each time the device performed any operation on sensitive data. This would quickly render the system unusable and many users would disable the authentication system out of annoyance. Another mechanism would require the user to "unlock" the device once at boot. This would enhance the users experience but leave data vulnerable if the device were lost or stolen. These two models highlight an inherent tension between security and usability.

Transient Authentication resolves this tension. Users can have a small token (Mobile Phone) with modest computational resources. It constantly authenticates the device on behalf of the user. The limited short wireless range serves as a proximity cue, letting a device take steps to protect its data when the user leaves the physical area. We assume that since users have the token which is been frequently used by her, it is far less likely to be misplaced or stolen.

2. Transient Authentication

2.1 Principles:

Transient Authentication is standing on the following four principles:

A] Access Capabilities to Authorized Users.

The computer system should carry out the critical operations only when the authorized user is present. Thus, all encryption keys must reside solely on the

token, which is in her possession at all times and hence it is far less likely to be stolen or misplaced. The keys must be flushed from the cache of computer system in absence of the user.

B] No Burdensome involvement of User.

Users tend to immediately disable inconvenient and cumbersome security mechanisms. But, anecdotal evidence proves that users conveniently accept infrequent insertion of authentication codes. Transient Authentication requires user participation that is convenient. Users will also quickly disable the system with poor performance, thus to ensure complete adoption, the additional overhead of key authentication, communication, and data encryption must not be excessive.

C] In Users Absence/presence system should secure/restore respectively.

When the user departs, the device must quickly secure itself so as to avoid the attack, to physically extract any information, by an unauthorized user. Conversely, when a user walks back to use the device, the token should regain wireless contact while she is still some meters away. This gives the system several seconds to restore the device's state thereby avoiding the attackers attempt to extract sensitive data.

D] Always Ensure Authorized User's Consent.

The device must not attempt to perform any critical action without the authorized user's consent. Transient Authentication must ensure that only the respective token is capable to carry out the authentication process with the corresponding devices only with her knowledge. To limit the consequences of mobile phone loss, users must authenticate themselves to their token daily.

Armed with these authentication principles, laptop protects data when the user departs by encrypting it. Cryptographic file systems secure data in persistent storage, but the unique characteristics of laptops make protecting data in other memory locations critical as well. Batteries and wireless network links allow devices to continue running while traveling and in public places. This is precisely where they are most vulnerable to loss or theft. Some processes can safely continue while the user is absent, either because they do not handle sensitive data or because they secure their secrets themselves.

3. Connection Establishment

3.1 Communication module:

The communication module consists of a token (mobile phone) and computer system (laptop) which is implemented using User Datagram Packets. Each datagram packet in data field is simply the text inputted. The module establishes a typical single slave Bluetooth Piconet scenario; it opens up a Bluetooth port in both laptop and mobile phone for receiving communications as shown in Fig. 1.1. Once Laptop system receives the packet, it attempts to decrypt that packet using the key currently received from mobile phone and thereby allows the user to access the sensitive data in its original form.

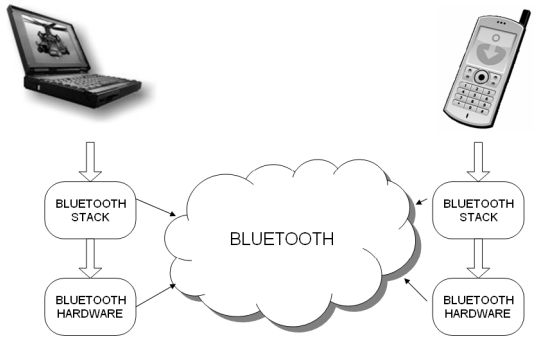


Fig. 1.1: Communication module

3.2 Connection establishment at laptop side:

The laptop acts as client in the Piconets, the communication is achieved in following sequential manner:

1. Initializing the Bluetooth stack which involves setting the device name, security settings and/or turning the Bluetooth radio on/off.
2. Searching the respective mobile phone that is in proximity.
3. Opening, closing and initiating connections.
4. Perform security Input and Output messages.

These above mentioned steps are carried out by Bluetooth control centre, which typically is a set of control panels that serves as the central authority for local Bluetooth device settings. Before creating the connection the application retrieves local device information, which is used for creating the respective connection. The Bluetooth connection is established using the logical link control and adaptation layer (L2CAP) of the Bluetooth protocol stack. L2CAP does a simple Ns lookup and gets the address of the mobile phone (server) and tries to establish a logical connection with the L2CAP of the server (mobile phone) through the host controller interface (HCI) layer below. After creating the connection the application performs the security I/O messages. This is explained in Fig 1.2.

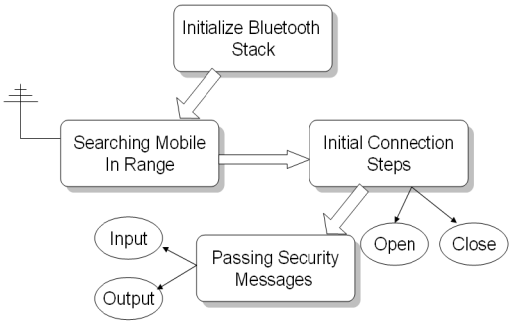


Fig. 1.2 Connection Establishment at Laptop Side (Client Side)

3.3 Connection establishment at mobile phone side:

The mobile phone acts as server in the Piconet, it performs the following steps:

1. creates a server connection using the L2CAP
2. Waits for accepting connection and then opens up the connection with the client (laptop)
3. Performs security application I/O messages.

Before creating the connection the application gets, the information about local device and discovers it in the proximity. Meanwhile the client (laptop) establishes the connection to it. When mobile phone receives a L2CAP connection request, it immediately accepts and opens up the connection, then starts performing security I/O messages and accordingly manages the connection. . This is explained in Fig 1.3.

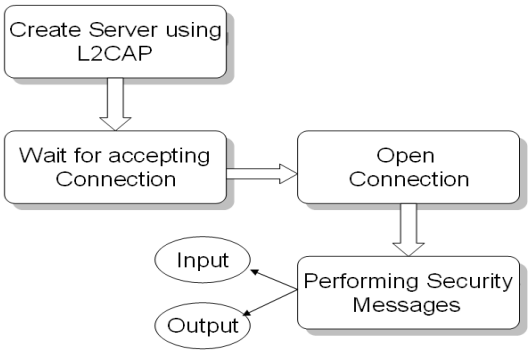


Fig. 1.3 Connection Establishment at mobile phone side (Server Side)

4. Authentication System

4.1 Initial authentication process:

In initial authentication process the system performs an operation based on challenge-response messages between the laptop (client) and mobile phone (server) in order to authenticate each other based on immutable Universal Unique Identification system. This system uses UUID which represents a 128-bit value.

4.2 User authentication process:

As mentioned earlier User authenticates his/her mobile phone infrequently as well as persistently, when the mobile phone requests user for authentication then positive results of this authentication will be valid for a day , if failed to do so user cannot access his/her data for further use. . This is explained in Fig 1.4

Fig 1.4: User Authentication: User has to re-authenticate once in 24 hours to access the data as per persistent authentication.

4.3 Authentication and Encryption-decryption key creation:

Authentication key is used to authenticate the user to the laptop once in 24 hours.

Once the authentication process is complete then the user is requested to select the encryption-decryption (E-D) key to be used for those 24 hours, here the user need not perform a burdensome job of remembering the E-D key. If the process is completed successfully then the encryption-decryption process commences to perform the operation of encrypting the data in absence of the user and decrypting the data in presence of the user, using the same E-D key.

4.4 Disconnection and reconnection

The laptop system periodically sends nonce to mobile phone which ensures the laptop system whether the authorized user is present or absent in the proximity. If the user is present then the sensitive data will be accessible. But if the user is absent then the system will secure itself immediately. But what if the short wireless link between the two devices drops the packet? In that case laptop will secure itself if the response is not received in expected round trip time. Since this is a single, uncontested network hop, this time is relatively stable. Then the Laptop system retries sending a request, if the response is achieved then data will be accessible otherwise it remains in secured state. The overall process is illustrated in Fig 1.5.

Fig. 1.5 Connection and Disconnection: Laptop checking for mobile phone presence.

