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A Machine Learning-Based Blood Donor Recommendation System to Enhance Blood Donation Efficiency

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Abstract—Blood is an essential part of receiving medical care, yet maintaining a sufficient supply of blood is still difficult. This research provides a machine learning (ML) based recommendation system for blood donor availability. Given the growing need for particular blood types and the urgency of donations, this kind of technology is crucial for effectively matching donors and recipients. We employ the Random Forest algorithm to build the recommendation system. Through the use of a dataset containing attributes such as age, location, and blood type, the model predicts the likelihood of available donors. The preferred approach is Random Forest since it can handle complex data and generate accurate predictions. The system can determine and order the top ten potential blood donors according to relevant criteria and the required blood type. This information improves blood donation operations by streamlining the process of rapidly locating eligible donors. By putting this strategy in place, healthcare facilities can better handle emergencies and blood drives. Subsequent investigations could concentrate on including real-time data streams and broadening the model to encompass supplementary elements like donor eligibility standards and contribution chronicles, thereby enhancing the precision of recommendations and system usefulness.

Index Terms—Blood donor availability, Machine learning recommendation system, Random Forest algorithm, Healthcare logistics optimization, Donor-recipient matching,Donation history analysis

I. INTRODUCTION

Medical analytics is crucial to the advancement of humanity. Many manually performed operations must be automated in order to avoid delays in medical care. Treatments administered on time will always help to save lives. Blood is one of these, and its prompt availability is essential for treating any emergency cases[1]. Accidents and other life-threatening situations happen rather frequently in this fast-paced society. The hospitals are required to treat each of these individuals as soon as possible.

One admirable idea to aid in this process is to deal with the problem of arranging blood at a time. People are voluntarily offering their assistance to one another these days. However, one of the most difficult tasks is connecting these donors with patients in need[16]. These procedures are always started as soon as an emergency occurs. However, automating this would facilitate the process overall and eliminate the need to wait for the circumstance to arise before responding. This project would, in general, be more proactive than reactive.

Because machine learning algorithms can forecast the future, they are assisting in the resolution of numerous realworld problems. It is capable of handling data that is labeled or unlabeled. There are several supervised methods for managing the labeled data[18], and classification is one of the duties it must carry out. Many of these problems would be resolved if the observed input data were properly classified. Conversely, unsupervised methods such as clustering will tackle the problem of unlabeled data. There are numerous well-liked supervised methods for solving classification issues. Applications in medicine stand to gain the most from these methods.

The frequency of a donor's donations and information regarding their most recent donation are two important pieces of donor data that should be taken into account. It will be crucial to maintain track of these two records in order to resolve this need-based donation[15]. In the modern era of social media, it is simple to contact a donor; nevertheless, the matters of eligibility and availability must be verified.

The development of a system that would automate this procedure will be much appreciated by humanity to aid in an emergency, yet the traditional blood bank system will coexist and continue to provide its services as it has in the past [10]. because, regardless of the urgency of the case, the traditional system is always laborious and takes its sweet time to reply to any inquiry.

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To a certain extent, many issues could be resolved by keeping records properly. The execution would be delayed if there was any human intervention in this. This is the primary reason that total system automation would, to a certain extent, resolve these problems. This technique of forecasting the future based on the present records would be supported by machine learning algorithms. Accurate record availability would guarantee that this process proceeds as planned.

This study is structured as follows: an introduction, relevant literature, a suggested system, and an analysis of the results. We will be able to determine which strategy is most likely to perform more accurately and provide us with the flexibility to act through its categorization abilities thanks to this analysis. quick decision-making process.

II. Literature Survey

A clinical decision support system for matching patients with suitable donors and managing situations more skillfully by raising standards was suggested [2] as a decision support system-based blood banking system. It was predicted that occasionally 50 percent of potential donors would not be available, which is another significant issue that needs to be properly addressed[3]. For managing such unforeseen situations, individual-level estimations based on a machine learning algorithm would be useful.

