



Kisan Seeva

Kunal Jain¹, Mohammed Ahmed Ansari², Sankalp Kumar Gupta³, Deepali Shrikhande⁴

Information Technology, Vidyalkar Institute of Technology, Mumbai

Abstract: *The total number of people has been exponentially growing, and it is predicted that by the middle of 2030, there will be 8.6 billion people on the planet. Due to the enormous growth in population, there will be an increase in both food production and consumption. Crop diseases that harm agricultural products as they grow are the main threat to food security.*

Due to the lack of adequate infrastructure, it is still difficult to quickly identify crop-damaging diseases in several parts of India. By utilizing the app to take crop photographs and analyze the presence or absence of illnesses, the farmer can have a solution which is workable.

Farmers now have a diverse array of crops on their land. Additionally, they aim to expand the variety of crops they grow on their farm. Because they don't foresee crop illnesses at an early stage, farmers with this kind of "Experimental farming" mentality occasionally incur significant losses. They now find it more costly to draw lessons from the past.

The purpose of this article is to examine the requirement for an electronic expert system (android app) that enables farmers to make wise decisions and enhance their farming operations without incurring significant losses.

The suggested system employs an innovative method of object detection to identify plant diseases, which significantly improves the speed and precision of disease detection on leaves. We have utilized CNN models to detect diseases. The CNN model is more accurate than other models in the market. In the suggested approach, we identify whether crops are infected or not, and if they are, the user will be informed and can take appropriate action if the crop is sick.

Keywords: *Plant Disease Prediction, Farmer, crop,*

I. INTRODUCTION

According to our survey in some villages and city; more than 70 percent farmer heists to try new kind of crops instead of their traditional crops because they don't have required knowledge or experience. There are other instances where new crops are tried, but they are severely harmed by diseases, nutrient deficiencies, or other factors. several of the farmers in the area invest in farming based more on experience than on proper understanding. Additionally, make selections based on ocular inspection of plants. However, this necessitates ongoing assessment of expertise, which in huge farms could be too expensive.

Additionally, in some regions, farmers may need to travel a great distance to reach specialists (agricultural officers of panchayat samiti or zilla parishad), making the cost and time of expert consultation excessively high. The automatic diagnosis of plant illnesses from the symptoms that occur on the plant leaves is an interesting study area since it may prove advantageous in monitoring vast fields of crops. This makes machine vision possible, which will allow for image-based process control, robot navigation, and autonomous inspection. The process of diagnosing plant diseases by optically seeing their symptoms on plant leaves is extremely difficult.

Even seasoned agronomists and plant pathologists frequently struggle to accurately diagnose specific diseases, which leads them to draw incorrect conclusions and administer incorrect treatments, because of this complexity, there are vast number of cultivated plants, and their Phyto pathological issues. Agronomists who are requested to make these diagnoses through the optical examination of diseased plants' leaves would benefit greatly from the development of an automated computational system for the identification and diagnosis of plant diseases. Farmers in regions of the world without the necessary infrastructure for the provision of agronomic and Phyto pathological advice may find the system to be a useful tool if it was simple to use and available through a straightforward mobile application. Additionally, the system might be used in conjunction with autonomous agricultural tractors in the case of large-scale cultivations to find Phyto pathological issues precisely and quickly across the cultivation field via continuous image collecting. All of these are, of course, true provided that the system can detect and diagnosing certain diseases in real-world settings (i.e., a cultivation field) and that it can be used in conjunction with a suitable, simple-to-use mobile application.

II. LITERATURE REVIEW

Konstantinos P. Ferentinos. "Deep learning models for plant disease detection and diagnosis". Computers and Electronics in Agriculture [4]. In this article they have implemented CNN Model for disease detection and diagnosis.



Alam, Mohammad Jahangir, Md Abdul Awal, and Md Nurul Mustafa. "Crop disease detection and solution system." International Journal of Electrical and Computer Engineering [2]. In this article an Android app is developed to predict the plant disease and give a solution for the disease. The BRISK algorithm is used to detect disease in plants.

Z. Doshi, S. Nadkarni, R. Agrawal and N. Shah. "AgroConsultant: Intelligent Crop Recommendation System Using Machine Learning Algorithms". International Conference on Computing Communication Control and Automation (ICCUBEA) [6]. In this article they have compared the accuracy of 4 different algorithms i.e., Decision tree, K-NN, Random Forest and Neural Network.

Rainfall prediction model is also implemented for helping the model to make better decision for crop recommendation.

S. M. PANDE, P. K. RAMESH, A. ANMOL, B. R. AISHWARYA, K. ROHILLA and K. SHAURYA. "Crop Recommender System Using Machine Learning Approach." 2021 5th International Conference on Computing Methodologies and Communication (ICCMC) [20]. In this paper they have used various Machine Learning algorithms, with a comparison of error rate and accuracy for predicting crop yield for specific region. They have developed an android application most profitable crop. A GPS based location identifier to retrieve the rainfall estimation at the given area. A recommender system to suggest the right time for using fertilizers.

Medar, R., Rajpurohit, V. S., & Shweta, S. (2019). "Crop Yield Prediction using Machine Learning Techniques." 2019 IEEE 5th International Conference for Convergence in Technology (I2CT) [18]. In this paper they have used two algorithms i.e. Naïve bayes and KNN to predict the crop yield. Naive Bayes is having high accuracy as compared to KNN

III. PROBLEM STATEMENT

The farmer should have greater production in the field, which he can do by routinely examining the crops for pests and illnesses. However, the main issue for farmers is that they are unable to spot infections in time. Even if they phone a helpline for farming professionals, the response time will be lengthy.

Therefore, to address this problem, we are developing an android application that will help farmers spot diseases using plant photographs that are provided to the application. Additionally, the app will be extended with prices of different crops of nearby mandis using API, rental options for farming equipment, and support for several regional farmers through its multilingual nature.

IV. CONCLUSIONS

We have successfully developed and implemented an intelligent crop recommendation system in this study that Indian farmers can utilize right away. The farmers would benefit from this system's help in making educated decisions about the types of diseases affecting their crops and possible treatments. Mandi Price, the ability to rent out equipment, and the ability to support many languages have also been included. Utilizing the methods outlined previously, the building of an electronic expert system for the identification of plant diseases affecting the leaves is accomplished with the inclusion of the other services outlined above.

V. ACKNOWLEDGMENT

We would like to express our special thanks of gratitude to our guide Prof. Deepali Shrikhande who gave us the golden opportunity to do this wonderful project on the topic KISAN SEVA which also helped us in doing a lot of Research and we came to know about so many new things we are thankful to him. Secondly, we would also like to thank our professors of review panel in finalizing and improving this project within the limited time frame. This project helped us in understanding the various parameters which are involved in the development of desktop application and the working and integration of front end along with the back end.

REFERENCES

- [1] Reddy, Santosh, et al. "A survey on crop disease detection and prevention using an android application." International Journal of Innovative Science, Engineering & Technology 2.4 (2015): 621-6.
- [2] Alam, Mohammad Jahangir, Md Abdul Awal, and Md Nurul Mustafa. "Crop disease detection and solution system." International Journal of Electrical and Computer Engineering 9.3 (2019): 2112.
- [3] Ashok, Vani, and D. S. Vinod. "A novel fusion of deep learning and android application for real-time mango fruit disease detection." Intelligent System Design. Springer, Singapore, 2021. 781-791.
- [4] Konstantinos P. Ferentinos, "Deep learning models for plant disease detection and diagnosis", Computers and Electronics in Agriculture, Volume 145, 2018, Pages 311-318, ISSN 0168-1699, <https://doi.org/10.1016/j.compag.2018.01.009>.
- [5] N. Patil, S. Kelkar, M. Ranawat and M. Vijayalakshmi, "Krushi Sahyog: Plant disease identification and Crop recommendation using Artificial Intelligence," 2021 2nd International Conference for Emerging Technology (INCET), 2021, pp. 1-6, doi: 10.1109/INCET51464.2021.9456114.
- [6] Z. Doshi, S. Nadkarni, R. Agrawal and N. Shah, "AgroConsultant: Intelligent Crop Recommendation System Using Machine Learning Algorithms," 2018 Fourth International Conference on Computing Communication Control and Automation (ICCUBEA), 2018, pp. 1-6, doi: 10.1109/ICCUBEA.2018.8697349.
- [7] TY - BOOK AU - Kumar, Rakesh AU - Singh, Maharana AU - Kumar, Prabhat AU - Singh, Jyoti PY - 2015/05/06 TI - Crop Selection Method to Maximise Crop Yield Rate using Machine Learning Technique DO - 10.1109/ICSTM.2015.7225403.



- [8] A. Morbekar, A. Parihar and R. Jadhav, "Crop Disease Detection Using YOLO," 2020 International Conference for Emerging Technology (INCET), 2020, pp. 1-5, doi: 10.1109/INCET49848.2020.9153986.
- [9] Roy, Arunabha M. and Bhaduri, Jayabrata, "A Deep Learning Enabled Multi-Class Plant Disease Detection Model Based on Computer Vision", AI, 2021, URL = (<https://www.mdpi.com/2673-2688/2/3/26>).
- [10] R. Kumar, M. P. Singh, P. Kumar and J. P. Singh, "Crop Selection Method to maximise crop yield rate using machine learning technique," 2015 International Conference on Smart Technologies and Management for Computing, Communication, Controls, Energy and Materials (ICSTM), 2015, pp. 138-145, doi: 10.1109/ICSTM.2015.7225403.
- [11] Wani, J.A., Sharma, S., Muzamil, M. et al. "Machine Learning and Deep Learning Based Computational Techniques in Automatic Agricultural Diseases Detection: Methodologies, Applications, and Challenges." Arch Computat Methods Eng 29, 641–677 (2022). <https://doi.org/10.1007/s11831-021-09588-5>.
- [12] V. Pallagani, V. Khandelwal, B. Chandra, V. Udutalapally, D. Das and S. P. Mohanty, "dCrop: A Deep-Learning Based Framework for Accurate Prediction of Diseases of Crops in Smart Agriculture," 2019 IEEE International Symposium on Smart Electronic Systems (iSES) (Formerly iNiS), 2019, pp. 29-33, doi: 10.1109/iSES47678.2019.00020.
- [13] A. Nigam, S. Garg, A. Agrawal and P. Agrawal, "Crop Yield Prediction Using Machine Learning Algorithms," 2019 Fifth International Conference on Image Information Processing (ICIIP), 2019, pp. 125-130, doi: 10.1109/ICIIP47207.2019.8985951.
- [14] Ahmed, A.A.; Reddy, G.H. "A Mobile-Based System for Detecting Plant Leaf Diseases Using Deep Learning." AgriEngineering 2021, 3, 478-493. <https://doi.org/10.3390/agriengineering3030032>.
- [15] Medar, Ramesh & Rajpurohit, Vijay & Shweta, Shweta. (2019). "Crop Yield Prediction using Machine Learning Techniques." 1-5. 10.1109/I2CT45611.2019.9033611.
- [16] Manik Rakhra, Ramandeep Singh, "A study of machinery and equipment used by farmers to develop an uberized model for renting and sharing," Materials Today: Proceedings, 2021, ISSN 2214-7853, <https://doi.org/10.1016/j.matpr.2020.11.784>.
- [17] Suresh, N., Ramesh, N. V. K., Inthiyaz, S., Priya, P. P., Nagasowmika, K., Kumar, K. V. N. H., ... Reddy, B. N. K. (2021). "Crop Yield Prediction Using Random Forest Algorithm." 2021 7th International Conference on Advanced Computing and Communication Systems (ICACCS). doi:10.1109/icaccs51430.2021.9441871.
- [18] Medar, R., Rajpurohit, V. S., & Shweta, S. (2019). "Crop Yield Prediction using Machine Learning Techniques." 2019 IEEE 5th International Conference for Convergence in Technology (I2CT). doi:10.1109/i2ct45611.2019.9033611 10.1109/I2CT45611.2019.9033611.
- [19] Selvaraj, M.G., Vergara, A., Ruiz, H. et al. "AI-powered banana diseases and pest detection." Plant Methods 15, 92 (2019). <https://doi.org/10.1186/s13007-019-0475-z>.
- [20] Geetharamani G., Arun Pandian J., "Identification of plant leaf diseases using a nine-layer deep convolutional neural network." Computers & Electrical Engineering, Volume 76, 2019, Pages 323-338, ISSN 0045-7906, <https://doi.org/10.1016/j.compeleceng.2019.04.011>.



BookBarn: Web Based Book Recommendation and E-Commerce System

Shardul Birje¹, Rohana Survase², Sayali Khamgaonkar³, Deepali Shrikhande⁴

^{1,2,3,4}Department of Information Technology, Vidyalankar Institute of Technology, Mumbai, India

Abstract: *In the current scenario websites or apps allow users to buy new books sell old books or rent books but none of them provides all of these features on the same platform. Many websites exist on the internet which are focusing on the business of E-books as they are easy to maintain and they can be read anytime and anywhere. The system allows a user to buy or sell new books, buy or sell old books, rent old books all at the same destination. The web based application would have a recommendation system based on collaborative and content based recommendations that would recommend books to users based on title and based on similar user's preferences. The recommendation system is designed using Machine learning algorithms thus making it almost close to real life recommendations. The system would also have general features like filter for products, search option for products, responsive website user interface etc.*

Keywords: *E-Books, Recommendation system, Machine learning, Product Filters, Website.*

I. INTRODUCTION

Books have been our source for gaining information or learning new things since a long time but recently we have seen a fall in the number of book readers. People have shifted their attention to E-books which are available easily and can be read anytime a user wants whereas a physical book is available in a Library or it needs to be purchased. But a study suggests that a physical book helps the reader to absorb more information than an E-book.

It is a need to make books easily available to people or to bring the library online. A physical book helps the reader to stay focused and is easier on the eyes. However, the rise of E-books wasn't prevented by these benefits. To solve this many E-commerce companies like Amazon, Flipkart tried to sell books online and allowed users to sell used books. Amazon provides an extra option to buy E-books. A website called Padhega India offered users an opportunity to rent books or buy and sell used books. But none of them offered all the services together in the same platform. We have tried to improve this by building a platform where a user can do all the above services at the same place and thus provide users with features like Shopping Cart, Product recommendations etc.

The objective of our project is to develop a web-based application which would provide users with a variety of books and allow users to buy/sell new books, buy/sell old books, rent books with all other features including a shopping cart, recommendation system to recommend books to the user based on titles as well as based on similar user's choices, a responsive user interface and other features that a regular E-commerce website has. Hence, reducing user's efforts to buy a book and saving the user's time by bringing books to the user's phone. This would not only allow users to buy books but at the same time boost the sale of physical books

II. LITERATURE SURVEY

In paper [1] Nayana Vaidya and Prof. Khachane A.R describe recommender system as an information filtering system which recommends the products or items to the user. They further describe Content based recommender system as the system that compares the already purchased or searched items by the user and recommends similar items to the user and Collaborative Filtering as a method where prediction for the active user is done by calculating the weighted average of all ratings of similar users.

In paper [2] authors Aayush Jain, Shweta Rajeev, Mayank Katiyar, Shreya Sreenivasan, Mohammed Zabeulla proposed to build a shopping website including product recommendation with the title OYE, the application made use of MEAN Stack i.e. Mongo DB, Express, Angular, NodeJS. The recommendation system for their application was built using KNN algorithm. OYE is an e-commerce website that uses Recommender Systems; it even eradicates fake reviews on products while shopping online. It helped the end-users to completely rely on the website while shopping. This project focused on making use of content-based approach in addition to Collaborative Filtering approach to endorse quality content to its users. The project also aimed at using soft computing technologies to create an automated process and develop an intelligent web application



In paper [3] author Kaivan Shah proposes to build a Book Recommendation System using Item Based Collaborative Filtering, He walks us through the different approaches for recommendations and uses the goodbooks10K data set for performing Collaborative filtering. The paper contains the implementation of Item Based Collaborative Filtering with Python.

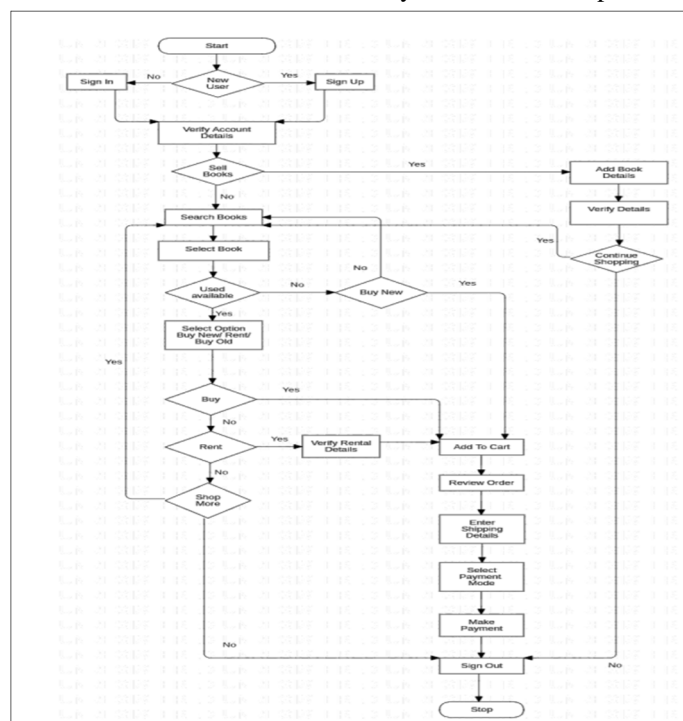
In paper [4] authors E. Uko Okon, B. O. Eke and P. O. Asagba aim to build a Book recommendation system using Collaborative Filtering. They describe a recommender system as a type of filtering system that predicts the rating or preference that a user would give to an item. They have further listed the type of recommendation systems as Personalized and Non Personalized Recommendation systems. They use the MovieLens dataset where the best weak and the best strong generalization results are compared. They propose to use Firebase for storing data.

In paper [5] authors Wei, Fan & Zhang, Qian propose to build an Online Shopping System based on Browser/Server model which is described as a hidden client mode after WEB development. This network structure mode would merge the Web browser as the client to the server. The reason for using Browser/Server model is that it simplifies system development, maintenance, and usage. The client only needs one Browser under the Browser/Server model and the browser would exchange data with database through the web server. In order to do this the system would use Java. Java Server Page, Spring Architecture which is a Model-View-Controller (MVC) architecture.

In paper [6] Khalid Anwar and Jamshed Siddiqui survey machine learning based book recommender system, their main focus is on Collaborative Filtering, Content Based Recommendation system and Hybrid Recommendation System. The paper further gives a brief idea about existing book recommendation systems built till date and the technology used for the same and further gives detailed information about the each of them.

III.PROPOSED SYSTEM

When the user first visits BookBarn he will be displayed all the available books on the homepage with a navigation bar that would navigate the user to different sections of the website, if the user wants to buy a book, he would have to create an account to begin shopping on our website. If he already has an account, he could simply login/Sign in to the website. After which the user would be taken to the Account page and the user can now carry out all the activities like selling books, buying books, renting books. The user can edit his account details, at the same time view different products and add them to shopping cart for checking out later. The user can search for books using the search feature provided in the website. We have provided the user with a chance to search book details using Google Books API thus reducing the user's efforts while filling in book details for selling/renting the book. If an old version of the same book is available then the user would be able to buy/rent the book as per the seller has specified.



. Fig 3.1 flowchart



A. Algorithm to be Used

For Recommending books to the user, we would use Collaborative Filtering and content-based Recommendation. Collaborative filtering would use the KNN (K Nearest Neighbor) +SVD algorithm and for Content based filtering we would use TF-IDF (Term Frequency-Inverse Document Frequency)

The KNN algorithm works as follows:

- Step-1: Select the number K of the neighbors (Other users in our case)
- Step-2: Calculate Euclidean distance for K neighbors
- Step-3: Take the K nearest neighbors as per the Euclidean distance that was calculated.
- Step-4: Among these k neighbors, count the number of the data points (books) in each category.
- Step-5: Assign the newly obtained data points to the category for which the count of the neighbor is maximum.

IV.DESIGN

The given diagram shows how application works and how users interact with it.

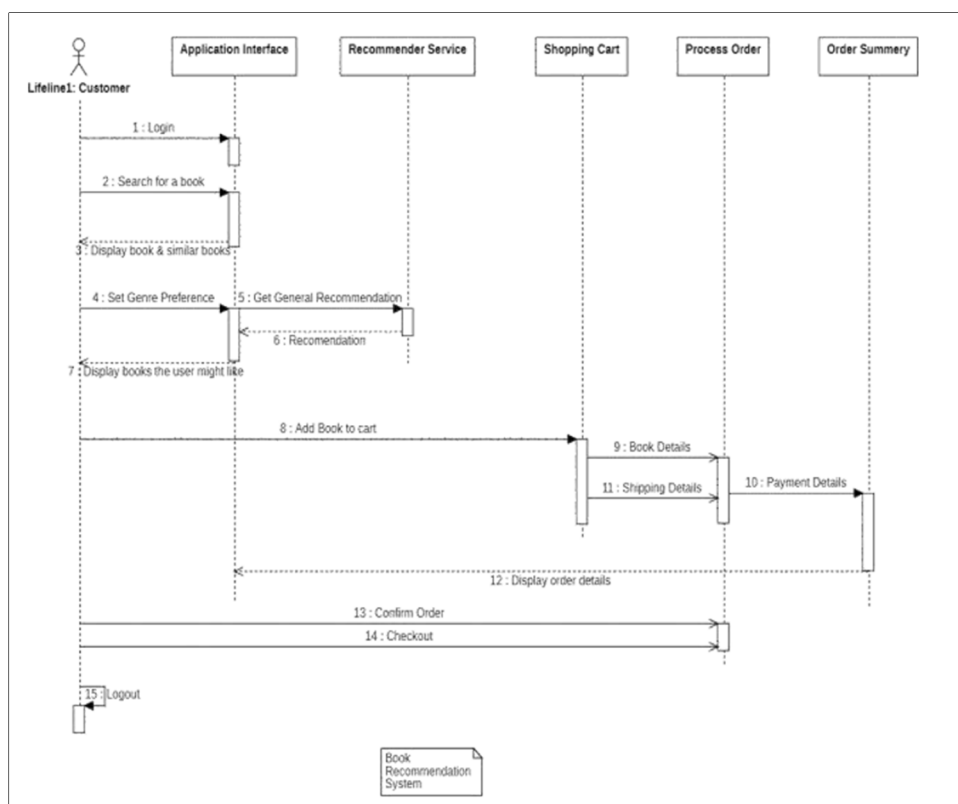


Fig. 4.1 Sequence Diagram

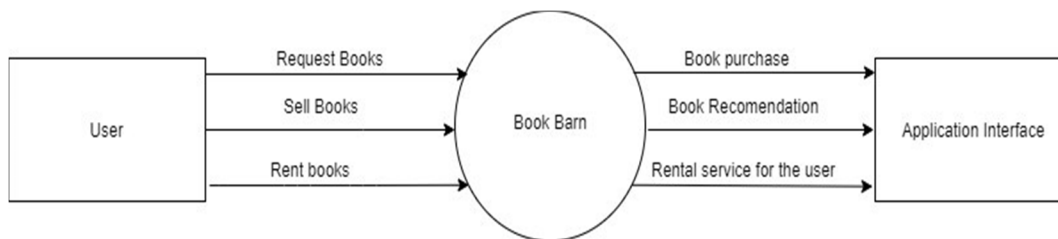


Fig. 4.2 Level 0 DFD



V. SYSTEM SCREENSHOTS



Fig 5.1 User Signup Page



Fig 5.2 Homepage



Fig 5.3 Book Description Page



Fig 5.4 Search Page



Fig 5.5 User Account page



Fig 5.6 Rental page

VI. CONCLUSION AND FUTURE SCOPE

Recommender systems have become an important tool on many websites like NetFlix, Amazon, FlipKart, Spotify. These websites use it for recommending movies, music, products etc. We use this recommendation system to recommend books to users according to their rating history and based on other similar user's experiences. This would thus reduce user's searching time and at the same user could explore more books from our website. This website would further allow users to buy, rent, and sell books on the website thus reducing efforts of the user. Thus, the application would be beneficial to user in terms of efforts and at the same time it would save the user's money as a user can rent a book instead of paying full cost. Some features that could be added in the future includes



- 1) The website could be made available in many different languages
- 2) The website can have a Chat Bot to answer user queries
- 3) A point-based system, where a user gets points for reading books could be added to increase user's engagement.
- 4) The website can have a separate section for buying E-Books.
- 5) BookBarn could be made available as an Android app.

REFERENCES

- [1] N. Vaidya and A. R. Khachane, "Recommender systems-the need of the ecommerce ERA," 2017 International Conference on Computing Methodologies and Communication (ICCMC), Erode, India, 2017, pp. 100-104, doi: 10.1109/ICCMC.2017.8282616.
- [2] OYE-Web based Product Recommendation & Shopping System, Aayush Jain, Shweta Rajeev, Mayank Katiyar, Shreya Sreenivasan, Mr. Mohammed Zabeeulla, International Research Journal of Engineering and Technology(IRJET), Volume: 07 Issue: 06, June 2020
- [3] Kaivan Shah, Book Recommendation System using Item based Collaborative Filtering, International ResearchJournal of Engineering and Technology(IRJET), Volume: 06 Issue: 05, May 2019
- [4] Okon, Emmanuel & O., B. & O., P.. (2018). An Improved Online Book Recommender System using Collaborative Filtering Algorithm. International Journal of Computer Applications. 179. 41-48. 10.5120/ijca2018917193
- [5] Wei, Fan & Zhang, Qian. (2018). Design and Implementation of Online Shopping System Based on B/S Model. MATEC Web of Conferences. 246. 03033. 10.1051/mateconf/201824603033.
- [6] Anwar, K., Siddiqui, J., & Sohail, S. S. (2020). Machine learning-based book recommender system: a survey and new perspectives. International Journal of Intelligent Information and Database Systems, 13(2/3/4), 231. doi:10.1504/ijiids.2020.109457
- [7] Amazon: <https://www.amazon.in/Books/b?ie=UTF8&node=976389031>
- [8] Padhega India: <https://www.padhegaindia.in/>
- [9] Books Wagon: <https://www.bookswagon.com/>
- [10] Sapna Online: <https://www.sapnaonline.com/>



Spam Mail Classifier

Aryan Shirwadkar¹, Samuel Jacob²

Information Technology, Vidyalkar Institute of Technology, Mumbai

Abstract: Email is the worldwide use of communication application. It is because of the ease of use and faster than other communication application. However, its inability to detect whether the mail content is either spam or ham degrade its performance. Nowadays, lot of cases have been reported regarding stealing of personal information or phishing activities via email from the user. This project will discuss how machine learning help in spam detection. Machine learning is an artificial intelligence application that provides the ability to automatically learn and improve data without being explicitly programmed. Binary classifier will be used to classify the text into two different categories: spam and ham. The algorithm will predict the score more accurately. The objective of developing this model is to detect and score word faster and accurately.

Keywords: Mail, Classifier, Detection

I. INTRODUCTION

In today's globalized world, email is a primary source of communication. This communication can vary from personal, business, corporate to government. With the rapid increase in email usage, there has also been increase in the SPAM emails. SPAM emails, also known as junk email, involves nearly identical messages sent to numerous recipients by email. Apart from being annoying, spam emails can also pose a security threat to computer system. We try to identify patterns using classification algorithms to enable us to classify the emails as HAM or SPAM.

In this project, a machine learning technique is used to detect the spam message of a mail. Machine learning is where computers can learn to do something without the need to explicitly program them for the task. It uses data and produce a program to perform a task such as classification. Machine learning techniques require messages that have been successfully pre-classified. The pre-classified messages make the training dataset which will be used to fit the learning algorithm to the model in machine learning studio.

A specific algorithm is used to learn the classification rules from these messages. Those algorithms are used for classification of objects of different classes. The algorithms are provided with input and output data and have a self-learning program to solve the given task.

Searching for the best algorithm and model can be time consuming. The Naive Bayes classifier is best used to classify the type of message either spam or ham. This algorithm is used to predict the probability and classification of data outcome.

II. LITERATURE REVIEW

A. Survey of Existing/Similar System

- 1) Google Spam Filter
- 2) Outlook Spam Filt

B. Project Contribution

- 1) This system is easy to use by the individual member due to flexibility of system.
- 2) It is user friendly which help the user to classify mail.
- 3) It provides sensitivity to the client and adapts well to the future spam techniques.
- 4) It considers a complete message instead of single words with respect to its organization.

III. PROBLEM STATEMENT

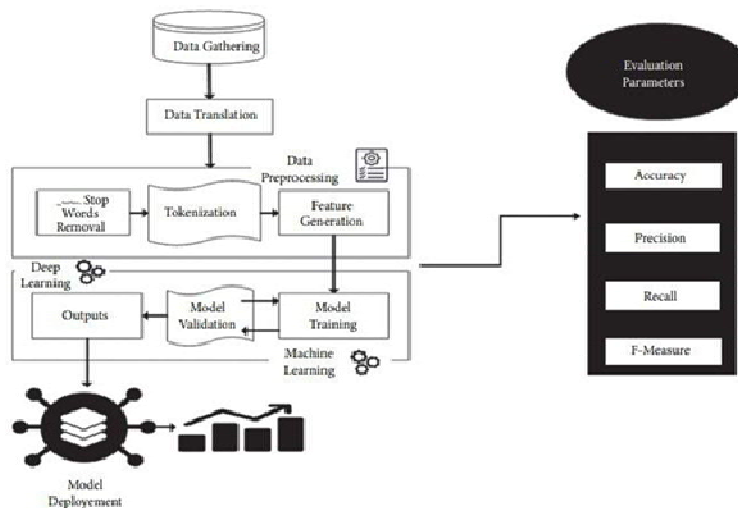
A tight competition between filtering method and spammers is going on per day, as spammers began to use tricky methods to overcome the spam filters like using random sender addresses or append random characters at the beginning or end of mails subject line. There is a lack of machine learning focuses on the model development that can predict the activity. Spam is a waste of time to the user since they must sort the unwanted junk mail and it consumed storage space and communication bandwidth. Rules in other existing must be constantly updated and maintained make it more burden to some user and it is hard to manually compare the accuracy of classified data.

IV. PROPOSED SYSTEM

A. Introduction

Naive Bayes work on dependent events and the probability of an event occurring in the future that can be detected from the previous occurring of the same event. This technique can be used to classify spam e-mails, words probabilities play the main rule here. If some words occur often in spam but not in ham, then this incoming e-mail is probably spam. Naive Bayes classifier technique has become a very popular method in mail filtering Email. Every word has certain probability of occurring in spam or ham email in its database. If the total of words probabilities exceeds a certain limit, the filter will mark the e-mail to either category. Here, only two categories are necessary: spam or ham.

B. Algorithm and Process Design



C. Naive Bayes

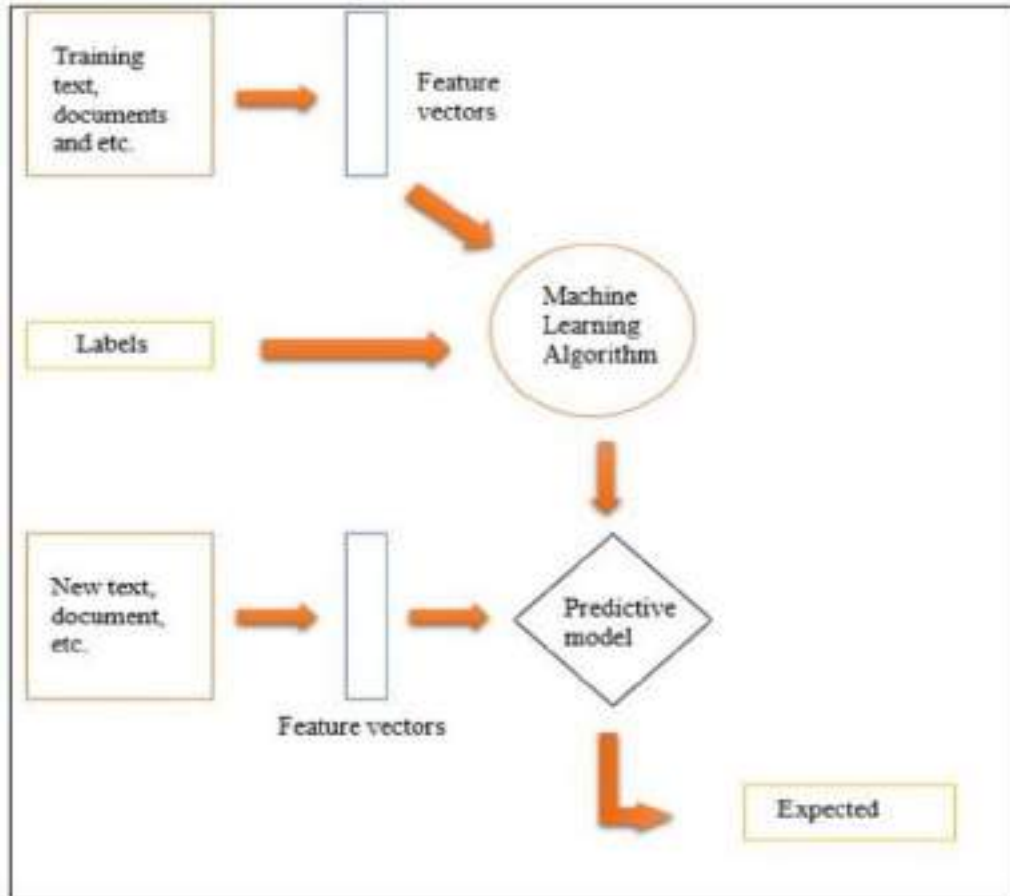
Naive Bayes classifier is based on Bayes theorem with an assumption of strong independence. The classifier is a probability-based classifier which computes the class probabilities of the given instances. The probability set is calculated by computing the combinational and frequency values of the data set. The class probability which is nearest to the rear end will be picked by the classifier. The Naïve Bayes classifier is a multiclass classifier and works efficiently with supervised learning approach. The concept of the Naïve Bayes classifier is explained with the help of Eq. (1). $P(y|x) = P(x|y) P(y) P(x)$

(1) Here, x is the set of feature vectors ($x_1, x_2, x_3, \dots, x_n$) and y stands for the class variable with m possible outcomes ($y_1, y_2, y_3, \dots, y_n$). $P(y|x)$ is the posterior probability which depends on the likelihood of the feature set or attribute value belonging to class $P(x|y)$, $P(y)$ is the prior probability and $P(x)$ is the evidence depending on the known feature variables.