4.5 Encryption and Decryption process:

In our system which we have implemented, we have used the Data Encryption Standard for the process of Encryption and Decryption. The reason for using this method is that since we have implemented our model using Java Technology, where the encryption and decryption function by default uses DES for encrypting and decrypting the data and also it is fast enough to run efficiently with limited memory resources and processing time. The process of encryption and decryption is explained below in fig 1.6:-

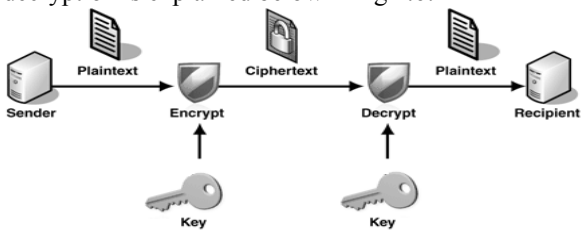


Fig. 1.6 Encryption and Decryption process: Mobile Phone sends the E-D key to for decrypting the data and Laptop uses this E-D key to decrypt the encrypted sensitive data.

4.6 Overall Authentication Process:

The over all processes of authentication system illustrated in Fig. 1.7.

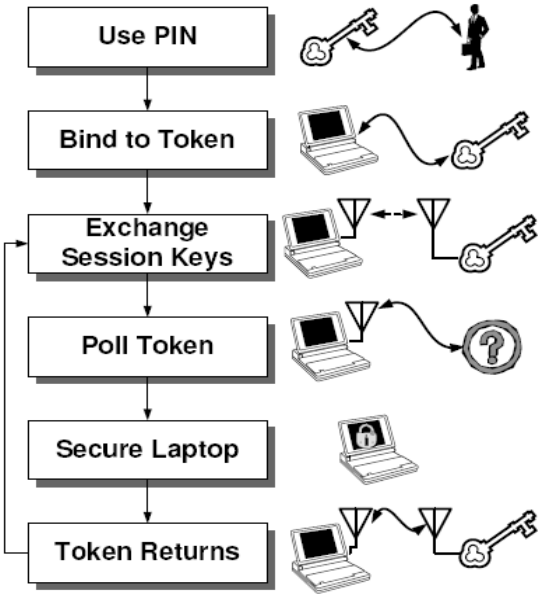


Fig. 1.7 Authentication System: The steps followed in overall Authentication Process.

5. Data Fortress Implementation

As we have mentioned earlier in that we have implemented the transient system using mobile phone and laptop. The Data fortress system uses mobile phone as token and Laptop as wireless device containing sensitive information. The languages used were J2SE and J2ME. The implementation algorithms developed by us are given below:

5.1 Algorithms

The vital Algorithms developed by us for implementing the Data Fortress applications are as follows:

Activity diagrams describe the workflow behavior of a system. Activity diagrams show the flow of activities through the system

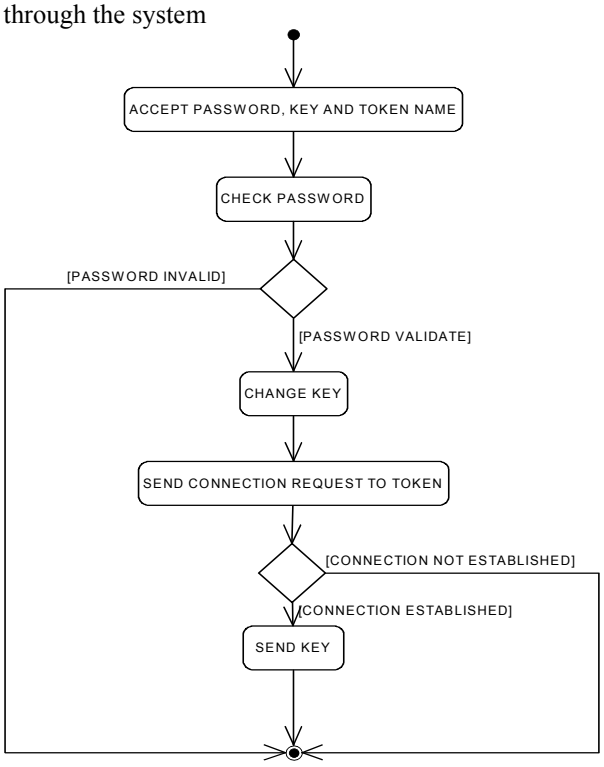


Fig 1.8 Process of Communication Establishment.

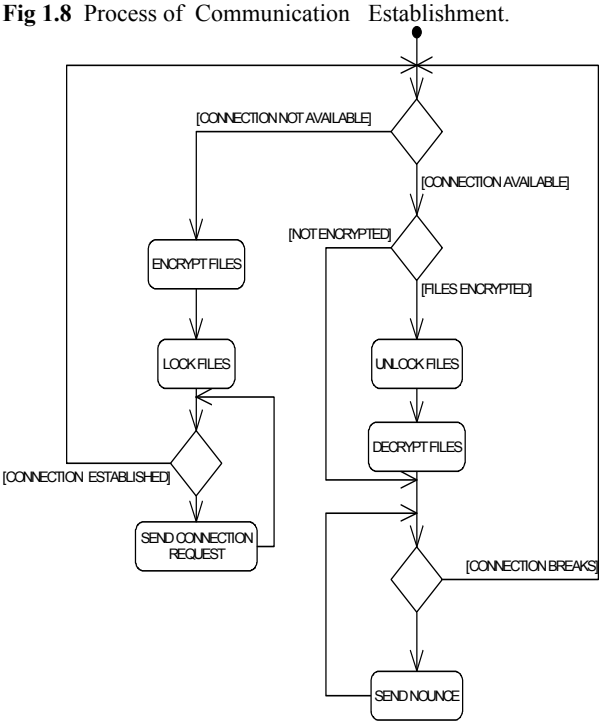


Fig 1.9 Processes at Laptop side.

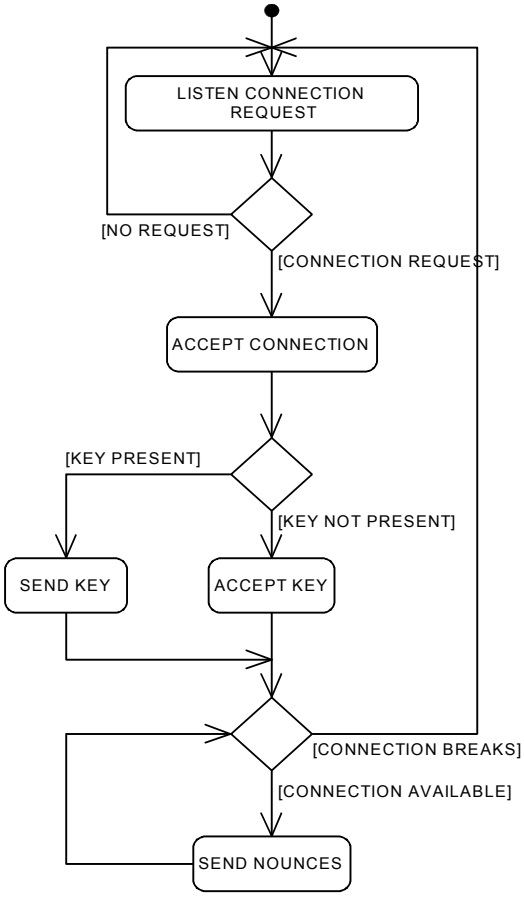


Fig 1.10 Process at Mobile phone.

The vital Algorithms developed by us for implementing the Data Fortress applications are as follows:

5.1.1 Algorithm for Connection

Establishment between Laptop and Mobile phone

BluetoothServiceDiscovery class is used to establish connection.

1. Creating the object of DiscoveryAgent.
2. A StartInquiry method of DiscoveryAgent object is called for searching the device in the proximity.
3. After completion of the Search for devices, a lock is applied until the user selects the respective device for the purpose of binding. Lock is applied for halting the processes.
4. An application service is searched on the selected device from step (C) using a SearchService method.
5. After application service is searched on the token device then L2CAP connection is established using Connector.open(connectionURL) where connectionURL is a string.
6. After connection is established Nounces are send/receive to validate the
7. presence of the token in the proximity.

5.1.2 Algorithm for monitoring and maintaining the connection

LaptopThread class is used for checking the status of connection and accordingly performing encryption and decryption.