Social media use [4] would be beneficial in disseminating any message to a large audience. An average of 3.8 hours passed until the right individual received the Twitter messages, which were examined to see if they met the blood requirement. Once more, it would only be reachable during the day, from 10 a.m. to 4 p.m. The results of testing the multivariable[5] machine learning algorithmic approach against the donor selection process for hematopoietic cell transplantation were positive.

Creating a profile of the blood donor would be a wise course of action in an emergency [7]. Given Egypt's reputation as a research hub for the myriad facets of blood donation, this study's donor profiling took cognitive and psychographic characteristics into account. Big Data techniques were used in New York [8] to encourage individuals to donate blood, which will help save many lives in emergency situations.

A transfusion system was suggested after taking into account the different aspects of two individuals: a donor and a recipient [9]. This work addressed the time-consuming procedure of manually matching requirements. Time was saved when treating patients in emergency situations thanks to the automation of this.

The presentation of integrated blood donation management [12] showed the obstacles in addressing this. Integrated methods would enable more effective handling of this. The global network [13] was deemed necessary, and its challenges—which mostly concerned blood and bone marrow transplantation—were raised.

As a result, this chapter presents some of the linked works, while the following chapter presents the planned work.

III. Proposed System

The proposed system uses machine learning algorithms to effectively match donors and receivers, revolutionizing the process of blood donation. Healthcare facilities can expedite the donation procedure and guarantee a steady supply of blood for patients in need by precisely forecasting donor availability based on multiple parameters, including age, geography, and blood type. Because it cuts down on wait times and minimizes blood shortages, this approach has the potential to save lives and enhance healthcare results. The Random Forest algorithm, a potent machine learning method renowned for its capacity to manage complicated datasets and generate precise predictions, is employed by the recommendation system. A large dataset comprising donor data, such as demographics, past donations, and geographic location, is used to train the model. The algorithm can determine patterns and trends to forecast the possibility of donor availability for particular blood types by examining these variables.The first two chapters restate the requirement for an intelligent system within the integrated framework. This chapter will outline the suggested framework that will allow the process to run automatically without the need for human input.

Global healthcare systems are very concerned about blood shortages. Critical shortages of blood may result from an increase in demand for the blood product during emergencies, natural catastrophes, or pandemics. The suggested system helps prevent blood shortages and guarantees a steady supply of blood, particularly in emergency situations, by precisely forecasting donor availability and effectively linking donors with recipients. Blood donation facilities frequently struggle to efficiently manage their donor resources. The contribution process may be hampered by low manpower, logistical limitations, and administrative overhead. The system increases the efficiency of blood donation operations, minimizes

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administrative overhead, and optimizes resource allocation by automating donor recommendation and priority.

A suitable dataset in a necessity is necessary for the entire procedure, and it must be correctly assessed. For this study, we gathered our own dataset by surveying blood donors at different blood donation locations . The dataset contains contact details and donor history in addition to demographic data like age and blood type.The considered dataset consists of various attributes such as Recency in months ,Frequency as numbers ,Monetary in cc and the donor information. By closely examining and confirming the responses, as well as by carrying out preprocessing procedures to address missing values and standardize the data format, we were able to assure the quality of the data.

A. Methodology

The methodology for the proposed system is given as follows:

Data collection: Gathering information about blood donors, such as contact information, blood type, age, location, frequency of donation, and recentness of donation. The machine learning model is trained using this dataset as a basis.

Data Preprocessing: Handle missing values, eliminate duplicates, and standardize data formats to clean up the dataset. To extract pertinent features and convert categorical variables into numerical representations appropriate for modeling, use feature engineering.

Feature Selection: Identifying which characteristics are most important in forecasting the availability of donors. To choose the best subset of features for model training, apply methods including domain expertise, feature importance ranking, and correlation analysis.

Model Selection :Select a suitable machine learning algorithm for constructing the recommendation framework. Ensemble approaches that can handle complex data and produce reliable predictions, such Random Forest, Gradient Boosting, or XGBoost, are a good fit for this project because of the characteristics of the dataset and the prediction objective.