D. SVM

SVM is a supervised machine learning algorithm which can be used for both classification and regression challenges. However, it is mostly used in classification problems. In this algorithm, we plot each data item as a point in n -dimensional space (where n is number of features you have) with the value of each feature being the value of a particular coordinate. Then, we perform classification by finding the hyperplane that differentiate the two classes very well [4].

Support Vectors are simply the coordinates of individual observation. Support Vector Machine is a frontier which best segregates the two classes (hyper-plane/ line). If the data requires non-linear classification, SVM can employ Kernel, which are functions which takes low dimensional input space and transform it to a higher dimensional space i.e., they convert non separable problem to separable problem.



E. Working of Algorithm

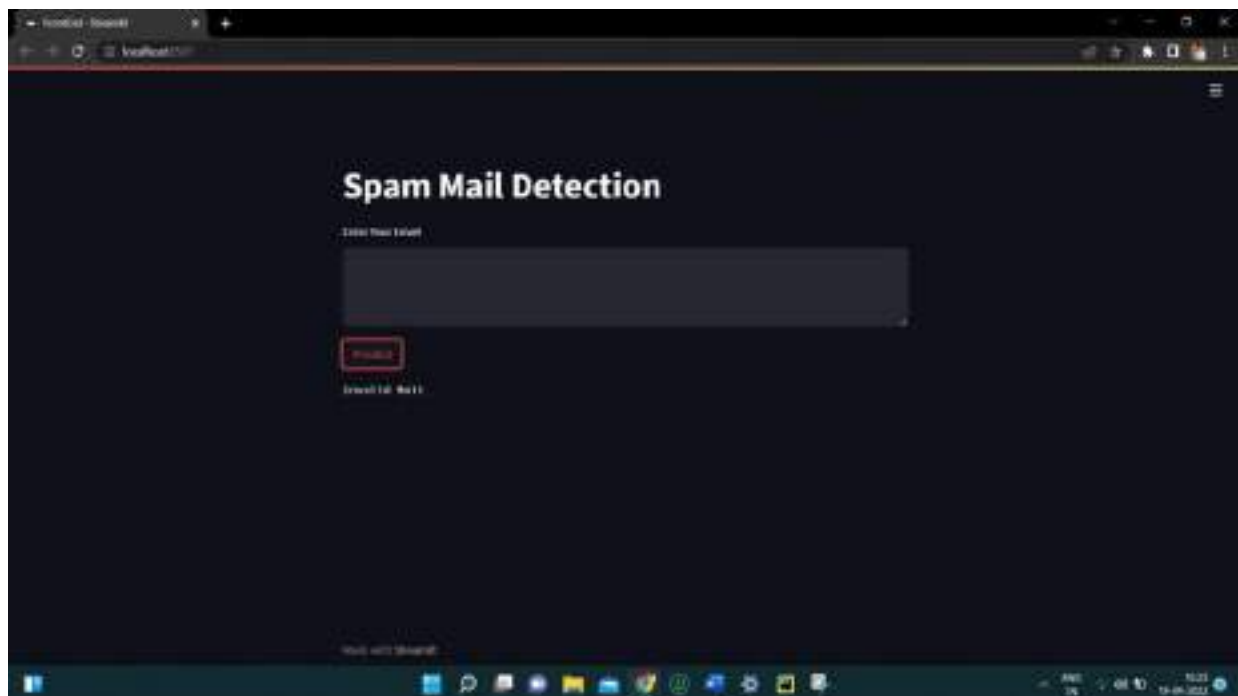
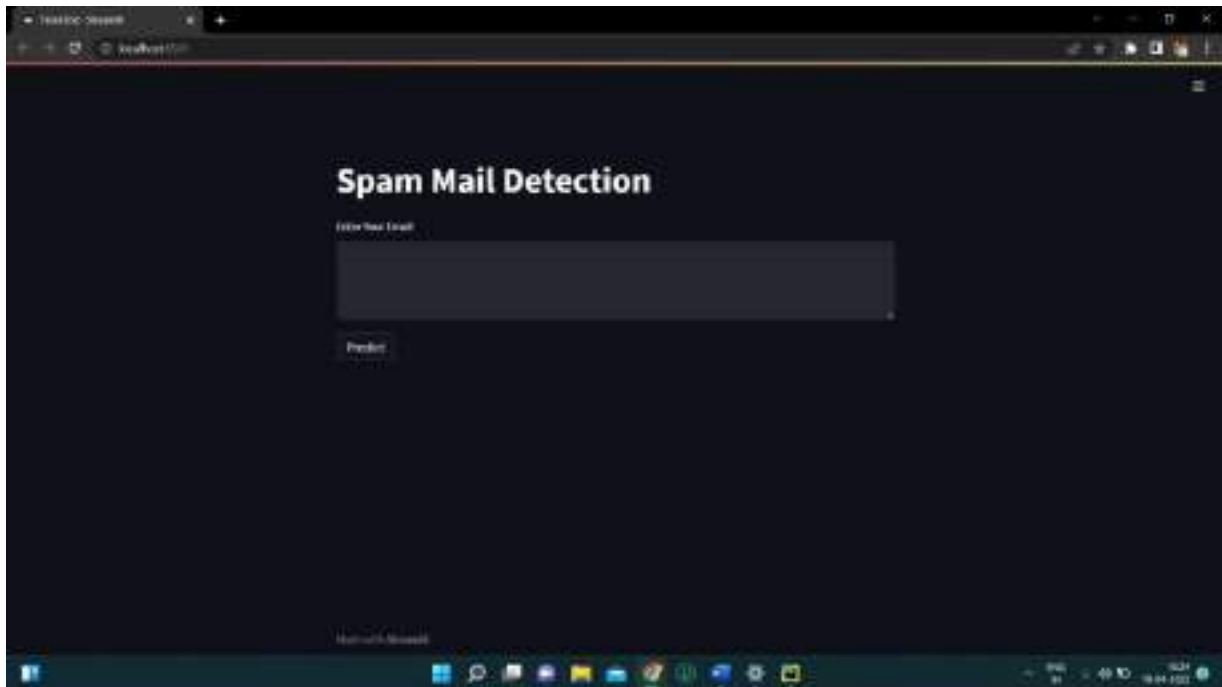
Input	Subject: A guaranteed return of 70% on investment . . . \$300 million increase in the economic growth in a year. After breakup of the largest monopoly of America earn some profit. Over 70% of returns annually. For complete details just click here
Tokenization	'Subject': 'A' 'guaranteed' 'return' 'of' '70%' 'on' 'investment' '. . . ' '\$300' 'million' 'increase' 'in' 'the' 'economic' 'growth' 'in' 'a' 'year' '. . . ' 'After' 'breakup' 'of' 'the' 'largest' 'monopoly' 'of' 'America' 'earn' 'some' 'profit' '. . . ' 'Over' '70%' 'of' 'returns' 'annually' '. . . ' 'For' 'complete' 'details' 'just' 'click' 'here'
Stop Word Removal	'guaranteed' 'return' '70%' 'investment' '\$300' 'million' 'increase' 'economic' 'growth' 'year' 'After' 'breakup' 'largest' 'monopoly' 'America' 'earn' 'some' 'profit' 'Over' '70%' 'returns' 'annually' 'complete' 'details' 'just' 'click' 'here'
Stemming	'guarantee' 'return' '70%' 'investment' '\$300' 'million' 'increase' 'economic' 'growth' 'year' 'After' 'breakup' 'largest' 'monopoly' 'America' 'earn' 'some' 'profit' 'Over' '70%' 'returns' 'annual' 'complete' 'details' 'just' 'click' 'here'
Classify Algorithm Output (NB or J48)	Email is Spam mail

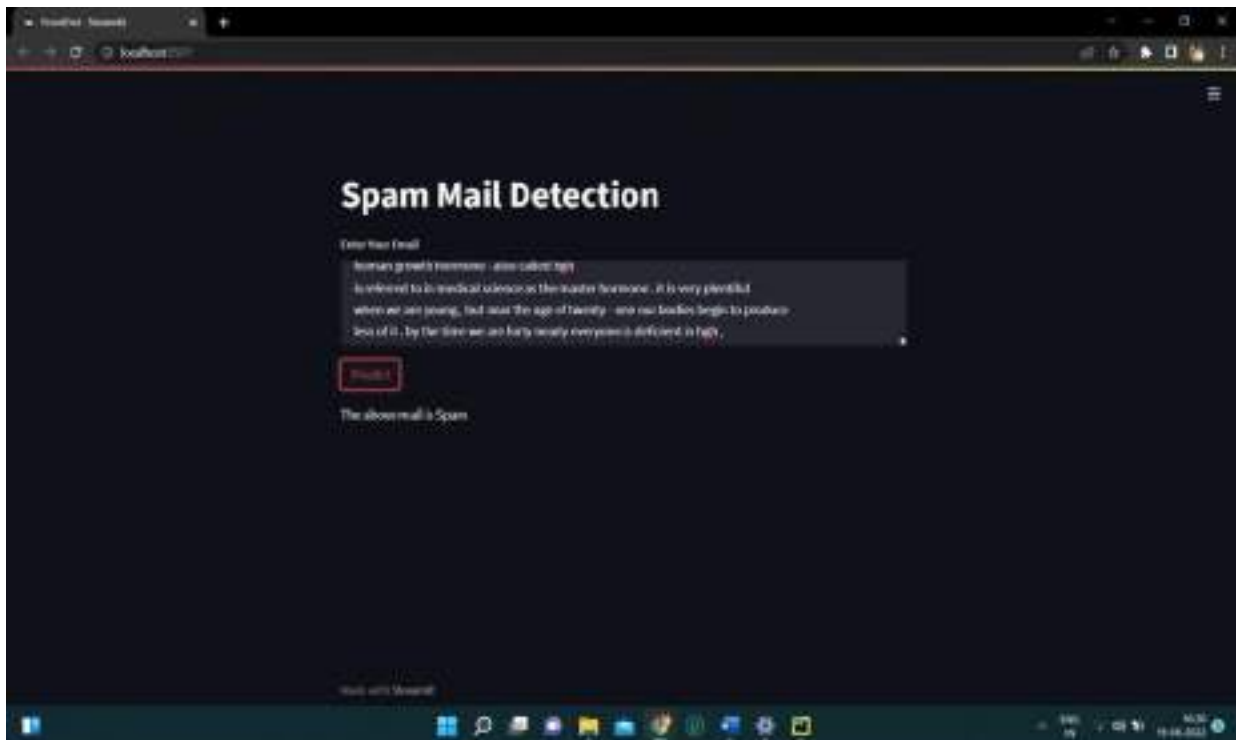
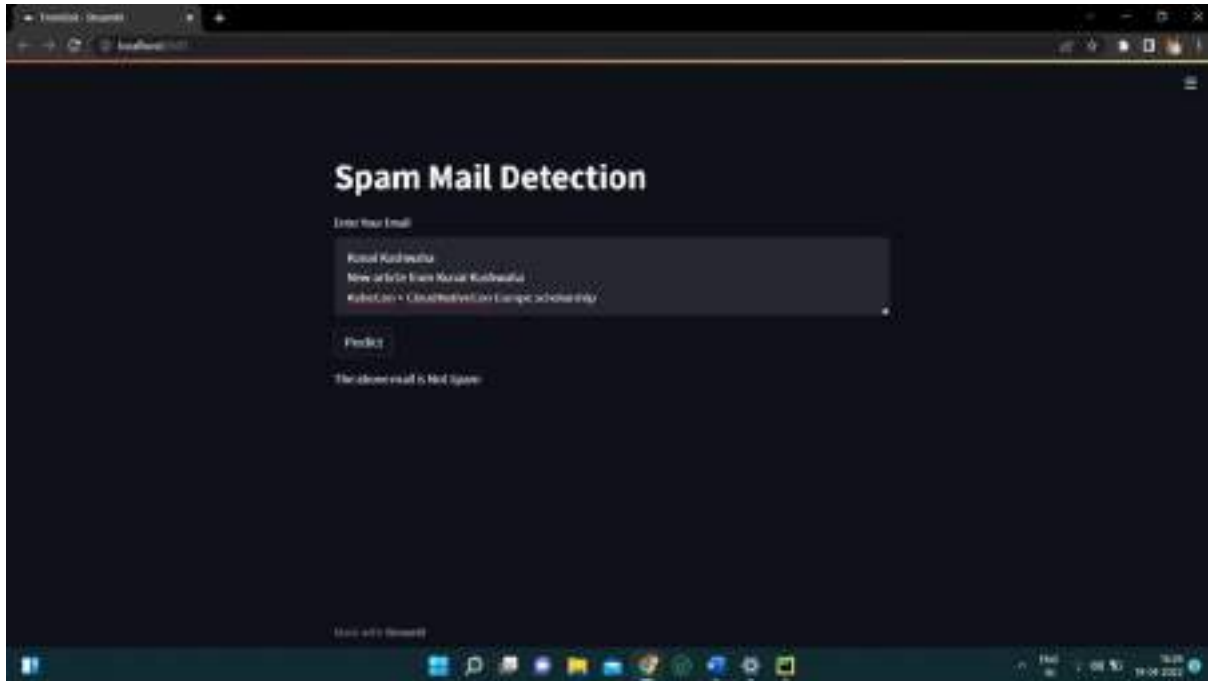


F. Details of Hardware & Software used Are

- 1) Python
- 2) Kaggle – Det dataset
- 3) Jupyter Notebook – Implementing model
- 4) Stream Lit - Front-end
- 5) PyCharm IDE

V. EXPERIMENT AND RESULTS





VI. CONCLUSIONS

We have successfully developed and implemented an intelligent crop recommendation system in this study that Indian farmers can utilize right away. The farmers would benefit from this system's help in making educated decisions about the types of diseases affecting their crops and possible treatments. Mandi Price, the ability to rent out equipment, and the ability to support many languages have also been included. Utilizing the methods outlined previously, the building of an electronic expert system for the identification of plant diseases affecting the leaves is accomplished with the inclusion of the other services outlined above.



VII. ACKNOWLEDGMENT

We would like to express our special thanks of gratitude to our guide Prof. Samuel Jacob who gave us the golden opportunity to do this wonderful project on the topic Spam Mail Classifier which also helped us in doing a lot of Research and we came to know about so many new things we are thankful to him. Secondly, we would also like to thank our professors of review panel in finalizing and improving this project within the limited time frame. This project helped us in understanding the various parameters which are involved in the development of desktop application and the working and integration of front end along with the back end.

REFERENCES

- [1] <https://ieeexplore.ieee.org/document/7868411/>
- [2] <https://ieeexplore.ieee.org/document/9291921>
- [3] <https://ieeexplore.ieee.org/document/4403192>



Integrating Human Computer Interaction To Software Development Architecture

Defining and Designing Methodology for Website Processing

¹Mr. Shrey Solanki, ²Ms. Archita Dube, ³Ms. Rujuta Lanke, ⁴Prof. Sachin Deshpande

¹Student, ²Student, ³Student, ⁴Associate Professor

Department of Computer Engineering,
Vidyalankar Institute of Technology, Mumbai.

Abstract: This study has been undertaken to investigate the flaws in the existing software development techniques to make software both more usable and easier to develop. There are an incredible number of benefits to adopting a human computer interaction (HCI) architecture into software development endeavor. The proposed system defines a method for website processing system while incorporating human computer interaction (HCI) as an important aspect.

Index Terms – Human Computer Interaction, Software Development, Design, Website Development

I. INTRODUCTION

To successfully implement human computer interaction (HCI), the need is to understand the basic concepts of user experience design, namely user-centered design and rapid prototyping. It is required to be familiar with design patterns that enable HCI functionality and learn how these interact with other technologies but this must be integrated as a part of the software development rather than having design as a different part of the process. Designers of Software Development Architecture wish to incorporate Human Computer Interaction (HCI) into their applications more than ever before but face issues with one-to-one development. With the development of websites, it is more important than ever that designers are capable of creating intuitive, easy to use products. HCI can be defined as "the design of interactive user experiences that encompass visual and haptics considerations into a system" (Webster).

1.1 User-Centered Design

Creating a user-centered design (UCD) is proved to be a successful way to include HCI into product development. UCD is an iterative process that involves multiple user testing and individual interviews with stakeholders to create a common definition of user. It is important for developers to note that the UCD process happens before any decision about the actual software development architecture is made. This does not imply to skip software design, but it means that while choosing software architecture, the users' comfort must be considered. In order to have a successful UCD, a common framework is created that all stakeholders are aware of before starting with any design.

1.2 Human Computer Interaction

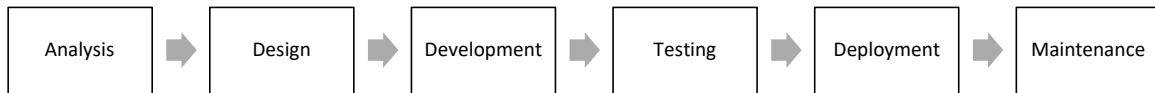
Human-computer interaction, an interdisciplinary subject, has recently emerged as a frontier study area. Human-computer interaction has been progressively used to construction safety management during the fourth industrial revolution, which has considerably accelerated the advancement of hazard detection in the construction sector. However, few researchers have explored the evolution of human-computer interaction in construction hazard identification in depth. [1]

1.3 Software Architecture

A system's architecture is a plan. It offers an associated abstraction for managing system complexity and establishing a communication and coordination mechanism among parts. It specifies an organized approach to meet all technical and operational requirements while improving common quality features such as performance and security. Furthermore, it entails a series of critical decisions about the organization involved with software system development, and each of those decisions will have a significant influence on the quality, maintainability, performance, and overall success of the final product. [2]

1.4 Software Development Cycle

Fig 1.4.1: Phases of Software Development



II. LITERATURE SURVEY

2.1 Software Development Models

A software development model is an expression of the whole software development process that clearly describes the major activities to guide the working tasks on software development that must be done. It is the structural foundation for all of the work and duties that are implemented by system creation, operation, and maintenance across the full software life cycle, as well as the interaction between the many phases of software development activities. As we all know, there are different software development methodologies that have been established and created that are utilized or employed during the software development process. These methods are often known as software development models. However, each model follows a certain life cycle to assure success in the development process, and its advantages and disadvantages are all present. The software development model has a direct impact on the software development cycle and software quality, and it is an essential form of structure and administration for software projects in modern IT enterprises. [3]

2.1.1 Waterfall Model

The Waterfall model is a standard software development approach, although the model's structure is significantly simpler. The paradigm includes development phases such as requirements analysis, design, coding, testing, and maintenance, however each process must be completed sequentially, and requirements must be understood ahead of time. In fact, though, it is difficult to anticipate every element. Most initiatives begin with some ambiguity, and as the project proceeds, more information is revealed. The main downside of the concept is that issues in the system are not detected until late in the process (testing phase), leaving little time for rectification, potentially resulting in severe impacts on project schedule and expense. The use of this paradigm in modern IT enterprises is limited at the moment. [3]

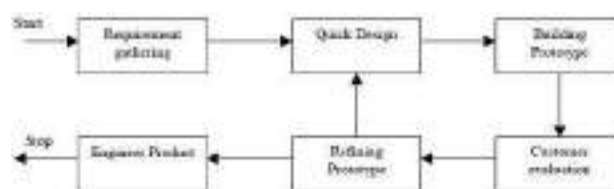
Fig 2.1.1.1: Waterfall Model



2.1.2 Prototype Model

Another basic software development paradigm that is currently frequently utilized is the prototype model. The main concept of the prototype approach is that developers and users quickly define the most critical needs for consumers at first, and a software product prototype may be accomplished quickly. The prototype is regularly changed by developers based on user evaluation and feedback until users are satisfied. Prototype models are appropriate for environments where user needs are unknown at the start of development. Developers should have prior development expertise, so that the most critical criteria may be met by creating a software product prototype. However, applications based on this paradigm may stall the development process, limit developers' inventive ideas, and make updating and managing papers onerous. [3]

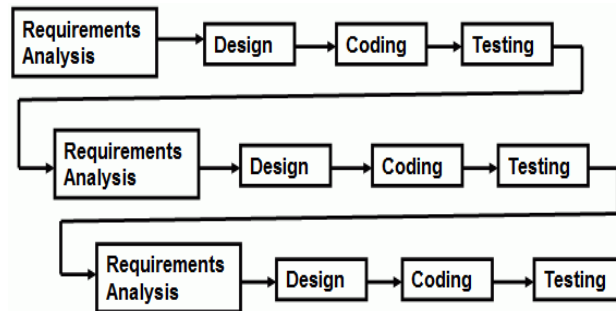
Fig 2.1.1.1: Prototype Model



2.1.3 Incremental Model

The incremental paradigm is not a monolithic model. The model blends the sequential characteristics of the waterfall model with the quick iteration characteristics of the prototype model. The latter increment is built based on the preceding increment, and each increment may be developed utilizing a waterfall or a fast prototype methodology. A software product that is separated into various phases can be released, allowing users to utilize some of the fundamental features while other parts of the product continue to be created by developers at the same time. The methodology is also appropriate for early-stage software projects with design risks and unknown needs. [3]

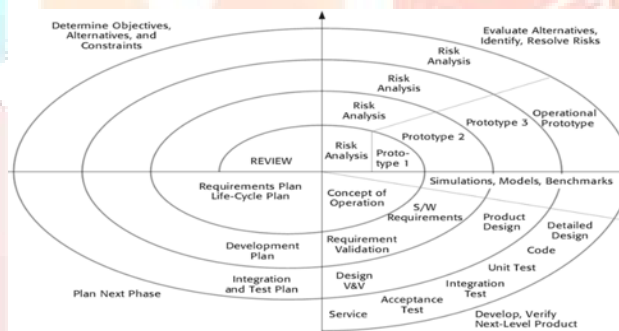
Fig 2.1.3.1: Incremental Model



2.1.4 Spiral Model

The spiral model develops the system using a periodic mechanism. Each cycle is divided into four stages: requirements definition, risk analysis, project implementation, and assessment. Iterations of the four stages are performed. When an iteration phase in the model is completed, software development is promoted to a level. The paradigm has the benefit of emphasizing risk assessments for developers and users in each round of iteration, making it suited for the creation of larger systems. However, the model's downside is that the adoption of the spiral model necessitates the participation of a large number of specialists with competence in risk assessment, and excessive iterations will raise development costs and create submission delays. [3]

Fig 2.1.4.1: Spiral Model



2.1.5 Fountain Model

The Fountain paradigm is user-driven and object-driven, and thus is appropriate for the object-oriented software development process. In the concept, there are no precise ordering or obvious limits for each phase of growth, and all phases of development might take place on a worldwide scale. The fountain model has the benefit of allowing a progressive piece of software to be introduced on each iterative development, as well as making it easier to fill gaps in other phases of development at any moment throughout one development period. The disadvantage of using the fountain model is that during iterative development, you may encounter the possibility of adding a variety of information, requirements, and information at the same time, which necessitates the use of a large number of developers and is inconvenient for project management. [3]

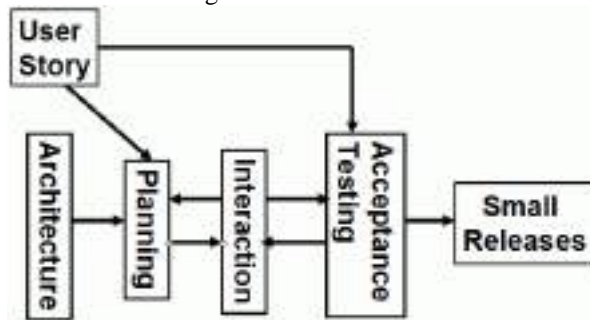
Fig 2.1.5.1: Fountain Model



2.1.6 XP Model

The XP (Extreme Programming) paradigm is a lightweight and progressive approach based on the agile software development process. The whole development process is organized into six phases in the XP model. The model's basic ideas are a collection of beliefs, principles, and methods for rapidly building high-quality software that gives the most value to the client in the shortest amount of time. The XP paradigm is frequently employed in the creation of short, high-risk software projects, and it has the benefit of quickly adjusting to changes in customer needs in modern IT enterprises. Applications based on the XP paradigm allow developers to concentrate on coding while avoiding the time-consuming task of document management. [3]

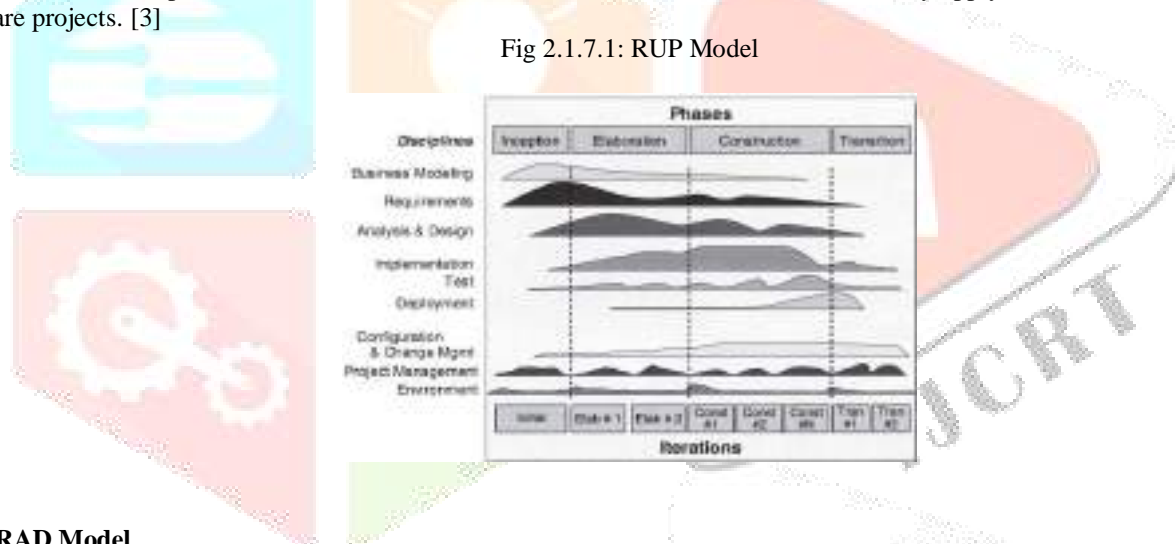
Fig 2.1.6.1: XP Model



2.1.7 RUP Model

The RUP (Rational Unified Process) model explains the life cycle of a complete software development across time via the evolution of project management. The RUP model contains nine main workflows that are employed in sequence and are reinforced on each iteration. RUP's major characteristics include centered architecture, use case driven architecture, iterative and incremental development. However, owing to the complexity of the RUP model's development process and its intimate linkages, it is not appropriate for small software development projects. At the moment, many software engineers are attempting to reduce or simplify various RUP model operations and combine them with the X model in order to successfully apply them to the creation of small software projects. [3]

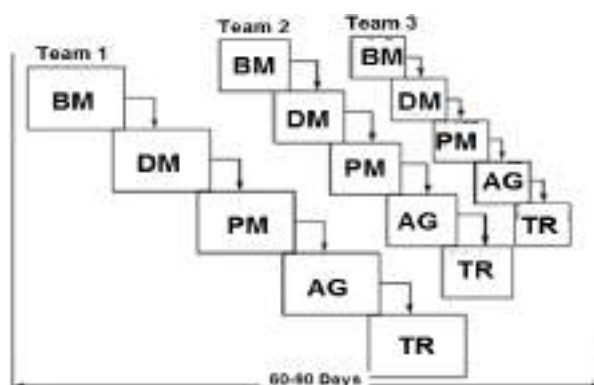
Fig 2.1.7.1: RUP Model



2.1.8 RAD Model

The RAD (Quick Application Creation) paradigm is a version of the waterfall approach that uses reusable components to complete the rapid development of applications. The RAD model is an incremental development methodology that stresses extremely short development cycles that allow a development team to construct a fully working system in as little as 60 to 90 days. Development processes in the RAD model do not use traditional third-generation programming languages to create software; that is, the RAD model is not suitable for development in which the system is not reasonably modularized, and it is also not suitable for development in which the system has a higher risk of requirements, or the interfaces on components must be changed frequently. [3]

Fig 2.1.8.1: RAD Model



2.1.9 WINWIN Model

WINWIN model combines spiral model features with prototype model, stressing risk analysis and identification, and achieving a double winning outcome for users and developers on software development activities via early agreements. Three objectives on life cycle milestones (defines a set of goals for each significant software engineering activity.), architecture on life cycle milestones (Establishes the goals that must be met when system and software architectures are defined.) Initial operation capability (Represents a set of goals, as well as the preparation for these goals and pre-installation sites for the software to be installed or sold, which is associated with the software help.) are in the WINWIN model, to represent the three different views on the progress of the spiral project development. The WINWIN paradigm has the benefit that both users and developers understand the risk that emerges at each stage of evolution and respond accordingly. They will achieve a balance in terms of developing resources. On the one hand, most of the system's functionalities are accessible to users. Developers, on the other side, may learn about realistic budgets and time frames. [3]

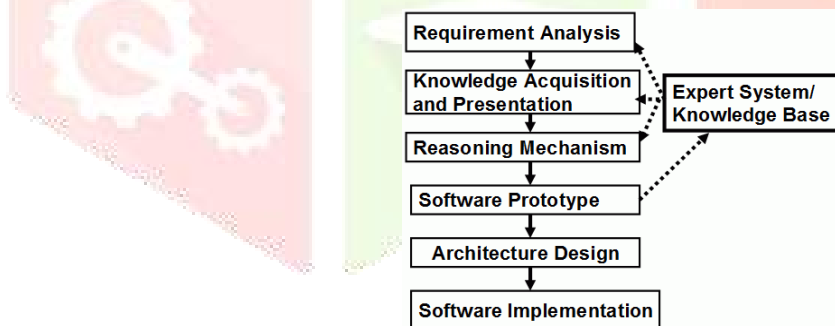
Fig 2.1.9.1: WINWIN Model



2.1.10 Intelligent Model

Intelligent models are also known as "knowledge-based software development models," as they combine a waterfall model with an expert system to integrate knowledge system (based on software engineering knowledge) and expert system (including knowledge rules in the application area), with the expert system assisting software developers in their work. The intelligent model includes a set of tools (such as data query, report generation, data processing, screen definition, code generation, high-level graphics functions and spreadsheets, and so on), each of which enables developers to define certain software characteristics at a high level and automatically generate the developer-defined software as source code. [3]

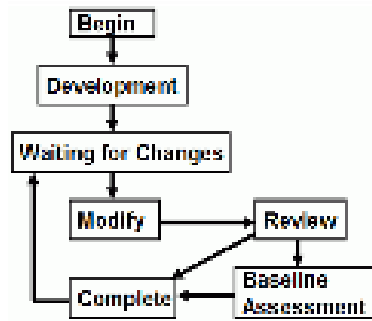
Fig 2.1.10.1: Intelligent Model



2.1.11 Parallel Model

An activity network is a parallel model that focuses on the status of a succession of technical tasks and activities in software engineering. Each online action can occur in parallel with other activities, and this model offers an accurate picture of the project's present status. The parallel model is not driven by time, but by user needs, management choices, and result reviews, allowing for the parallelization of the whole software development process. Because the C/S programme is implemented by numerous components, and each component may be created and implemented in parallel, the model's application is better appropriate for system development with a C/S (Client/Server) structure. [3]

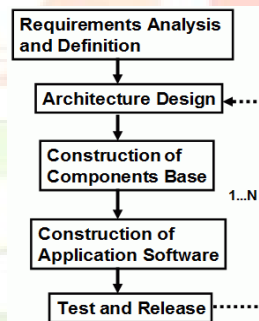
Fig 2.1.11.1: Parallel Model



2.1.12 Component-based Model

The development procedures of a component-based model are iterative, and the model typically consists of five phases. Components, such as EJB (SUN), DCOM (Microsoft), CORBA (OMG), and others, have swiftly evolved into essential software technologies and tools. These are some examples of common new technologies and techniques used in component-based development. The model's fundamental application is to begin the development activity by finding the candidate component by exploring the current component base to determine if the necessary component exists or not. If the component exists previously, it is reused from the component base. If it does not exist, the component must be created using an object-oriented technique. The model's application must modularize the system to be produced and reuse one or more software components in component base by supporting a certain component model. Developers use a comparable combination approach to create an application on a software system. Many software organisations are beginning to construct and apply customised component assembly and interface specification standards to carry out software development operations, however the component interface standards must be generalised further. Furthermore, numerous software professionals have developed several efficient new component assembly methods to finish large-scale software system development operations. The author of the paper proposes that readers who are interested in this read the references on the website. [3]

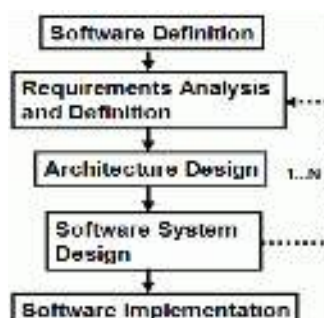
Fig 2.1.12.1: Component-based Model



2.1.13 Architecture-based Model

The heart of this paradigm, which is built on the component-based development process, is software architecture. The analysis and design processes use an iterative incremental approach, translating the functional design space to the structural design space and then back to the system design space. Acquisition and analysis of requirements based on architecture first, in order to give better support for the transition from the analysis to the design phases. The architecture is then designed based on the results of the requirements analysis. It is the same as the component-based development paradigm when creating the architecture to search for matching components based on the syntax and semantics of the constituent elements. The reuse of software components has progressed from code-level reuse to architecture-level reuse. Of course, iterations are present throughout the development process. The benefits of this approach make the framework of the software system more visible and beneficial to system design, development, and maintenance. [3]

Fig 2.1.13.1: Architecture-based Model



2.1.14 Software Development Models in Certain Application Fields

Many software developers and researchers have recently devoted themselves to making appropriate improvements on existing development models based on the characteristics of actual software projects for specific application fields, redesigning processes or activities for new development models, and achieving good results. [3]

2.2 Flaws in Software Development Architecture

The software development architecture entertains a major flaw resulting in a delay during the development and an inaccurate design replica affected by front end development skillset. With the increase in user-centric design and psychological design approach through human computer interaction, designers prepare the software interface with extreme precision and thought process. The prototype made by the designers need to be programmed from scratch by the developers leading to inaccuracies and delay. The flaw in the flow indicates design as a separate task more than the software development.