1. The lock is applied. This lock helps in keeping the track of the connection.
2. This lock is notified when disconnection/reconnection occurs.
3. The status of the connection is checked and respective action is taken, that is,

If disconnection occurs

1. Encrypt the sensitive data
2. Stop the accessibility of the access rights of these files

If Reconnection occurs

1. Allow the access rights to be accessible
2. Decrypt the data
3. Go to step A.

5.1.3 Algorithm for Locking the Access Rights of sensitive files

Locker class was developed to block the access rights for the purpose of unauthorized access. To achieve this we developed two functions.

Lock() function is called when disconnection occurs.

1. Store the path of the files.
2. File channel uses pointer to access the Read-Write rights of the files.
3. Lock is applied.

Unlock() function is called when reconnection occurs.

1. Release the lock applied in Lock().
2. Close the file channel to allow the user to access the file.

5.1.4 Algorithm for protecting the sensitive files.

Protection, encryptfile and decryptfile classes are used to provide the protection to the sensitive files. For encryption and decryption Data Encryption Standard Algorithm was used.

For encrypting the file,

1. Create the object of Encryptor class and the file.
2. Store the file in the FileInputStream, which reads the input file in bytes.
3. The E-D key and data is passed to the encrypt() of the Encryptor class.
4. Obtain the encrypted file by using the FileOutputStream.

For decrypting the file,

1. Create the object of Encryptor class and the file.
2. Store the encrypted file in the FileInputStream, which reads the input file in bytes.
3. The E-D key and encrypted data is passed to the decrypt() of the Encryptor class.
4. Obtain the decrypted file by using the FileOutputStream.

6. Future Work

The threat of losing the token is very serious. Several future research topics could mitigate this problem. The first is to require biometric feedback to keep the token functioning.

Although a fingerprint may work for an initial authentication, continuous monitoring of heartbeat or body temperature could detect if the user removes the token. If the pulse or heat source is lost, the token must be revived with a password.

If the mobile system can provide a small amount of physically secure hardware, there are simpler ways to construct this system. For instance, this hardware would store the key-encrypting keys, which can only be unlocked by a wireless token.

This token need only supply the correct pseudo-random sequence—similar to a SecureID. This requires trusting the physical security of the hardware, and in exchange the token can be constructed as a one way transmitter with significantly less computational power. Such a system still requires the use of mechanisms to deal with lost authentication, binding, and key-management.

7. Results

System declares user absent after three tries to connect to mobile phone without response. Figures1.12 below show the time required by laptop program to declare user absent and secure laptop by run semi screen sever threaded program. Laptop continues sense the return of the mobile phone and hence the user to stop security program and reconnect user. Figure 1.11 shows the time required by laptop program to reconnect user and stop security thread.

There are two concepts in system security:

1. User's mobile phone cannot provide authentication services to other user's laptops.
2. Mobile phone cannot send authentication messages over wireless link in clear text form

System security:

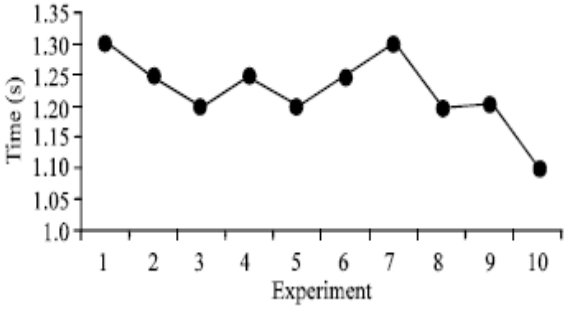


Fig. 1..11: Time required for user reconnection

.

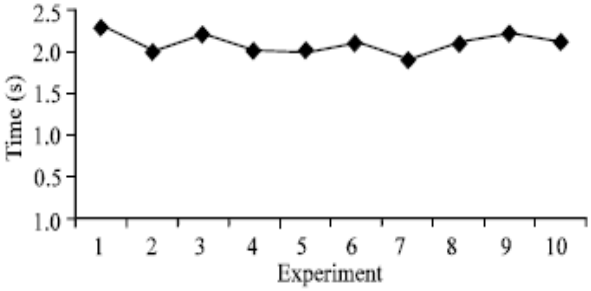


Fig. 1.12 : Time required for user disconnection

8. Conclusion

Now-a-days, information in wireless devices is indispensable for the users of the respective devices. This information may be present in laptops, desktop computers etc. which is vulnerable to theft. We provide a secure system which protects the sensitive data of the user in these devices.

In our system, we are using cell phone as a token which will authenticate the system and the client machine, which can be a laptop or a desktop computer. These two systems are connected to each other via a Bluetooth.

Once, the devices are authenticated and connected then our application will ask the user to declare the sensitive files and folders on laptop or desktop machine.

When the user along with his cell phone is in the range of the laptop or desktop computer, the sensitive data will be available for access and as soon as the user is outside the range then the data will be inaccessible to others.

Hence, our application provides security to the sensitive data in the laptop or desktop machine. The advantage of our application is that the user doesn't have to authenticate him/her time and again to the system, as authenticity is taken care by our application. We have developed the pioneer version of Data Fortress application we strictly feel that this application has various areas in which it can further be extended. We the developers conclude that our security makes system more efficient and also assures high level of reliability to the users of Data Fortress.

9. References

[1] A. Adams and M.A. Sasse, "Users Are Not the Enemy: Why Users Compromise Security Mechanisms and How to Take Remedial Measures," Comm. ACM, vol. 42, no. 12, pp. 40-46, Dec. 1999.

[2] R. Anderson, "Why Cryptosystems Fail," Comm. ACM, vol. 37, no. 11, pp. 32-40, Nov. 1994.

[3] M. Blaze, "Key Management in an Encrypting File System," Proc. Summer 1994 USENIX Conf., pp. 27-35, June 1994.

[4] M. Burrows, M. Abadi, and R. Needham, "A Logic of Authentication," ACM Trans. Computer Systems, vol. 8, no. 1, pp. 18-36, Feb. 1990.

[5] Anthony J. Nicholson, Mark D. Corner , Brian D. Noble ," Mobile Security Using Transient Authentication " IEEE Transaction on Mobile Computing, VOL. 5, NO. 11, NOVEMBER 2006

[6] B. Schneier, Applied Cryptography. John Wiley and Sons, 1996

[7] M. Corner and B. Noble, "Zero-Interaction Authentication," Proc. Eighth Int'l Conf. Mobile Computing and Networking (ACM MobiCom'02), Sept. 2002.

[8] C. Landwehr, "Protecting Unattended Computers without Software," Proc. 13th Ann. Computer Security and Applications Conf. (ACSAC), pp. 274-283, 1997.

[9] Kahate, A., 2003. Cryptography and Network Security, 1st Edn., Tata McGraw-Hill Company, India.

[10] Chang, J.K.W., 2003. An interaction of Bluetooth technology for zero interaction authentication. Honours Project, School of Computer Science, Carleton University.

AET - 0025

Green Marketing

*CH.R.S.CH.MURTHY,

Asst.Professor, School of Management Science, Sreenidhi Institute of Science and Technology, Ghatkesar, Hyderabad, Andhrapradesh, Email : chodisetty.b4u@gmail.com, Mobile No : 7396957328, 9989199668

Abstract

Green marketing encourages the selling of eco friendly products. Green marketing has started as a small promotional campaign initially but now we can hardly find any company which is not practicing green marketing . Consumers appreciate the green marketing campaigns but they do not buy eco friendly products if they are expensive. So a green marketer should produce eco friendly products that are less costly and qualitative. Toyota's "Hybrid Synergy Drive." System allows the driver to constantly monitor the amount of energy drawn from its electric motor, as opposed to the less eco-friendly gas motor. This paper highlights the perception of customers on green marketing and reasons for choosing green products.

Keywords: Green Marketing, Customers, Eco-friendly products.

1. OBJECTIVES OF THE STUDY

- To study the perception of customers on green marketing
- To study whether the customers are choosing green products

2. INTRODUCTION

Green marketing refers to the process of selling products and/or services based on their environmental benefits. Such a product or service may be environmentally friendly in it or produced and/or packaged in an environmentally friendly way. The obvious assumption of green marketing is that potential consumers will view a product or service's "greenness" as a benefit and base their buying decision accordingly. The not-so-obvious assumption of green marketing is that consumers will be willing to pay more for green products than they would for a less-green comparable alternative product - an assumption that, in my opinion, has not been proven conclusively. While green marketing is growing greatly as increasing numbers of consumers are willing to back their environmental consciousnesses with their dollars, it can be dangerous. The public tends to be skeptical of green claims to begin with and companies can seriously damage their brands and their sales if a green claim is discovered to be false or contradicted by a company's other products or practices. Presenting a product or service as green when it's not is called green washing.