Model Training :To assess the performance of the model, divide the dataset into training and testing sets. Using the training data, train the chosen machine learning model. Adjust the hyperparameters to get the best results in terms of accuracy, precision, recall, or F1 score.

```
Enter the blood group (e.g., A+, O-, AB+): A+
Top 10 donors for blood group A+
```

Donor name	Email ID	Location	Contact number
G.Jahnavi	jahnavigedda8749@gmail.com	Vijayawada	7386097503
K.Ngalakshmi	nagalakshmikalipanani@gmail.com	RL Nagar	8999547521
M.Kamalakar	kamalakar2567@gmail.com	Jangareddygudem	8989245678
B.Satya rao	satya246@gmail.com	Machilopatnam	9951242881
J.Sai Teja	saitejai73@gmail.com	Yanamalakuduru	6325874251
O.Kiran	kirankumarsai98@gmail.com	Ganguru	9586211486
Md.Haseena	haseena56@gmail.com	Rajahmundry	9505236921
P.Amrutha vally	vally45@gmail.com	Pushpa hotel	8688673211
N.Rajesh	nulirajesh76@gmail.com	Lingapalem	9705345671
R.Anjaneyulu	anjaneyulu436@gmail.com	Guntur	9502772714

Model Evaluation: Analyze the prediction power and generalization capacity of the trained model using the testing dataset. Cross-validate and analyze performance indicators to make sure the system is reliable and robust.

System Development :Create a user-friendly application or interface and incorporate the learned machine learning model into it to develop the recommendation system. To provide smooth system interaction, implement features for user input, prediction generation, and outcome visualization.

IV. RESULTS AND ANALYSIS

The recommendation system will be put into place and give healthcare facilities useful information about donor availability. This information will help them make better decisions and connect with possible donors. The technology reduces reaction times during emergencies by identifying the top donors based on predetermined parameters (such as frequency of donations or proximity to the donation site). This results in better patient care, lower medical expenses, and increased operational effectiveness for blood donation facilities.The following picture depicts the output of this system:

Figure 1 depict the result obtained sample screenshot of the top blood donors of given blood group.In the above figure 1 the blood group given as A+ .The result shows donor information such as Donor name, Email id, Location, Contact number.It is the sample only and all the results are obtained in a similar way.

Accuracy = (TP + TN) / (TP + TN + FP + FN)

Fig. 1. Results

Accuracy	Precision	F1 Score	Recall	ROC AUC Score
0.2083	0.1810	0.1912	0.2083	0.5120

TABLE I
PERFORMANCE ANALYSIS

Precision = TP / (TP + FP)

Recall = TP / (TP + FN)

F1 Score = 2 * (Precision * Recall) / (Precision + Recall)

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The result which are shown in the table 1 using above equations consists of details of True Positive, True Negative, False Positive and False Negative.With those values the various performance metrics are calculated like Accuracy, Precision etc.

In Figure 2, the confusion matrix also formed to test the results based on blood groups.The confusion matrix can be used in the context of the blood donor recommendation system project to assess how well the machine learning model performing the blood donor prediction performed.It consists of all the blood group.

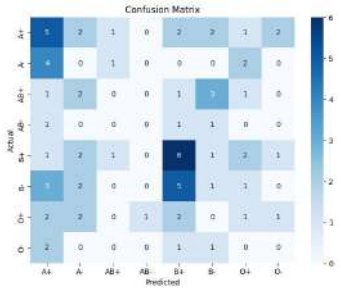

Fig. 2. Confusion Matrix

V. Conclusion and Future Scope

When the requirement is really high, this suggested solution is a concept that might be expanded to a big scale. A few benefits and dimensions of this effort include the narrowing of the gap between the recipient and the donor, the potential to even target rare blood types, and the potential use of prior data to learn more about the donor's background. The data from current blood donors will be linked with social media to create an application as part of the ongoing effort. In this manner, it would help a nation like India's vast populace. This innovative initiative's public-private collaboration should improve the process of allocating proper money for the development as well as for market across the country. Sorting the donors using a machine learning algorithm would be an additional benefit in finding the ideal donor in every way. Therefore, automating has its advantages in resolving a crucial problem that will protect humanity in the event of an emergency. Additionally, this could guarantee that the primary focus and area of treatment will be healthcare.