III. PROPOSED SYSTEM

To successfully implement human computer interaction (HCI) integration into the process, the approach was to come up with a technique to generate code through designs. The vision was to create a superior prototyping methodology for designers and the general users to directly generate the front-end code. Taking a step towards the idea of design to code automation, the concept put fourth is defining and designing methodology for **website processing**.

3.1 Website Processor

To improve the technique of development of a website, we need a platform capable of providing a programmer's precision to any computer literate person. The idea is for the use of making websites to be as easy as creating word documents keeping in mind personalization and customization. The initial step is to make us known to small businesses and website developers so that the team gets enough feedback to expand the advantages for larger scale businesses. The front-end module creates a strong user experience to increase client-side interaction by defining an application's user interface. To apply design thinking and improve the UX of each step of a particular application, it is necessary to empathize with the user.

Websites are built – coded in sections or in blocks. This sets the limitation to the existing system or website builders. Users are allowed to insert their content but within the blocks either as a replacement or at a fixed position, restricting the creativity a person can bring to the canvas. The proposed work presents an idea to overcome this limitation and take a major step towards website processing. A simple comparison can be made with any word processing software which allows users to enter the contents or elements in a line-by-line format. The idea proposes a similar approach to develop web pages which can collectively be linked as a website.

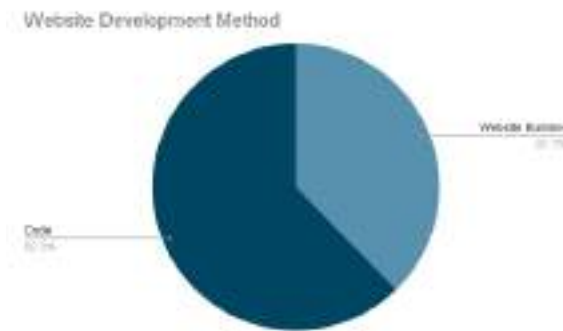
The canvas would include:

- A slew of tools including shapes, texts, graphs, images and icons: The user would have the ability to use combinations of the same to innovate and create a webpage with his/her imagination. Choice of colors as per the content and audience would provide a detailed output as per the requirements and agenda. The users could gain an opportunity to present their idea as planned and structured in their mind without the need of any programming.
- Navigation bar as the header: The header option can have a default name of web pages or can be customized as per the requirements. This place could hold the logo with the links to the webpages or can simply be removed.
- Multiple webpages: A collection of web pages linked together forms a website and the proposed system does that by providing pages. Each page represents one webpage.
- Cloud Storage: All the progress made on current or previous websites can be saved on a cloud storage under the profile of each user.
- Plugins: Provides animations and scripted additions like calculator, forms, interactive interfaces or a converter which can simply convert the designs for mobile preview, etc.

To collect data out of the canvas an AI bot would run through the lines from left to right, embedding each element in the form of HTML code with appropriate spacing and layout in reference to the canvas. A CSS attachment would be made according to a selected template or a customized design system. The user would have the flexibility to plugin JavaScript to enhance their websites with animations and other interactive elements. The inspiration was the interpretation of python that reads code line by line and hence holds several benefits. For our website developer this interpreter would be referred to as a bot. The bot would run line by line converting each element to HTML code. A stylesheet could be implied in the form of CSS. With this the experience of developing a website would be enhanced as the code reading and implementing would be running in the background and the user would only have to focus on their website, personalizing and creating whatever vision they have in mind.

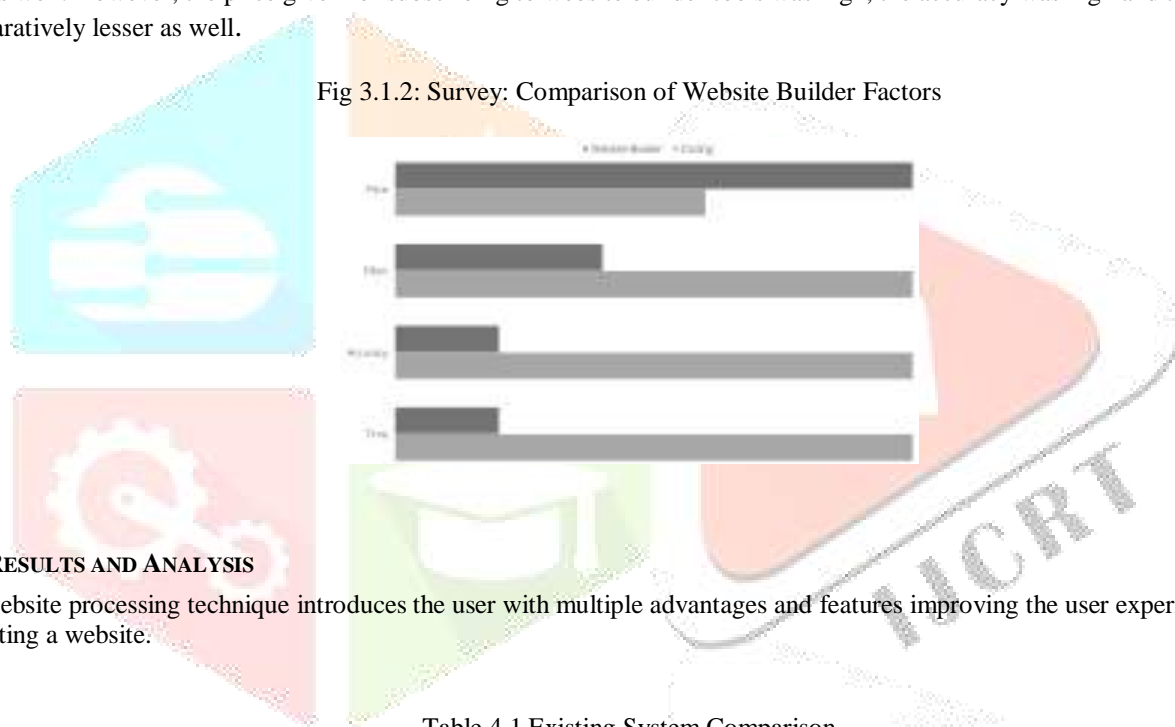
According to the results of a survey made, the performance of website builders among users is rather average.

Fig 3.1.1: Survey: Website Builder against Code



The goal is to improve this user experience such that it meets their demands more efficiently and in less time. The meters against which website processing is done was measured by price, efforts, accuracy and time taken to develop a particular website. The findings showed that the efforts taken using the traditional HTML ways were maximum and hence time taken was relatively high as well. However, the price given for subscribing to website builder tools was high, the accuracy was high and time taken was comparatively lesser as well.

Fig 3.1.2: Survey: Comparison of Website Builder Factors



IV. RESULTS AND ANALYSIS

The website processing technique introduces the user with multiple advantages and features improving the user experience and ease of hosting a website.

Table 4.1 Existing System Comparison

Parameter	Existing Website Builders	Proposed Website Processor
Design to code	Absent	Present
Design Flexibility	Absent	Present
Quick Response Time	Absent	Present
UX Focused	Absent	Present
UI Focused	Present	Present
Design Restrictions	Present	Absent

Our survey shows a high response in difficulty for design to code procedure:

Fig 4.2 Limitations in the existing Software Development Process

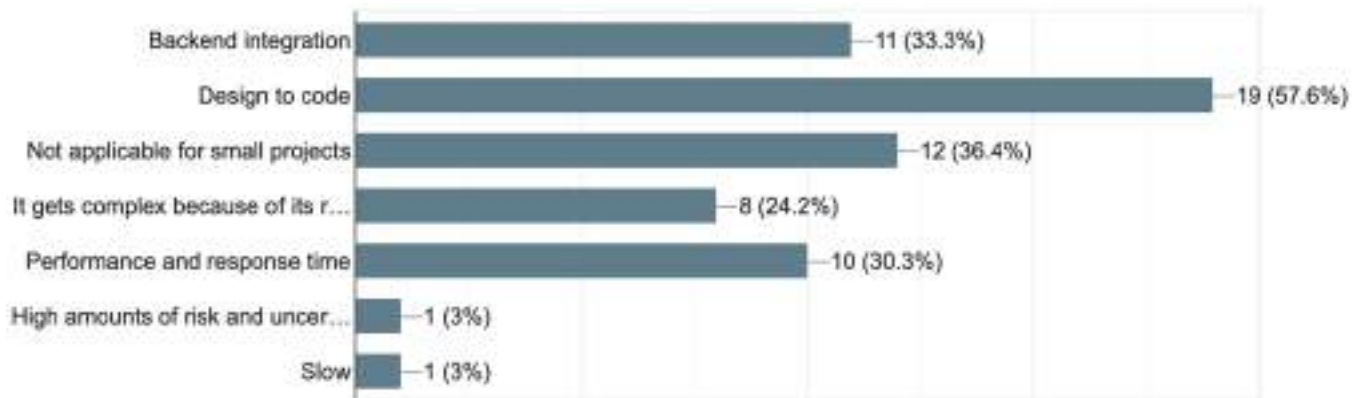
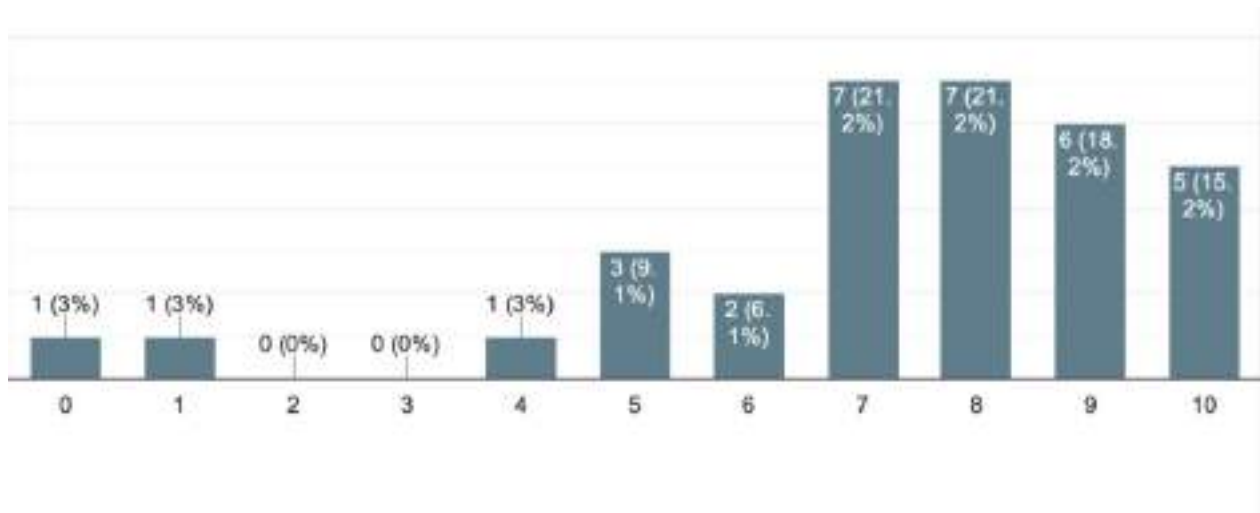


Fig 4.3 Difficulty in Design to code



V. ACKNOWLEDGMENT

We would like to thank our professor and guide – Prof. Sachin Deshpande, through our journey.

REFERENCES

[1] Wang,J.;Cheng,R.; Liu, M.; Liao, P.-C. Research Trends of Human–Computer Interaction Studies in Construction Hazard Recognition: A Bibliometric Review. Sensors2021,21,6172. [https:// doi.org/10.3390/s21186172](https://doi.org/10.3390/s21186172)

[2] Jaiswal, Manishaben, Software Architecture and Software Design (November 5, 2019). International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056, p-ISSN: 2395-0072, Volume: 06 Issue: 11, s. no -303 , pp. 2452-2454 , Nov 2019 Available at: <https://www.irjet.net/archives/V6/i11/IRJET-V6I11303.pdf>, Available at SSRN: <https://ssrn.com/abstract=3772387> or <http://dx.doi.org/10.2139/ssrn.3772387>

[3] Yu, Jiujiu. (2018). Research Process on Software Development Model. IOP Conference Series: Materials Science and Engineering. 394. 032045. 10.1088/1757-899X/394/3/032045.

“Recommendation system using location sensing (LBSN) and sentiment analysis”

*Kushal Bhoja Suvarna¹ and Dr.Sachin Bojewar²

¹Student, Information Technology, Vidyalankar Institute of Technology, Wadala(E), Maharashtra 400037

²Professor & Head of department, Computer Engineering, Vidyalankar Institute of Technology, Wadala (E), Maharashtra 400037

Abstract: Customer reviews have become increasingly important in digital marketing of products and services in the digital era. Sentiment analysis is a popular approach for analysing reviews that uses machine learning and natural language processing[2][3]. The proliferation of social networks has resulted in the establishment of a network based on geographic location. This aids in determining the user's location, which aids in the recommendation of location-based information [1][4]. The recommendation system is a method of connecting items or services to users and assisting them in confirming their decision [7][8]. This paper's main approach will be to look at both sentiment analysis and location-based social networks, as well as their many forms, to see how integrating the two can improve recommendation systems with a variety of applications.

Keywords: Sentiment Analysis, Natural language Processing, Machine learning, location-based social network, recommendation system

1. Introduction

E-commerce and e-business are making great strides today, encouraging start-ups to run their businesses through applications. With this trend, application developers have a strong responsibility to provide comprehensive customer support and user-friendly tools such as recommendations and filters. From 2006 to 2009, Netflix sponsored the contest and offered the team a \$ 1,000,000 grand prize. The award was able to obtain a dataset of over 100 million movie reviews provided and return recommendations that are 10% more accurate than the company's existing recommender systems[7][8]. These tools help users effectively select their preferences based on a variety of factors. In applications such as online transportation and hotel reservations, users always prefer a nearby location based on their situation. The main goal of our project is to provide a location-specific recommender system, analyse ratings and ratings together, and provide a clear view to customers [1][4]. The applicability of this system is demonstrated by an application for artists who find clients making money for their art. The purpose of this system is to use sentiment analysis using supervised machine learning and a location-based social network using the Google Maps application interface[1][4]. The location can be used as input when registering with the

application, or it can be changed later in the application interface. Emotion and rating analysis is averaged and the resulting score determines the ranking of each entity or customer [2][3].

2. Literature Survey

In this paper “Sentiment Analysis of Twitter Data” which is published by Sahar A. El Rahman; Feddah Alhumaidi AlOtaibi; Wejdan Abdullah AlShehri in the publication IEEE MAY 2019 follows the work as each tweet extracted classified based on its sentiment whether it is a positive, negative or neutral. Data were collected on two subjects McDonalds and KFC to show which restaurant has more popularity [1]. This paper “Movie Recommendation System Using Sentiment Analysis from Microblogging Data” published by Sudhanshu Kumar, Kanjar De, and Partha Pratim Roy in IEEE JUNE 2020 and their purpose is to use movie tweets is to understand the current trends, public sentiment, and user response of the movie. Experiments conducted on the public database have yielded promising results.[2]. The paper” Striking the Balance Between Novelty and Accuracy in Location-Based Recommendation System” published by Vivek Agrawal, ShivamSahu, Sneha Oommen, G. Ram Mohana Reddy in IEEE JANUARY 2020 in this paper the proposed algorithm provides users with a personalized ranked list of venues based on their past check-in data and social relationships, which is novel yet accurate at the same time.[3] .In this paper “ Location Based Place Recommendation using Social Network” published by Ms. Priya Naik, Ms. Palak V. Desai, Ms. Supriya Patil In IEEE MARCH 2019 and their Point-of-interest(POI)recommendation assists users to search new locations as per their preferences or choices. In the recent study of location based social networks, influence factors are taken into consideration.[4]. This paper “ Comprehensive Study on Sentiment Analysis: Types, Approaches, Recent Applications, Tools and APIs” published by Ms. Binju Saju, Ms. Siji Jose , Mr. Amal Antony In IEEE NOVEMBER 2020 The paper gives a detailed study of sentiment analysis. It explains the basics of sentiment analysis, its types, and different approaches of sentiment analysis. [5]. In this paper “ Recommender Systems Challenges and Solutions Survey ” published by Marwa Hussien Mohamed, Mohamed Helmy Khafagy , Mohamed Hasan Ibrahim in IEEE FEBRUARY 2019. This paper introduces a survey about recommendation systems, techniques, challenges the face recommender systems and lists some research papers that solve these challenges. [7]

3. Design Methodology

This system uses user and customer locations to provide recommendations or search results to users[8][11]. The system also provides a detailed sentiment analysis of reviews and averages them in ratings to provide scores that help user’s better rate customer service. Location specificity is provided using a location-based social network (LBSN) that uses Haversine formulas for distance calculations [6]. Sentiment analysis of reviews is performed using supervised machine learning techniques using IMDB datasets. The sentiment analysis score is then evaluated and averaged, allowing for a better analysis of the user's evaluation of the customer.[2][3][12]

3.1. Design Methodology for Sentiment Analysis

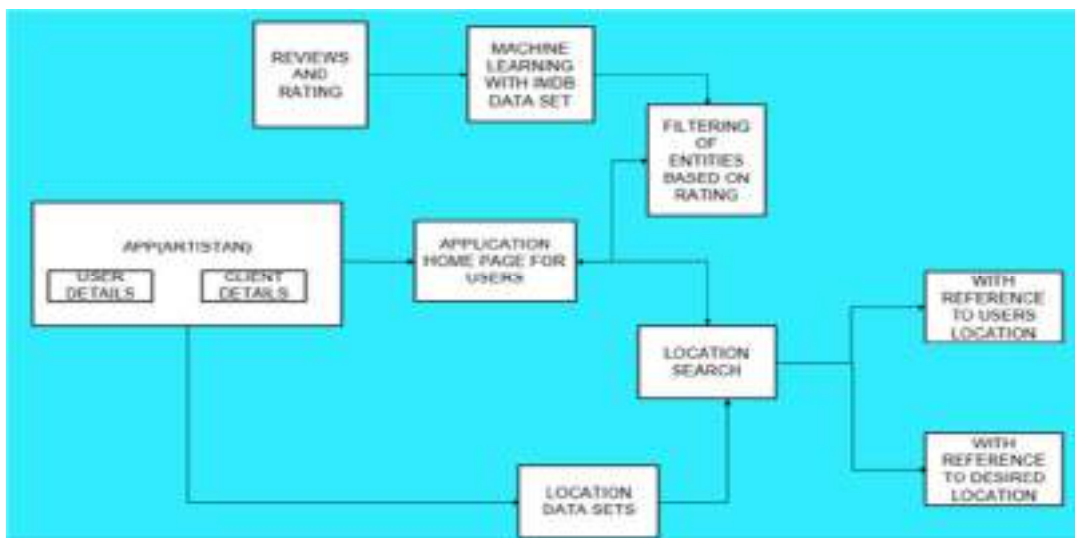


Figure 1. Flow chart of Design Methodology for Sentiment Analysis

The system will be demonstrated using an application that binds all artists of different art movements. When the application home page is displayed, there is a search bar that allows users to search for artists based on artist category and provide recommendations based on score and location. There are two options for location search.

- i. . Refer to User's Location Here, the user keeps his location data as a reference point.
- ii. Browse to the desired location here, users can enter the desired location to find nearby businesses and customers.

Users can also search based on the artist's score as rated from the sentiment analysis of reviews averaged by rating.

3.1.1. Mathematical Model of algorithm AWD-LSTM:

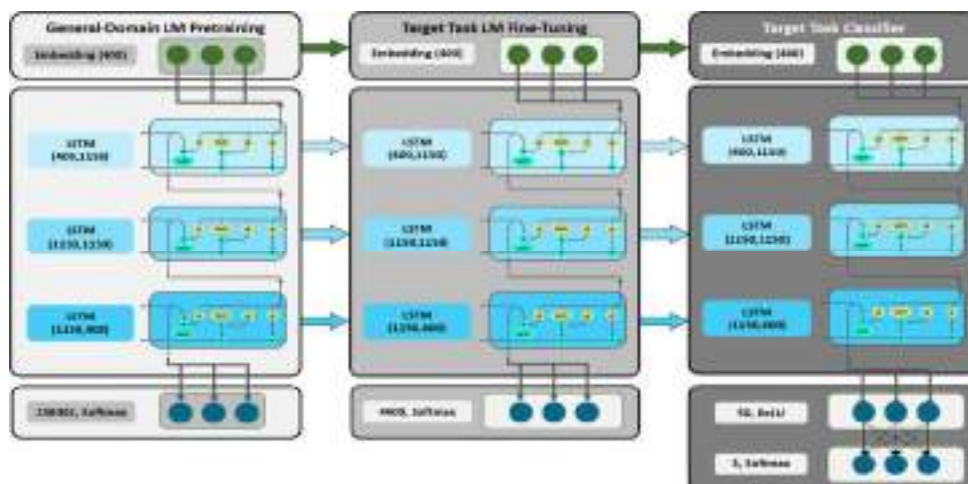


Figure 2. Mathematical model of AWD-LSTM

AWD-LSTM is NT-ASGD (Non-monotonically Triggered ASGD), is an averaged random probability distribution technique gradient descent technique. Weight-Dropped LSTM. It uses Drop Connect and the average random gradient descent method, in addition to other regularization strategies. Due to the memory element existing in this recurrent neural network (RNN) we choose this algorithm.[10][13]

LSTM equations:

$$i_t = \sigma(W^i x_t + U^i h_{t-1})$$

$$f_t = \sigma(W^f x_t + U^f h_{t-1})$$

$$o_t = \sigma(W^o x_t + U^o h_{t-1})$$

$$\tilde{c}_t = \tanh(W^c x_t + U^c h_{t-1})$$

$$c_t = i_t \odot \tilde{c}_t + f_t \odot c_{t-1}$$

$$h_t = o_t \odot \tanh(c_t)$$

where $[W^i, W^f, W^o, U^i, U^f, U^o]$ are weight matrices, x_t is the vector input to the time step t , h_t is the current exposed hidden state, c_t is the memory cell state, and \odot is element-wise multiplication.

The following is implementation of AWD-LSTM in the recommendation system:

```
from fastai.text.all import *

dls = TextDataLoaders.from_folder(untar_data(URLs.IMDB), valid='test')
learn = text_classifier_learner(dls, AWD_LSTM, drop_mult=0.5, metrics=accuracy)
```

Fig 3 Implementation of AWD-LSTM in the recommendation system

3.2 Design Methodology for review score

- First we create a supervised machine learning algorithm using the IMDB data set (sentiment analysis of reviews) and train the model.
- We run this model with the reviews given by user and generate the score of entity.
- The sentiment analysis approach used is automatic approach.
- The type of sentiment analysis used is standard sentiment analysis.
- Sentiment analysis result is as follows:

Percentage	Sentiment	Equivalent score (Es)
90	NEGATIVE	0.5
80	NEGATIVE	1
70	NEGATIVE	1.5
60	NEGATIVE	2
50	NEUTRAL	2.5
60	POSITIVE	3
70	POSITIVE	3.5
80	POSITIVE	4
90	POSITIVE	4.5
100	POSITIVE	5

Figure 4. Review Score

The Es as per the above table is averaged with average star rating to get score with the formula:

$$\text{ENTITY_SCORE} = (\text{STAR RATING} + \text{ES}) / 2$$

4. Design Methodology for Location Based Social Network (LBSN)

- Locations are recorded by creating a location-based social network (LBSN)[9].
- Records of received user and customer data are marked.
- The location is determined using Haversine formulas.
- If you have two different values of latitude and longitude from two different points on the earth, you can easily calculate the great circle distance (the shortest distance between two points on the surface of the sphere) using Haversine's equation[6].

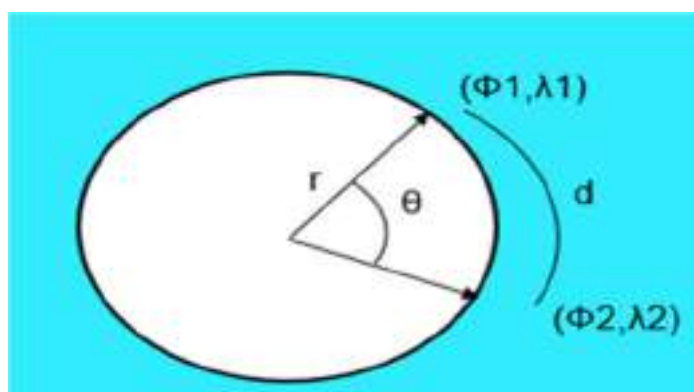


Figure 5. Haversine Formula

The Haversine formula calculates the shortest distance between two points on a sphere using their latitudes and longitudes measured along the surface. It is important for use in navigation. The haversine can be expressed in trigonometric function as:

$$\text{haversine}(\theta) = \sin^2(\theta/2) \quad (1)$$

The haversine of the central angle θ (which is d/r) is calculated by the following formula:

$$\text{haversine}(d/r) = \text{haversine}(\varphi_2 - \varphi_1) + \cos\varphi_1 \cos\varphi_2 \text{haversine}(\lambda_2 - \lambda_1) \quad (2)$$

Where r is the radius of earth (6371 km), d is the distance between two points, φ_1, φ_2 is the latitude of the two points and λ_1, λ_2 is the longitude of the two points respectively.

Solving d by applying the inverse haversine or by using the inverse sine function, we get: ($h = \text{hav}(\theta)$)

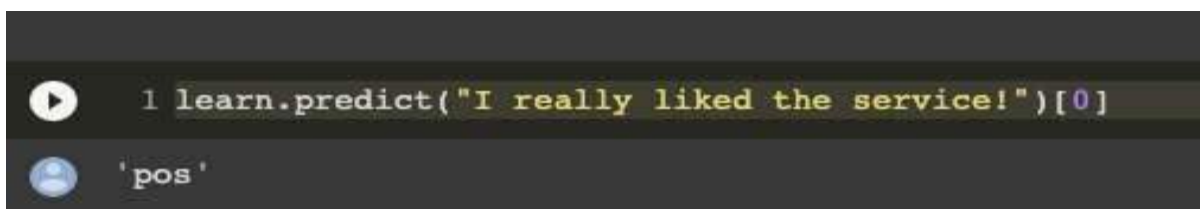
$$d = r * \text{hav}^{-1}(h) = 2r \sin^{-1}(\sqrt{h}) \quad (3)$$

5. Results

5.1 Results for sentiment analysis


By using sentiment analysis we predict the review of the artists provided by the users and we categorize them as positive and negative.

5.1.1 Positive Results :



```
1 learn.predict("I really liked the service!")[0]
'pos'
```

Figure 6. Positive result of sentiment analysis



```
1 learn.predict("Recommended artist")
('pos', TensorText(1), TensorText([1.5132e-05, 9.9998e-01]))
```

Figure 7. Positive result of sentiment analysis

5.1.2 Negative Results :



```
[13] 1 learn.predict("Bad service")
('neg', TensorText(0), TensorText([0.9923, 0.0077]))
```

Figure 8. Positive result of sentiment analysis

5.2 LOCATION BASED SOCIAL NETWORK (LBSN)

The below picture shows how haversine formula is executed to track location of specific user:

```

from math import radians, cos, sin, asin, sqrt

def haversine(lon1, lat1, lon2, lat2):
    """
    Calculate the great circle distance in kilometers between two points
    on the earth (specified in decimal degrees)
    """
    # convert decimal degrees to radians
    lon1, lat1, lon2, lat2 = map(radians, [lon1, lat1, lon2, lat2])

    # haversine formula
    dlon = lon2 - lon1
    dlat = lat2 - lat1
    a = sin(dlat/2)**2 + cos(lat1) * cos(lat2) * sin(dlon/2)**2
    c = 2 * asin(sqrt(a))
    # Radius of earth in kilometers. Use 3956 for miles. Determines return value units.
    r = 6371
    return c * r

```

Figure 9. Positive result of sentiment analysis

6. Conclusion

Therefore, by using LBSN and sentiment analysis together, you can build a powerful search and recommendation system that allows users to find the preferences they need. This ultimately helps users get site-specific results and also provides them with the information they need about customer service reliability. LBSN is very effective in assisting location-based recommendations by showing the shortest distance from a customer's available unit. Sentiment analysis can provide inferences about authenticating reviews, ensuring that customers receive information about quality service.

7. References

- [1] Striking the Balance Between Novelty and Accuracy in Location-Based Recommendation System, IEEE Published on 16 January 2020,INSPEC Accession Number: 19280015,Authors:Vivek Agrawal, Shivam Sahu, Sneha Oommen, G. Ram Mohana Reddy
- [2] Sentiment Analysis of Twitter Data, INSPEC Accession Number: 18674174, IEEE published on 16 May 2019,Authors:Sahar A. El Rahman; Feddah Alhumaidi Al Otaibi; Wejdan Abdullah Al Shehri
- [3] Movie Recommendation System Using Sentiment Analysis From Microblogging Data, 2019,IEEE published on JUNE 2020, Authors: Sudhanshu Kumar , Kanjar De, and Partha Pratim Roy'
- [4] Location Based Place Recommendation using Social Network,IEEE published on March 2019, 978-1-5386-8075-9/19,Authors:Ms. Priya Naik, Ms. Palak V. Desai, Ms. Supriya Patil
- [5] Comprehensive Study on Sentiment Analysis: Types, Approaches, Recent Applications, Tools and APIs ,IEEE published on NOVEMBER 2020,Authors:Ms. Binju Saju, Ms. Siji Jose , Mr. Amal Antony
- [6] Shortest Path Calculation: A Comparative Study for Location-Based Recommender System,IEEE published on 2016,Authors: Hagar Mahmoud; Nadine Akkari
- [7] Recommender Systems Challenges and Solutions Survey, IEEE published on FEBRUARY 2019,Authors:Marwa Hussien Mohamed, Mohamed Helmy Khafagy , Mohamed Hasan Ibrahim

- [8] "Recommendation systems: Principles, methods and evaluation," Elsevier Egyptian Informatics Journal, pp. 261–273, August 2015, Authors: F.O. Isinkaye, Y.O. Folajimi, and B.A. Ojokoh,
- [9] "Social Network Analysis Tools," IEEE Fourth International Conference on Communication Systems and Network Technologies, pp. 388-392, May 2014. Author: N Akhtar
- [10] "Enhancing deep learning sentiment analysis with ensemble techniques in social applications," Expert Syst. Appl., vol. 77, pp. 236–246, Jul. 2017. Authors: O. Araque, I. Corcuera-Platas, J. F. Sánchez-Rada, and C. A. Iglesias
- [11] "Hybrid recommender systems based on content feature relationship," IEEE Trans. Ind. Informat., early access, Nov. 21, 2016, doi: 10.1109/TII.2016.2631138. Authors: E. Aslanian, M. Radmanesh, and M. Jalili
- [12] "Opinion Mining and Sentiment Analysis – An Assessment of Peoples' Belief: A Survey", International Journal of Ad hoc, Sensor & Ubiquitous Computing IJASUC, Vol 4 No 1, Feb 2013. Authors: S.Padmaja
- [13] "Handbook Chapter: Sentiment Analysis and Subjectivity. Handbook of Natural Language Processing," Handbook of Natural Language Processing. Marcel Dekker, Inc. New York, NY, USA, 2009, Authors: B Liu

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MULTIPLE OBJECT TRACKING WITH WEIGHTED ADAPTIVE STRUCTURAL NETWORK IN REAL-TIME SURVEILLANCE SYSTEM

Mr. Ravindra Sangle* & Dr. Ashok Kumar Jetawat

Keywords: multiple object tracking, real-time surveillance system, weighted fusion, local filtering, adaptive structure, regression tracker

ABSTRACT

One-shot multiple object tracking (MOT) framework has gotten a lot of interest in the MOT research community, due to its advantage in inference speed. However, the present one-shot techniques' tracking precision may cause them to perform worse than their two-stage counterparts. The causes are twofold: one, due to the single-image input, motion information is frequently overlooked. This research proposes multiple object tracking with weighted adaptive structural network in real-time surveillance system. The adaptive neural network is involved in the processing of information with desired adjustments to achieve the target in the system. The evaluation is based on an examination of the large complex information processing in the artificial intelligence system. Initially, the mask is created to capture the local target structure. Through the implementation of the weighted fusion, local filtering is performed. The designed model is implemented over the adaptive structure with a regression tracker to classify the multiple objects in the surveillance system. While image-based object detection produces a local choice, tracking method authorizes as well as validates detection over time, making it temporal detection that makes a global decision over time. MOT approach provides feedback to object detection module in form of predictions of object locations. As a result, the technique strongly integrates object identification and tracking. The experimental results reveal a significant improvement in the tracker's performance, with the suggested technique achieving accuracy of up to 94 percent, precision of up to 93 percent, recall of up to 82 percent, and MAP of up to 92 percent, all of which are competitive with existing algorithms.