3. METHODOLOGY

The study is based on the primary data and secondary data. Primary data is collected through Questionnaire and Secondary data was collected from various books, internet.

4. STRATEGIES FOR GREEN MARKETING SUCCESS

Under the new rules, the currency of sustainable branding is innovation & flexibility

- Understand the deeply held environmental and social beliefs and values of customers and other stakeholders and develop a long-term plan to align with them.
- Create new products and services that balance customer's desires for quality, convenience, and affordability with minimal adverse environmental and social impacts over the life of the product.
- Develop brands that offer practical benefits while empowering and engaging customers in meaningful ways about the important issues that affect their lives.

5. FEW EXAMPLES OF CORPARATE-GO GREEN

Bank of America: The Company reduced paper use by 32% from 2000-2005, despite a 24% growth in their customer base. Bank of America also runs an internal recycling program that recycles 30,000 tons of paper each year, good for saving roughly 200,000 trees for each year of the program's operation. As if that weren't enough, the company also offers employees a $3,000 cash back reward for buying hybrid vehicles

- **DuPont:** In addition to drastically lowering its emissions greenhouse gases, DuPont has appointed an ex-Greenpeace head as an adviser to the board. And true to its word, the company successfully reduced greenhouse gas emissions during the 90′s by 63% – far ahead of the timetable set forth in the controversial Kyoto Protocol.

- **MacDonald:** McDonalds now works in close collaborations to systematically reform its business practices to be more humane and friendly to the environment in which they operate.

- **Starbucks:** Starbucks has green advocates smiling about its "bean-to-cup" approach, which stresses top efficiency at each link of its global supply chain. By all measures the program appears to be a great success, with the company's decision to use coffee cup sleeves made of recycled paper saving roughly 78,000 trees per year

6. NEW RULES OF GREEN MARKETING

- Values guide customer purchasing.
- Life Cycle Considerations are Important.
- Manufacturer and retailer reputation count now more than ever.
- Businesses are their philosophies**.**
- Nearly everyone is a corporate stakeholder.
- Authenticity.

7. KEYS TO SUCCESSFUL GREEN MARKETING

- ***Being genuine*** means that you are actually doing what you claim to be doing in your green marketing campaign and that the rest of your business policies are consistent with whatever you are doing that's environmentally friendly. Both these conditions have to be met for your business to establish the kind of environmental credentials that will allow agree marketing campaign to succeed.
- ***Educating the customers*** isn't just a matter of letting people know you're doing whatever you're doing to protect the environment, but also a matter of letting them know why it matters. Otherwise, for a significant portion of your target market, it's a case of "So what?" and your green marketing campaign goes nowhere.
- ***Giving customers an opportunity to participate*** by personalizing the benefits of companies environmental friendly actions, normally through letting the customer take part in positive environmental action.

8. ANALYSIS OF STUDY

8.1. NEED FOR GREEN MARKETING

S.NO	Statement	Number of respondents	% of respondents
1.	YES	94	94
2.	NO	06	06
	Total	100	100

Interpretation: Most of the respondents are of opinion that, there is a green emergency prevailing in the world. The reason is to protect our environment and have maximum utilization of scarce resources.

8.2. OPINION ON THE QUALITY OF PRODUCTS RELEASED THROUGH GREEN MARKETING

S.NO	Statement	Number of respondents	% of respondents
1.	HIGHLY SATISFIED	06	06
2.	SATISFIED	21	21
3.	DIS SATISFIED	73	73
	Total	100	100

Interpretation: Very few customers are satisfied with the quality of the products. They are of opinion that these products perform well initially but the performance declines by the passage of time.

8.3. WOULD YOU SUPPORT THE CONCEPT OF GREEN MARKETING

S. NO	Statement	Number of respondents	% of respondents
1.	EXCELLENT	04	04
2.	GOOD	07	07
	NEEDS IMPROVEMENT	89	89

Interpretation: It is evident that many of the respondents support the green marketing concept as it results in producing eco-friendly products which improves peoples responsibility towards the environment, protect the resources .

8.4. REASON FOR NOT PURCHASING THE GREEN PRODUCTS

S.NO	Statement	Number of respondents	% of respondents
1.	FREQUENT REPAIRS	23	23
2.	LACK OF AWARENESS	41	41
3.	EXPENSIVE	36	36
	Total	100	100

Interpretation: The lack of appreciation of green products is lack of awareness. Some are of opinion that they do not buy these products as they are costly and performance of these products is very low.

8.5. OPINION ON RESEARCH AND DEVELOPMENT OF GREEN PRODUCTS

S.NO	Statement	Number of respondents	% of respondents
1.	YES	94	94
2.	NO	06	06
	Total	100	100

Interpretation: It is revealed that companies practicing green marketing should increase their research and development and produce products that perform well. Steps should be taken to reduce their prices also**.**

8.6. WOULD YOU BELIEVE IN THE GREEN MARKETING CAMPAIGNS

S.NO	Statement	Number of respondents	% of respondents
1.	YES	77	77
2.	NO	23	23
	Total	100	100

Interpretation: Everyone support the green marketing campaigns. Number of green washers increased. Most of these are just brand building steps. There is a fix to decide whether it is an ethical campaign or it is just a green wash

FINDINGS

- Green products require renewable and recyclable material, which is costly
- Requires a technology, which requires huge investment in R & D
- Majority of the people are not aware of green products and their uses
- Majority of the customers are not willing to pay a premium for green products
- Durability and quality of green products should be increased

9. CONCLUSION:

The world is after green marketing. Most of the consumers are interested in green marketing. They must be ready to pay high for the green products. The companies should also increase the awareness of usage of green products. It is the responsibility of the public to propagate and consume green products. The only one thing that they want is the companies should produce green products that perform well and yield low damages.

10. REFERENCES:

- Chopra, S. Lakshmi (2007), "Turning Over a New Leaf", Indian Management, Vol-64, April-2007
- Ottman, J.A. et al, "Avoiding Green Marketing Myopia", Environment, Vol-48, June-2006
- www.greenmarketing.net/stratergic.html
- www.epa.qld.gov.au/sustainable_ industries
- Green Marketing - benefits http://www.referenceforbusiness.com/encyclopedia/Gov-Inc/Green-Marketing.html#ixzz1Vf69E4L5
- Mintu-Wimsatt, Alma T., and Michael J. Poloinsky, eds. *Environmental Marketing; Strategies, Practice, Theory, and Research.* Binghamton, NY: Haworth Press, 1995;
- Ottman, Jacquelyn A. and Reilly, William K. *Green Marketing:*
- *Opportunity for Innovation.* Lincolnwood, IL: NTC Business Books, 1998.
- Smith, Toby. *The Myth of Green Marketing: Tending Our Goats at the Edge of Apocalypse.* Toronto: University of Toronto Press, 1998.

AET - 0026

Customer Preferences

*P.LAKSHMI NARAYANAMMA,

Asst.Professor, School of Management Science, Sreenidhi Institute of Science and Technology, Ghatkesar, Hyderabad, Andhrapradesh, Email : lakshmipathi.mba@gmail.com, Mobile No : 9030359812

Abstract

Preference is a person feeling of pleasure resulting from the power or ability to choose one thing over another with the anticipation that the choice will result in greater satisfaction. Weighing needs or preferences against provided product or service attributes results in the balance of satisfaction pointing in a negative or positive direction; depending on whether interests are conflicting or corresponding. Thus the objective of this paper is to study the awareness of customers towards the vehicles of Maruti Suzuki, satisfaction of customers on services of Mitra agencies dealer of Maruti Suzuki. Samples of respondents are interviewed with the help of structured questionnaire. The study concludes that majority of customers are satisfied with the product of Maruti Suzuki along with the services of Mitra Agencies.

Keywords: Customer Preference, Awareness, Satisfaction,

1. OBJECTIVES OF THE STUDY

- To study the awareness of customers towards the vehicles of Maruti Suzuki.
- To study the customer satisfaction on Mitra Agencies a dealer of Maruti Suzuki.

2. INTRODUCTION

"Marketing is the process of planning and executing the conception, pricing, promotion, and distribution of ideas, goods and services to create exchanges that satisfy individual and organizational objectives."

The American Marketing Association (AMA) states, "Marketing is the activity, set of institution, and processes for creating, communicating, delivering, and exchanging offerings that have value for customers, partners, and society at large."'