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Assessing Brain-Age prediction throughcomprehensive evaluation using Machine Learning Algorithm

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ABSTRACT-Machine learning (ML) algorithms play a crucial role in brain-agee estimation systems, yet a comprehensive evaluation of their impact on prediction accuracy remains unexplored. In this study, we aimed to evaluate the effectiveness of various regression algorithms for brain-agee estimation. Our methodology involved constructing a brain-agee estimation framework using a large training set of cognitively healthy (CH) individuals (N = 788) and testing 22 different regression algorithms. We then assessed each algorithm on independent test sets consisting of 88 CH individuals, 70 mild cognitive impairment patients, and 30 Alzheimer's disease patients. The prediction accuracy in the independent test set (CH set) showed variations across regression algorithms, with mean absolute error (MAE) ranging from 4.63 to 7.14 years and R2 from 0.76 to 0.88. The Quadratic Support Vector Regression algorithm achieved the highest accuracy (MAE = 4.63 years, R2 = 0.88; 95% CI = [-1.26; 1.42]), while the
Binary Decision Tree algorithm demonstrated the lowest accuracy (MAE = 7.14 years, R2 = 0.76; 95% CI = [-1.50; 2.62]). Our experimental results highlight the impact of regression algorithms on prediction accuracy in brain-agee estimation frameworks, indicating that advanced machine learning algorithms have the potential to improve precision in clinical settings.

Keywords: **Brain-agee, Machine Learning, Regression Algorithms**

I. INTRODUCTION

Brain-agee estimation, a method utilizing machine learning (ML) algorithms, holds promise for assessing brain health and detecting neurological disorders. ML algorithms have been extensively employed in this domain, yet there remains a gap in understanding the comprehensive impact of regression algorithms on prediction accuracy. In this study, we aimed to address this gap by evaluating the efficacy of various regression algorithms [1] for brain-agee estimation. Our investigation involved constructing a robust brain-agee estimation framework utilizing a sizable training dataset of cognitively healthy (CH) individuals and testing a diverse set of 22 regression algorithms [2]. The evaluation was conducted on independent test sets comprising CH individuals, mild cognitive impairment patients, and Alzheimer's disease patients. By analyzing the performance metrics such as mean absolute error (MAE) and R2 [3], we aimed to discern the influence of regression algorithms on prediction accuracy and identify the most effective approach for precise brain-agee estimation. This research endeavors to shed light on the role of regression algorithms in enhancing the accuracy of brain-agee estimation models [4], thus potentially facilitating more accurate diagnoses and interventions in clinical settings.

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II. LITERARURE SURVEY

This literature review delves into the realm of brain-agee estimation, concentrating on the extensive assessment of regression algorithms and their implications for predictive precision in both the context of cognitively healthy aging and clinical applications. Various MRI contribute to feature extraction, with anatomical MRI commonly employed due to its accessibility and superior spatial resolution. The selection of regression algorithms, such as Gaussian process regression and support vector regression, significantly influences predictive accuracy, necessitating algorithms that showcase precision, sensitivity, and adaptability across diverse datasets. This review underscores the vital role of regression algorithms in clinical applications, emphasizing their importance in accurately estimating brain-agee in diverse neurological disorders. Although some studies have explored the impact of regression algorithms on brain-agee prediction accuracy, particularly in cognitively healthy individuals, there exists a noticeable void in evaluating these algorithms within clinical populations. To address this lacuna, future research should concentrate on comprehensive assessments utilizing varied regression techniques, encompassing diverse patient groups and refining methodologies to enhance predictive efficacy in neurological diagnostics and research.

III. PROBLEM STATEMENT

EXISTING SYSTEM:

When it pertains to brain-agee estimation, the most widespread strategy uses machine learning algorithms to forecast an individual's neural age via evaluation of neuroimaging data. The term "brain-agee-delta," which refers to the variance between the age anticipated in these machine learning models and their real age, has begun to receive more attention recently. This measure is useful in gauging healthy aging and diagnosing neurological disorders. A "healthy aging trajectory" is indicated by a brain-agee-delta of zero, but a large variance points to a "accelerated cognitive aging" and raises the prospect of age-related illnesses.