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Multi Object Detection using Gaussian Mixture Model with Convolved Moving Window Architecture Integrated by Kalman Filter for Background Subtraction Method

Ravindra Sangle

Research Scholar, PAHER, Udaipur, India

Ashok Kumar Jetawat

Professor, PAHER, Udaipur, India

Abstract:

Foreground object recognition in video is a critical step in several computer vision applications and automated video surveillance systems. Noise removal algorithms are used to detect mostly moving foreground objects. In recent decades, effective multi-object detection methodologies have been proposed for a variety of applications, like visual surveillance and behavior analysis. The range of applicants with the greatest performance and lowest cost is growing thanks to ongoing development in the technologies of video collection devices. Item detection methods are critical phases in objects recognition, surveillance, navigation systems. Object detection is the process of separating foreground and background items in photographs. Object tracking establishes the correlation among objects in a video sequence's succeeding frames. In this research, we offer algorithms that are split into 2 steps that includes Multi object detection utilizing Gaussian Mixture Model (GMM) and background suppression have performed. Multiple moving objects tracking using convolved moving window Kalman filter (CMWKF). It can, however, cope with a variety of video sequences in the MOT 20 dataset. The experimental findings reveal that the proposed method detects and tracks foreground objects in complex and dynamic scenarios with high accuracy, robustness, and efficiency. This method also produces smoothed images without noise.

Keywords: multi-object detection, Gaussian Mixture Model (GMM), convolved moving window Kalman filter (CMWKF), background suppression, video surveillance, video sequence.

1. Introduction:

Multiple Object Tracking intends to extricate directions of various moving articles in a picture grouping, is an essential errand in video understanding. A hearty and dependable MOT framework is the reason for a wide scope of uses including video observation, independent driving, and sports video examination [1]. Each following strategy requires an Object Detection instrument either in each casing or when the item initially shows up in the video. It handles division of moving articles from fixed foundation objects. This spotlights on more elevated level handling. It likewise diminishes calculation time. Because of ecological circumstances like light changes, shadow object division becomes troublesome and huge issue. A typical methodology for object identification is to involve data in a solitary edge. Notwithstanding, some item identification strategies utilize the worldly data figured from a grouping of edges to diminish the quantity of misleading recognitions. This worldly data is typically as casing differencing, which features districts that changes progressively in continuous casings [2].

GMM (Gaussian Mixture Model) is a limited blend likelihood appropriation model. The EM (Expectation-Maximum) calculation is an overall strategy for tracking down the Maximum Likelihood Estimation (MLE) from a deficient information and is really a superior drop calculation [3]. The benefit of GMM approach is that various kinds of burden dispersions can be genuinely addressed as an arched mix of a few ordinary appropriations with separate means and fluctuations. The issue of getting different blend parts (weight, mean, and difference) is formed as a Parametric Estimation issue. The EM calculation is an incredible asset in boundary assessment issues. It is an overall strategy for observing the Maximum-Likelihood gauge of the boundaries of a fundamental circulation from a given informational index when the information are inadequate or have missing qualities [4].

To manage various items following in unique scenes, a Kalman Filter Based Tracking calculation is utilized. The Kalman channel gives a powerful item following structure under questionable conditions. To deal with impediments, a few highlights are utilized. The covariance networks of interaction and estimation commotions are assessed consequently utilizing a moving-window assessment method. Specifically, process commotion covariance is tuned through a negative input conspire. Accordingly, underlying reaction and boundaries, as well as interaction and estimation commotion covariance, are all the while assessed in the recursive course of the channel [5]. The objective of this work is to follow the various items in the unique scenes. To accomplish this reason, this paper proposes the Kalman channel based numerous articles following calculation with tangled moving window. The commitment of this paper is as per the following

- To collect the various real time video surveillance data and convert the video into video frames.
- To detect multiple object in the video frames using Gaussian mixture model (GMM) which is integrated with convoluted moving window architecture and kalman filter (CMW_KF), smoothed images are then applied to background subtraction method with moving window which gives detected object present in background image.

The organization of the paper is as follows: In Segment 2, Works related to the proposed model is simply explained. The suggested model is described in depth in Segment 3. The experimental findings and some discussion are then reported in segment 4. Finally, segment 5 contains the paper's conclusion.

2. Related Works:

Moving article location and following utilizing Kalman channel was depicted in [6]. The following is vital for various item. The articles are followed the assistance of Kalman channel. This channel is utilized for the pixel astute deduction of current edge. As well as additionally used to be figure out the blunder between genuine place of the ball and assessed position esteem with the assistance of this channel. The item following technique on video transfers from genuine street climate was created and assessed by [7]. They contrasted the outcomes and other following calculations. This approach can follow the item with continuous impediment issues in a negligible measure of time in correlation with other existing calculations. A crossover model that further develops location precision with low computational time was introduced in [8]. The information picture is rearranged and bunched at different scales utilizing SLIC and K-implies grouping calculations separately. Gaussian Mixture Model (GMM) is created on different shading parts of the advanced picture at various scales. The vital highlights of this technique are object culmination and proficiency as far as computational time. Little notable highlights in the pictures are not distinguished. In [9] develops with mass age in view of highlights removed from submerged scenes utilizing the Bi-layered Empirical Mode Decomposition (BEMD) Algorithm. These separated elements are then familiar with the nonexclusive Gaussian Mixture Model (GMM) to give a premise to an item observing framework. This approach is contrasted and condition of-craftsmanship object identification conspires and dissected both subjectively and quantitatively and ended up being effective. An adjusted Gaussian Mixture Model (GMM) and Adaptive thresholding planned in [10] to further develop object recognition exactness for the open air reconnaissance. Inborn and extraneous upgrades in conventional GMM will deal with the open air dynamic scenes. The test results reason that this calculation productively distinguish objects in unique conditions as well as handle fractional impediments and certain measure of shadows proficiently. A Multi-Dimensional Kalman channel (MDKF) calculation is proposed in [11] for object following and movement identification. The mathematical examination of this following calculation accomplishes cutthroat following execution conversely, with best in class following calculations prepared on standard benchmarks. The state assessment with obscure non-fixed Heavy-Tailed Process And Measurement Noises (HPMN) is considered in [12]. A pointer is acquainted with recognize whether it is produced by the ostensible covariance or the bigger covariance by utilizing Kalman channel. Tries different things with manufactured information and genuine shrewd vehicle information show the viability of this channel under obscure non-fixed HPMN. The benchmark for quite a long time Tracking, MOT Challenge, was sent off in [13] with the objective to lay out a normalized assessment of Multiple Object Tracking Methods. The test centers around numerous individuals following, since walkers are very much examined in the following local area, and exact following and recognition has high down to earth significance. This allows to opportunity to assess best in class techniques for quite a long time following while dealing with very packed situations.

When the illumination changes there will be changes in the scene, and fails in the preservation of edge computing in moving object. Mistracking is occurred in the object's appearance and disappearance because of the occlusion. These are the drawbacks in most of the existing system. To overcome these limitations, Gaussian mixture model (GMM) which is integrated with convoluted moving window architecture and kalman filter (CMW_KF) is proposed in this paper.

3. System Model:

This study provides a multi-object identification technique based on the Gaussian Mixture Model, as well as a convoluted movable windows Kalman filter approach for object tracking. In perplexing scenarios, this approach provides effective monitoring of many moving objects. Figure 1 represents the Gaussian mixture model with convoluted moving window architecture integrated by kalman filter. MOT20 is the real time video dataset taken in this model, this video is converted into small video frames. Multiple moving objects are detected by GMM model and noises will be present in the frames of the detected object. The noise is removed and smoothed by using Convoluted moving window kalman filter. After the removal noise the video frames are processed and analyzed.

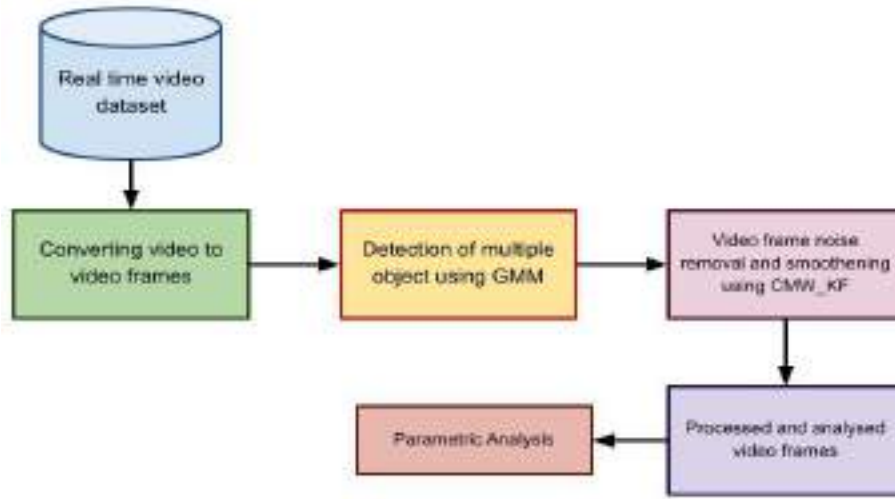


Figure 1: Gaussian mixture model with convoluted moving window architecture integrated by kalman filter

A parametric probability density function, GMM is a parametric model that estimates the probability distribution function based on a variety of object characteristics. When there is strong occlusion and dynamic scene changes, it is difficult to recognize several moving objects in computer vision technologies. Background modelling is always the initial stage in implementing background removal method to detect moving objects from each segment of video frames. The Gaussian Mixture Model may be used for this background modelling. To achieve the intended outcome, all incoming frames from a video series are subtracted from a reference background modelling frame and the difference is compared to a threshold value.

The general formula for Gaussian Mixture Model [14] is expressed in equation (1) as follows

$$P(x_t) = \sum_{i=1}^k (\omega_{i,t} n(x_t; \mu_{i,t}, \Sigma_{i,t})) \quad (1)$$

Where, $\sum_{i=1}^k (\omega_{i,t}) = 1$

The mixture equal mean is given in equation (2) is

$$\mu_t = \sum_{i=1}^k \omega_{i,t} \mu_{i,t} \quad (2)$$

Background subtraction is a common technique for recognizing moving objects in films captured by static cameras. Assume that the backdrop has previously been updated for a certain sequence of frames before beginning the tracking procedure in the suggested technique. It is written as follows in equation (3):

$$B_t(x, y) = \begin{cases} 0 & \text{if } |I_t(x, y) - b(x, y)| < \tau_B \\ 1 & \text{if } |I_t(x, y) - b(x, y)| \geq \tau_B \end{cases} \quad (3)$$

Where $b(x, y)$ is the background that is already obtained. $I_t(x, y)$ is the gray image at time t . τ_B gives threshold value. Equation (1) and (2), are enough for detecting multiple moving object in videos. The $B_t(x, y)$ has information greater than $P(x_t)$ relatively, as $P(x_t)$ has many noises caused by lightness.

The Kalman filter is a technique that estimates the parameters of a system and predicts future observations based on noisy measurements collected over time. It makes predictions, takes a measurement, and then updates itself depending on the forecast and measurement comparison at each time step. It is a mathematical evaluator that predicts and updates the states of a large number of linear processes.

Processing equation is expressed in equation (4) as follows

$$x_k = Ax_{k-1} + w_{k-1} \quad (4)$$

Where A is the transition matrix and x_k denotes the state from time $k-1$ to time k . The Gaussian process noise $N(\cdot)$ vector w ($k-1$) has the following normal probability distribution $p(\cdot)$. Consider a tracking system in which X_k is the state vector, which represents the object's location, velocity, and dynamic behaviour, and subscript k indicates discrete time. The basic goal is to use the measurement Z_k to estimate the value of X_k . Equation (5) represents the probability distribution function, whereas equation (6) reflects the observed measurement.

$$p(w) \sim N(0, Q) \quad (5)$$

$$Z_k = Hx_k + V_k \quad (6)$$

Here H denotes the measurements matrix and Z_k denotes the measurements taken at times $k-1$ to k . The Gaussian measurement noise V_k is represented in equation (7). $N(\cdot)$ with the standard probability distribution $P(v)$.

$$p(v) \sim N(0, R) \quad (7)$$

O gives output of the system noise and R is covariance matrix for apriori estimate for measured KF.

Time update equation Equation (4) and (6) describe linear model with time k that states x_k is shown in the following equations (8) and (9).

$$x_k = Ax_{k-1} + W_{k-1} \quad (8)$$

$$P_{\bar{k}} = AP_{k-1}A^T + Q \quad (9)$$

The covariance error estimates Q, R with Apriori knowledge are given in the above equation (8) and (9). Convolved moving window is applied for tracking objects in the kalman filter. For this window the covariance error estimates with Apriori knowledge is necessary. This moving filter is used to measure and process noise present in the filter to obtain the smoothened image. The noise measurement is obtained by the following equation (10)

$$\varepsilon_k = O_k - O_k^i \quad (10)$$

Where true O_k gives true system output, and O_k gives raw measurement vector. The measure of noise ε_k estimating for O_k^i .

$$O_k^S = (1 - \omega_i)O_{k-1} + \omega_i O_k \quad (11)$$

ω_i gives weighting factor, and smooth O_k^S gives Equation (11) smoothes time series of measurement data. Replace true O_k with smooth O_k in Equation (12), the estimated noise is

$$\varepsilon'_k = O_k - O_k^S \quad (12)$$

$$E[\varepsilon'_j] = \frac{1}{N_s} \sum_{j=k-N_s+1}^k \varepsilon'_j \quad (13)$$

$$R_k = \frac{1}{N_s-1} \cdot \sum_{j=k-N_s+1}^k (\varepsilon'_j - E[\varepsilon'_j]) \cdot (\varepsilon'_j - E[\varepsilon'_j])^T \quad (14)$$

From the above equations, the noise measured is given in equation (15) and (16)

$$\varepsilon'_k = ((1 - \omega_i) \cdot [(O_k^i - O_{k-1}^i) + (\varepsilon_k - \varepsilon_{k-1})]) \quad (15)$$

$$\varepsilon'_k \approx (1 - \omega_i) \cdot (\varepsilon_k - \varepsilon_{k-1}) \quad (16)$$

The covariance of the actual measurement noise can be estimated in equation (17) as

$$R_k^A \approx \frac{1}{2(1-\omega_i)} R_k \quad (17)$$

The feature of the complex movable window Kalman filter is its recursive behaviour while estimating states. After the moving objects have been split, some sort of tracking procedure is necessary. First, this window must be assigned to each moving item in the scene. The picture size is somewhat greater than the complicated moving window size. It not only eliminates noise interference, but it also decreases picture processing time and improves operating speed.

These equations have to do with the system's feedback. The goal is to calculate posteriori, which would be a linear function of the priori and fresh measurement [15]. Below are the equations (18), (19), and (20).

$$C_k = P_k H^T (L P_k L^T + R_k)^{-1} \quad (18)$$

$$\hat{x}_k = \hat{x}_{\bar{k}} + C_k (Z_k - L \hat{x}_{\bar{k}}) \quad (19)$$

$$P_k = (1 - C_k L) P_{\bar{k}} \quad (20)$$

C gives Kalman gain which is figured by over the estimation update conditions. L gives linearization network. After C_k posterior state gauge and aposterior blunder gauge P_k is processed by the estimation. The time and estimation conditions are determined recursively with past posterior gauge to foresee new aprior gauge.

CMWKF utilized for a considerable length of time recognition is characterized as far as its states, movement model and estimation condition lattice x_k is an eight layered framework state vector which can be addressed in condition (21) as

$$x_k = [x_{o,k}, y_{o,k}, l_k, h_k, v_{x,k}, v_{y,k}, v_{l,k}, v_{h,k}]^T \quad (21)$$

$x_{o,k}$ and $y_{o,k}$ represent even and vertical centroid coordinate. l_k and h_k represent half width and half tallness of CMW. $v_{x,k}, v_{y,k}, v_{l,k}$ and $v_{h,k}$ represent their speed individually. After the state condition and estimation condition of movement model are characterized in the following casing, CMWKF will be utilized to gauge the article area

Model update When the worth of the expense work is viewed as least then the boundaries of CMWKF is should be refreshed and use them as a contribution to the following edge.

Algorithm:

To simplify the procedure, the algorithm steps are sketched and summarized below.

Step 1: Conversion of video into video frames

Step 2: Design of Gaussian Mixture Model

$$P(x_t) = \sum_{i=1}^k (\omega_{i,t} n(X_t; \mu_{i,t}, \Sigma_i, t))$$

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Step 3: Obtain the mixture equal mean

$$\mu_t = \sum_{i=1}^k \omega_{i,t} \mu_{i,t}$$

Step 4: Process Background subtraction modelling

$$B_t(x, y) = \begin{cases} 0 & \text{if } |I_t(x, y) - b(x, y)| < \tau_B \\ 1 & \text{if } |I_t(x, y) - b(x, y)| \geq \tau_B \end{cases}$$

Step 5: Design of kalman filter

Step 6: Processing of kalman filter

$$x_k = Ax_{k-1} + w_{k-1}$$

Step 7: Estimation of Probability distribution function

$$p(w) \sim N(O, Q)$$

Step 8: Estimation of noise covariance

$$\varepsilon_k = O_k - O_k^i$$

Step 9: Design of Convolved moving window

$$E[\varepsilon'_j] = \frac{1}{N_s} \sum_{j=k-N_s+1}^k \varepsilon'_j$$

Step 10: Covariance of actual noise measured

$$R_k^A \approx \frac{1}{2(1-\omega_i)} R_k$$

Step 11: The multiple object detected by the eight dimensional system state vector

$$x_k = [x_{o,k}, y_{o,k}, l_k, h_k, v_{x,k}, v_{y,k}, v_{l,k}, v_{h,k}]^T$$

4. Experimental Analysis:

In GMM CMW_KF, the tool for simulation is PHYTHON. MOT20 is the real time video dataset is considered as a dataset. The results of background suppression after processing GMM is shown in the figure 2a and 2b.



Figure 2a& 2b: The image frame taken from MOT 20-01 sequence of MOT 20 real time dataset and background suppressed image

The parameters taken for analysis are Accuracy, Precision, recall, False positive rate (FP), True positive rate (TP), Ground truth (GT), detection rate (DET), Mean Absolute position (MAP).

Accuracy Analysis:

The degree of similarity between a noise measurement and its real value is called accuracy. Table 1 represents the accuracy analysis of the proposed method

Table 1: Accuracy analysis of the proposed method

Sequence	Accuracy (%)
MOT20-01	82.86
MOT20-02	88.87
MOT20-03	84.63
MOT20-04	80.67
MOT20-05	90.69
MOT20-06	75.58
MOT20-07	89.84
MOT20-08	79.53

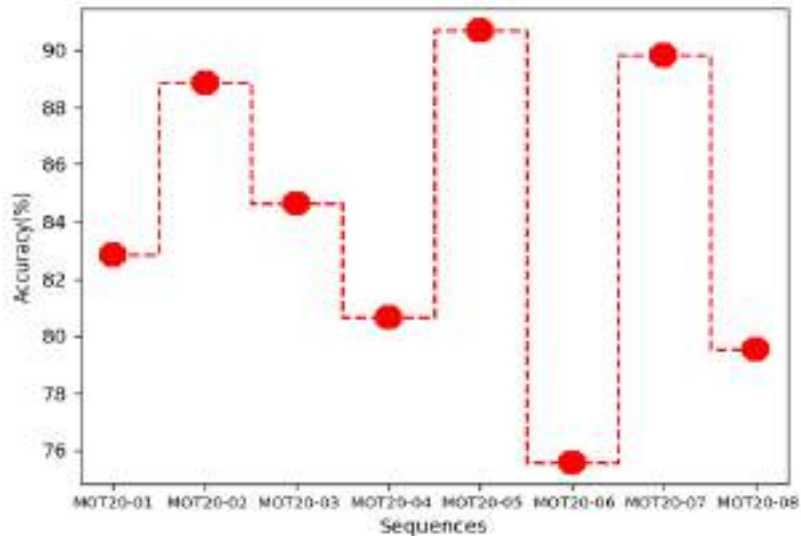


Figure 3: Accuracy analysis of the proposed method

In the figure 3 different sequences of video frames in the dataset MOT 20 are present in the X-axis and accuracy in percentage is considered in Y-axis. From this MOT20-05 achieves highest accuracy rate of 90.69%.

Precision Analysis:

The degree toward which repeated noise measurements under the same conditions get the same results is known as precision. Table 2 shows the Precision analysis of the proposed method

Table 2: Precision analysis of the proposed method

Sequence	Precision (%)
MOT20-01	99.65
MOT20-02	99.62
MOT20-03	98.72
MOT20-04	98.36
MOT20-05	99.68
MOT20-06	82.27
MOT20-07	93.78
MOT20-08	72.31

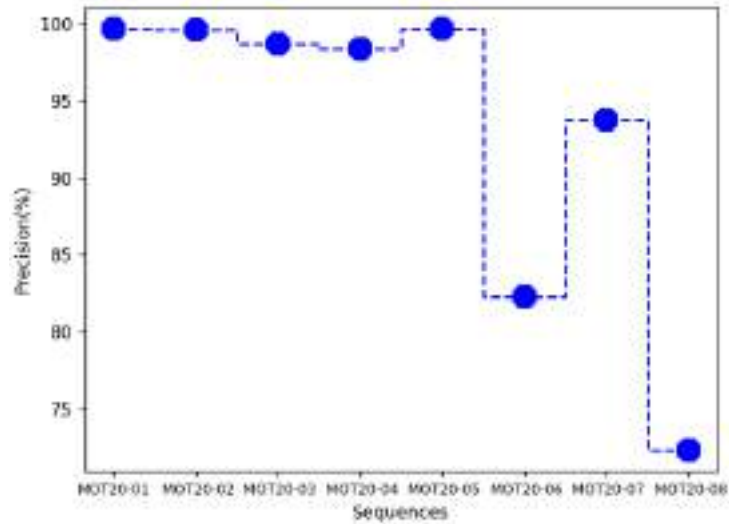


Figure 4: Precision analysis of the proposed method

In the figure 4, different sequences of video frames in the dataset MOT 20 are present in the X-axis and precision in percentage is considered in Y-axis. From this MOT20-05 achieves highest Precision rate of 99.68%.

Recall Analysis:

This is defined as the ratio of how many relevant images you have retrieved overall. Table 3 indicates the Recall analysis of the proposed method

Table 3: Recall analysis of the proposed method

Sequence	Recall (%)
MOT20-01	89.24
MOT20-02	88.31
MOT20-03	64.3
MOT20-04	75.6
MOT20-05	70.32
MOT20-06	63.5
MOT20-07	87.8
MOT20-08	63.2

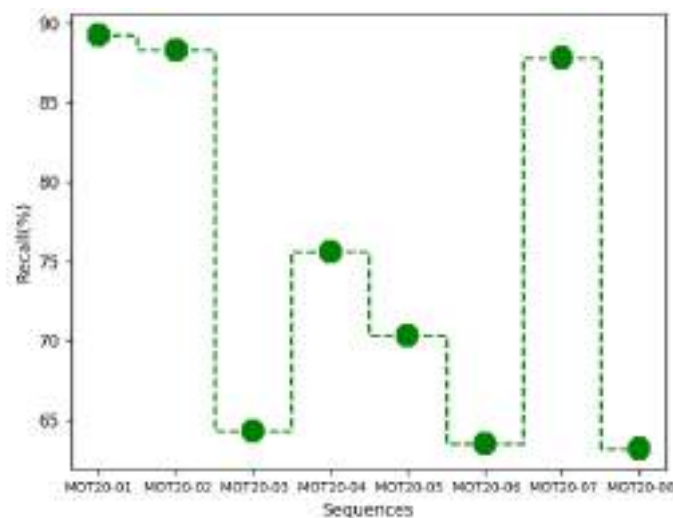


Figure 5: Recall analysis of the proposed method

In the figure 5, different sequences of video frames in the dataset MOT 20 are present in the X-axis and recall in percentage is considered in Y-axis. From this MOT20-01 achieves highest recall value of 89.24%.

True positive Analysis:

The requirements for calculating a tracker's performance. One is to see if each postulated output is a true positive (TP) that corresponds to a real (annotated) goal. Table 4 describes True positive analysis of the proposed method.

Table 4: True positive analysis of the proposed method

Sequence	True Positive
MOT20-01	1151
MOT20-02	9201
MOT20-03	15428
MOT20-04	11682
MOT20-05	11496
MOT20-06	3603
MOT20-07	789
MOT20-08	2059

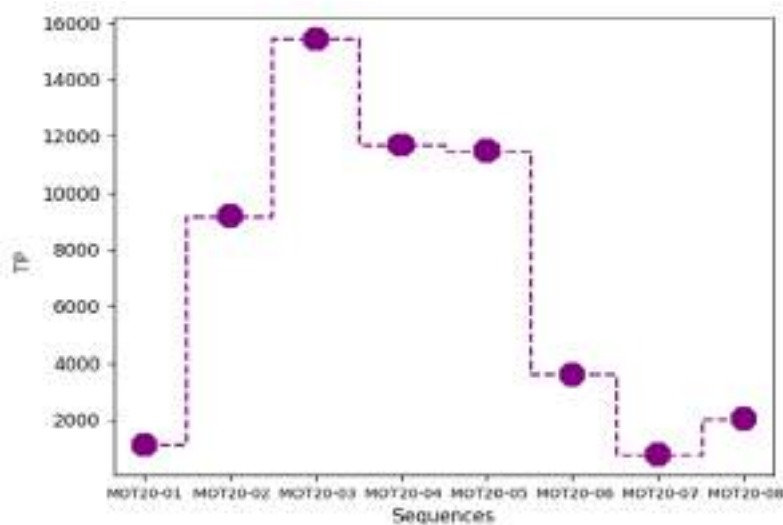


Figure 6: True Positive analysis of the proposed method

In the figure 6, different sequences of video frames in the dataset MOT 20 are present in the X-axis and true positive is considered in Y-axis. From this MOT20-03 achieves highest True Positive value of 15428.

False Positive Analysis:

The requirements for calculating a tracker's performance. The first step is to establish if each postulated outcome is just a false alarm or a false positive, FP Table 5 shows False positive analysis of the proposed method

Table 5: False positive analysis of the proposed method

Sequence	False Positive
MOT20-01	35383
MOT20-02	155661
MOT20-03	94209
MOT20-04	165294
MOT20-05	238859
MOT20-06	52413
MOT20-07	47148
MOT20-08	32622

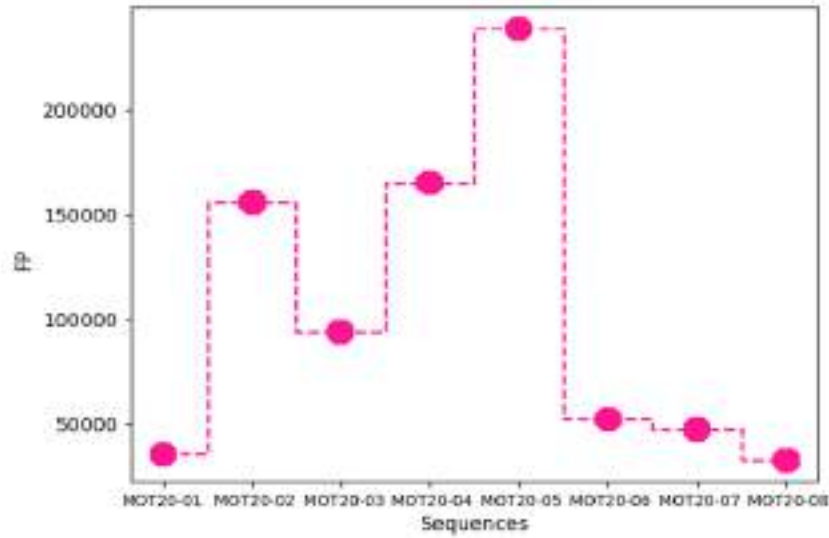


Figure 7: False Positive analysis of the proposed method

In the figure 7, different sequences of video frames in the dataset MOT 20 are present in the X-axis and false positive is considered in Y-axis. From this MOT20-05 achieves highest False Positive value of 238859.

Ground Truth Analysis:

The term "ground truth" refers to data gathered on the spot. Image data may be linked to real-world characteristics and materials using ground truth. Atmospheric adjustment is also aided by ground truth. Table 6 represents Ground Truth analysis of the proposed method.

Table 6: Ground Truth analysis of the proposed method

Sequence	GT
MOT20-01	12610
MOT20-02	89837
MOT20-03	177347
MOT20-04	228298
MOT20-05	381349
MOT20-06	69467
MOT20-07	20330
MOT20-08	43703

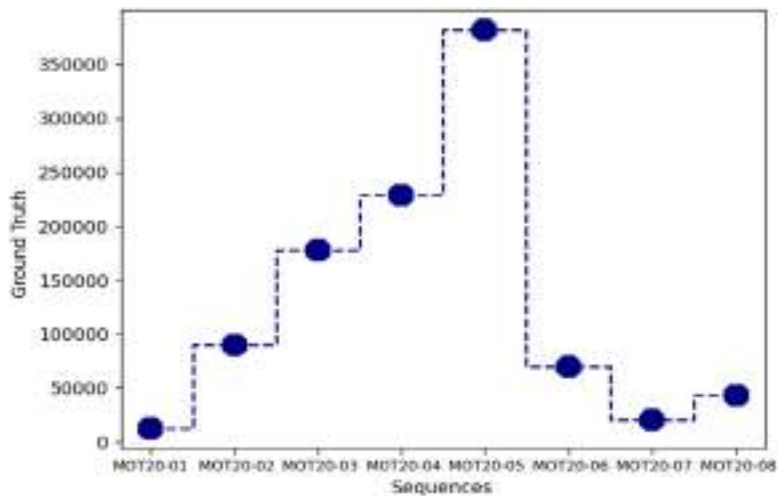


Figure 8: Ground Truth analysis of the proposed method

In the figure 8, different sequences of video frames in the dataset MOT 20 are present in the X-axis and Ground truth is considered in Y-axis. From this MOT20-05 achieves highest ground truth value of 381349.

Detection analysis:

Only pedestrians are considered in this analysis. Static people and other classes are ignored and filtered out of both the detections and the ground truth. Table 7 shows Detection analysis of the proposed method

Table 7: Detection analysis of the proposed method

Sequence	DET
MOT20-01	36534
MOT20-02	164862
MOT20-03	109637
MOT20-04	176976
MOT20-05	250355
MOT20-06	56016
MOT20-07	47937
MOT20-08	34681

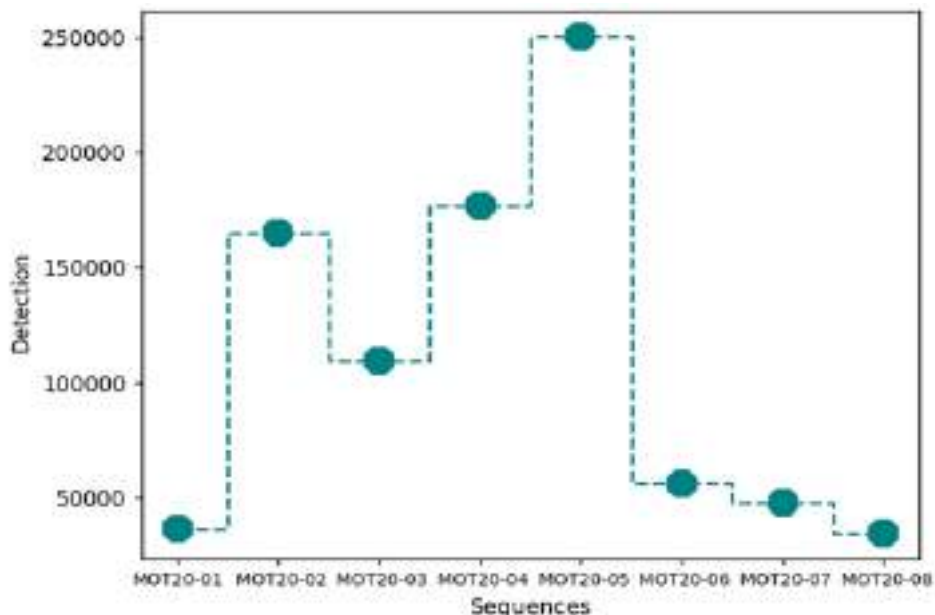


Figure 9: Detection analysis of the proposed method

In the figure 9, different sequences of video frames in the dataset MOT 20 are present in the X-axis and detection is considered in Y-axis. From this MOT20-05 achieves highest detection value of 250355.

Mean Absolute Position Analysis:

Mean Absolute Position is positional information which has details of coordinates related to a unique image. Table 7 represents Mean Absolute Position analysis of the proposed method

Table 7: Mean Absolute Position analysis of the proposed method

Sequence	MAP
MOT20-01	95.63
MOT20-02	96.3
MOT20-03	91.44
MOT20-04	92.1
MOT20-05	92.3
MOT20-06	90.3
MOT20-07	94.38
MOT20-08	87.9

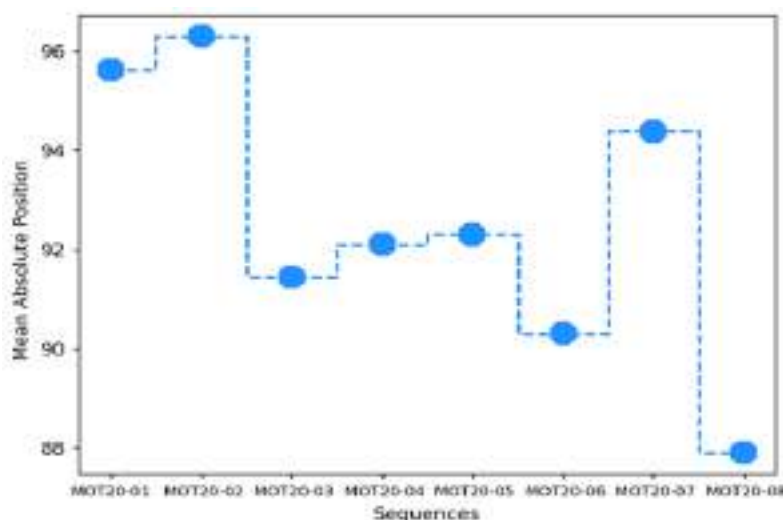


Figure 10: Mean Absolute Position analysis of the proposed method

In the figure 10, different sequences of video frames in the dataset MOT 20 are present in the X-axis and Mean Absolute Position is considered in Y-axis. From this MOT20-02 achieves highest Mean Absolute Position value of 96.3.