-American Marketing Association (AMA)

Customer Preference

As with much research on customers, and indeed social science in general, there is a lot of terminological confusion and sometimes a lack of rigour. This is acknowledged within the academic literature and steps are being taken to rectify this situation. The following definitions of key terms are provided in the hope of clarifying the following discussion of the literature.

This is used primarily to mean an option that has the greatest anticipated value among a number of options. This is an economic definition and does not tap into 'wishes' or 'dreams' but for all practical purposes is an appropriate definition. Preference and acceptance can in certain circumstances mean the same thing but it is useful to keep the distinction in mind with preference tending to indicate choices among neutral or more valued options with acceptance indicating a willingness to tolerate the statuesque or some less desirable option.

Customer Expectations

The distinction between expectations and preferences is often blurred though the concepts are distinct. Expectation is used in three slightly differing sense sin the literature. One is the act of expecting or looking forward – a belief about what will happen in the future. Most consumers in Europe expect that clean and safe water will come out of their taps the next time they turn them on. A related but more technical use of expectation is to denote a more formal estimation of the probability of an event occurring. These first two definitions can be distinguished from preference in that

preferences refer to some desired state and, as in the above definition, imply that more than one state is possible and that there are some options.

3. METHODOLOGY

The present research being descriptive in nature mainly depends upon primary and secondary sources of data. The secondary information is collected from Journals, Thesis, reports and websites. Primary data was collected using the structured questionnaire

4. DATA ANALYSIS & INTERPRETATION

Composite Table of Customer Preferences towards Maruti Cars at Mithra Agencies

ATTRIBUTES	PERCENTAGE OF RESPONCES
Reasons for preferring a car	
Symbol of status	23
Necessity	56
Luxury	21
Features preferred before buying car	
Power	9
Fuel efficiency	53
Safety	22
Style	16
Major strengths of maruti cars	
Quality	68
Service	20
Providing loans	12
Cost of car when compare to other	
Expensive	4
Moderate	43
Economical	53
feel while driving maruti	
More comfortable	20
Comfortable	68
Less comfortable	11
Un comfortable	1
Type of car	
Small size	68
Middle size	20
Large size	12
Mode of awareness	
Magazines	11
News papers	23
TV ads	19
Friends	47
Decision maker	
Father	53
Mother	31
Son	14
Daughter	2
Over all performance of the cars	
Excellent	17
Good	59
Average	24
Bad	0
Worst	0
Rank for the mileage of car	
Very good	20
Good	54
Average	26
Bad	0
Worst	0
Dealers attitude towards customers	
Polite	36
Kind and soft	30
Knowledgeable	19
Excellent support	15
Information about service offered by company	
Yes	85
No	15
Customers preference towards different models	
MARUTI SUZUKI	60
HYUNDAI MODEL	25
Preference of the customers on what basis	
Style	12
Latest technology and futures	68
Luxury	20

FINDINGS

- 60% of customers are satisfied with Maruti model.
- 68% of customers are satisfied with latest technology, safety features and its performance of Maruti Suzuki vehicles.
- 53% of the customers are satisfied with fuel efficiency of Maruti Suzuki vehicles.
- Customers are satisfied with the services of Mitra Agencies a dealer of Maruti Suzuki
- Sunday car servicing would be an added advantage to official people and it will be very convenient for every customer

CONCLUSION:

- Maruti Suzuki has a better customer satisfaction rating. Customer's satisfaction towards organization builds long term relation & strong value in them. The organization has been successful in satisfying individual needs of customers.

REFERENCES:

- Philip Kotler, "Marketing Management Prentice Hall , 13th edition (March 6, 2008)
- James H. Gilmore and B. Joseph Pine , "Authenticity: What Consumers Really Want" (Sep 24, 2007)
- www.maruti.com
- www.india.maruti.com

AET - 0027

Foreign Direct Investment in Indian Retail Sector –

Challenges, Growth and Politics on Foreign Direct Investment Policy

Author
Mr. Siddharth Raval
Assistant Professor, V.M. Patel College of Management Studies,
Ganpat University, Kherva (North Gujarat).India
E-mail: srr01@ganpatuniversity.ac.in Mo.: 098242 22989

Co-Author
Mr. Yupal Shukla
Assistant Professor, V.M. Patel College of Management Studies,
Ganpat University, Kherva (North Gujarat).India
E-mail: yss01@ganpatuniversity.ac.in Mo.: 099796 63904

Co-Author
Mr. Kiran J. Patel
Assistant Professor, V.M. Patel College of Management Studies,
Ganpat University, Kherva (North Gujarat).India
E-mail: kjp01@ganpatuniversity.ac.in Mo.: 099249 29070

Abstract

The retail industry in India is of late often being hailed as one of the sunrise in the economy. AT Kearney, the well-known international management consultancy, recently identified India as the 'second most attractive retail destination' globally from among thirty emergent markets. It has made India the cause of a good deal of excitement and the cynosure of many foreign eyes. With a contribution of 15% to the national GDP and employing 7% of the total workforce (only agriculture employs more) in the country, the retail industry is definitely one of the pillars of the Indian economy. But the fears expressed in the Indian parliament by the opposing parties and making politics on policy.

FDI has proved to be beneficial to developing countries like Mexico, Thailand and Brazil. Even China has been seeing positive benefits since it opened its doors to FDI in retail in 1992. A cumulative FDI flow to the retail sector in the 20 largest developing countries in the last decade amounted to 7% of the total flow and has led to positive growth, according to a World Bank report.

Keywords: - Challenges, Growth, Foreign Direct Investment (FDI) in India and Politics on policy.

I. INTRODUCTION

Retailing in India is one of the pillars of its economy and accounts for about 15% of its GDP. The Indian retail market is estimated to be US$ 450 billion and one of the top five retail markets in the world by economic value. The great Indian retail sector is changing day by day. The various global players are trying to enter into the highly opportunistic Indian retail sector. India's retail and logistics industry, organized and unorganized in combination, employs about 40 million Indians (3.3% of Indian population).The typical Indian retail shops are very small. Over 14 million outlets operate in the country and only 4% of them being larger than 500 sq ft (46 m^2) in size. India has about 11 shop outlets for every 1000 people. Vast majority of the unorganized retail shops in India employ family members, do not have the scale to procure or transport products at high volume wholesale level, have limited to no quality control or fake-versus-authentic product screening technology and have no

training on safe and hygienic storage, packaging or logistics. The unorganized retail shops source their products from a chain of middlemen who mark up the product as it moves from farmer or producer to the consumer. Finally, most transactions at unorganized retail shops are done with cash, with all sales being final.

II. LITERATURE REVIEW

Cheng, (1993) noted the growing importance of cross-border R & D activities and suggested that additional research on FDI should be done on why firms internationalize their R & D.

Dijkstra (2000), Tybout (2000) and Vachani (1997) found that investment policy liberalisations have major impacts on firms in less developed countries (LDCs) where the pre-liberalisation level of protection was high. Not all firms are affected equally; some will be losers while others will be winners, depending on their characteristics.

Nagesh Kumar (2001) analyses the role of infrastructure availability in determining the attractiveness of countries for FDI inflows for export orientation of MNC production.

Kulwinder Singh (2005) has analyzed FDI flows from 1991-2005. A sectoral analysis in his study reveals that while FDI shows a gradual increase has become a staple of success in India, the progress is hollow. The telecommunication and power sector are the reasons for the success of infrastructure. He finds that in the comparative studies the notion of infrastructure has gone a definitional change.FDI in sectors is held up primarily by telecommunication and power is not evenly distributed.

Jaya Gupta (2007) in his paper made an attempt to review the change in sectoral trends in India due to FDI Inflows since liberalization. This paper also examines the changed policy implications on sectoral growth and economic development of India as a whole.

Jayashree Bose (2007) in his book studied the sectoral experiences faced by India and China in connection with FDI inflows. This book provides information on FDI in India and China, emerging issues, globalization, foreign factors, trends and issues in FDI inflows, FDI inflows in selected sectors. A comparative study has also been conducted on FDI outflows from India and China. This book also revealed the potential and opportunities in various sectors in India that would surpass FDI inflows in India as compared to China.

Tanay Kumar Nandi and Ritankar Saher (2007) in their work made an attempt to study the Foreign Direct Investment in India with a special focus on Retail Trade. This paper stresses the need of FDI in India in retail sector and uses the augment that FDI is allowed in multiple sectors and the effects have been quite good without harming the domestic economy. The study also suggests that FDI in retail sector must be allowed.