Neuroimaging modalities play a crucial role in the existing system, with various techniques such as anatomical MRI, contributing to the extraction of features from brain imaging data. Anatomical MRI, owing to its common accessibility, towering spatial ruling, and first-rate tissue disparity, is frequently employed in brain-agee studies. Additionally, data reduction techniques, including principal component analysis (PCA), are applied to manage the challenges associated with a large number of extracted features.

The choice of regression algorithms is pivotal in the existing system, with GPR and SVR being commonly use for their effectiveness in capturing complex relationships within the data. These regression algorithms are crucial in predicting brain-agee values during the training stage.

The existing system has demonstrated promising results particularly in clinical populations. A few studies have investigated this aspect, highlighting the importance of assessing these algorithms at the clinical level to ensure their efficacy and reliability across different datasets and patient groups.

In summary, the existing system utilizes machine learning algorithms, neuroimaging modalities, and regression techniques for brain-agee estimation, showing potential for applications in monitoring healthy aging and diagnosing neurological disorders. Ongoing research seeks to refine and enhance these methods, particularly in the context of clinical populations, to improve predictive accuracy and broaden the scope of applications in neurological diagnostics and research.

PROPOSED SYSTEM:

In our proposed system, we aim to integrate and evaluate the k-Nearest Neighbors (k-NN) algorithm and Ridge regression method as integral components of the brain-agee estimation framework. The k-NN algorithm, renowned for its non-parametric classification capabilities, will be explored for its potential application in regression tasks within our brain-agee prediction model. By leveraging the proximity-based nature of k-NN, we anticipate capturing intricate relationships within the brain imaging data for more nuanced and accurate age predictions.

Additionally, we propose the incorporation of Ridge regression as a model tuning method to address potential multi-collinearity issues within the brain-agee estimation dataset. Ridge regression's ability to handle correlated features will contribute to mitigating potential challenges arising from complex interactions within the neuroimaging data. This inclusion aligns with our goal of improving the efficiency and robustness of the brain-age prediction model.

The proposed system will involve an iterative process of training and testing, using a diverse and comprehensive dataset that includes cognitively healthy individuals as well as a broader representation of clinical populations. We plan to assess the predictive accuracy of the k-NN algorithm and Ridge regression in comparison to other regression methods, emphasizing their effectiveness in capturing both local and global relationships within the brain-agee data.

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Furthermore, the proposed system will explore various hyperparameter configurations for both algorithms to optimize their performance. Regularized tuning of the k-NN algorithm and fine-tuning of the Ridge regression parameters will be conducted to achieve an optimal balance between accuracy and generalizability.

Through rigorous experimentation and validation on independent test sets, including diverse clinical groups, we anticipate demonstrating the effectiveness of integrating k-Nearest Neighbors and Ridge regression within the brain-agee estimation framework. This proposed system aims to contribute to the refinement of regression algorithms, paving the way for other accurate and reliable brain-age predictions, particularly in irrefutable setting.

ADVANTAGES:

Enhanced Predictive Accuracy: The integration of the k-Nearest Neighbors (k-NN) algorithm and Ridge regression in the proposed system is expected to lead to improved predictive accuracy for brain-agee estimation. By leveraging k-NN's ability to capture intricate relationships and Ridge regression's capacity to handle multi-collinearity, the proposed system aims to provide more nuanced and precise age predictions.

Robust Handling of Multi-Collinearity: Ridge regression, as a model tuning method, addresses the challenge of multi-collinearity often present in brain-agee estimation datasets. Its regularization technique ensures stability in the presence of correlated features, contributing to a more robust and reliable prediction model.

Adaptability to Diverse Data: The proposed system advocates for an iterative approach, allowing the adaptation and evaluation of the k-NN algorithm and Ridge regression across diverse datasets. This adaptability ensures that the model is capable of generalizing well to different populations, including cognitively healthy individuals and those with various neurological conditions.