The experimental findings reveal that the proposed method detects and tracks foreground objects in complex and dynamic scenarios with high accuracy, robustness, and efficiency. This approach also yields noise-free smoothed pictures.

5. Conclusion

Multi object detection utilizing Gaussian Mixture Model (GMM) and background suppression has been performed. Multiple moving objects tracking using convoluted moving window Kalman filter (CMWKF) has also been performed in this paper. It can, however, cope with a variety of real-time video sequences in the MOT 20 dataset. The experimental findings reveal that the proposed method detects and tracks foreground objects in complex and dynamic scenarios with high accuracy, robustness, and efficiency. This method also produces smoothed images without noise. The obtained results are free from and it takes less computation time. There is no mistaking of the objects and if illumination changes, the tracking of moving object is not changed, this makes this system to be more efficient. This method is to be improved in future by conducting experiments in very crowded environment with more video sequences.

References

- [1] Gautam, A., & Singh, S. (2019, December). Trends in video object tracking in surveillance: A survey. In *2019 Third International conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud)(I-SMAC)* (pp. 729-733). IEEE.
- [2] Luo, W., Xing, J., Milan, A., Zhang, X., Liu, W., & Kim, T. K. (2021). Multiple object tracking: A literature review. *Artificial Intelligence*, 293, 103448.
- [3] Bukey, C. M., Kulkarni, S. V., & Chavan, R. A. (2017, September). Multi-object tracking using Kalman filter and particle filter. In *2017 IEEE International Conference on Power, Control, Signals and Instrumentation Engineering (ICPSI)* (pp. 1688-1692). IEEE.

- [4] Santosh, D. H., & Mohan, P. K. (2014, May). Multiple objects tracking using extended Kalman Filter, GMM and Mean Shift algorithm-A comparative study. In *2014 IEEE International Conference on Advanced Communications, Control and Computing Technologies* (pp. 1484-1488). IEEE.
- [5] Farahi, F., & Yazdi, H. S. (2020). Probabilistic Kalman filter for moving object tracking. *Signal Processing: Image Communication*, 82, 115751.
- [6] Gunjal, P. R., Gunjal, B. R., Shinde, H. A., Vanam, S. M., & Aher, S. S. (2018, February). Moving object tracking using kalman filter. In *2018 International Conference On Advances in Communication and Computing Technology (ICACCT)* (pp. 544-547). IEEE.
- [7] Makhmutova, A., Anikin, I. V., & Dagaeva, M. (2020, September). Object tracking method for videomonitoring in intelligent transport systems. In *2020 International Russian Automation Conference (RusAutoCon)* (pp. 535-540). IEEE.
- [8] Singh, V. K., Kumar, N., & Singh, N. (2020). A hybrid approach using color spatial variance and novel object position prior for salient object detection. *Multimedia Tools and Applications*, 79(39), 30045-30067.
- [9] Mathias, A., Dhanalakshmi, S., Kumar, R., & Narayanamoorthi, R. (2021). Underwater object detection based on bi-dimensional empirical mode decomposition and Gaussian mixture model approach. *Ecological Informatics*, 66, 101469.
- [10] Ghedia, N. S., & Vithalani, C. H. (2021). Outdoor object detection for surveillance based on modified GMM and Adaptive Thresholding. *International Journal of Information Technology*, 13(1), 185-193.
- [11] Zhu, H., Zhang, G., Li, Y., & Leung, H. (2021). A novel robust Kalman filter with unknown non-stationary heavy-tailed noise. *Automatica*, 127, 109511.
- [12] Babu, P., & Parthasarathy, E. (2022). FPGA implementation of multi-dimensional Kalman filter for object tracking and motion detection. *Engineering Science and Technology, an International Journal*, 33, 101084.
- [13] Dendorfer, P., Rezaatfighi, H., Milan, A., Shi, J., Cremers, D., Reid, I., ... & Leal-Taixé, L. (2020). Mot20: A benchmark for multi object tracking in crowded scenes. *arXiv preprint arXiv:2003.09003*.
- [14] Dong, E., Han, B., Jian, H., Tong, J., & Wang, Z. (2020). Moving target detection based on improved Gaussian mixture model considering camera motion. *Multimedia Tools and Applications*, 79(11), 7005-7020.
- [15] Chavan, R., & Gengaje, S. R. (2017). Multiple object detection using GMM technique and tracking using Kalman filter. *Int. J. Comput. Appl*, 172(3), 20-25.



An Overview of Personality Recognition through Machine Learning For E-Recruitment

¹Priyanka Kamble, ²Umesh Kulkarni, ³Ankit Sanghavi

¹Student, ²Professor, ³Professor

¹Department of Computer Engineering,

¹ARMIET College of Engineering and Technology, Shahapur, India

Abstract : In our daily lives it is crucial to identify the personality of a human based on his behavior, therefore the prediction of personality has a large scope in the field like recruitment of organizations or industries. The personality can be positive or negative that can be identified by their actions in different situations and behaviors in different conditions. In the research study it is noticed that, personality traits are based on the Big Five Model i.e. OCEAN model. In the previous study, many investigations done in the field of personality recognition where they have used different techniques and different algorithms to predict the personality of different people by using verbal and non-verbal cues. Some have used segments from the resume, resume classification, text based approach to predict the personality of the different candidates. Some of the case studies used facial expressions where they have used CNN features. One study reviewed on the prediction of personality by using various deep learning algorithms. Apart from this there are certain limitations on the single model as discussed above. As per research terminology, there is no other system which can be used by the interviewee and interviewer on the same platform for personality prediction which helps candidates to get selected in the organization by checking his ability from the resume and interviewer to select the perfect candidate for the organization by analyzing the candidates during the interview. As the system discussed above can be a better solution for the candidates and HR of the organizations.

IndexTerms - Big five personality traits, Personality Recognition, Machine learning, deep learning, CNN.

I. INTRODUCTION

It is difficult for every individual to predict the personality of humans. At the recruitment process it becomes more crucial as the interviewer has to recruit the best suitable candidate for the organization. As the interviewer has responsibility to determine the actual personality of the interviewee when it comes to online interviews hence it becomes difficult.

The personality of the human can be determined by two categories such as verbal and non-verbal where verbal personality can be determined by some of the factors which includes communication skills, use of specific phrases or facial expression, etc. The non-verbal personality factors include the posture, speech tone, etc. of an individual human. The personality can be detected by some other factors too such as handwriting of the person, social media activities like updating posts, profile pictures, reactions or comments on other posts, resume analysis by interviewer or HR and psychometric test.

In recent years, online or intelligent recruitment systems have played an important role in the recruitment process with advanced text processing techniques. The job recruiters posted most of the job requirements on various online platforms in recent years. The online recruitment systems gather a large number of resumes from different sources. In the recruitment process the resume or CV is the golden key for the job seekers. As the recruitment companies spend a lot of time and energy to filter and pull out the data from the resumes according to the job requirements. Therefore many recruitment tools are developed for the retrieval of the information from the resume.

CV/ Resume analysis becoming beneficial for the organization in prediction of personality of candidates for human resource management. Also the CV analysis can be beneficial for the candidate to select the appropriate job title for the organization. Some organizations conduct the online aptitude test and personality assessment tests for evaluating the personality of candidates. Nowadays, multimodal systems are popularly used to determine the personality traits of speakers from seminar videos, YouTube videos and vlogs.

The job seekers can postal their personality by using a resume which helps to express themselves in a good manner. Humans with great communication skills are more likely to have an impressive personality than those who face difficulties in communicating with others. Great communication can build strong bonds among people. The posture and hand gestures of individuals can help them to present their personalities effectively.

In recent years, the recruitment process inserted psychometric assessment which helps to assess whether the candidate is capable of growing vigorously in a specific professional role. Psychometric testing is a calculation of an individual's logical skills and personality traits which can help to understand aspects of mental ability and behavioral style that organizations are unable to measure during conversation and interviews. The psychometric assessments are astronomically used in recruitment and selection process, performance evaluation, employee engagement, employee training and development, career guidance, high-potential identification and succession planning. The psychometric test in recruitment is a strong correlation between psychometric test score and job performance. For example, the high scorer candidate will show the high performance on the job. Hence the psychometric

testing or assessment becoming the testing part of the interviewee in the recruitment process. The psychometric test is easy to administer and scale to match the hiring requirement.

Similarly, every person has unique behavior as the posture, facial expressions and hand gestures of individuals helps candidates to present their personalities effectively during the recruitment process.

The human and computer are linked by Natural Language Processing (NLP) that focuses on how computers can be utilized to understand original language text/speech to perform some effective tasks.

II. RELATED WORK

A lot of work has been already done in prediction of personality which is always been a crucial task and mainly in recruitment process as follows:

In the existing e-recruitment process, they worked on personality prediction through personality assessment tests and cognitive skills tests. In existing systems, interviewers used to make decisions by filtering interviewees on the basis of their CVs and behavior during online interviews sessions. They simply mark the personality on the basis of online interviews and scan the submitted CVs and shortlist the candidates within the suggested system.

Hung-Yue Suen, et al. [1] experiments on the recognition of individual personality traits through automatic analysis of video interviews. The working interviewing system developed using asynchronous video interview (AVI) processing with tensor flow-based AI engine to perform automatic personality recognition (APR) based on the feature extracted from AVIs. The true personality scores are evaluated by the facial expression and self-reported questionnaires of 120 real job applicants [1].

Octavia Arriaga, et al. [2] proposes the general CNN building framework for designing real time CNNs. They validate the model by creating a real time vision system to accomplish the tasks of face detection, gender classification and emotion classification. The IMBD gender dataset and FER-2013 emotion dataset is used by author to develop the model. The author successfully reduces the gap between the slow performances and real time architecture [2].

Dina Al-Hammadi, et al. [3] compares four different machine learning techniques with their performances to recognize personality traits from non-verbal cues. As the author reported the result by using speaker personality corpus provided by the Interspeech 2012 challenge. The proposed work gives an increase in performance. The non-verbal things are focused in this research such as speech attributes, prosody, gestures, facial expressions and body movement. For implementation purpose the proposed system used Support Vector Machine which gives the good result as 60% for all traits whereas naïve Bayes, SVM with linear kernel and SVM with Radial Basis Function (RBF) are also used by researcher which increase the result high for extraversion, conscientiousness, and neuroticism [3].

Shivam Gupta [4] states a fully automatic recognition of facial emotions using the computer vision and machine learning algorithms which classifies eight different emotions. The support vector machine algorithm is best suited for the classification process with accuracy 94.1% according to the author. The fully automatic real time coding facial expressions in the continuous video stream is achieved by author at least for applications in frontal views can be assumed using webcam [4].

Bernhard Kratzwalda, et al. [5] investigates how emotion recognition is done by using neural networks and deep learning. The emotions are affecting human decision making which can be the goal of affective computing. The proposed scheme is a tailored form of transfer learning for affective computing which has past work as the traditional machine learning used as utilized methods with advanced deep learning and recurrent neural networks and transfer learning. The proposed system summarizes the baselines from traditional machine learning and deep learning and uses the inherent nature of affective computing with multiple innovations concerning the network architecture.

Jaejin Cho, et al. [6] improves the acoustic information and conversation transcripts are used to improve the emotion recognition. The system had researched in the field of deep learning networks to generate vectors at frame level from raw spectral representation and merge the features over time into utterance level feature vectors by classifying it with a softmax layer. The proposed system is compared with SVM and DNN training. The system is combined with a transcript based system to improve the acoustic system. The acoustic system in this work is based on the LSTM network and the multi resolution CNN is used for prediction of emotion from ASR transcripts and human annotated transcripts.

Gunaseelan B [7] extracts various features from the text and built a classifier to predict whether a text line in the resume is heading or not. They researched that XG boost outperforms the other classifier in predicting headings. They have extracted the skillsets information from the resume pdf and word files format.

Ricardo Stegh Camati [8] et al. investigates the new TB-APR approach using projective tests to build a corpus. The method developed is labeling of textual corpus using z-test projective instrument conducive to mitigate the limitation of inventories which is very sensitive and offers the possibility of collective applications. The proposed work used a corpus of 363 individuals labeled by the z-test. The proposed model used bag-of-words techniques with some state of art machine learning inductors.

Berkay Aydin et al. [9] presents the multimodal method for predicting personality from the short video clips. According to the big five personality traits to predict personality, the proposed work used audiovisual features and random decision forest regression. This paper is presenting the framework which uses audio features, global motion energy features and facial landmark features to perceive automatic personality prediction. In this proposed work the visual features extracted from the videos, the overall visual activity of the person is computed by using Weighted Motion energy Images (WMEI). The proposed system is developed for the Chalearn First Impressions Challenge where the system is presented with an in depth analysis of the usage of non-verbal audio visual features, energy image based features and facial landmarks in automatic personality perception. The overall observation of all the features results in obtaining accuracies in the range of 85% to 89%.

Mr. Ramraj S et al. [10] predicts the domain adaptation, used for the sensitive nature of resume data. Also the classifier is trained on job description snippets as a large dataset, used to classify the resume data. The paper aims to compare the results gained by all the various state of art algorithms generated by the same data so the efficiency of each algorithm can be evaluated. As per author's research, it is evident that character level CNN gives the better F1 score as compared to other models. As a result, CNN can also be used to classify the text rather than images and exceptional results as compared to text classification algorithms. In future the dataset size can be increased by using Generative Pre-Trained Transformer (GPT-2) algorithm which will help to train the model to learn better with more information.

Made Artha Agastya et al. [11] reviews on personality trait recognition has an essential role in the job screening process which can perform the analysis based on the survey, the handwriting of the participant, or conduct the interview which takes a lot of time

and money. Hence, there should be a system that can help in the screening process. This paper is the study to classify the latest deep learning algorithms in personality trait classification. The author collected 25 key papers from Scopus, IEEE, science direct, Emerald Insight and ACM on the basis of Preferred Reporting Items for Systematic reviews and Meta-Analyses Method (PRISMA).

Christopher Pramerdorfer et al. [12] overviews the state of art in image based facial expression recognition using CNNs and highlights algorithmic differences and their performance. In this paper the previous bottlenecks and consequently for advanced research directions are identified. This paper is demonstrated to overcome the previous bottleneck which outperform without requiring auxiliary training data or face registration with deep CNNs which obtains FER2013 test accuracy of 75.2%. The FER2013 dataset is used to study the FER performance which is the most common dataset in CNNs based FER.

Allan Robey, Kaushik Shukla, et al. [13] directs to examine the organization oriented enrollment that they will hire a passionate and right candidate for a particular job profile. In this paper [13] they have used NLP to structure unstructured data sources but NLP doesn't have a user interface to communicate with the framework. NLP needs to include the permit clients in the organization.

Hung - Yue Suen et al. [14] suggests that there is not only a considerable calculation instrument for approximating interpersonal abilities in organized but also they made decisions about their non-verbal correspondence. They have used the Novel Deep Learning model for great simultaneous permissibility and accuracy to anticipate an interviewee's relational abilities and characteristics.

MICHAEL M. TADESSE et al. [15] proposes the relationship between client personalities with their nature in social networks. The online interactions are monitored by the SNA which gives the accuracy better than LIWC, SPLICE and the combination of SNA+LIWC+SPLICE. For implementation purposes they have used the combination of SNA, LIWC and SPLICE so the performance is low.

Chen-Lin Zhang, et al. [16] refers YouTube videos to predict personality by the author in this paper for this they have developed the DBR model for improving visual regression performance. They have used traditional CNN for development. They divided the video into images and audio features. For images they have used deep regression and for audio features they have used regression. The 10000 videos with time duration 15 seconds from YouTube dataset is used for development by the author.

Dr. V. Suma [17] extends the work of analysis of the Indian e-commerce market using data mining approach for prediction of demand of renovated electronics. The real world factors and real world datasets are used from the three random e-commerce websites which are considered for analyzing the work. Based on the result of the author, the highly accurate prediction can be made with the proposed approach in spite of the impact of varying customer's behavior and market factors. In the CLSC method, the item cost and demand are a few questionable parameters that are to be measured absolutely by implementing advanced forecast strategies.

Dr. Abraham Chandy [18] administers the savvy asset in cloud computing that is used for an enormous information processing system that is fulfilled in this paper influencing machine learning. The work stack request is associated with asset assignment where the proposed work predicts the work stack utilizing the arbitrary timberland and degrades the assets utilizing the genetic calculations.

Heysem Kaya and Albert Ali Salah suggests that proposed work is used for the interactive media work applicant screening task. The multimodal combination is used for proposed work that is followed by the choice tree (DT). The DT is used to create text based clarification of its choices. The DT is better accuracy wise as per research work. The job candidate is analyzed by the short video to produce apparent personality scores and a prediction about whether the candidate will be selected for the job interview or not. The system gives the explanation of its decision that provides a visual and textual explanation [19].

Matthew J.W. McLarnona, et al. [20] studies within person, two wave data that investigates faking on a conscientiousness and faking conditions using latent transition analysis (LTA) that identify different types of faker. The author examined whether counterproductive workplace behavior (CWB) differed across the faking types. The result supported three class solutions in honest responding and faking conditions. As the respondent can be classified as honest respondent, slight fakers and extreme fakers. The high agreeableness and low neuroticism as predictive of stable response patterns are supported by the system.

Mihai Gavrilescu and Nicolae Vizireanu propagate the psychological qualities that are examined consequently by the facial features of people to assess the diversity. The Facial Expression Recognition (FER) framework is used to predict the sentimental state of the individual. The emotions and facial movements are analyzed with proposed architecture with 16PF qualities [21].

Table 1: Comprehensive Analysis of Personality Prediction Based On the Previous Study

Sr. No.	Years	Methodology	Datasets /Achievements	Limitations
1.	2019	Convolutional Neural Network (CNN), Tensorflow, Big five	Datasets are R, R2, MSE with above 90% Accuracy	The system used only 120 job applicants to predict their personality. Restricted or limited population can be produced
2.	2021	CNN	Used dataset of IMDB gender with 96% accuracy and FER-2013 with 66% accuracy	more parameters in naïve implementation leads to less robust features. The CNNs for gender classification found biased towards western facial features.

3.	2021	Sampling technique, OCEAN Model	Used Dataset of Speaker Personality Corpus (SPC) with higher result using SVM	The smaller datasets are considered for personality recognition.
4.	2018	SVM, noise-tip method,	Cohn-kanade (CK) database is used. Used images, facial landmark datasets with accuracy 93.7%	Complexity level increases with real time emotion recognition.
5.	2018	Deep Learning, neural networking, transfer learning, lexicon based methods	Holistic setting across 6 benchmark dataset, ISEAR, semEval-2007 & SemEval-2018 with improvement of performance up to 23.2% in F1 Score and 11.6 % in regression task.	Some of the algorithms like naive network struggling with task of emotion recognition. Decreases performance with the larger dataset
6.	2018	Deep neural networks, LSTM network	Datasets used USC-IEMOCAP with accuracy 24% & US English telephone speech with accuracy 3.4%	The degree of system can be improve by the trained transcript performance
7.	2020	Random forest, LSTM, N-gram RNN models, NLP, sampling techniques	Test dataset used from the recruitment process with 85% accuracy	Fails to extract the skillset from the resume with all type of file formats
8.	2020	Bag-of word techniques,	Datasets are used corpus z-test, AUC-ROC with 0.85 average	Provides the low performance
9.	2016	Random forest regression, Big five model,	Dataset used from first impression challenge, video clips from the youtube with 10 fold cross validation accuracy of 0.90197 and test set accuracy of 0.898	Increase in data can trouble the system
10.	2020	CNN, SVM, ML, subsampling technique	Dataset used from Kaggle with 159571 labeled samples, images dataset with 0.886 F1 score. Dataset used PASCAL VOC	Poor performance on the small dataset with CNN
11.	2020	Deep Learning,	Dataset used MyPersonality with accuracy 67% and 61% on CxD dataset	Lower accuracy in personality trait recognition
12.	2016	CNN based FER method	Used dataset FER-2013 with 75.2% test accuracy	Decreases in performance due to FER dataset bias in real world
13.	2019	NLP	.csv Dataset is used with 75.4 % accuracy	Only depends on CV and aptitude tests The candidate's interview does not matter
14.	2020	NLP, data collection, AVI-AI technique	Dataset are R, R2, MSE with 95% accuracy in communication skills and 98.8% accuracy in personality traits	Fails to explain candidate's probability which is going to be scrupulous and extraverted

15.	2018	OCEAN Model., LIWC, SPLICE linguistic features, social network Analysis (SNA)	XG boost classifier with 74.2% accuracy and SNA with 78.6% accuracy	Lower performance
16.	2019	Deep bimodal regression (DBR), CNN	APA competition dataset with best regression mean accuracy (0.9130)	Does Not work on discriminative audio for personality prediction
17.	2018	Closed loop supply chain (CLSC) method	Real world e-commerce website datasets with higher conclusions trade analytics within the field of restored items.	Could be achieve the better result with the machine learning calculations to analyze the design within the huge information for the more precise expectation of future advertise requests for the restored items
18.	2019	Cloud computing, random forest algorithm	Achieves high performance in time, cost, memory utilization	Issued the security problems that has to be tended to amid the assignment of the comes about
19.	2018	Visual feature extraction, experimental result using regression, experimental result using classification	Dataset used from youtube with 67.3% accuracy	Fails to work on both the interviewers and interviewees during interaction
20.	2019	Counterproductive workplace behavior (CWB), latent transition analysis (LTA)	Results highly supported three class solution in honest responding and faking condition	Increases in CWBs might have negative financial implications Limited result by single source data
21.	2017	CNN features	Datasets used MMI with accuracy 75% and JAFFE with 70% accuracy	Lower expectation precision for few 16PF characteristics

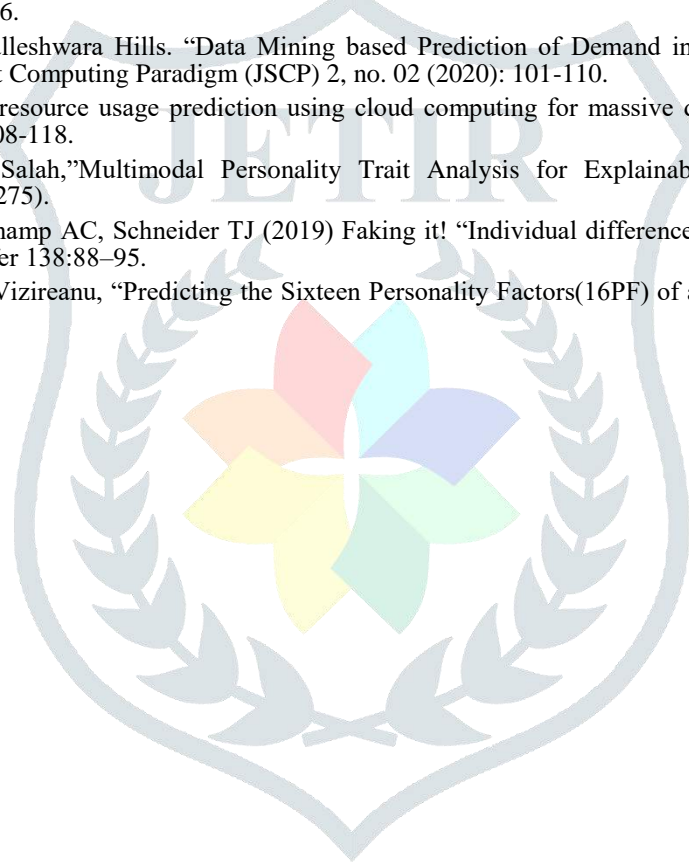
III. CONCLUSION

The objective of this paper is to study various methods to extract and analyze verbal and non-verbal data to predict the personality of an individual. The research methodology discussed the OCEAN model and how it is used to predict personality. Various techniques are developed to predict personality, some of the techniques providing lesser accuracy and some of them are providing high accuracy. Among all of the higher accuracy providing algorithms worked on limited people / dataset or used on verbal or non-verbal features. As per the previous study, the emotion feature's performance is very low but can be achieved with the help of advanced methodologies. Basically, advanced convolutional neural network (CNN), VGG neural network, Support vector machine (SVM), Naïve Bayes, Logical regression, deep learning algorithms are used by the methods presented in previous study. Multimodal are effective according to case studies and to make test automatic. The intelligent multimodal agent can identify the personality traits better based on verbal and non-verbal features. So, we conclude that several methodologies have been done in the field of personality recognition but none of the system is completely perfect and there is still scope to improve such systems.

REFERENCES

- [1] Hung- Yue Suen, Kau-En Hung and Chien-Liang Lin, "TensorFlow-based Automatic Personality Recognition Used in Asynchronous Video Interviews" IEEE Access vol. 7, pp. 61018-61023, 2019,
- [2] Octavio Arriaga, Paul G. Ploger and Matias Valdenegro, "Real Time Convolutional Neural Networks for Emotion and Gender Classification", 2020 International Conference on Smart Innovations in Design, Environment, Management, Planning and Computing (ICSIDEMPC), Jan 2021
- [3] Dina Al-Hammadi, Prof. Roger K. Moore, "Using Sampling Techniques and Machine Learning Algorithms to Improve Big Five Personality Traits Recognition from Non-Verbal Cues", 2021 National Computing Colleges Conference (NCCC), March 2021.
- [4] Shivam Gupta, "Facial emotion recognition in real time and static images", 2nd International Conference on Inventive Systems and Control (ICISC), June 2018.
- [5] Bernhard Kratzwald, Suzana Ilic, Mathias Kraus, Stefan Feuerriegel, helmut Prendinger, "Deep Learning for affective computing: text based emotion recognition in decision support", Decision Support System pp. 1-28, Sept 2018.
- [6] Jaejin Cho, Raghvendra Pappagari, et. al., "Deep Neural Networks for Emotion Recognition Combining Audio and Transcripts", Interspeech, Computer science, Sept 2018.

- [7] Gunaseelan B, Supriya Mandal and Rajagopalan V, "Automatic Extraction of Segments from Resumes using Machine Learning", IEEE, 2020.
- [8] Ricardo Stegh Camati and Fabrício Enembreck, "Text-Based Automatic Personality Recognition: a Projective Approach", 2020 IEEE International Conference on Systems, Man, and Cybernetics (SMC) October 11-14, 2020. Toronto, Canada, 2020.
- [9] Berkay Aydin, Ahmet Alp Kindiroglu, Oya Aran and Lale Akarun, "Automatic Personality Prediction from Audiovisual Data using Random Forest Regression", 2016 23rd International Conference on Pattern Recognition (ICPR) Cancún Center, Cancún, México, December 4-8, 2016.
- [10] Mr. Ramraj S, Dr.V. Sivakumar and Kaushik Ramnath G, "Real-Time Resume Classification System Using LinkedIn Profile Descriptions", IEEE International Conference on Computational Intelligence for Smart Power System and Sustainable Energy (CISPSSE-2020),2020
- [11] Made Artha Agastya, Dini Oktarina Dwi Handayani and Teddy Mantoro, "A Systematic Literature Review of Deep Learning Algorithms for Personality Trait Recognition", IEEE 2020.
- [12] Christopher Pramerdorfer and Martin Kampel, "Facial Expression Recognition using Convolutional Neural Networks: State of the Art", arXiv organization, Dec 2016.
- [13] Allan Robey, Kaushik Shukla, Kashish Agarwal, Keval Joshi and Professor Shalmali Joshi, "Personality Prediction System through CV Analysis", International Research Journal of Engineering and Technology (IRJET), Feb 2019.
- [14] Hung- Yue Suen 1 , Kuo- En Hung 1 and Chien- Liang Lin 2, "Intelligent video interview agent used to predict communication skill and perceived personality traits", 2020.
- [15] Michael Mesfin Tadesse, Hongfei Lin and V, "Personality Predictions Based on User Behavior on the Facebook Social Media Platform",October 2018.
- [16] Zhang, Chen-Lin, et al. "Deep bimodal regression for apparent personality analysis". European conference on computer vision. Springer, Cham, 2016.
- [17] Suma, V., and Shavige Malleshwara Hills. "Data Mining based Prediction of Demand in Indian Market for Refurbished Electronics." Journal of Soft Computing Paradigm (JSCP) 2, no. 02 (2020): 101-110.
- [18] Chandy, Abraham. "Smart resource usage prediction using cloud computing for massive data processing systems.", J Inf Technol 1, no. 02 (2019): 108-118.
- [19] Heysem Kaya,Albert Ali Salah,"Multimodal Personality Trait Analysis for Explainable Modeling of Job Interview Decisions", 2018 (pp. 255- 275).
- [20] McLarnon MJW, DeLongchamp AC, Schneider TJ (2019) Faking it! "Individual differences in types and degrees of faking behavior", Pers Individ Differ 138:88–95.
- [21] Mihai Gavrilescu, Nicolae Vizireanu, "Predicting the Sixteen Personality Factors(16PF) of an individual by analyzing facial features", 30 August 2017.



Design and Development of IntelliHome

Sudarshan Sangle¹, Abhay Gupta², Dhruv Maddirala³, Prof. Sangeeta Joshi⁴

¹Student, Dept. of Electronics Engineering, Vidyalkar Institute of Technology, Mumbai, India

²Student, Dept. of Electronics Engineering, Vidyalkar Institute of Technology, Mumbai, India

³Student, Dept. of Electronics Engineering, Vidyalkar Institute of Technology, Mumbai, India

⁴Professor, Dept. of Electronics Engineering, Vidyalkar Institute of Technology, Mumbai, India

Abstract - This paper centers on the critical objective to develop home automation system in more proficient way and giving more highlights alongside security to the consumer. Other than this we have focused on accomplishing other goals like Designing and Developing IntelliHome product to encourage ease of access to electric domestic appliances and subsequently lessening of utilization of Power, improving security by implanting smart lock feature, observing climate parameters like Temperature | Humidity | Rainfall, Progressing the plant or garden watering framework and all these applications in single smartphone application. It is valuable for elderly or disabled people to urge farther access to electric appliances through their smartphones, to know most exact climate condition of their residency or a holiday home before visiting, keeping up gardens and plants even if they forget to water. We have made isolated modules to perform each task and connected to the microcontroller NodeMCU. Our project's goal is to provide the best and most useful home automation system, known as INTELLIHOMe. We did our best to identify the flaws in the existing system and created a new one. Different electronic components were employed to conduct required hardware functions, and Google Firebase was used to transport data to the cloud. The project's social benefit would include more security in daily life, more accurate weather forecasts, and easier garden or plant management. We now live in a smart world where IoT has progressed to a higher level. INTELLIHOMe ensures a comfortable smart home experience. The project's future potential is enormous, since every normal person or consumer seeks for the best alternative accessible. Almost all electronic gadgets will benefit from this technology in the near future, thanks to home networks and the internet. For the time being, we've just designed the product for a few appliances and uses. We can improve and upgrade the system in the future to make it more efficient.

Key Words: Microcontroller, Biometric Sensor, Smartphone application, Security, Safety.

1. INTRODUCTION

To live or work happily, everyone prefers to live or work in a secure, safe, and well-maintained environment. We all spend the majority of our time at home. As a result, the goal of our project IntelliHome is to make routine tasks in the home

easier and more convenient. Essentially, it provides users with security, a comfortable living environment, and more perks. Its goal is to improve inhabitants' safety and security while also improving their quality of life and convenience at home. Smart home technologies can also help you save money on energy. The capacity to control appliances, an automated watering system, and a smart lock system for greater security will benefit the elderly and disabled, among others. The term "intelligent house" was coined by IntelliHome. Intelligent or Smart Home is a networked collaboration of technology and services that provides many automated applications for a better quality of life. The most significant goal of this project is to improve the efficiency of home automation systems while also delivering more features and ensuring consumer safety. Apart from that, we have concentrated on achieving other goals such as designing and developing the IntelliHome product to make it easier to access electric home appliances and thus reduce electricity consumption, monitoring weather parameters such as temperature, humidity, and rainfall, and automating the plant or garden watering system, all of which can be done through a single mobile application. Controlling appliances through smartphone, Personal Weather Station, Advanced plant watering system, and all-in-one Smartphone Application are among the features.

2. LITERATURE REVIEW

There are a variety of smart home systems on the market, each based on a distinct technology. Bluetooth-based home automation systems, Zigbee-based home automation systems, GSM-based home automation systems, and Wi-Fi-based home automation systems are all examples of mobile phone-based home automation systems.

A. Literature Survey

Bluetooth based home automation system using cell phones:[1] In a Bluetooth-based home automation system, household appliances are connected to the Arduino BT board at input output ports via relay. The program for the Arduino BT board is written in the high-level interactive C language for microcontrollers, and the connection is made via Bluetooth. The unauthorized users won't be allowed but the authorized users are accepted to access the appliances, which is protected by a secured password. A Bluetooth connection is established between the Arduino BT board and the phone for wireless communication. This system makes use of the

python script, which can be installed on any Symbian OS environment, making it portable.

Zigbee based home automation system using cell phones:[1] The system is built and deployed utilizing Zigbee to monitor and control the home appliances Network coordinators keep track of and save device performance. This is accomplished through the use of a Wi-Fi network, which employs a four-switch port standard wireless ADSL contemporary router. The SSID of the network and the Wi-Fi security parameter have already been defined. The message is initially processed by the virtual house algorithm for security purposes, and once it is declared secure, it is re-encrypted and forwarded to the home's real network device. Messages were transmitted to the end over the Zigbee network by the Zigbee controller. The virtual home algorithm's safety and security of all messages it receives. To lower the cost of the system and the time it takes to deploy it, Zigbee communication was chosen.

GSM based home automation system using cell phones:[1] Because of mobile phones and GSM technologies, GSM-based home automation is drawing attention. For GSM communication, we looked at SMS-based home automation, GPRS-based home automation, and dual tone multi frequency (DTMF)-based home automation.