III. GROWTH OVER 1997-2010

India in 1997 allowed foreign direct investment (FDI) in cash and carry wholesale. Then, it required government approval. The approval requirement was relaxed, and automatic permission was granted in 2006. Between 2000 to 2010, Indian retail attracted about $1.8 billion in foreign direct investment, representing a very small 1.5% of total investment flow into India. Single brand retailing attracted 94 proposals between 2006 and 2010, of which 57 were approved and implemented. For a country of 1.2 billion people, this is a very small number. Some claim one of the primary restraints inhibiting better participation was that India required single brand retailers to limit their ownership in Indian outlets to 51%. China in contrast allows 100% ownership by foreign companies in both single brand and multi-brand retail presence.

Indian retail has experienced limited growth, and its spoilage of food harvest is amongst the highest in the world, because of very limited integrated cold-chain and other infrastructure. India has only 5386 stand-alone cold storages, having a total capacity of 23.6 million metric tons. However, 80 percent of this storage is used only for potatoes. The remaining infrastructure capacity is less than 1% of the annual farm output of India, and grossly inadequate during peak harvest seasons. This leads to about 30% losses in certain perishable agricultural output in India, on average, every year.

GROWTH AFTER 2011

Before 2011, India had prevented innovation and organized competition in its consumer retail industry. Several studies claim that the lack of infrastructure and competitive retail industry is a key cause of India's persistently high inflation. Furthermore, because of unorganized retail, in a nation where malnutrition remains a serious problem, food waste is rife. Well over 30% of food staples and perishable goods produced in India spoils because poor infrastructure and small retail outlets prevent hygienic storage and movement of the goods from the farmer to the consumer.

One report estimates the 2011 Indian retail market as generating sales of about $470 billion a year, of which a miniscule $27 billion comes from organized retail such as supermarkets, chain stores with centralized operations and shops in malls. The

opening of retail industry to free market competition, some claim will enable rapid growth in retail sector of Indian economy. Others believe the growth of Indian retail industry will take time, with organized retail possibly needing a decade to grow to a 25% share. A 25% market share, given the expected growth of Indian retail industry through 2021, is estimated to be In 2011, food accounted for 70% of Indian retail, but was under-represented by organized retail. A.T. Kearney estimates India's organized retail had a 31% share in clothing and apparel, while the home supplies retail was growing between 20% to 30% per year.

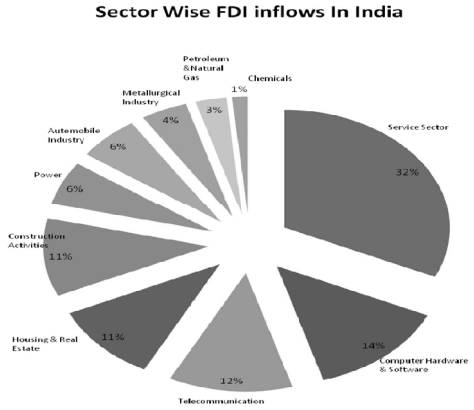
IV. FDI INFLOWS IN INDIA

Sector-wise FDI Inflows in India from April 2010-Dec 2010

Sector–wise FDI Inflows (Rupees in Crores)

Sector	2009-10 (April-March)	2010-11 (for April '10)	Cumulative Inflows (April '00 - April '10)	% age to Total Inflows (In terms of US$)
Services Sector (financial & non- financial)	20,958	1,581	106,992	**21 %**
Computer Software & Hardware	4,350	765	44,611	**9 %**
Tele-communications	12,338	1,914	42,620	**8 %**
Housing & Real Estate	13,586	246	37,615	**7 %**
Construction Activities (including roads & highways)	13,544	345	36,066	**7 %**
Power	6,908	547	21,466	**4 %**
Automobile Industry	5,609	187	20,864	**4 %**
Metallurgical Industries	1,935	404	13,845	**3 %**

Source Foreign Direct Investment Policy (2009-11), department of Industrial policy and promotion, Ministry of Commerce and Industry, Government of India.



FDI Inflows in India since April 2000- Dec 2010

V. POLITICS ON POLICY

The issue of whether India should allow Foreign Direct Investment (FDI) in the retail sector has been the newest topic of contention between the two Indian coalitions, the UPA (United Progressive Alliance) and NDA (National Democratic Alliance).

The fears expressed in the Indian parliament by the opposing parties include; the death of small family-run retail shops and the related unemployment it will create as well as the competition being oligopolistic, crowded by a few buyers and therefore the ability to exploit the supplier or farmer. While they may be exaggerated, they aren't incorrect; every economic policy comes with its burden. But that's when it's important to draw two columns and run a simple cost-benefit analysis. History and studies have shown that it does more good than bad. Among other things (like international standards of quality), allowing FDI in retail will solve one of the biggest problems in the rural economy in India, that of the exploitative middleman. Profit realisation for farmers is almost 60% higher when they sell to retailers, than to the middleman, as is the situation currently.

Indian political parties just simply being opportunistic (a chance to say that the government doesn't care about the poor farmers, and grab their votes); and genuine frustration with how Prime Minister Manmohan Singh's administration has been handling a whole slew of massive policy issues.

VI. CHALLENGES

McKinsey study claims retail productivity in India is very low compared to international peer measures. For example, the labor productivity in Indian retail was just 6% of the labor productivity in United States in 2010.

India's labor productivity in food retailing is about 5% compared to Brazil's 14%; while India's labor

productivity in non-food retailing is about 8% compared to Poland's 25%.

Total retail employment in India, both organized and unorganized, account for about 6% of Indian labor work force currently - most of which is unorganized. This about a third of levels in United States and Europe; and about half of levels in other emerging economies. A complete expansion of retail sector to levels and productivity similar to other emerging economies and developed economies such as the United States would create over 50 million jobs in India. Training and development of labor and management for higher retail productivity is expected to be a challenge.

To become a truly flourishing industry, retailing in India needs to cross the following hurdles:

- Automatic approval is not allowed for foreign investment in retail.
- Regulations restricting real estate purchases, and cumbersome local laws.
- Taxation, which favours small retail businesses.
- Absence of developed supply chain and integrated IT management.
- Lack of trained work force.
- Low skill level for retailing management.
- Lack of Retailing Courses and study options

VII. CONCLUSION

Opening up of FDI in multi-brand retail in India could potentially be a mixed blessing for domestic players. While initially the small indigenous retailers' business would be impacted once modern retail enters the locality, this adverse impact is expected to be short-lived and to weaken over time. While this long awaited move is not expected to have an immediate impact on the Indian retail sector, it is expected to reap benefits in the medium to long-term as it will help improve the a) balance sheet and liquidity profile of cash-starved retailers with aggressive expansion plans b) supply chain and back-end infrastructure while reducing margins for middlemen through direct sourcing from farmers and c) arrest inflationary pressures through increased supplies facilitated by improved productivity of farmers and reduction of agri-waste.

However, once 100% FDI is allowed in retail, that is when the landscape will become extremely competitive. Further, the move needs to be monitored in the wake of the current opposition by several political parties.

VIII. FDI ISSUES AND POLICY RECOMMENDATION

FDI can be instrumental in developing rural economy. There is abundant opportunity in Greenfield Projects. But the issue of land acquisition and steps taken to protect local interests by the various state governments are not encouraging. MOU Arecelor- Mittal controversy is one of the best examples of such disputes.

India has a huge pool of working population. However, due to poor quality primary education and higher there is still an acute shortage of talent. This factor has negative repercussion on domestic and foreign business. FDI in Education Sector is less than 1%. Given the status of primary and higher education in the country, FDI in this sector must be encouraged. However, appropriate measure must be taken to ensure quality. The issues of commercialization of education, regional gap and structural gap have to be addressed on priority.

Indian economy is largely agriculture based. There is plenty of scope in food processing, agriculture services and agriculture machinery. FDI in this sector should be encouraged. The issue of food security, interest of small farmers and marginal farmers need cannot be ignored for the sake of mobilization of foreign funds for development.

India has a well developed equity market but does not have a well developed debt market. Steps should be taken to improve the depth and liquidity of debt market as many companies may prefer leveraged investment rather than investing their own cash. Looking for debt funds in their own country invites exchange rate risk.