Incorporation of Local and Global Relationships: The k-NN algorithm, known for its non-parametric nature, excels at capturing local relationships within the data, complementing Ridge regression's ability to capture global patterns. The combined strengths of these algorithms supply to a added all-inclusive perceptive of the intricate structures within brain imaging data.

Optimized Hyperparameter Configurations: The proposed system involves a systematic exploration of hyperparameter configurations for both algorithms, ensuring optimal settings for improved performance. This optimization process contributes to the fine-tuning of the model, striking a balance between accuracy and generalizability.

Iterative Model Refinement: Through an iterative training and testing process, the proposed system allows for continuous refinement of the brain-agee estimation model. This iterative approach includes experimenting with various algorithmic configurations, contributing to the ongoing enhancement of the model's effectiveness and adaptability.

Applicability in Clinical Settings: By assessing the proposed system on diverse clinical populations, the advantages extend to its applicability in real-world clinical settings. This ensures that the refined model is not only accurate but also clinically relevant for the untimely revealing and monitoring of neurological disorders.

In summary, the proposed system's advantages lie in its commitment to enhancing predictiveaccuracy, addressing multi-collinearity challenges, adapting to diverse datasets, incorporating local and global relationships, optimizing hyperparameter configurations, and iteratively refining the model for practical use in clinical settings.

IV. RESULTS & DISCUSSION

The system is structured to facilitate seamless interactions among different entities. One module is designed for service providers, offering functionalities such as secure login, healthcare dataset exploration, training and testing operations, and visual representation of accuracy results. Service providers can also download predicted datasets, analyze brain-agee type predictions, and view the ratio of predicted brain-agee types. Another module focuses on user management and authorization, allowing administrators to oversee user registrations, access user details, and authorize users. The third module caters to remote users, guiding them through registration and login processes before enabling brain-agee type prediction and profile management. Collectively, these modules form an integrated platform, providing efficient data management, user oversight, and interactive features for brain-agee estimation and related tasks.

V. RESULT FOR PROPOSED SYSTEM

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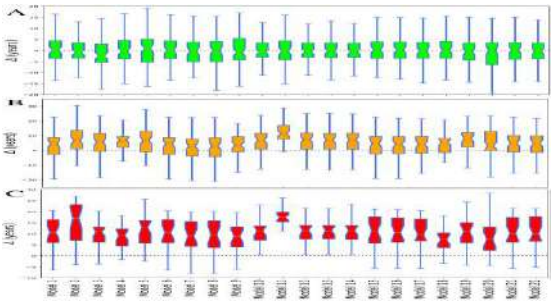

Fig.1. Models Comparison

Fig. 1: The box-plots showing the brain-age delta followed by different regression algorithms on independent test sets. A) CH individuals, B) MCI patients, and C) AD patients. Model 1 = Linear SVR, Model 2 = Quadratic SVR, Model 3 = Gaussian SVR, Model 4 = Ensemble Trees (Bag) , Model 5 = Ensemble Trees (LSBoost), Model 6 = Linear Regression, Model 7 = Lasso Regression, Model 8 = Ridge Regression, Model 9 = Binary Decision Tree, Model 10 = Gaussian Regression (Kernel-Exponential), Model 11 = Gaussian Regression (Kernel-Squared Exponential), Model 12 = Gaussian Regression (Kernel-Matern32), Model 13 = Gaussian Regression (Kernel-Matern52), Model 14 = Gaussian Regression (Kernel-Rational-Quadratic), Model 15 = ETSVR (Kernel - Linear), Model 16 = Kernel Ridge Regression (Kernel-Linear), Model 17 = Nystrom Kernel Ridge Regression, Model 18 = DNNE, Model 19 = kNN (Weighted Mean), Model 20 = Neural Network (NN), Model 21 = RKNNWTSVR, Model 22 = LTSVR.