Wi-Fi based home automation system using cell phones:[1] The server, the hardware interface module, and the software package are the three essential components of a Wi-Fi-based home automation system. Wi-Fi, or Wireless-Fidelity, is a method of data transport that utilises radio waves. It offers high-speed internet access as well as network connectivity. It's a wireless network that allows you to communicate with people in different parts of the house and connect different gadgets. It can be used for a range of purposes and in a variety of specifications. Equipment can be placed in almost any location. In your home, there are no unnecessary cords. There's no need for additional ethernet output, and it's also more efficient and has a wider range. Wi-Fi has become a popular option for many individuals.

B. Comparison

[2] Comparison between different systems:

No. No.	System	Communication Interface	Controller	User Interface	Applications	Benefits
1.	WiFi based using Arduino Microcontroller	Arduino ESP-8266 and Wi-Fi shield	Hardware Interface module	web based Application	Temperature and Humidity, Motion detection, Fire detection, Door status, Light level, Video monitoring, Controlling appliances	Low cost, Secure, Easily accessible, Jam-proof, Reliability, cost-effective
2.	Web server and android app Based using Raspberry pi	Web server and Interface card	Raspberry pi	Android application	Controlling status of window	Secure, and Cost-effective
3.	Cloud Based Using Backup System	Cloud based data server uses Hadoop Technology	Home gateway and Router	Smart device	Monitoring and Controlling Home Appliances	Efficiency, manage local connected and unconnected devices, Reduce computational burden of smart devices
4.	Email Based using Raspberry pi	Internet Modem	Raspberry pi	Email	Switching LED	Simple, Economical, and Efficient

Table -1: Comparison

C. Researches [3]

Several studies have been conducted on the use of IOT devices in home automation platforms. In the past, research on the IOT was conducted in conjunction with a study of numerous internets of things applications. The future expansion of the Internet of Things (IOT) is entirely dependent on us.

Ahmed ElShafee (2012) [4]: This paper presents a design and prototype implementation of a novel home automation system that connects its components using Wi-Fi technology as a network architecture. As a result, they came to the conclusion that the home automation system's required aims and objectives had been met. The prototype shows the fundamental level of home appliance control, and the system design and architecture were considered and remote monitoring has been implemented. Finally, their system is better from the scalability and flexibility point of view than the commercially available home automation system.

Vinay Sagar K (2015) [5]: This system is designed to be low-cost and scalable, allowing it to control a wide range of devices. By connecting simple appliances to the Internet of Things, home automation has been experimentally demonstrated to work adequately, and the appliances have been successfully controlled remotely through the internet. Neha Malik (2017) [6]: The author goes over the many types of intelligent home automation systems and technology. The endeavor was focused on the home automation idea, in which smart devices are used to control and monitor operations.

Shaikh Amreen (2017) [7]: The author discusses the many forms of intelligent home automation technology and systems. The project was centered on the home automation concept, which involves the use of smart devices to control and monitor activities.

Anurag Tiwari et al. (2017) [8]: The writers discussed the IoT Challenges and Ongoing Research. IoT systems are extremely common and widely used. As a result, the likelihood of security and privacy issues has increased. As a result, the safety of everything connected to the internet may be jeopardized. IOT has been unable to establish itself as a reliable technology due to security and privacy concerns.

Satish Palaniappan (2015) [9]: Sensors such as motion sensors, light sensors, and temperature sensors can be integrated into homes to allow automated device switching based on conditions. More energy may be saved by ensuring that the house is occupied before turning on devices, checking the brightness, and turning off lights when not in use. The technology can be tightly connected with home security solutions to give homeowners more control and protection. The next stage would be to expand this technology to automate a large-scale environment like offices or factories.

3. SYSTEM DESIGN

A. System Design for Plant watering:

The plant watering system additionally requires a water container, water pump and a 12V power supply. The water pump will be kept in a container filled with water as it is required to flow the water through a tube to the plants. The water pump requires 12V power supply to operate and that will be provided with the help of a 12V power supply and a relay channel. The input pin of the relay channel is connected to an esp32 pin which controls the relay channel to switch on or off the water pump.

B. System Design for Personal Weather Station:

The weather station has been designed with a DHT22 sensor which consists of a temperature as well as humidity sensor. The DHT22 uses thermistor and a capacitive humidity sensor to measure the surroundings weather and sends a digital signal to the data pin. It is connected to the esp32 module and so, the esp32 sends the digital data to the database which is then displayed on the mobile app.

C. System Design for Solenoid Lock:

The solenoid lock tongue is always open when it is has not been supplied any voltage i.e., in zero voltage supply state. So, when voltage is supplied to the solenoid lock it gets triggered and its tongue closes. We use zero voltage supply state to keep the door locked when not in use. The lock has 2 wires, positive and negative. The positive wire is connected to the 12V power supply, and the negative wire is connected to the relay and this relay is connected to the esp32 module. So, when the esp32 triggers the relay pin, the smart lock is supplied 12V and it starts operating and the door is unlocked.

D. System Design for all-in-one Smart phone Application:

The mobile application has a few tabs for various home applications. The app is designed with keeping security in mind and hence it also has a login page when any user will open the app. It consists of buttons to control the home appliances like the fans, lights, lock. It also has a tab for watering plants and for knowing the surroundings weather conditions. The mobile app has a login page that will require the user's credentials to login to the app and authorize them to control the appliances of their own house and no one else's. We are using Google Firebase as our cloud database connected to the app. The app will store all the login details in the cloud database. The esp32 module has a Wi-Fi module which is connected to the app through the cloud. When the app is used to switch on or off any appliance, it sends the data to the firebase and stores it and sends a signal to the esp32 to operate the same appliance.

4. SPECIFICATIONS

A. Hardware

1) ESP 32 (microcontroller): Espressif Systems, the makers of the ESP8266 SoC, have released the ESP32, a low-cost System on Chip (SoC) Microcontroller. Tensilica's 32-bit

Xtensa LX6 Microprocessor with integrated Wi-Fi and Bluetooth is the successor to the ESP8266 SoC and is available in single-core and dual-core varieties.

Features:

Processors:

- CPU: Xtensa dual-core (or single-core) 32-bit LX6 microprocessor, running at 160 or 240 MHz and capable of 600 DMIPS performance.
- Co-processor with ultra-low power (ULP)

Memory:

- 320 KiB RAM, 448 KiB ROM
- Internet access via wireless: 802.11 b/g/n Wi-Fi
- Bluetooth v4.2 BR/EDR with BLE (Bluetooth Low Energy) (shares the radio with Wi-Fi)

Peripheral interfaces:

- 34 × programmable GPIOs
- 12-bit SAR ADC up to 18 channels
- 2 × 8-bit DACs
- ten different touch sensors (capacitive sensing GPIOs)
- 4 × SPI
- 2 × I²S interfaces
- 2 × I²C interfaces
- 3 × UART
- SD/SDIO/CE-ATA/MMC/eMMC host controller
- SDIO/SPI slave controller
- Support for IEEE 1588 Precision Time Protocol and Ethernet MAC interface with dedicated DMA
- CAN bus 2.0
- Infrared remote controller (TX/RX, up to 8 channels)
- Motor PWM
- LED PWM (up to 16 channels)
- Hall effect sensor
- Ultra-low power analog pre-amplifier

2) 12V Solenoid Lock: The slug on this 12V solenoid lock has a slanted cut and a nice mounting bracket. It's essentially an electronic lock for a standard cabinet, safe, or door.

3) Dual channel Relay Module: It is a 5V, 10A 2-Channel Relay interface board. It can be used to regulate a variety of appliances and other high-current devices. It can be used to regulate a variety of appliances and other high-current devices. A microcontroller can control it directly with 3.3V or 5V logic signals (Arduino, 8051, AVR, PIC, DSP, ARM, ARM, MSP430, TTL logic). A 1x4 (2.54mm pitch) pin header is used to connect power (5V and 0V) and control the two relays.

4) Mini Water Pump: In the home, a tiny submersible water pump is commonly used for cooking, cleaning, bathing, space heating, and watering flowers, among other things. A tiny submersible water pump is a centrifugal water pump, meaning it uses a motor to drive an impeller that rotates and pushes water outwards.

- Operating Voltage: 9V
- Operating Current: 130 ~ 220mA
- Flow Rate: 80 ~ 120 L/H
- Maximum Lift: 40 ~ 110 mm

- Outlet Outside Diameter: 7.5 mm
- Outlet Inside Diameter: 5 mm

5) DHT22: With a single wire digital interface, the DHT22 is a low-cost digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to monitor the ambient air and delivers a digital signal on the data pin. The sensor is calibrated and requires no additional components, so you can start measuring relative humidity and temperature straight away. It's simple to use, but data collection necessitates careful timing while performing. It can only give you new info every 2 seconds.

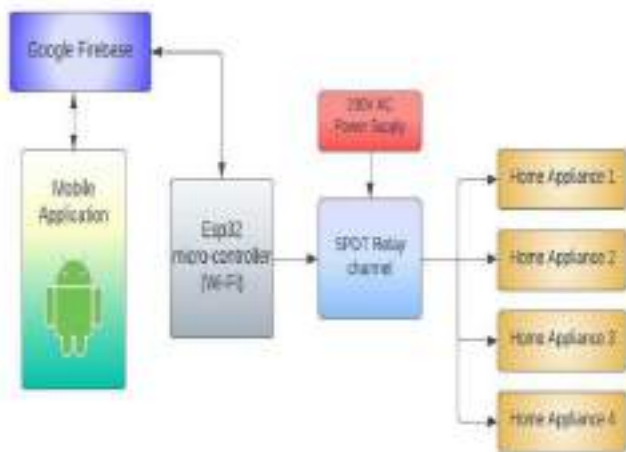


Fig -1: Block Diagram

The above block diagram is to explain the overview of how the whole IntelliHome system works:

1. Mobile Application: The app is created for the users to control their home appliances. It consists of various tabs and buttons to control each appliance. It is connected to the Google Firebase.
2. Google Firebase: This cloud database keeps record of everything that is being operated on the app or the esp 32 module. It takes data from the app and sends it to the esp32 module and vice versa.
3. Esp32: The esp32 module is used to change the mode of any appliance as per user's will. It is connected to the database and all the home appliances.
4. SPDT Relay Channel: The relay channel is connected to each appliance so that it can provide the required power to each appliance and switch to any appliance when triggered by the esp32 module.
5. Power Supply: The 230V AC power supply is required to supply power to the appliances through the relay. It is directly connected to the relay channel.
6. Home Appliances: All the home appliances are being controlled by the user through the app and it is operated by the esp32 module at hardware level.

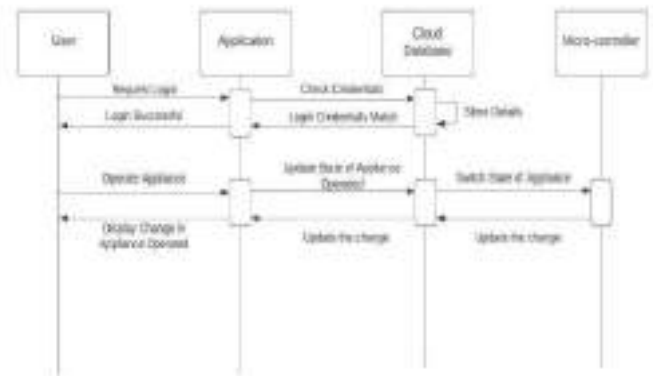


Fig -2: Sequence Diagram

It shows the visual representation of the system that we have designed. It helps in understanding how each object of the model is interacting with each other.

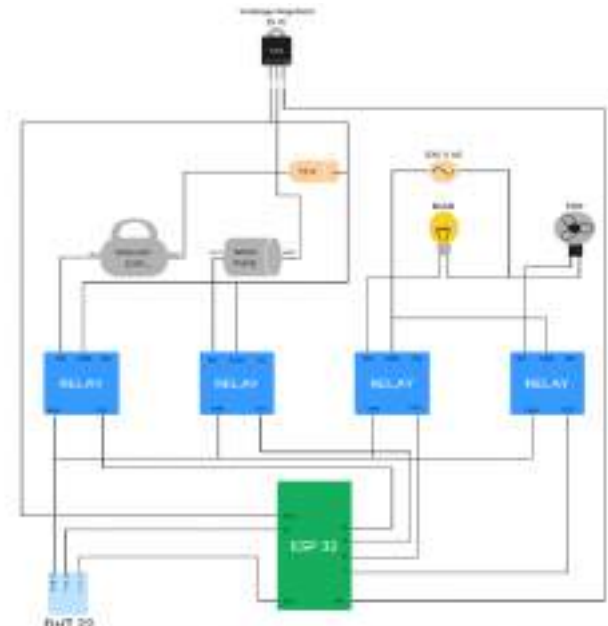


Fig -3: Circuit Diagram

B. Software:

1) Arduino IDE: The Arduino integrated development environment (IDE) is a Java-based cross-platform tool that runs on Windows, Mac OS X, and Linux. It's used to program Arduino-compatible boards and upload them. Here we are going to install COM/Serial Port Driver and ESP8266 Board Package in Arduino IDE to program NodeMCU ESP8266. The Arduino IDE is a free and open-source program for developing and compiling code for the Arduino and NodeMCU modules. On the board of each of them is a microcontroller that has been programmed and accepts data in the form of code. The core code, also known as a sketch, written on the IDE platform will eventually generate a Hex File, which will be copied and uploaded into the board's controller.

2) Android Studio: Android Studio is the official integrated development environment (IDE) for Google's Android operating system, and specifically designed for Android development. It is available for download on Windows, macOS and Linux based operating systems. Features:

- Support for Gradle-based builds. Refactoring and simple fixes for Android.
- Lint tools are used to detect issues like as performance, usability, version compatibility, and other issues.
- Create standard Android designs and components using template-based wizards.
- Users may drag-and-drop UI components in a powerful layout editor, and layouts can be previewed on numerous screen configurations.
- Google Cloud Platform compatibility is built-in, allowing connection with Firebase Cloud Messaging (formerly 'Google Cloud Messaging') and Google App Engine.
- In the Android studio, use the Android Virtual Device (Emulator) to execute and debug apps.

3) Firebase: Google Firebase is an app development platform powered by Google that lets developers to create apps for iOS, Android, and the web. Firebase offers analytics tracking, reporting, and app bug solutions, as well as marketing and product testing.

5. APPLICATION INTERFACE AND WORKING

Now, coming to the actual smart phone application that we have designed to get updates and operate about IntelliHome. The mobile application opens to a login page where the user will have to create their account if they are a new user. Each user will require an email id and a password to log into the app. Once, the account has been created by the user they can login to the app and use it to control the appliances. This account can be shared by user with the family members and operators from same office.



Fig -4: Login Screen

The mobile application interface consists of a tab that includes switches and lock buttons to operate the appliances.

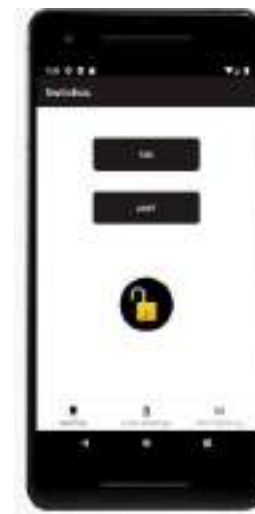


Fig -5: Interface with Options

The fan and light buttons operate the fans and lights of the home while the lock icon button operates the solenoid lock. The icon appears as the current status of the lock i.e., when the solenoid lock is opened the app will display the lock icon as open and when the solenoid lock is locked the app will show the icon in locked state.



Fig -6: Lock Option

So, when the user presses on the lock icon button, the app will ask for the user's fingerprint or face ID (whichever is authorized) to open the lock. If the fingerprint / face ID matches, the lock will open, and the app will pop up a text showing lock is opened as well as the lock icon will be changed to open state. All this data will be stored in the Firebase whenever a home appliance is being operated. The esp32 is connected to the app through the cloud database as well and it operates the lock accordingly.



Fig -7: Plant Watering System

The plant watering tab in the app consists of a start button and a timer to water the plants as per use. The timer is designed to water the plants at a particular time and for a particular period. The start button as it states, will start the watering process by sending a signal to the esp32 through the cloud and then the water pump will start flowing water. The user can put the amount of time they want to water the plants and then press start timer button to proceed. As the timer ends the system will stop flowing water.



Fig -8: Weather Monitoring

This tab displays the surrounding weather of the house. It displays the temperature and the humidity of the surrounding. It keeps updating every 5 seconds or so. All the data displayed on the app is stored in the database as well.

6. SYSTEM AND RESULTS

We have made a home module to set up different modules for demonstration.



Fig -9: Demonstration Model



Fig -10: Internal System



Fig -11: Internal Circuit



Fig -12: Watering System



Fig -13: Smart Lock setup



Fig -14: Appliances and Switches

Login Activity at backend on Google Firebase:



Fig -15: Login Activity at backend

Database:

In this project we are using the Google Firebase as our database. It logs all the data when a user uses the app for any specific appliance. It is connected to both the app and the esp32 module.



Fig -16: Database

ACKNOWLEDGEMENT

We have an opportunity to express our regard to Dr. Sangeeta Joshi, Professor, Department of Electronics Engineering, Vidyalankar Institute of Technology who supported our group throughout the course of this project. We are thankful for their aspirant counselling, indispensable assistance, and support. We are truly obliged to them for sharing their genuine and enlightening views on several issues related to the project.

REFERENCES

- [1] Neha Malik, Yogita Bodwade: "Literature Review on Home Automation System", IJARCCCE, Vol. 6, Issue 3, March 2017.
- [2] Vaishnavi S. Gunge, P. Yalagi: "Smart Home Automation: A Literature Review", Semantic Scholar.
- [3] Radhika Garg: "A Review on Internet of Thing for Home Automation", IJERT, Volume 8, Issue 10.
- [4] Ahmed ElShafee(2012) "Design and Implementation of a WiFi Based Home Automation System" International Journal of Computer, Electrical, Automation, Control and Information Engineering Vol:6, No:8, 2012.
- [5] Vinay Sagar K (2015) Home Automation Using Internet of Things International Research Journal of Engineering and Technology (IRJET).
- [6] Neha Malik and Yogita Bodwade, "Literature Review on Home Automation System" International Journal of Advanced Research in Computer and Communication Engineering, Volume 6, 2017.
- [7] Shaikh Amreen, Londhe Nishigandha, Birhade Apeksha, Gaikwad Jayprakash and Kodak Priyesh," Architecture for internet of things for home automation "International Journal of Engineering and Computer Science, Volume 6, 2017.
- [8] A. Tiwari and H. Maurya, "Challenges and Ongoing Researches for IOT (Internet of Things): A Review," Volume 5, no. 2, pp. 57-60, 2017.
- [9] Satish Palaniappan "Home Automation Systems - A Study", Volume 116, 2015

THORAX DISEASES DETECTION USING MACHINE LEARNING

Pratik Prakash Dhasade*¹, Dr. Sangeeta Joshi*², Sujay Ambelkar*³

*^{1,3}Student, Department of Electronics and Telecommunication Engineering, Vidyalkar Institute of Technology, Mumbai, Maharashtra, India.

*²Professor, Department of Electronics Engineering, Vidyalkar Institute of Technology, Mumbai, Maharashtra, India.

ABSTRACT

The chest is a part of the human anatomy located between the neck and the abdomen. The chest has more priority in the human body. Detection of chest disease becomes a challenging factor faced by doctors. So, chest-related diseases are the main reason for a huge number of death in the world over the last few decades. To reduce the large scale of deaths from chest diseases there is a need for a reliable, accurate, and feasible system that can detect such diseases in time for proper treatment. A large dataset of chest X-rays is available. So, this is a good condition to use this dataset and implement the project. The difficulty is an available large dataset has a lot of noise. So, Chest x-ray images will be pre-processed to extract their features and make them suitable for disease detection as normal or abnormal. We will use Machine Learning to process data as well as create models for diagnosing patients and propose an automatic chest disease detection system. In particular, we will demonstrate that the most commonly occurring thoracic diseases such as Cardiomegaly, Pneumonia, Pneumothorax, Mass, Nodule, Infiltration, and Effusion can be detected.

Keywords: Machine Learning, Convolution Neural Network, Data, Thorax Disease, VGG Algorithm, Artificial Intelligence.

I. INTRODUCTION

The chest is a crucial part of the human body. The chest contains the most respiration and circulation organs which sustain a number of the foremost critical life functions of the body. Lungs are pair of spongy organs located on both sides of the chest. The most function of the lungs is the process of gas exchange called respiration. In respiration, oxygen from incoming air enters the blood, and waste gas from the metabolism leaves the blood. Changes in lifestyle, work stress, and bad food habits contribute to the rise in the rate of several chest-related diseases. Thus the feasible and accurate detection of heart-related diseases is extremely important. Studies about thorax diseases are one of the most interesting research topics in recent years. With the several uses of X-ray images in hospitals, pathologies, and diagnostic centers, the size of the medical image datasets is also expanding expeditiously to capture the diseases in hospitals. A lot of research has been carried out on chest-related diseases in recent years. Many researchers have been using several machine learning techniques to help the health care industry and professionals in the diagnosis of chest-related diseases. Machine learning algorithms play a very important role in this area and it helps medical center with the detection of various disease.

A large amount of patient-related data is maintained on monthly basis. This data can be useful for detecting the disease by using machine learning techniques such as Convolution Neural Network based algorithm such as VGG. The main objective of this research project is to detect the chest disease of a patient using CNN algorithms. The proposed model consists of Convolutional layers, a Pooling layer, ReLU Activations, and a totally connected layer. The endmost full connected layer consists of four output units. Each output unit will predict the probability of any one of the fifteen diseases. The foremost commonly available dataset is called Chest X-Ray which consists of fifteen classes named Atelectasis, Cardiomegaly, Effusion, Infiltration, Mass, Nodule, Pneumonia, Pneumothorax, Consolidation, Edema, Emphysema, Fibrosis, Pleural Thickening, are utilized to train this model. The proposed model will perform extremely well in chest disease detection.

II. METHODOLOGY

Dataset

We will be performing a computer simulation on a dataset. Dataset is a chest X-RAY dataset. Dataset will contain N samples and M input features. The images in the dataset are labelled with different diseases in order

to differentiate healthy X-rays from affected ones. We will enhance the dataset by adding images that are augmented.

Data Pre-Processing

For the purpose of image-based identification which includes, the training phase to the evaluation phase where the performance of classification algorithms is evaluated, it is necessary to have process data sets. Pre-processing images involves outsourcing background noise, intensity normalization of individual image particles, removing reflections, and masking portions of images. Data pre-processing will consists of the following steps:

1. Images are rescaled, reducing the feature that makes training faster by reducing the size of the image
2. Converting the images into gray and RGB, which are used for different models.
3. Read the image to the NumPy array, then normalized by dividing the image matrix by 255.

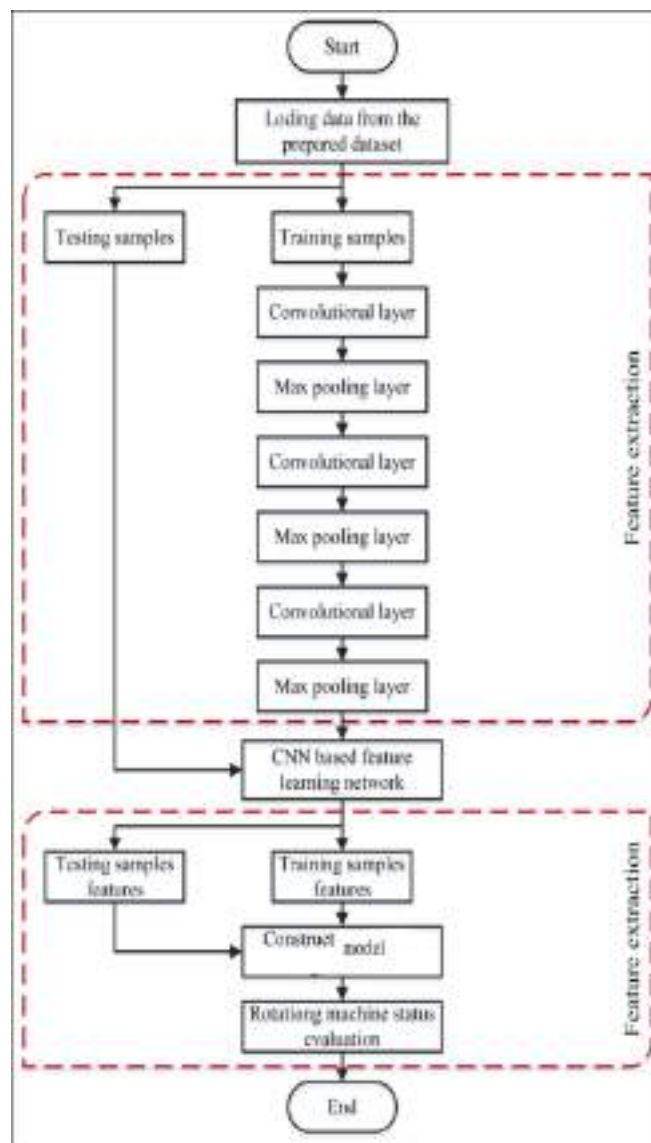


Figure 1: Block Diagram

Convolution Neural Networks Algorithm

Deep Learning has proved to be a very powerful tool because of its ability to handle large amounts of data and its complexity. In pattern recognition, mostly hidden layers are used. One of the most popular deep neural networks is a convolutional neural network. We will use CNN to detect chest disease. The dataset containing X-ray images is trained in the python tool. Convolution Neural Networks are designed for accurate analysis.

Unsupervised learning classification is used as the input image is not known or is new to the algorithm. As input is unknown to the algorithm in real-time application it needs unsupervised learning data.

CNN model will consist of multiple layers which are the input layer, convolutional layers, pooling layers, full-connection layers, and output layer. This model can be trained end-to-end in order to allow feature extraction and selection, classification, and prediction. The algorithm processing the image is complex, but it is known that features obtained in different layers of a network give better than human-built features.



Figure 2: VGG Architect Extract Feature

III. MODELING AND IMPLEMENTATION

This paper put forth a model which is used to train CNN in order to identify chest disease. The proposed algorithm has the following basic architecture:

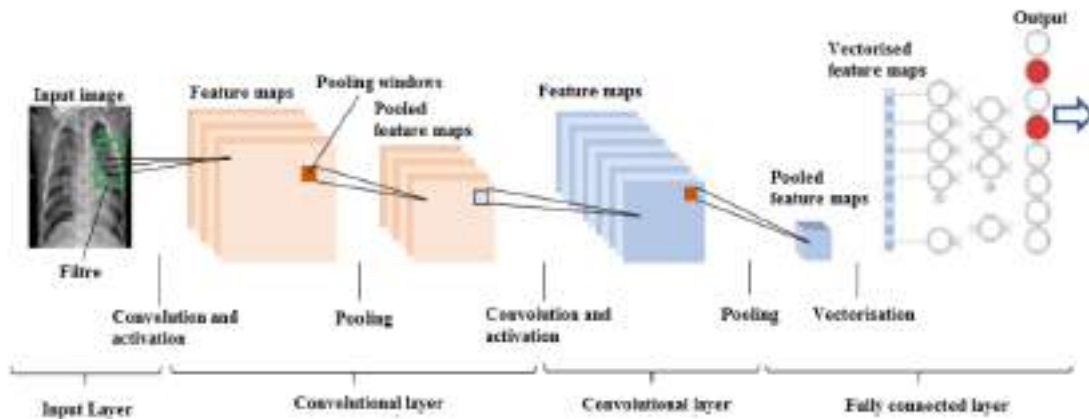


Figure 3: Architecture of baseline CNN

Input layer: We will feed input that is X-Ray images in our project. The parameters are defining the image dimension.

Convolutional layers: A convolution is a linear operation that consists of the multiplication of a set of weights with the input. It's designed for two-dimensional input; the multiplication is performed between a two-dimensional array of filters and an array of input data. We will have 3 layers with a filter of size 3x3.

Pooling Layers: Pooling layers is a technique to down sample feature maps by summarizing the presence of features in patches of the feature map. There are two types of pooling methods that are average pooling and max pooling. In the proposed architecture we used Max pooling in order to calculate the maximum value in each patch for every feature map. The max-pooling will be set to 2x2 with a stride of 2.

ReLU layers: ReLU-based deep convolutional networks are trained several times faster than tanh and sigmoid-based networks. We will be using 4 ReLU layer for each convolutional layer.

Fully Connected Layers: Treats the input data as a simple vector and produces an output as a single vector. We have one inner-product layer in this model.

In this paper, we have designed three different convolutional neural network-based models which are modified VGG for the prediction of chest diseases from the chest X-ray dataset.

Model 1

The input layer is fed with an image which is of size 100 × 100 with the RGB feature. The first convolution layer filters the input image with 512 kernels of size 3x3. After max pooling is applied, the first layer is the flattened

layer from the output of the VGG layer here the data will be converted into a 1-dimensional array then it is given to a fully connected layer FC-1 of 256 neurons followed by a fully connected layer FC-2 of 128 neurons followed by fully connected layer FC-3 of 64 neurons followed by fully connected layer FC-4 of 32 neurons. The last layer is called softmax. This will give output categories. In our project, we will get whether a patient is suffering from chest disease or not and which disease.

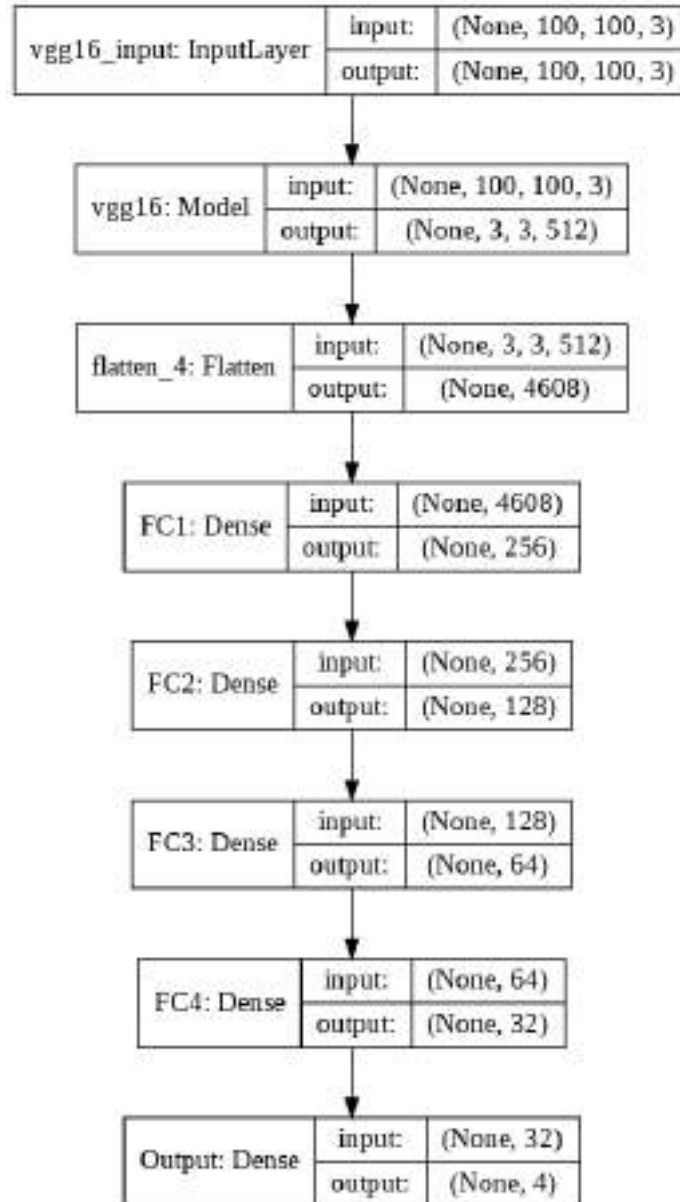


Figure 4: Model 1

Model 2

The input layer is fed with an image which is of size 100 × 100 with the RGB feature. The first convolution layer filters the input image with 512 kernels of size 3x3. After max pooling is applied, the first layer is the flattened layer from the output of the VGG layer here the data will be converted into a 1-dimensional array then it is given to a fully connected layer FC-1 of 512 neurons followed by a fully connected layer FC-11 of 256 neurons followed by a fully connected layer FC-2 of 128 neurons followed by fully connected layer FC-3 of 64 neurons followed by fully connected layer FC-4 of 32 neurons. The last layer is called the softmax layer. This will give output categories. In our project, we will get whether a patient is suffering from chest disease or not and also the disease name.