In order to improve technological competitiveness of India, FDI into R&D should be promoted. Various issues pending relating to Intellectual Property Rights, Copy Rights and Patents need to be addressed on priority. Special package can be also instrumental in mobilizing FDI in R&D.

IX REFERENCES

[1] Cheng, Joseph L.C. 1993, " The management of Multinational R& D : A neglected topic in international business research", Journal of International Business Studies, 24(1) ;1-18.

[2] Dijkstra, A. Geske. 2000. "Trade Liberalization and Industrial Development in Latin America," World Development, vol. 28, no. 9, pp. 1567-1582.

[3] Tybout, James. 2000. "Manufacturing Firms in Developing Countries: How Well Do They Do, and Why? Journal of Economic Literature, vol. XXXVIII (March), pp. 11-44.

[4] Vachani, Sushil. 1997. "Economic liberalization's effect on sources of competitive advantage of different groups of companies: The case of India," International Business Review, vol. 6, no. 2 (April), pp. 165-18.
[5] Kumar, Nagesh (2001). Globalization and the Quality of Foreign Direct Investment: Role of Host Country Characteristics and Emerging WTO Regime, New Delhi: OxfordUniversity Press, forthcoming.
[6] Jaya Gupta(2007), "Gloablisationa and Indian Economy: Sector-wise Analysis.
[7] Tanay Kumar Nandi and Ritankar Sahu, "Foreign Direct Investment In India With Special Focus On Retail Trade", Journal Of International Trade Law And Policy, Year: 2007, Vol.: 6,Issue: 2,Page: 40-53,Emerald Group Publishing Limited.
[8] Jayashree Bose(2007), "FDI Inflows in India and China – A Sectoral Experiences", ICFAI University Press, Hyderabad.
[9] Singhal, Arvind, Indian Retail: The road ahead, Retail biz, www.etretailbiz.com
[10] "The Bird of Gold - The Rise of India's Consumer Market". McKinsey and Company. May 2007.
[11] "Winning the Indian consumer". McKinsey & Company. 2005.
[12] Majumder, Sanjoy (25 November 2011). "Changing the way Indians shop". *BBC News*.
[13] "Global Economy: China, India confront WalMarts". Asia Times. 31 January 2004.
[14] "FDI IN MULTI-BRAND RETAIL TRADING". KPMG. 2010.
[15] "India Unlocks Door for Global Retailers". The Wall Street Journal. November 25, 2011.
[16] "Wal-Mart Waits With Carrefour as India Wins Instant Gain: Retail". Bloomberg BusinessWeek. 30 November 2011.
[17] "Indian retail: The supermarket's last frontier". The Economist. 3 December 2011.
[18] "INDIAN RETAIL INDUSTRY: A Report". CARE Research. March 2011.
[19] "INDIAN RETAIL INDUSTRY: A Report". CARE Research. March 2011.
[20] "Global Powers of Retailing 2011". Deloitte. 2011.
[21] "India's retail reform: No massive rush". The Economist. 2 December 2011.
[22] "Retail Global Expansion: A Portfolio of Opportunities". AT Kearney. 2011.
[23] Foreign Direct Investment Policy (2009-11), department of Industrial policy and promotion, Ministry of Commerce and Industry, Government of India.
[24] 24)http://www.policymic.com/article/list?category_id=1
[25] http://en.wikipedia.org/wiki/Retailing_in_India

AET - 0028

"Attribute based Perceptual Mapping of traditional wear Retail Brands": An Empirical study at Navi Mumbai

Samant Shant Priya*, Faculty,
Sinhgad Institute of Business Administration & Computer Application, Lonavala
samantsp@gmail.com, +919923190752

Jay Kumar Bachwani, Student,
Sinhgad Institute of Business Administration and Computer Application, Lonavala
bachwanijay@gmail.com, +917875062958

Aashish Deshpande
Professor, NITTTR, Bhopal
Aashish.deshpande@gmail.com

Vimelesh kumar Soni
Assistant Professor, MANIT, Bhopal
soni_vk@rediffmail.com

Abstract:

Perceptual Mapping has been widely used by the marketers in order to study the consumer perception towards the brand. To develop a sustainable position it is important to understand the market in which the product is to compete and the way in which competitor brands are competing. This research paper analyses the perception of the consumers at Navi Mumbai towards the traditional wear retail brands. Discriminant analysis is used to map selected traditional wear retailers along various attributes. The study reflects how the consumer perceives the traditional wear brands with respect to selected attributes.

Keywords: Traditional Wears, Brand Positioning, Perceptual Mapping.

Introduction

Indian traditional dresses- the epitome of style and elegance with India being a country rich in varied and diversified cultures and vast heritage, traditional Indian dresses have always attracted people towards it. It very subtly reflects the Indian culture in its varied forms and designs. Even the top notch designers are no exception to it that opt for the ethnic designs and very elegantly portray the Indian culture and its tradition.

Traditional clothing has come into lime light once again. The present trends in the fashion industry have aped the styling and the designing of the bygone eras, the period of royalty, where the Kings and the Queens used to spend extravagantly on their dresses which are a reminiscent of the splendor and luxury. But with the changing times and the prevailing western culture in India, the creative fashion designers of today are going for the ethnic designs which follow and have a glimpse of the India's glorious past.

India has been well known and recognized worldwide for its hand-woven textiles, richly embroidered fabrics, and handloom works; exclusive designer dresses reflecting the rich Indian culture in its true sense. Indians have always been very fond of dressing up in their traditional outfits and accessories during the festivals and other occasions. Recently, Indian outfits have been gaining worldwide appreciation and have carved a niche for themselves. They are being recognized all over the globe for their esthetic values.

Not only the Indians but the craze for traditional Indian dresses has not remained untouched by the people belonging to other countries than India as well. The subtle and the ethnic Indian costumes have been very successful in fascinating the people everywhere in the world. The aura and charm for the traditional Indian wear is on its way to achieve great success in the global market.

Indian outfits have been stealing the scene everywhere nowadays. It is one of the most talked about, adored and preferred style of today. The Indian attire today is a combination of many eras. The Indian dress has evolved over the years and it has gathered different styles from different royal classes.

Brand Positioning

Positioning encompasses two fundamental elements. The first concerns the physical attributes, the functionality and capability that a brand offers. For example, a car's engine specification, its design, and carbon emissions. The second positioning element concerns the way in which a brand is communicated and how consumers perceive the brand relative to other competing brands in the marketplace. This element of communication is vitally important as it is 'not what you do to a product, it is what you do to the mind of a prospect' (Ries and

Trout, 1972) that determines how a brand is really positioned in a market.

'Positioning is the act of designing the company's offering and image so that they occupy a meaningful and distinct competitive position in the target customers' minds. (Kotler 1997).

A brand's position is the set of perceptions, impressions, ideas and feelings that consumers have for the product compared with competing products. Marketers plan positions that give their products the greatest advantage in selected target markets, and they design marketing mixes to create these planned positions.[1]

Brand Positioning and Brand Communication are important and difficult topics for the marketers. How to position your brand and how to communicate it to the prospective customers are critical to success. The art of personality projection has been used by many brand managers in an attempt to solve his problem.

Perceptual mapping:

Perceptual Mapping is the aggregated visual representation of customer perceptions of brands in a market segment. It provides the data and visuals about the strategic marketing decisions like developing new and revising current product

positioning strategies and understanding the brand image and its reputation relative to the competitors.

Also known as "Product Mapping" because it produces a picture map of a market which indicates as to how a product is perceived on specific features or attributes in the market. Product maps show which products compete in the customers mind and suggests how a product can be positioned to maximize preference and sales.

It is a key element of the competitive marketing strategy. Each brand within a set of competitive offerings is thought of as occupying a certain position in a customer's "perceptual space". Thus perceptual mapping generally refers to techniques used to graphically represent this product space.

Literature Review:

In today's scenario brands are the basis of ***consumer relationship***. A Brand to some may be a simple name, logo or symbol whereas to others it may be a promise, guarantee, reputation or identification. They bring together consumers and marketers closer and bind them together.