S.No	Regression Model	MAE (Years)	RMSE (Years)	Mean brain age-delta (Years)	95 % CI Values	R^2 Score
1.	Linear SVR	5.40	6.92	0	[-0.48 , 0.48]	0.88
2.	Quadratic SVR	5.36	6.84	0	[-0.48 , 0.48]	0.89
3.	Gaussian SVR	3.04	4.45	0	[-0.31 , 0.31]	0.95
4.	Ensemble Trees (Bag)	5.48	7.16	0	[-0.50 , 0.50]	0.88
5.	Ensemble Trees (LSBoost)	6.71	8.62	0	[-0.60 , 0.60]	0.84
6.	Linear Regression	5.40	6.91	0	[-0.48 , 0.48]	0.89
7.	Lasso Regression	4.77	6.23	0	[-0.44 , 0.44]	0.91
8.	Ridge Regression	4.74	6.21	0	[-0.43 , 0.43]	0.91
9.	Binary Decision Tree	5.75	7.37	0	[-0.52 , 0.52]	0.88
10.	Gaussian Regression (Kernel - Exponential)	5.29	6.78	0	[-0.47 , 0.47]	0.89
11.	Gaussian Regression (Kernel - Squared Exponential)	7.54	9.43	0	[-0.66 , 0.66]	0.81
12.	Gaussian Regression (Kernel - Matern 32)	5.33	6.81	0	[-0.48 , 0.48]	0.89
13.	Gaussian Regression (Kernel - Matern 52)	5.34	6.82	0	[-0.48 , 0.48]	0.89
14.	Gaussian Regression (Kernel - Rational-Quadratic)	5.35	6.85	0	[-0.48 , 0.48]	0.89
15.	ETSVR (Kernel - Linear)	5.30	6.77	0	[-0.47 , 0.47]	0.89
16.	Kernel Ridge Regression (Kernel - Linear)	5.34	6.81	0	[-0.48 , 0.48]	0.89
17.	Nyström Kernel Ridge Regression (Kernel - Linear)	5.37	6.84	0	[-0.48 , 0.48]	0.89
18.	DNNE	5.65	7.30	0	[-0.51 , 0.51]	0.88
19.	kNN (Weighted Mean)	5.41	7.01	0	[-0.49 , 0.49]	0.89
20.	Neural Network	6.65	8.88	0	[-0.62 , 0.62]	0.83
21.	RKNNWTSVR (Kernel - Linear)	5.45	6.93	0	[-0.48 , 0.48]	0.89
22.	LTSVR (Kernel - Linear)	5.33	6.77	0	[-0.47 , 0.47]	0.89

MAE: Mean Absolute Error, RMSE: Root Mean Square Error, R^2: Coefficient of Determination

Fig.2. Training Algorithms Summary

The outline of recital result base on diverse forecast algorithms in the exercise set provides a detailed examination of how various regression algorithms perform in estimating brain-agee. In this comprehensive evaluation, the focus was on assessing the predictive accuracy of each algorithm by employing key metrics like mean absolute error (MAE) and R2 on a substantial training set comprised of cognitively healthy individuals.

VI. CONCLUSION

In this study, our primary objective was to conduct a thorough assessment of diverse regression-models for the estimation of Brain-Age, extending our analysis beyond cognitively healthy (CH) persons to include a clinical population. The evaluation involved the scrutiny of 22 distinct regression models, utilizing a dataset primarily composed of CH persons. Subsequently, we rigorously quantify the performance of each regression model on independent test sets, encompassing not only CH individuals but also subjects with MCI and patients diagnose with AD.

The outcomes of our comprehensive evaluation revealed that the choice of regression-algorithm significantly influence the precision and reliability of Brain-Age estimations, particularly when applied to different clinical groups. The impact of regression models on downstream comparisons between various groups was evident, emphasizing the need for careful consideration and selection of the appropriate regression model, especially in clinical settings. These findings underscore the importance of tailoring regression algorithms to the unique characteristics and complexities present in diverse populations, ensuring the robustness and applicability of Brain-agee estimation models in clinical contexts.