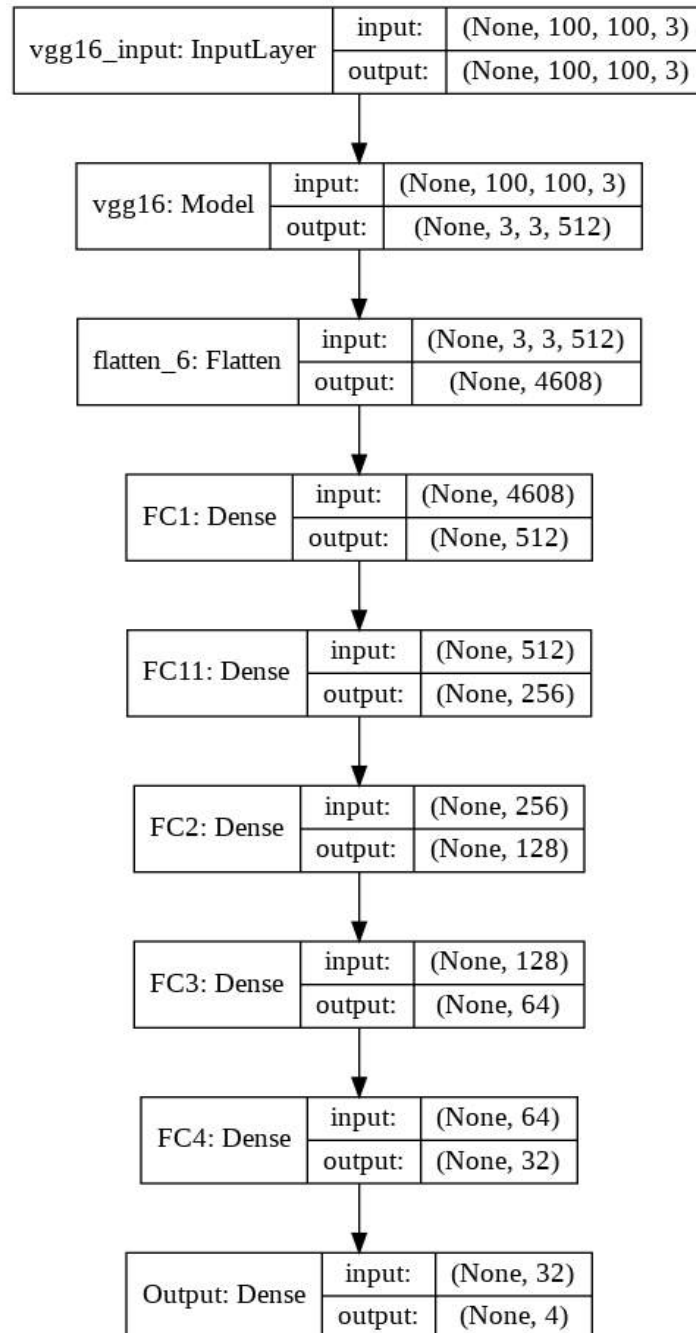


Figure 5: Model 2

Model 3

The input layer is fed with an image which is of size 100×100 with the RGB feature. The first convolution layer filters the input image with 512 kernels of size 3×3 . After max pooling is applied, the first layer is the flattened layer from the output of the VGG layer here the data will be converted into a 1-dimensional array then it is given to a fully connected layer FC-1 of 256 neurons then output is applied to dropout. The Dropout layer is a mask that nullifies the contribution of some neurons towards the next layer and leaves unmodified all others. We will apply a Dropout layer after a fully connected layer, in which it nullifies some of its features; but we can also apply it to a hidden layer, in which it nullifies some hidden neurons. Then we will feed the output to a fully connected layer FC-2 of 128 neurons followed by a fully connected layer FC-3 of 64 neurons followed by a fully connected layer FC-4 of 32 neurons. The last layer is called the softmax layer. This will give output categories. In our project, we will get whether a patient is suffering from chest disease or not and also the disease name.

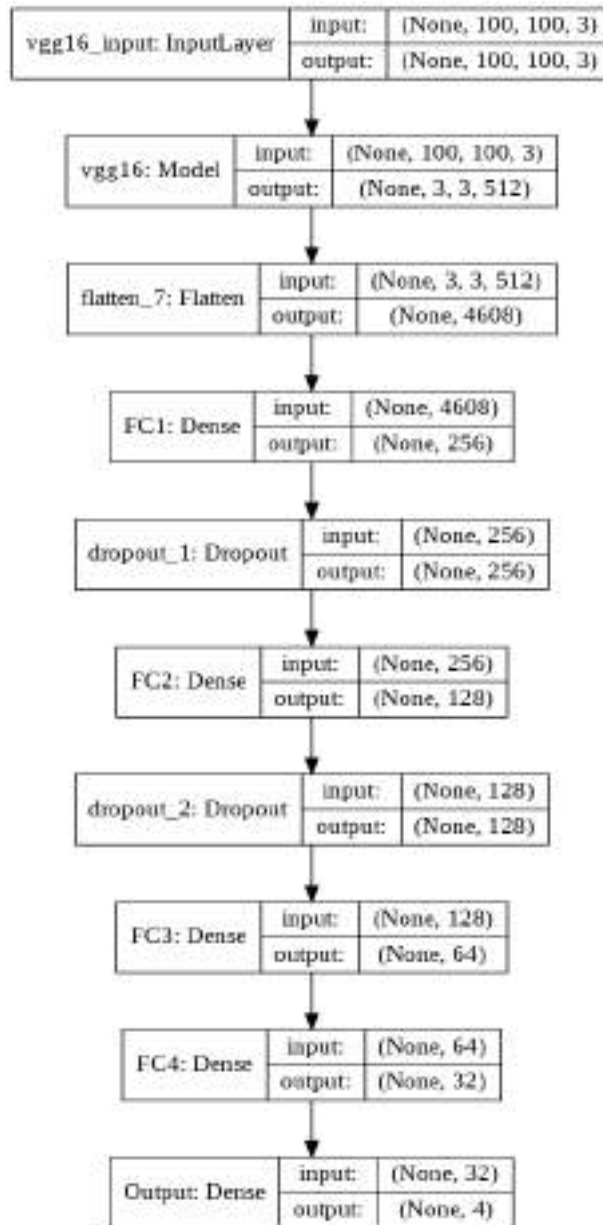


Figure 6: Model 3

IV. RESULTS

Model 1 Accuracy & Loss Graph

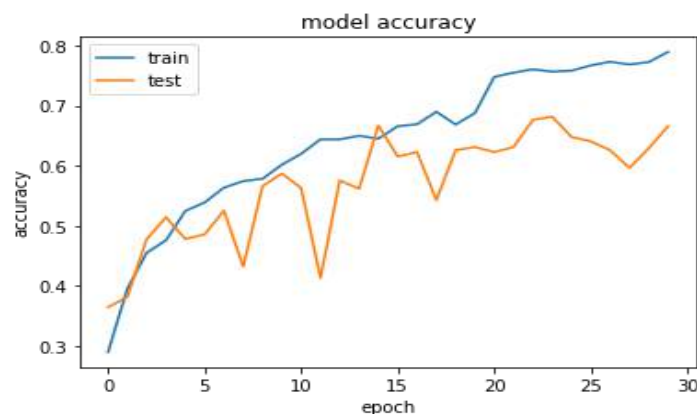


Figure 7: Model 1 Accuracy

As it is shown in the figure 5 above, the train curve of model 1 accuracy increases as epoch increases. The test curve of model 1 accuracy can be divided into two intervals: The first one starts from epoch 0 to epoch 3 where we can observe a quick increase of accuracy up to 55.03%. In the second interval, the accuracy slowly increases to 70.42%.

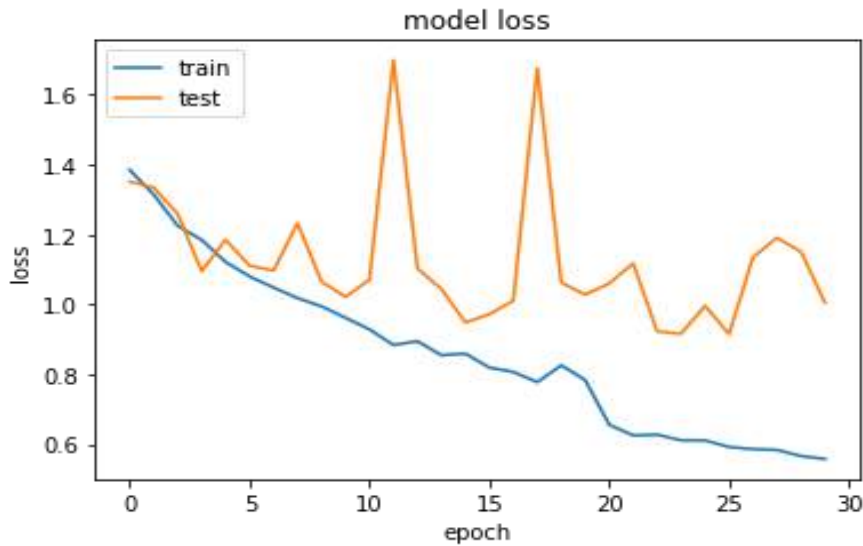


Figure 8: Model 1 Loss

As it is shown in the figure above, the train curve of model 1 loss decreases as epoch increases. In test loss curve of model 1 we can observe, from epoch 0 to epoch 3 the loss is decreasing where is equal to 1.1 and rapidly increases at epoch 11 and epoch 17, then it starts to decrease and equals to 0.9 at epoch.

Model 2 Accuracy & Loss Graph

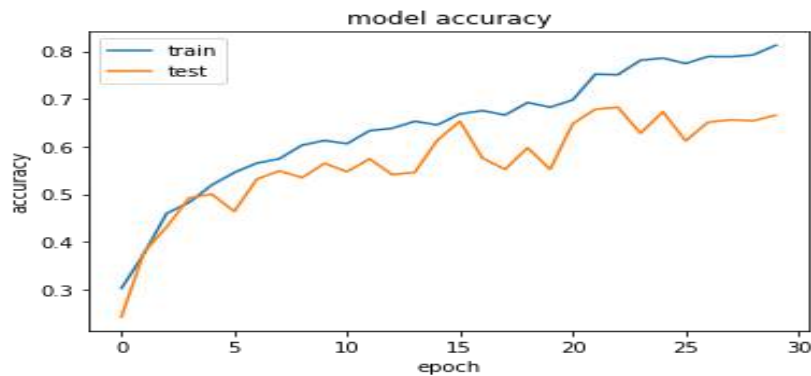


Figure 9: Model 2 Accuracy

As shown in the above figure 9, the accuracy curve of model 2 quickly increases up to 49.03% from epoch 0 to epoch 4 and then the accuracy slowly increases to 63.20% from epoch 25 to epoch 30.

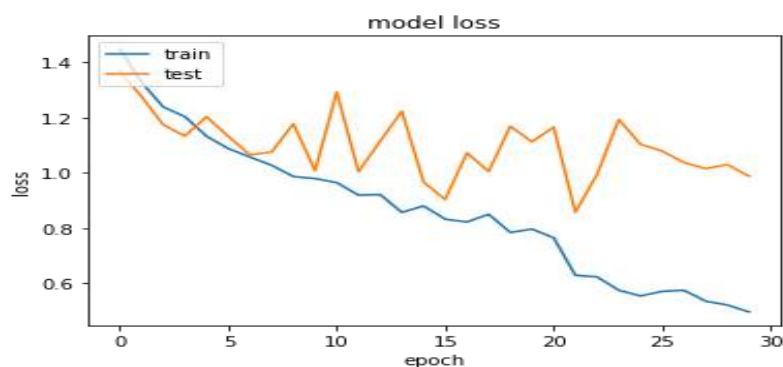


Figure 10: Model 2 Loss

As it is shown in figure 10, the curve of model 2 loss we can observe, from epoch 0 to epoch 4 the loss is decreasing where is equal to 1.2 and increases at epoch 10 and epoch 13, then it starts to decrease and equals to 0.9 at epoch 30.

Model 3 Accuracy & Loss Graph

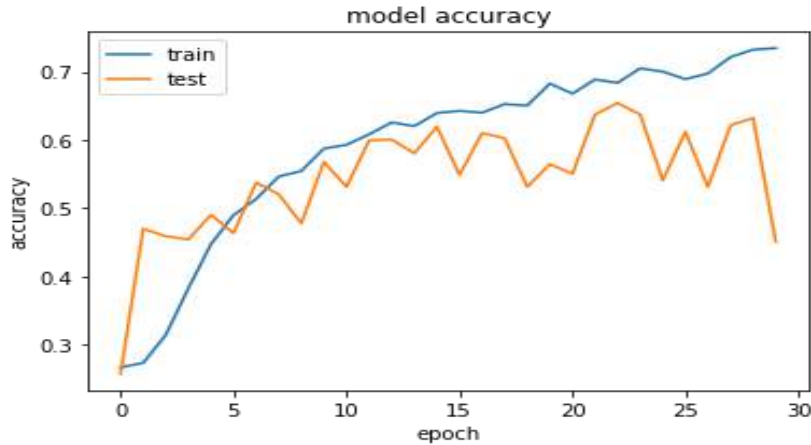


Figure 11: Model 3 Accuracy

As shown in the above figure 11, the train accuracy curve of model 3 increases as the epoch increases and reaches up to 80% at epoch 29. The test accuracy curve of model 3 quickly increases to 48% at epoch 3 and slowly reach to 65% at epoch 22.

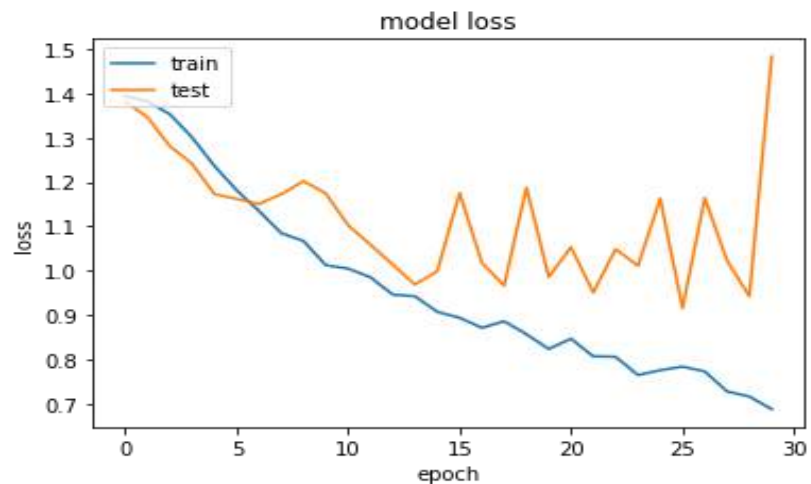


Figure 12: Model 3 Loss

As shown in the figure 12, train loss curve of model 3 decreases as epoch increases. We can also observe, test loss curve rapidly decreases from epoch 0 to epoch 15 and then slowly converge to 0.8 at epoch 27.

Table 1. Model Accuracy Comparison

SN.	Model Type	Accuracy
1	Model-1	79%
2	Model-2	81%
3	Model-3	74%

V. CONCLUSION

This paper provides deep insight into machine learning techniques for the classification of chest diseases. The role of the algorithm is crucial in the healthcare industry so that the results can be used for disease detection. We used CNN based VGG algorithm to detect and identify the chest disease. We trained the model using a chest x-ray dataset and used these models for disease detection. The whole development of the algorithm is done in

Python. Model 1 achieved an accuracy of 79%, Model 2 achieved an accuracy of 82%, and Model 3 achieved an accuracy of 74%. This shows the ability of CNN to extract important features in chest disease detection. From the results, it is clear that the model provides reliable results. It can be concluded that there is a huge scope for CNN algorithms in the detection of chest diseases or thorax-related diseases. Each of the above-mentioned algorithms has performed extremely well in some cases but not so well in some other cases.

ACKNOWLEDGEMENTS

I take this momentous opportunity to express my heartfelt gratitude and regard to my project guide, Dr. Sangeeta Joshi, Vidyalankar Institute of Technology, Mumbai, India for providing me an opportunity to complete my project on "Thorax Diseases Detection Using Machine Learning. I would like to acknowledge with much appreciation the crucial role of the staff of the Electronics and Telecommunication Department, Vidyalankar Institute of Technology, Mumbai, India who gave me support to complete the project. I attribute my heartiest thanks to all the faculty of the Department of Electronics & Telecommunication of Vidyalankar Institute of Technology and friends for their valuable advice and support.

VI. REFERENCES

- [1] O. Er, N. Yumusak, and F. Temurtas, "Chest diseases diagnosis using artificial neural networks," *Expert Systems with Applications*, vol. 37, no. 12, pp. 7648–7655, 2010.
- [2] Xiaosong Wang, Yifan Peng, Le Lu, Zhiyong Lu "Hospital-scale Chest X-ray Database and Benchmarks on Weakly-Supervised Classification and Localization of Common Thorax Diseases" *IEEE Conference on Computer Vision and Pattern Recognition*, 2017. pp. 2097-2106 , 2017.
- [3] O. Er, C. Sertkaya, F. Temurtas, and A. C. Tanrikulu, "A comparative study on chronic obstructive pulmonary and pneumonia diseases diagnosis using neural networks and artificial immune system," *Journal of Medical Systems*, vol. 33, no. 6, pp. 485–492, 2009.
- [4] S. Khobragade, A. Tiwari, C. Y. Pati, and V. Narke, "Automatic detection of major lung diseases u sing chest radiographs and classification by feed-forward artificial neural network," in *Proceedings of 1st IEEE International Conference on Power Electronics. Intelligent Control and Energy Systems (ICPEICES-2016) 2016 IEEE*, pp. 1–5, Delhi, India, 2016.
- [5] G. Litjens, T. Kooi, E. B. Bejnordi et al., "A survey on deep learning in medical image analysis," *Medical Image Analysis*, vol. 42, pp. 60–88, 2017.
- [6] S. Albarqouni, C. Baur, F. Achilles, V. Belagiannis, S. Demirci, and N. Navab, "Aggnet: deep learning from crowds for mitosis detection in breast cancer histology images," *IEEE Transactions on Medical Imaging*, vol. 35, no. 5, pp. 1313–1321, 2016.
- [7] B. van Ginneken, S. Katsuragawa, B. M. ter Haar Romeny, K. Doi, and M. A. Viergever, "Automatic detection of abnormalities in chest radiographs using local texture analysis," *IEEE transactions on medical imaging*, vol. 21, no. 2, pp. 139–149, 2002.
- [8] Y. Bengio, P. Lamblin, D. Popovici, and H. Larochelle, "Greedy layer-wise training of deep networks," in *Proceedings of Advances in Neural Information Processing Systems*, pp. 153–160, Vancouver, BC, Canada, 2007.
- [9] M. R. Avendi, A. Kheradvar, and H. Jafarkhani, "A combined deep-learning and deformable-model approach to fully automatic segmentation of the left ventricle in cardiac MRI," *Medical Image Analysis*, vol. 30, pp. 108–119, 2016.
- [10] H.-C. Shin, K. Roberts, L. Lu, D. Demner-Fushman, J. Yao, and R. M. Summers, "Learning to read chest X-rays: recurrent neural cascade model for automated image annotation," *Cornel University library*, 2016.
- [11] Hooda R, Sofat S, Kaur S, Mittal A & Meriaudeau F. "Deep-learning- a potential method for tuberculosis detection using chest radiography". *IEEE International Conference on Signal and Image Processing Applications*, 2017.
- [12] A Krizhevsky, I Sutskever, and G E Hinton, "Imagenet classification with deep convolutional neural networks" *Advances in neural information processing systems*, 2012.
- [13] S. Katsuragawa, K. Doi, and H. MacMahon, "Computer-aided diagnosis in digital radiography, Detection and characterization of interstitial lung disease in digital chest radiographs" 2003.

- [14] P. Moeskops, J. Wolterink, B. van der Velden, K. Gilhuijs, T. Leiner, M. Viergever, and I. Isgum. Deep learning for multi-task medical image segmentation in multiple modalities. In MICCAI. Springer, 2016.
- [15] M. Oquab, L. Bottou, I. Laptev, and J. Sivic. Is object localization for free-weakly-supervised learning with convolutional neural networks. In IEEE CVPR, pages 685–694, 2015.
- [16] P. O. Pinheiro and R. Collobert. From image-level to pixel level labelling with convolutional networks. In Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition, pages 1713–1721, 2015.

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New Methods for Ranking of Trapezoidal Fuzzy to Obtained Optimum Solution to Fuzzy Transportation Problem

Ambadas Deshmukh*, Ashok S. Mhaske, Dr. Arun Jadhav & K. L. Bondar

Keywords: Ranking, Area, Fuzzy Transportation, LCM, Trapezoidal, Python

Abstract

The objective of this article is to solve fuzzy transportation problem using new ranking method to order trapezoidal fuzzy numbers. To make decision in fuzzy multi criteria decision making models the proposed methods will be very helpful. To order trapezoidal fuzzy numbers the area of membership function is used. To convert crisp transportation problem into a fuzzy transportation problem trapezoidal fuzzy numbers are used. Fuzzy Least Cost Method (FLCM) is used to solve Fuzzy transportation problem....

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Fuzzy database and Fuzzy logic Using Triangular and Trapezoidal Fuzzy Number for coronavirus disease - 2019 diagnosis

Ambadas Deshmukh, Ashok S. Mhaske, K. L. Bondar, Dr. Arun Jadhav

DOI: <https://doi.org/10.17762/msea.v71i4.1445>

Abstract

The objective of this article is to introduce correct information for coronavirus disease when there is uncertainty in a medical fuzzy database. Global health crisis had a deep impact due to outbreak of the coronavirus disease 2019. COVID-19 is a reminder that well-prepared decision-making is essential for effective health management. Fuzzy database and fuzzy logic methods are best ways to reduce this ambiguity in medical science. Thirteen scientific databases are selected that affect the patient most in coronavirus. The inputs are fuzzy trapezoidal numbers according to the range that they fall in and output is fuzzy triangular number. The main risk issues of coronavirus disease according to the medical Science are Age, Blood Pressure, blood Sugar, Heart Rate, WBC, CRP, Hemoglobin, Platelet?to? lymphocyte ratio, lymphocyte, neutrophil, monocytes, Hepatitis-B and Liver function therefor there are thirteen input variables. The output is the coronavirus disease condition shown in linguistic terms such as very healthy, healthy critical and very critical.

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How to Cite

Ambadas Deshmukh, Ashok S. Mhaske, K. L. Bondar, Dr. Arun Jadhav. (2023). Fuzzy database and Fuzzy logic Using Triangular and Trapezoidal Fuzzy Number for coronavirus disease - 2019 diagnosis. *Mathematical Statistician and Engineering Applications*, 71(4), 8196–8207. <https://doi.org/10.17762/msea.v71i4.1445>

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Empowering and Directive Leadership: The Cost of Changing Styles

Business Perspectives and Research
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Smita Mukherjee¹ and Zubin R. Mulla² 

Abstract

We examine the cost of leaders changing between empowering and directive leadership styles on team outcomes. In a laboratory experiment, we collected data from 240 participants in 80 teams. Confederates enacted different leadership styles and led teams of participants in performing a series of tasks. When leaders changed their style from directive to empowering, teams took time to respond in terms of higher satisfaction with leader and affective commitment. However, when leaders changed their style from empowering to directive, the deterioration of satisfaction with leader and reduction in affective commitment were immediate. Moreover, teams of leaders who had been consistently directive showed higher affective commitment as compared to teams of leaders who had a history of being empowering but later shifted to being directive. First time managers can get inputs on how they should enact their leadership style and be aware that switching between styles may impose long-term costs on the team's affective commitment and satisfaction with the leader.

Keywords

Empowering leadership, directive leadership, impression formation

Leadership has been conceptualized as a set of desirable traits (Zaccaro, 2007), behavior demonstrated by leaders through the pattern of interaction between leaders and followers, and through contingency approaches such as contingency model (Fiedler, 1971), normative decision-making model (Vroom & Yetton, 1973), and situational leadership theory (Hersey et al., 1979).

Hersey and Blanchard's situational leadership theory suggests that a leader should change leadership styles for task and relationship behavior depending on the follower's maturity level. Combining followers' maturity and leadership behavior, they described four styles of leadership, namely delegating,

¹ Vidyalankar Institute of Technology, Sangamnagar, Wadala East, Mumbai, Maharashtra, India.

² Tata Institute of Social Science, Deonar, Mumbai, Maharashtra, India.

Corresponding author:

Zubin R. Mulla, Tata Institute of Social Sciences, V. N. Purav Marg, Deonar, Mumbai, Maharashtra 400088, India.

E-mail: zubin@tiss.edu

participating, selling, and telling (Blanchard et al., 1993). Hersey and Blanchard believed that leaders should be flexible and change their styles as followers and situations change over time. This study investigates the impact of leaders changing their leadership style on team outcomes.

Despite their popularity, there are serious concerns with contingency theories of leadership; for example, it is still unclear what constitutes effective leadership behavior (Yukl, 2012). In addition, leaders tend to develop their own theory of what works for them instead of following the situational theory, and therefore, leaders always look for information on when to be empowering and when to be directive or to follow both the styles (Sims et al., 2009).

Empirical tests of Hersey and Blanchard's situational leadership theory to determine appropriate leadership style have revealed severe limitations. First, using leader rating as the only information in assessing the effectiveness of followers' maturity is inadequate, and second, leaders are unable to diagnose followers' maturity (Thompson & Glasø, 2018). The effectiveness of leaders in identifying followers' maturity depends upon leaders' ability (skills of leaders), motivation (impetus for identifying followers' maturity), and opportunity (situational and contextual constraints) (Almutawa et al., 2016; Boselie, 2010; Hughes, 2007).

It is difficult for leaders to change styles as per the situation, and there is little evidence of leaders changing their styles appropriately when needed. When individuals feel that they are powerful, their natural neurological processes of empathy and altruism are degraded (Barstow, 2008; Keltner et al., 2003). Once people get power, they show an increased tendency to act impulsively, aggressively, and selfishly. They also have difficulty in understanding others' perspective. Therefore, the paradox skills which make an individual powerful tend to degrade once they get into power (Anderson et al., 2012). In fact, there are several instances of corporate and political leaders who though popular in the beginning; later, when faced with crisis, decided to be tough (presumably, to deal with followers who were neither able nor willing) and then found it difficult to go back to being empowering when the situation returned to normalcy (O'Toole, 1995).

In this study, we investigate the impact of changing leadership styles by taking two extreme styles of leadership suggested by Hersey and Blanchard, telling (directive) and participative style (empowering). The rationale behind taking these two styles for our study originates from a critical question, that is, whether leaders' actions alone bring performance (i.e., leader being directive), or is performance a result of the leader enabling subordinates to fulfil responsibility, generate confidence to make decisions, building trust to take actions, and employees taking charge of leading themselves (i.e., leader being empowering) (Srivastava et al., 2006). Leaders face a dilemma, that is, whether to empower people to self-manage themselves or direct people toward achievement of goals (Sims et al., 2009). There have been studies on outcomes of directive and empowering leadership exclusively on individual, team, and organizational levels; however, studies on situations when a leader exhibits changes in leadership style and adopts either empowering or directive style of leadership are limited (Martin et al., 2013).

Using a laboratory experiment in which we have groups of participants, each led by a confederate, we study the impact of the leader alternating between empowering and directive styles on team outcomes. The findings of the study provide insights into improving the leader-follower interaction and also help human resource (HR) managers to shape their strategies related to talent acquisition (i.e., choosing the right leader) and development of leaders in their organization (through a well-organized training).

Empowering and Directive Leadership

Empowering leadership has been conceptualized as demonstrating behavior involving leading by example, coaching, participative decision making, informing, showing concern, and interacting with

teams (Arnold et al., 2000). Through empowering subordinates, leaders enhance autonomy, self-management, and confidence in their team (Chen et al., 2011).

On the other hand, directive leadership is where a leader sets goals for the team and structures and sequences tasks of subordinates with an unsaid rule of compliance from subordinates (Lorinkova et al., 2013; Martin et al., 2013). Leaders following directive leadership style structure and sequence tasks, thereby increasing role clarity (Dolatabadi & Safa, 2011). Directive leaders expect subordinates to comply with instructions, which increases task proficiency. Directive leadership does not give much scope to employees to think and anticipate problems.

Beyond performance, managers are concerned with the affective outcomes of team members such as satisfaction with the leader and commitment level of the team (Kim & Beehr, 2018). In this study we explore the effect of changes in empowering and directive leadership on team members' satisfaction with their leader and team members' affective commitment. High-quality leader–follower relationships are the result of high level of trust, interaction, support, and rewards (Lee, 2005). Leaders who encourage greater independence from authority, greater lateral cooperation, and increased individual self-management skills are considered to have subordinates with a higher level of satisfaction and performance (Srivastava et al., 2006). Empowering leaders encourage independence of authority, greater lateral cooperation and communication, and greater individual self-management skills (Arnold et al., 2000). Therefore, empowering leadership has a positive effect on satisfaction levels of subordinates with the leader.

In addition to satisfaction with leader, another important outcome for individuals working in a team is affective commitment, a type of organizational commitment. Affective commitment is an individual's emotional attachment toward the organization, level of involvement in the organization, and identification of self with the organization (Allen & Meyer, 1990). Empowering leadership positively affects individual, team, and organizational outcomes (Fong & Snape 2015; Gao et al., 2011; Lee et al., 2014; Raub & Robert 2010; Tuckey et al., 2012; Zhang & Bartol 2010), including affective commitment (Albrecht & Andreetta, 2011). Followers show increased performance, high confidence, feeling of contribution, increase in self-efficacy, and meaningfulness toward the role and organization (Albrecht & Andreetta, 2011). This is likely to lead to increased commitment toward the organization.

Followers are constantly observing the leader's behavior, making judgments based on leader's behavior, and adjusting their own affect and behavior with respect to their observations and judgments. In other words, followers' perception and impressions formed about leaders and leadership have an impact on individual, team, and organizational outcomes (Offermann et al., 1994). Followers use implicit leadership theories to interpret empowering behavior of a leader (Humborstad & Giessner, 2018). In other words, followers perceive signals from leaders' behaviors and fit them into preexisting patterns in their mind to form lasting impressions about the leader.

Impression Formation

In order to simplify the process of understanding others in a meaningful way, individuals categorize others as a part of a group (Neuberg & Fiske, 1987). When people form an impression about others, they infer either from the target's social category membership or target's individual and specific behavior. Moreover, perceivers give preference to already formed impressions instead of new information received (Gawronski et al., 2003; Xie et al., 2019).

While forming impressions of others, people succumb to negativity bias (Rozin & Royzman, 2001). Negativity bias refers to the influence of negative and extreme information, attributes, traits, and behavior on impression formation. Studies have shown that judgments are more likely influenced by an actor's negative traits than the positive traits (Bargh & Pietromonaco, 1982; Corns, 2018). In case of directive

versus empowering leadership, directive leadership forms a negative impression on the followers because directive leadership does not give scope to employees to think and anticipate problems, which in turn is detrimental to employees' growth and satisfaction (Martin et al., 2013). Directive leadership merely expects compliance (Lorinkova et al., 2013), whereas empowering leadership forms a positive impression on followers because participation and empowerment increase and fulfil the higher order needs for recognition of followers' such as self-efficacy and self-fulfillment (Kahai et al., 1997).

As a result of negativity bias, individuals take less time to judge negative traits as compared to the time they take to judge positive traits (Carney et al., 2007). Hence, followers may be quick to judge directive leaders negatively and relatively slower to judge empowering leaders positively.

The two ways in which these negativity biases are manifested are first, negative differentiation and second, negative dominance (Rozin & Royzman, 2001). Negative differentiation is where negative events, objects, or personal traits are more diverse, elaborated, and result in more complex cognitive responses than positive events, objects, or personal traits (Ito & Cacioppo, 2005). Negativity dominance suggests that a combination of negative and positive traits yields impressions and evaluations that are more negative than positive. Negative information tends to influence impression formation more strongly than comparably extreme positive information (Bebbington et al., 2017). As a result of combining effects of both the above-mentioned phenomena, negative impression formation is not only quick but durable as well. Positive impression formation judgments are delayed and fragile (Ito et al., 1998).

On the one hand, when a leader changes from directive to empowering leadership, the negative impressions and judgments made by followers because of the initial use of directive leadership will be durable and despite changing style to empowering, positive impressions will not be made immediately. The negative impression formed by the followers because of leaders being directive will be durable against the positive impression formed by followers because of leaders being empowering.

On the other hand, when leaders change from empowering to directive leadership, the positive impressions and judgments made by followers because of the initial use of empowering leadership will be fragile and on changing to directive leadership, negative impressions will be immediately made. Hence, we propose the following hypotheses:

Hypothesis 1a: When the leader changes style from directive to empowering, there will be a positive impact on follower outcomes (i.e., the increase in followers' affective commitment and followers' satisfaction with the leader). However, the positive impact on follower outcomes will be delayed (i.e., after a time lag and not immediate).

Hypothesis 1b: When the leader changes styles from empowering to directive, there will be a negative impact on follower outcomes (i.e., the deterioration in followers' affective commitment and followers' satisfaction with the leader). The negative impact on follower outcomes will be immediate.

Another mechanism which works in conjunction with the negative bias while changing leadership styles is the contrast effect. A contrast effect happens when a stimulus is perceived to be more extreme than it otherwise would be because of comparison of the stimulus with some internal standard or reference point (Skowronski & Carlston, 1989). In other words, followers' responses to a leader's style are path-dependent.

When a leader changes styles from empowering to directive, the change is seen as much more severe as compared to what it would have been had the leader been directive to start with. In other words, once a leader has been empowering, followers have an internal reference point with which to compare his or her future behavior. If the leader's behavior following empowering leadership is directive, followers succumb

to negative bias as well as contrast effect and judge the leader far more severely than they would have in the absence of an initial positive reference point, that is, if the leader had been consistently directive.

The contrast effect would amplify the negative effects of being directive, especially if it followed the leader's being empowering. Also, the contrast effect would amplify the positive effects of empowering leadership, especially if it followed the leader's being directive. Hence, we propose the following hypotheses:

Hypothesis 2a: When the leader has been consistently directive, followers will have better affective outcomes (satisfaction with the leader and affective commitment) as compared to when the leader starts off with an empowering style and then changes to a directive style.

Hypothesis 2b: When the leader starts by being directive and then changes to an empowering style, followers will have better affective outcomes (satisfaction with the leader and affective commitment) as compared to when the leader starts off with an empowering style and then changes to a directive style.

Method

In the area of leadership, an experimental study can give best results when it is done in a laboratory setting to see how leaders are perceived by followers and its outcomes (Antonakis et al., 2010). Moreover, our objective was to study the effect of changes in the leader's style on followers' affective outcomes over a period of time. Observing these changes in leader's style for all possible combinations and sequences and their impact on followers would have been almost impossible in a field setting. Hence, an experimental design was used for the study.

Research Participants

The participants in the experiment were 240 final-year engineering students who were about to graduate after completing a 4-year course in engineering from a college located in Mumbai, India. These students were organized as 80 teams led by leaders. The leaders were 20 students pursuing their master's in business administration from the same college. The "leaders" were not aware of the specific hypotheses and were merely trained to enact empowering or directive leadership on demand. The postgraduate students were exposed to the concept of leadership, and they had applied leadership skills in their team projects. In addition to this, since they had some experience working in organizations (either full time or during internships), they had observed and learned skills from corporate leaders.

Experiment Design

The experiment was divided into four conditions, with three rounds in each condition. The logic of using a total of three rounds was that we wanted to observe when the effects of a change in style were immediate and when the effects of a change in style were delayed.