Michael Treacy and Fred Wiersema distinguished among three major positioning (which they called "value"): product leadership*,* operational excellence*, and* customer intimacy. Some customers value most the firm that offers the best product in the category; others value the firm that operates most efficiently; and still others value the firm that responds best to their wishes. They advise a firm to become the acknowledged leader in one of these value disciplines and be at least adequate in the other two. It would be too difficult or expensive for a company to be best in all three value disciplines.[2] No positioning will work forever. As changes occur in consumers, competitors, technology, and the economy, companies must reevaluate the positioning of their major brands. Some brands that are losing share may need to be repositioned. This must be done carefully. Remaking your brand may win new customers but lose some current customers who like the brand as it is.[3]

According to Kotler positioning is about a product being perceived by consumers in a certain way either by an attitude, benefit, the use or application, price, class or level of quality. In essence you may position exactly the same product in a variety of ways but targeting different markets segments and products needs.[4]

In the paper "Branding of Apparels" by Mr. J. Sriram Prabhu, Mr. P. Sasi Kumar & Mr. Nooruddin, states the importance of the need for apparel brands; various brand elements and the factors that must be remembered before branding of any product, especially apparels.[5]

Various studies have been made taking into consideration different factors playing a role in consumer buying behaviour towards apparels.

Preferences, which influence the selection of products, fall into extrinsic criteria such as brand, label and price and intrinsic attributes such as style, design, uniqueness, appearance, attractiveness fabrication, construction, durability, maintainability, etc (Plumlee and Little, 2001)[6]

Dr. Avinash Kapoor and Dr. Chinmaya Kulshrestha in "The Effect of perception on Indian urban female consumer buying behaviour" presented the parameters namely price and quality influencing the retail apparel purchase decision making.[7]

A study reveals that factors such as Signaling Style and Status, Fabric quality and Value for money play an important role in consumer buying decision process.[8]

The researchers during the study found that the consumers also look for the schemes and offerings made by the retailers during their purchase. (Fornell, *et al*., 2006; 2009) [9&10].

Research Methodology:

Data Collection: Data for the research study was collected through a representative sample survey of 100 respondents at Navi Mumbai. The survey instrument used rating scale: 1-10 with 10 variables. The variables were drawn from the survey of existing literature. The sample was considered at 95% confidence level and 10 % confidence interval for a population of 26, 00,000 which turned out to 96 as sample size.[11]

Statistical Technique Used:

In order to achieve the research objective, discriminant analysis was used to identify the parameters related to the traditional wear brands under the study. The discriminant analysis output gives the Eigen values of each function and the Wilk Lambda Values. The discriminate function represents the axes on which the brands are first located and then attributes are located.

Analysis of the Study

The discriminant analysis was used to obtain the Brand Positioning of the various brands present in the traditional wears. The Eigen values in table 1 show that first two functions represent 85.4% of the cumulative variance.

Table No: 1 Eigen values

	1	2
Durability	**.458***	-.017
Style	**.245***	.184
Quality	.354	**.545***
Convinence	.138	**.360***
Value4Money	.141	**.325***
Offers	.079	**.188***

Similarly Wilk Lambda Values in table 2 show that the first two values are less than 0.5 (Wilk Lambda Value < 0.5, Accepted)

Table No: 2 Wilks Lambda

Brand	**1**	**2**
DiwanSaheb	.871	-1.433
Manyavar	-1.957	-.329
Millionaire	-1.060	1.041
FabIndia	-.179	-.011
Raymond	2.325	.733

Hence these two functions have been used for further interpretation.The first six values of attributes in table 3 of structure matrix constitute the two functions which are considered under study and used for plotting the brand positioning.

Table No: 3 Structure Matrix

Test of Function(s)	Wilks' Lambda	Chi-square	Df	Sig.
1 through 4	**.104**	207.290	40	.000
2 through 4	**.347**	96.736	27	.000
3 through 4	.624	43.120	16	.000
4	.853	14.554	7	.042

Perceptual map was drawn using SPSS output of the discriminant analysis and excel work sheet. Figure 1 shows the perceptual map of the selected traditional wear brands and different attributes.

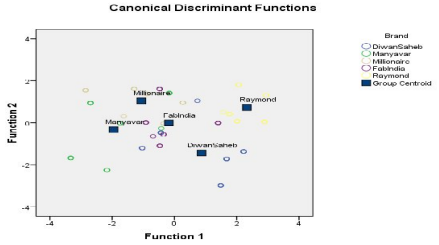


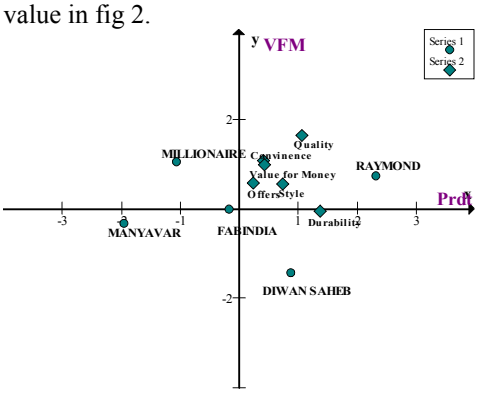
Fig 1: Canonical Discriminant Function

To depict the brands on the map as shown in figure 2, the researchers took coordinates of (Functions at group Centroids) table 6.

Table No: 6 Function at Group Centroid

Function No	Eigen Value	% of Variance	Cumulative %	Canonical Correlation
1	**2.348[a]**	**63.7**	**63.7**	.837
2	**.797[a]**	**21.6**	**85.4**	.666
3	.366[a]	9.9	95.3	.518
4	.172[a]	4.7	100.0	.383

But to plot the value of structure matrix, table 5, were very small and required to multiply that value by the ceiling value of the term which is highest among the values in (functions at group Centroids) table 6 here the highest value is 2.325 and as a result the ceiling value i.e. = 3.This in turn was multiplied with all the values of the structure matrix and were in turn used for plotting the value in fig 2.



Brands and their association with the Attributes/Dimensions

On Style quotient Raymond is placed ahead of all the three brands Manyavar, Fabindia and Millionaire but Diwan Saheb scores over this parameter.

Quality is good as compared to all the three brands Manyavar, Fabindia and Millionaire but as compared to Diwan Saheb its moderate.

VFM (Value for Money) and convenience gives Raymond an upper edge compared to other brands but Diwan Saheb is perceived ahead of Raymond

On Offer attribute also Raymond positions higher over all other brands. Manayavar may be considered for repositioning.

Scope for further Study

The study was limited for five brands which may further be extended by taking into consideration more brands and parameters.

The researchers are sure that this paper will help the brands to understand their positioning in the market and they can apply certain other strategies to get the Top of Mind position in the minds of the customers.

References:

[1] http://www.brandingstrategyinsider.com/2009/09/brand-positioning-and-perceptual-maps.html
[2] http://www.marsdd.com/entrepreneurstoolkit/articles/competitive-strategies-value-disciplines(1)
[3] http://www.marsdd.com/entrepreneurstoolkit/articles/positioning-kotler-on-marketing
[4] http://www.marsdd.com/entrepreneurstoolkit/articles/positioning-kotler-on-marketing(3)
[5] J. Sriram Prabhu, Mr. P. Sasi Kumar & Mr. Nooruddin," Branding of apparels", http://www.fibre2fashion.com/industry-article/25/2481/branding-of-apparels1.asp, retrieved on dtd: 21st Nov 2011.
[6] Plumlee May T. & Little, T.J (2001), "Consumer purchase data as a strategic product development tool", Journal of Textile and Apparel Technology and Management
[7] Dr. Avinash Kapoor and Dr. Chinmaya Kulshrestha, The effect of perception on Indian urban female consumer buying behavior
[8] http://tejas.iimb.org/articles/83.php dtd : 29th Nov 2011
[9] Fornell, C., S. Mithas, and F.V. Morgeson III (2009). "The Economic and Statistical Significance of Stock Returns on Customer Satisfaction," Marketing Science, 28(5), 820-825.
[10] Fornell, C., S. Mithas, F.V. Morgeson III, and M.S. Krishnan (2006) "Customer Satisfaction and Stock Prices: High Returns, Low Risk," Journal of Marketing, 70(1), 3－14
[11] .http://www.surveysystem.com/sscalc.htm, retrieved on Dt: 3rd Dec 2011..

Guidelines for Manuscript Submission

- A Paper in IEEE two column format can be submitted for possible publication in the "Applied Engineering and Technologies "Journal of VIT. The template for the IEEE two column format is available at: http://www.vit.edu.in in Instructions to authors link.
- The paper should be submitted in MS word format to editor.aet@vit.edu.in
- The Authors of the accepted papers have to sign the copy-right form which is available at: http://www.vit.edu.in in Instructions to authors link
- For more information and queries refer http://www.vit.edu or email at: editor.aet@vit.edu.in