In the first two conditions, the leader started with enacting one style and then switched to the other style in the next two rounds. In the first condition (Condition 1), we studied the effect of the leader switching styles from directive to empowering. Hence, the leader first enacted directive leadership in the

first round, followed by empowering leadership in the second and third rounds. In the second condition (Condition 2), we studied the effect of the leader switching styles from empowering to directive. Hence, the leader first enacted empowering leadership in the first round, followed by directive leadership in the second and third rounds.

In the third condition (Condition 3), we observed the result of a consistently empowering style and hence, the leader enacted empowering leadership in all the three rounds. Similarly, in the fourth condition (Condition 4), we observed the result of a consistently directive style and hence, the leader enacted directive leadership in all the three rounds.

For all conditions, in each of the three rounds, the team was asked to solve a different team game. The participants were given the team game “Lost at sea,” followed by “Lunar Survival” and “Dessert Survival task” (Giessner et al., 2013) in the three rounds. The three games selected were similar in their design but not identical. This ensured that the nature of the task did not change between the different rounds, and yet the participants did not find the task repetitive.

Upon arriving at the experimental venue, we randomly assigned the participants and the leaders to a team. We told the participants that the session was on interpersonal skills where they would be exposed to leadership styles and team-building games which they need to solve as a team along with the leaders. Then we introduced the teams to the game for round one. We gave 20 min to each team to solve the game and to write the solutions. After each round, we asked participants to fill surveys relating to empowering leadership, satisfaction with leader, and affective commitment. After all the three rounds, we asked the leaders to leave the venue and then shared the results of all three rounds with the participants.

Measures

We measured empowering leadership using a scale developed by Arnold (2000) and affective commitment using a scale developed by Allen and Meyer (1990). We measured satisfaction with the leader using statements like; “I felt happy working with the leader” and “I felt satisfied working with the leader”. For all surveys, participants responded to a 5-point scale ranging from 1 to 5, of which 1 represented “strongly disagree” and 5 represented “strongly agree.”

Though we had not hypothesized any effects of changing leadership styles on team performance, we measured team performance on the three tasks to provide some feedback to participants and ensure that they were interested in the game. We measured team performance as the difference between the expert and the team score of the game. Hence, higher scores denote poor performance and lower scores denote good performance. We also tested for differences in team performance across the various conditions and rounds to provide some insight for further exploration in future.

Results

We calculated the reliability for all the measures (Bonett & Wright, 2014) and found that Cronbach alphas of empowering leadership, affective commitment, and satisfaction with leader scales were 0.72, 0.82, and 0.77, respectively. The intra-class correlation coefficient (ICC) was calculated and found to be 0.80, which is adequate, (Mcgraw, 1996; Weir, 2005) and hence, the team members’ scores on affective commitment and satisfaction were averaged to calculate the team’s score on each of these variables for a given round in a given condition.

Table 1 shows the means and standard deviations (SDs) of all the key variables and correlation coefficients. Satisfaction with leader and affective commitment were positively correlated with empowering leadership (0.766 and 0.737, respectively) and directive leadership (0.667 and 0.690, respectively). Satisfaction with leader was highly correlated with affective commitment (0.910). There was low correlation of performance with empowering leadership, directive leadership, satisfaction with leader, and affective commitment (0.143, 0.012, 0.048, and 0.032, respectively).

We then conducted one-way analysis of variance (ANOVA) and analyzed the results within each of the conditions to the effect of changes or consistency in leadership style across the three rounds.

Condition 1 (Directive, Empowering, Empowering)

For the 20 groups in Condition 1, the leader enacted directive style in the first round followed by empowering style in the next two rounds. To test for a change in perceived empowerment by the team members, we conducted a one-way repeated measures ANOVA to evaluate the null hypothesis that there is no change in participants' perception of empowering leadership over the three rounds ($N = 20$). The results of the ANOVA indicated a significant effect of the round (Wilks' Lambda (λ) = 0.62, $F(2, 18) = 5.39$, $p < 0.05$, $\eta^2 = 0.37$).

Follow-up comparisons indicated that the pair-wise differences between empowering leadership scores in round 2 and round 3 were significantly greater than those in round 1 ($p < 0.05$). However, there were no significant differences between the empowering leadership scores in round 2 and round 3. Hence, our experimental manipulation was successful, and followers actually perceived that the leader changed styles from being directive in the first round to being empowering in the second and third rounds.

Next, we looked for changes in team members' satisfaction with the leader across the three rounds in Condition 1. To test for a change in satisfaction with the leader, we conducted a one-way repeated measures ANOVA. The results of ANOVA indicated a significant difference in satisfaction with the leader across the three rounds (Wilks' $\lambda = 0.39$, $F(2, 18) = 13.79$, $p < 0.01$, $\eta^2 = 0.60$).

Follow-up comparisons indicated that the pair-wise differences between team members' satisfaction with leader scores in Round 3 were significantly greater than those in Round 1 and Round 2 ($p < 0.01$). However, there were no significant differences between the team members' satisfaction with leadership scores in Round 1 and Round 2. We also calculated effect size (Cohen's d) to measure the results in terms of magnitude by which the experimental manipulation affected the participants (McLeod, 2019). The effect size for team members' satisfaction with leader scores in Round 3 was 0.88 which is a large effect size.

Table 1. Means, Standard Deviations, and Intercorrelations of Key Measures.

Variables	Mean	SD	1	2	3	4	5
Empowering leadership	4.06	0.49					
Directive leadership	4.12	0.45	0.722**				
Satisfaction with leader	3.95	0.56	0.766**	0.667**			
Affective commitment	4.00	0.49	0.737**	0.690**	0.910**		
Performance	43.47	20.30	0.143*	0.012	0.048	0.032	

Source: The authors.

Note: $N = 240$. * $p < 0.05$ and ** $p < 0.01$ (two-tailed).

Table 2. Analysis of Variance (ANOVA) Differences in Outcomes Within Rounds for all Conditions.

Conditions		Variables			
		Empowering Leadership M (SD)	Satisfaction with the Leader M (SD)	Affective Commitment M (SD)	Performance* M (SD)
Condition 1	Round 1: Directive	4.07 (0.37)	4.03 (0.45)	4.10 (0.29)	47.95 (23.43)
	Round 2: Empowering	4.30 (0.25) ^a	4.10 (0.36)	4.12 (0.35)	41.80 (13.79)
	Round 3: Empowering	4.32 (0.25) ^a	4.37 (0.30) ^{a,b}	4.36 (0.24) ^{a,b}	45.00 (19.52)
Condition 2	Round 1: Empowering	4.26 (0.26)	3.90 (0.32)	3.98 (0.35)	52.05 (21.61)
	Round 2: Directive	3.95 (0.45) ^a	3.68 (0.36) ^a	3.74 (0.36) ^a	34.75 (19.04) ^a
	Round 3: Directive	3.62 (0.71) ^a	3.51 (0.61) ^a	3.51 (0.49) ^a	39.80 (25.12) ^a
Condition 3	Round 1: Empowering	4.01 (0.45)	4.03 (0.64)	4.03 (0.49)	54.35 (20.10)
	Round 2: Empowering	4.09 (0.34)	4.07 (0.47)	4.13 (0.48)	37.20 (15.90) ^a
	Round 3: Empowering	4.11 (0.46)	4.12 (0.51)	4.13 (0.45)	43.20 (15.83) ^a
Condition 4	Round 1: Directive	3.93 (0.58)	3.82 (0.77)	3.94 (0.58)	38.55 (21.50)
	Round 2: Directive	4.06 (0.47)	3.90 (0.60)	3.99 (0.61)	40.30 (17.10)
	Round 3: Directive	3.98 (0.68)	3.90 (0.68)	4.02 (0.62)	46.75 (23.01)

Source: The authors.

Notes: $N = 80$ groups (20 in each of the 4 conditions).

* Higher scores denote lower performance and lower scores denote higher performance.

^a Significantly different from round 1.

^b Significantly different from round 2 (at $p < 0.05$).

Hence, when the leader changed styles from being directive to empowering; at first, the team members' satisfaction with the leader did not change (even though they noticed a change in the leader's style). However, in the subsequent round, only when the team members noticed a consistency in empowering leadership style over two consecutive rounds did their satisfaction with the leader increase.

Next, we looked for changes in team members' affective commitment across the three rounds in Condition 1. To test for a change in affective commitment, we conducted a one-way repeated measures ANOVA. The results of ANOVA indicated a significant difference in affective commitment across the three rounds (Wilks' $\lambda = 0.41$, $F(2, 18) = 12.81$, $p < 0.01$, $\eta^2 = 0.58$).

Follow-up comparisons indicated that the pair-wise differences between team members' affective commitment scores in Round 3 were significantly greater than those in Round 1 and Round 2 ($p < 0.01$) with an effect size of 0.97, which is considered to be large effect size. However, there were no significant differences between the team members' affective commitment scores in Round 1 and Round 2. Hence, when the leader changed her style from being directive to empowering, at first, the team members' affective commitment did not change (even though they noticed a change in the leader's style). However,

in the subsequent round, only when the team members noticed a consistency in empowering leadership style over two consecutive rounds did their affective commitment increase.

In Condition 1, we did not find any significant change in performance across the three rounds.

Overall, in Condition 1, we found that both satisfaction with leader and affective commitment increased only after the leader had displayed empowering leadership consistently for two rounds. In other words, the change in affective outcomes (satisfaction with leader and affective commitment) occurred after a time lag when the leader switched from directive to empowering leadership. Hence, Hypothesis 1a was supported.

Condition 2 (Empowering, Directive, Directive)

For the 20 groups in Condition 2, the leader enacted empowering style in the first round followed by directive style in the next two rounds. Here again, we tested for a change in perceived empowerment by the team members, by conducting a one-way repeated measures ANOVA ($N = 20$) and found a significant effect of the round (Wilks' $\lambda = 0.52$, $F(2, 18) = 8.22$, $p < 0.01$, $\eta^2 = 0.47$).

We found that the pair-wise differences between empowering leadership scores in Round 2 and Round 3 were significantly lesser than those in Round 1 ($p < 0.01$). However, there were no significant differences between the empowering leadership scores in Round 2 and Round 3. Hence, our experimental manipulation was successful, and followers actually perceived that the leader changed styles from being empowering in the first round to being directive in the second and third rounds.

Next, we looked for changes in team members' satisfaction with the leader across the three rounds in Condition 2. To test for a change in satisfaction with the leader, we conducted a one-way repeated measures ANOVA. The results of ANOVA indicated a significant difference in satisfaction with the leader across the three rounds (Wilks' $\lambda = 0.66$, $F(2, 18) = 4.54$, $p < 0.01$, $\eta^2 = 0.33$).

Follow-up comparisons indicated that the pair-wise differences between team members' satisfaction with leader scores in Round 2 were significantly lesser than those in Round 1 ($p < 0.01$), and the team members' satisfaction with leader scores in Round 3 were significantly lesser than those in Round 1 ($p < 0.05$). The effect sizes were 0.64 (medium effect size) and 0.80 (large effect size). However, there was no significant difference in team members' satisfaction with leader scores between round 2 and round 3. Hence, when the leader changed her style from being empowering to directive, the team members' satisfaction with the leader changed as soon as they noticed a change in the leader's style.

Next, we looked for changes in team members' affective commitment across the three rounds in Condition 2. To test for a change in affective commitment, we conducted a one-way repeated measures ANOVA. The results of the ANOVA indicated a significant difference in affective commitment across the three rounds (Wilks' $\lambda = 0.50$, $F(2, 18) = 8.91$, $p < 0.01$, $\eta^2 = 0.49$).

Follow-up comparisons indicated that the pair-wise differences between team members' affective commitment scores in round 2 and round 3 were significantly lesser than those in round 1 ($p < 0.01$) with an effect size of 0.67 (medium) and 1.10 (large). However, there were no significant differences between the team members' affective commitment scores in round 2 and round 3. Hence, when the leader changed their style from being empowering to directive, the team members' affective commitment changed as soon as they noticed a change in the leader's style. Hence, Hypothesis 1b was supported.

Finally, we looked for changes in the teams' performance by conducting a one-way repeated measures ANOVA. The results of the ANOVA indicated a significant difference in performance across the three rounds (Wilks' $\lambda = 0.57$, $F(2, 18) = 6.70$, $p < 0.01$, $\eta^2 = 0.42$).

Follow-up comparisons indicated that the pair-wise differences between teams' performance in round 2 and round 3 were significantly higher as compared to teams' performance in Round 1 ($p < 0.01$ and $p < 0.05$, respectively). Hence, when leaders moved from an empowering leadership style to a directive style, there was an improvement in the team's performance.

Overall, in Condition 2, we found that affective outcomes (satisfaction with leader and affective commitment) decreased immediately or as soon as the leader moved from empowering to directive leadership. However, performance increased as a result of the change in leadership style from empowering to directive.

This finding, coupled with our earlier findings from Condition 1, shows support for our hypotheses that follower's change in perception from positive to negative (as a result of the leader's change in style from empowering to directive) is immediate, while the follower's change in perception from negative to positive (as a result of leader's change in style from directive to empowering) happens after a time lag.

Condition 3 (Empowering, Empowering, Empowering)

For the 20 groups in Condition 3, the leader enacted empowering style consistently in all the three rounds. To test for a change in perceived empowerment by the team members, we conducted a one-way repeated measures ANOVA which showed no significant difference in team members' perceived empowerment across the three rounds. Hence, our experimental manipulation was successful, and followers actually perceived that the leader's style remained consistent throughout the three rounds.

Next, we checked for changes in team members' satisfaction with the leader and team members' affective commitment. We found that there were no significant differences in both these variables across the three rounds in Condition 3.

Finally, we looked for changes in the teams' performance by conducting a one-way repeated measures ANOVA and found a significant difference in performance across the three rounds (Wilks' $\lambda = 0.45$, $F(2, 18) = 10.97$, $p < 0.01$, $\eta^2 = 0.54$).

Follow-up comparisons indicated that the pair-wise differences between teams' performance in Round 2 and Round 3 were significantly greater as compared to teams' performance in Round 1 ($p < 0.01$). However, there were no significant differences between teams' performance in Round 2 and Round 3.

Condition 4 (Directive, Directive, Directive [DDD])

For the 20 groups in Condition 4, the leader enacted directive style consistently in all the three rounds. To test for a change in perceived empowerment by the team members, we conducted a one-way repeated measures ANOVA which showed no significant difference in team members' perceived empowerment across the three rounds. Hence, our experimental manipulation was successful, and followers actually perceived that the leader's style remained consistent throughout the three rounds.

Next, we checked for changes in team members' satisfaction with the leader, team members' affective commitment, and team performance. We found that there were no significant differences in these three variables across the three rounds in Condition 4.

Are Leadership Outcomes Path-dependent?

In order to test whether leadership outcomes were path-dependent, we compared the third and final rounds of two pairs of experimental conditions. Specifically, the last round of Condition 1 (directive, empowering, empowering [DEE]) was compared to the last round of Condition 3 (empowering, empowering, empowering [EEE]) and the last round of Condition 2 (empowering, directive, directive [EDD]) was compared to the last round of Condition 4 (directive, directive, directive [DDD]).

We did a one-way ANOVA for the final round scores on all the dependent variables across the four groups. We found that team performance and satisfaction with the leader was not significantly different across either of the two comparison pairs. For affective commitment, we found that there was no significant difference in the last round's affective commitment between Condition 1 (DEE) and Condition 3 (EEE). However, the team members' affective commitment in Condition 4 (DDD) was significantly greater ($p < 0.01$) than affective commitment in Condition 2 (EDD) with an effect size of 0.91 (large effect size). This shows that even if the leader has been consistently directive, the team members' affective commitment will be better as compared to a group where the leader had started off being empowering and later on shifted to being directive. Hence, Hypothesis 2a is partially supported.

We also found that teams of leaders in Condition 1 (DEE) had a higher affective commitment as compared to teams of leaders in Condition 2 (EDD; $p < 0.01$) with an effect size of 2.20 (large effect size). This shows that leaders are better off starting their interactions with the team by being directive and then moving to an empowering style as compared to starting with being empowering and then moving to a directive style. Hence, Hypothesis 2b is partially supported. Details of the all the hypotheses, the results, and their implications have been summarized in Table 3.

Table 3. Table of Hypotheses and Results.

Hypotheses	Supported/Not Supported	Implications
Hypotheses 1a: When the leader changes style from directive to empowering, there will be a positive impact on follower outcomes (i.e., the increase in followers' affective commitment and followers' satisfaction with the leader). However, the positive impact on follower outcomes will be delayed (i.e., after a time lag and not immediate).	Supported	Both satisfaction with leader and affective commitment increased only after the leader had displayed empowering leadership consistently for two rounds. In other words, the change in affective outcomes (satisfaction with leader and affective commitment) occurred after a time lag when the leader switched from directive to empowering leadership.
Hypotheses 1b: When the leader changes styles from empowering to directive, there will be a negative impact on follower outcomes (i.e., the deterioration in followers' affective commitment and followers' satisfaction with the leader). The negative impact on follower outcomes will be immediate.	Supported	When the leaders changed styles from being empowering to directive, the team members' satisfaction with the leader and affective commitment changed as soon as they noticed a change in the leader's style.

(Table 3 continued)

(Table 3 continued)

Hypotheses	Supported/Not Supported	Implications
Hypotheses 2a: When the leader has been consistently directive, followers will have better affective outcomes (satisfaction with the leader and affective commitment) as compared to when the leader starts off with an empowering style and then changes to a directive style.	Partially supported	When the leader was consistently directive, the team members' affective commitment was better as compared to a group where the leader had started off being empowering and later shifted to being directive.
Hypotheses 2b: When the leader starts by being directive and then changes to an empowering style, followers will have better affective outcomes (satisfaction with the leader and affective commitment) as compared to when the leader starts off with an empowering style and then changes to a directive style.	Partially supported	When the leader was first directive and then empowering for the next two rounds, teams had a higher affective commitment as compared to teams of leaders when the leader was first empowering and then directive for the next two rounds. This shows that leaders are better off starting their interactions with the team by being directive and then moving to an empowering style as compared to starting with being empowering and then moving to a directive style.

Source: The authors.

Discussion

In this study, we found some interesting effects on followers' affective outcomes as a result of changing leadership styles. When leaders changed styles from being empowering to directive, we found that there was an immediate reduction in the followers' affective outcomes. On the other hand, when leaders change style from being directive to empowering, followers' affective outcomes increased only after a time lag. More specifically, only when followers had seen their leader acting consistently in an empowering style for two rounds did their affective outcomes increase. Therefore, the negative affective outcomes of being directive after being empowering are immediate, while the positive affective outcomes of being empowering after being directive are delayed.

Our results are consistent with negativity dominance and negativity bias, which suggests that negative information is perceived more strongly than positive information (Rozin & Royzman, 2001). Moreover, research on first impressions has shown that individuals judge negative traits faster than positive traits (Carney et al., 2007). Hence, positive impressions are delayed and fragile while negative impressions are immediate and durable (Ito et al., 1998). This study shows that followers form impressions in line with the above theories, and hence, leader's changing styles have a non-symmetrical impact on the followers' affective outcomes.

We also found that when leaders were consistently directive, their teams showed higher levels of affective commitment as compared to when leaders started off by being empowering and then moved to being directive. Moreover, we found that when leaders started with being directive and then changed to an empowering style, their followers had higher affective outcomes as compared to when leaders started

with being empowering and then changed to a directive style. This can be explained by the contrast principle (Cialdini, 2001; Shu & Cheng, 2012) which affects the way we see things that are presented to us one after the other.

Limitations of this Study

This study has a couple of limitations. First, since the study was an experimental study and the participants were final-year students, the findings may not be generalizable. Our study only provides the plausible range of possibilities that might occur with respect to team affective outcomes when leaders change their styles. Second, the leaders and team were introduced for the first time, whereas in organizations, the leaders and the team would work together for years, and it might increase the acceptability of leaders and their leadership styles. Third, the task involved a decision task and we did not simulate a real job environment. As a result of this, we were not able to hypothesize and accurately measure the performance of participants across the different conditions. Fourth, there are several individual differences that can influence followers' affective outcomes which we have not accounted for in our study. Future studies must consider including control variables such as leader's use of charismatic leadership tactics, followers' preference for empowering or directive leadership, or followers' perception of the situation as a crisis. Finally, our experiment is a first step in observing the effect of changing leadership styles on follower outcomes. A detailed analysis of the interaction between leadership styles and follower responses must be done to understand the effects of leadership styles and changes in leadership styles on followers. We urge future researchers to take up such studies using alternative methods.

Practical Implications of the Study

Despite limitations, the findings of this study have following implications for emerging leaders who are leading teams. First, our findings question the feasibility of applying several contingency and situational theories of leadership without thinking through their consequences. In a sense, we validate O'Toole's (1995) caution that changing styles frequently, as per recommendations of the situational and contingency approaches, is not without a cost in terms of the team's affective outcomes.

In addition, we provide some guidelines to leaders that if they must change styles, then certain sequences are preferred over others. As per our findings, it seems as if, starting off with a directive style and then moving to a more empowering style (or continuing with a directive style) is preferred as compared to starting with an empowering style and then becoming directive.

The study tried to reduce the dilemma of a leader concerning relative impact (benefits and consequences) of empowering versus directive leadership on team outcomes such as performance, satisfaction level, and affective commitment resolving the doubt concerning the relative benefits of empowering and directive leadership in teams. Changing styles is also related to followers' perception by connecting to the theory of impression formation and adding to the existing literature on which style of leadership brings sustained results in teams. This research will guide leaders on whether one approach is best for leaders or an integrated approach of directive and empowering style works better.

The study will also help Human Resource managers to develop leaders in their organization who can bring positive team outcomes. For example, designing a training program to make the budding managers/

leaders to know the benefits and consequences of changing styles and which style is best depending upon the organisation's objectives.

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ORCID iD

Zubin R. Mulla  <https://orcid.org/0000-0002-4448-0830>

References

- Albrecht, S. L., & Andreetta, M. (2011). The influence of empowering leadership, empowerment and engagement on affective commitment and turnover intentions in community health service workers: Test of a model. *Leadership in Health Services, 24*(3), 228–237. <https://doi.org/10.1108/17511871111151126>
- Allen, N. J., & Meyer, J. P. (1990). The measurement and antecedents of affective, continuance and normative commitment to the organization. *Journal of Occupational Psychology, 63*(1), 1–18. <https://doi.org/10.1111/j.2044-8325.1990.tb00506.x>
- Almutawa, Z., Muenjohn, N., & Zhang, J. (2016). The effect of human resource management system on employees' commitment: The mediating role of the Amo Model. *The Journal of Developing Areas, 50*(6), 17–29. <https://doi.org/10.1353/jda.2016.0147>
- Anderson, C., John, O. P., & Keltner, D. (2012). The personal sense of power. *Journal of Personality, 80*(2), 313–344. <https://doi.org/10.1111/j.1467-6494.2011.00734.x>
- Antonakis, J., Schriesheim, C. A., Donovan, J., Kishore Gopalakrishna, P., Pellegrini, E. K., & Rossomme, J. L. (2011). Methods for studying leadership. In J. Antonakis & D. V. Day (Eds.), *The nature of leadership* (pp. 48–70). http://www.hec.unil.ch/jantonakis/AntonakisChapter03_5013.pdf
- Arnold, J., Arad, S., Rhoades, J. A., & Drasgow, F. (2000). The empowering leadership questionnaire: The construction and validation of a new scale for measuring leader behaviors. *Journal of Organisational Behaviour, 21*, 249–269. [https://doi.org/10.1002/\(SICI\)1099-1379\(200005\)21](https://doi.org/10.1002/(SICI)1099-1379(200005)21)
- Bargh, J. A., & Pietromonaco, P. (1982). Automatic information processing and social perception: The influence of trait information presented outside of conscious awareness on impression formation. *Journal of Personality and Social Psychology, 43*(3), 437–449.
- Barstow, C. (2008). The power differential and the power paradox: Avoiding the pitfalls. *Hakomi Forum, 19-20-21*, 53–62.
- Bebbington, K., MacLeod, C., Mark Ellison, T., & Fay, N. (2017). The sky is falling: Evidence of a negativity bias in the social transmission of information. *Evolution and Human Behavior, 38*(1), 92–101. <https://doi.org/10.1016/j.evolhumbehav.2016.07.004>
- Blanchard, K. H., Zigarmi, D., & Nelson, R. B. (1993). Situational leadership after 25 years: A retrospective. *Journal of Leadership & Organizational Studies, 1*(1), 21–36. <https://doi.org/10.1177/107179199300100104>
- Bonett, D. G., & Wright, T. (2014). Cronbach's Alpha reliability: Interval estimation, hypothesis testing, and sample size planning. *Journal of Organisational Behaviour*. <https://doi.org/10.1002/job.1960>
- Boselie, P. (2010). High performance work practices in the health care sector: A Dutch case study. *International Journal of Manpower, 31*(1), 42–58. <https://doi.org/10.1108/01437721011031685>
- Carney, D. R., Colvin, R. C., & Hall, J. A. (2007). A thin slice perspective on the accuracy of first impressions. *Journal of Research in Personality, 41*, 1054–1072. <https://doi.org/10.1016/j.jrp.2007.01.004>

- Chen, G., Sharma, P., Edinger, S., Shapiro, D. L., & Farh, J.-L. (2011). Motivating and demotivating forces in teams: Cross-level influences of empowering leadership and relationship conflict. *The Journal of Applied Psychology, 96*(3), 541–557. <https://doi.org/10.1037/a0021886>
- Cialdini, R. B. (2001). *Influence—Science and practice* (4th ed. C. Merrill et al.). Allyn & Bacon A Pearson Education Company.
- Corns, J. (2018). Rethinking the negativity bias. *Review of Philosophy and Psychology, 9*(3), 607–625. <https://doi.org/10.1007/s13164-018-0382-7>
- Dolatabadi, H. R., & Safa, M. (2011). The effect of directive and participative leadership style on employees' commitment to service quality. *Journal of Business and Management, 4*(2), 31–42.
- Fiedler, F. E. (1971). Validation and extension of the contingency model of leadership effectiveness: A review of empirical findings. *Psychological Bulletin, 76*(2), 128–148. <https://doi.org/10.1037/h0031454>
- Fong, K. H., & Snape, E. (2015). Empowering leadership, psychological empowerment and employee outcomes: Testing a multi-level mediating model. *British Journal of Management, 26*, 126–138. <https://doi.org/10.1111/1467-8551.12048>
- Gao, L., Janssen, O., & Shi, K. (2011). Leader trust and employee voice: The moderating role of empowering leader behaviors. *Leadership Quarterly, 22*(4), 787–798. <https://doi.org/10.1016/j.leaqua.2011.05.015>
- Gawronski, B., Ehrenberg, K., Banse, R., Zukova, J., & Klauer, K. C. (2003). It's in the mind of the beholder: The impact of stereotypic associations on category-based and individuating impression formation. *Journal of Experimental Social Psychology, 39*(1), 16–30. [https://doi.org/10.1016/S0022-1031\(02\)00517-6](https://doi.org/10.1016/S0022-1031(02)00517-6)
- Giessner, S. R., van Knippenberg, D., van Ginkel, W., & Sleebos, E. (2013). Team-oriented leadership: The interactive effects of leader group prototypicality, accountability, and team identification. *Journal of Applied Psychology, 98*(4), 658–667. <https://doi.org/10.1037/a0032445>
- Hersey, P., Blanchard, K. H., & Natemeyer, W. E. (1979). Situational leadership, perception, and the impact of power. *Group & Organization Management, 4*(4), 418–428. <https://doi.org/10.1177/105960117900400404>
- Hughes, J. H. J. (2007). *The ability-motivation-opportunity framework for behavior research in IS*. In 40th Annual Hawaii International Conference on System Sciences (HICSS'07), pp. 1–10. <https://doi.org/10.1109/HICSS.2007.518>
- Humborstad, S. I. W., & Giessner, S. R. (2018). The thin line between empowering and Laissez-Faire leadership: An expectancy-match perspective. *Journal of Management, 44*(2), 757–783. <https://doi.org/10.1177/0149206315574597>
- Ito, T. A., & Cacioppo, J. T. (2005). Variations on a human universal: Individual differences in positivity offset and negativity bias. *Cognition and Emotion, 19*(1), 1–26. <https://doi.org/10.1080/02699930441000120>
- Ito, T. A., Larsen, J. T., Smith, N. K., & Cacioppo, J. T. (1998). Negative information weighs more heavily on the brain: The negativity bias in evaluative categorisation. *Journal of Personality and Social Psychology, 75*(4), 887–900.
- Kahai, S., Sosik, J., & Avolio, B. (1997). Effects of leadership style and problem structure on work group process and outcomes in an electronic meeting system environment. *Personnel Psychology, 50*(1), 121–146.
- Keltner, D., Gruenfeld, D. H., & Anderson, C. (2003). Power, approach, and inhibition. *Psychological Review, 110*(2), 265–284. <https://doi.org/10.1037/0033-295X.110.2.265>
- Kim, M., & Beehr, T. A. (2018). Empowering leadership: Leading people to be present through affective organizational commitment? *International Journal of Human Resource Management*. Routledge. <https://doi.org/10.1080/09585192.2018.1424017>
- Lee, J. (2005). Effects of leadership and leader-member exchange on commitment. *Leadership and Organisation Development Journal, 26*(8), 655–672. <https://doi.org/10.1108/02683940810894747>
- Lee, J., Lee, H., & Park, J. (2014). Exploring the impact of empowering leadership on knowledge sharing, absorptive capacity and team performance in IT service. *Information Technology & People, 27*(3), 336–386. <https://doi.org/10.1108/ITP-10-2012-0115>
- Lorinkova, N. M., Pearsall, M. J., & Sims, H. P. (2013). Examining the differential longitudinal performance of directive versus empowering leadership in teams. *Academy of Management Journal, 56*(2), 573–596.

- Martin, S. L., Liao, H., & Campbell, E. M. (2013). Directive versus empowering leadership: A field experiment comparing impacts on task proficiency and proactivity. *Academy of Management Journal*, 56(5), 1372–1395. <https://doi.org/10.5465/amj.2011.0113>
- Mcgraw, K. O. (1996). Forming inferences about some intraclass correlation coefficients. *Psychological Methods*, 1(1), 30–46. <https://doi.org/10.1037/1082-989X.1.1.30>
- McLeod, S., A. (2019, July 10). *What does effect size tell you? Simply psychology*. <https://www.simplypsychology.org/effect-size.html>
- Neuberg, S. L., & Fiske, S. T. (1987). Motivational influences on impression formation: Outcome dependency, accuracy-driven attention, and individuating processes. *Journal of Personality and Social Psychology*, 53(3), 431–444. <https://doi.org/10.1037/0022-3514.53.3.431>
- Offermann, L. R., Kennedy, J. K., & Wirtz, P. W. (1994). Implicit leadership theories: Content, structure and generalizability. *Leadership Quarterly*, 5(1), 43–58.
- O'Toole, J. (1995). *Leading change: The argument for values-based leadership*. Random House.
- Raub, S., & Robert, C. (2010). Differential effects of empowering leadership on in-role and extra-role employee behaviors: Exploring the role of psychological empowerment and power values. *Human Relations*, 63(11), 1743–1770. <https://doi.org/10.1177/0018726710365092>
- Rozin, P., & Royzman, E. B. (2001). Negativity bias, negativity dominance, and contagion. *Personality and Social Psychology Review*, 5(4), 296–320.
- Shu, W., & Cheng, C. (2012). How to improve consumer attitudes toward using credit cards online: An experimental study. *Electronic Commerce Research and Applications*, 11, 335–351. <http://doi.org/10.1016/j.elerap.2012.01.003>
- Sims, H. P., Faraj, S., & Yun, S. (2009). When should a leader be directive or empowering? How to develop your own situational theory of leadership. *Business Horizons*, 52(2), 149–158. <https://doi.org/10.1016/j.bushor.2008.10.002>
- Skowronski, J. J., & Carlston, D. E. (1989). Negativity and extremity biases in impression formation: A review of explanations. *Psychological Bulletin*, 105(1), 131–142.
- Srivastava, A., Bartol, K. M., & Locke, E. A. (2006). Empowering leadership in management teams: Effects on knowledge sharing, efficacy, and performance. *Academy of Management Journal*, 49(6), 1239–1251. <https://doi.org/10.5465/amj.2006.23478718>
- Thompson, G., & Glasø, L. (2018). Situational leadership theory: A test from a leader-follower congruence approach. *Leadership and Organization Development Journal*, 39(5), 574–591. <https://doi.org/10.1108/LODJ-01-2018-0050>
- Tuckey, M. R., Bakker, A. B., & Dollard, M. F. (2012). Empowering leaders optimize working conditions for engagement: A multilevel study. *Journal of Occupational Health Psychology*, 17(1), 15–27. <https://doi.org/10.1037/a0025942>
- Vroom, V. H., & Yetton, P. W. (1973). *Leadership and decision making*. University of Pittsburgh Pre. <https://doi.org/10.4135/9781412979351.n42>
- Weir, J. (2005). Quantifying test-retest reliability using the intraclass correlation coefficient and the SEM. *Journal of Strength and Conditioning Research*, 19(1), 231–240.
- Xie, S. Y., Flake, J. K., & Hehman, E. (2019). Perceiver and target characteristics contribute to impression formation differently across race and gender. *Journal of Personality and Social Psychology*. <https://doi.org/10.1037/pspi0000160>
- Yukl, G. (2012, November). Effective leadership behavior: What we know and what questions need more attention. *Academy of Management Perspectives*, 26(4), 66–85. <https://doi.org/10.5465/amp.2012.0088>
- Zaccaro, S. J. (2007). Trait-based perspectives of leadership. *The American Psychologist*, 62(1), 6–16. <https://doi.org/10.1037/0003-066X.62.1.6>
- Zhang, X., & Bartol, K. M. (2010). Linking empowering leadership and employee creativity: The influence of psychological empowerment, intrinsic motivation, and creative process management. *Academy of Management Journal*, 53(1), 107–128. <https://doi.org/10.5465/AMJ.2010.48037118>