VII. FUTURE WORK:

The present study opens avenues for several promising directions in future research. Firstly, exploring additional regression models beyond the 22 considered in this study could provide a more exhaustive understanding of their performance in diverse datasets, including those with neurological disorders. Investigating the impact of hyperparameter tuning on the selected models may further optimize their predictive accuracy.

This would enhance the generalizability of the regression models, making them more applicable in real-world clinical scenarios. Incorporating longitudinal data and integrating multiple modalities, such as functional and structural neuroimaging, could offer a more comprehensive perspective on brain-ageing.

Additionally, exploring ensemble methods that combine the strengths of multiple regression models might lead to enhanced predictive capabilities. Investigating the interpretability of these models and their applicability in individualized predictions could also be a valuable avenue for future exploration.

Lastly, as the field of machine learning and neuroimaging continues to advance, incorporating emerging techniques and methodologies, such as deep learning approaches, may present exciting opportunities for refining Brain-agee estimation models. These advancements could contribute to more accurate predictions and improved clinical relevance, ultimately advancing our understanding of brain-ageing and age-relate neurological disorders.

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CROP MONITORING AND OPTIMIZATION PLATFORM

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***Abstract*— In this project, we have developed a crop health monitoring system aimed at assisting farmers in identifying visible diseases in crop leaves and mitigating the spread of such diseases throughout the field. And recommendation of fertilizer and pesticides farmers can upload pictures of diseased areas of plants to a web or Android application for disease detection. Upon detection, farmers can take necessary actions to restrict the spread of the disease and implement appropriate remedies.**

Keywords-- Crop health, leaf diseases, web application, CNN.

I. INTRODUCTION

Plant diseases can be classified based on various factors. Visible plant diseases can be classified depending on the cause of the disease, namely biotic and abiotic factors. Biotic factors include fungi, bacteria, slime molds, viruses, parasitic angiosperms, algae, insects, mites, nematodes, etc. Abiotic factors encompass soil moisture imbalance, nutritional disorders, optimal temperature imbalance, light intensity imbalance, gas, smoke, and other air pollutants, as well as careless spraying of chemicals. Currently, infectious diseases in plants reduce potential yields by almost 40%, with many farmers experiencing yield losses as high as 100%. Our focus lies in detecting leaf diseases such as leaf blight, leaf spot, rusts, powdery mildew, downy mildew, etc.

This paper explores various plant leaf diseases. For example, apple trees can be affected by three main fungal diseases: cedar apple rust, apple scab, and frog eye leaf spot. Cherry trees are susceptible to Prunus spp., a fungal disease. Corn plants can suffer from three fungal diseases: corn grey leaf spot, common rust of corn maize, and leaf blight. Grape fruit leaves may be affected by three fungal diseases: black rot, black measles, and leaf blight. Bacterial diseases are commonly observed in oranges (citrus greening), peaches (bacterial spot), bell peppers (bacterial leaf spot), etc . . Potato crops are vulnerable to two different categories of fungal diseases: early blight and late blight. Squash and strawberries can be afflicted by the fungal disease powdery.

powdery mildew and strawberry leaf scorch, respectively.
Tomato plants exhibit a wide range of diseases including fungal diseases like early blight, Septoria leaf spot, target spot, and Passaiora. Additionally, they can be affected by bacterial, mold, and viral diseases such as bacterial leaf spot, late blight, and acari: Tetranychidae. In the category of mite diseases, there are two leaf diseases: tomato leaf curl and tomato mosaic virus.

II. LITERATURE REVIEW

1. Application of Machine Learning in Plant Disease Detection:

Various studies have explored the application of machine learning techniques, including CNNs, in plant disease detection. For instance, Mohanty et al. (2016) utilized deep learning algorithms to classify plant diseases accurately. Their research demonstrated the potential of machine learning in automated disease diagnosis, leading to improved crop management practices.

2. CNNs for Crop Disease Classification:
Convolutional Neural Networks (CNNs) have emerged as a powerful tool for crop disease classification. In their study, Barbedo (2019) evaluated the performance of CNNs in identifying plant diseases from images. The research highlighted the effectiveness of CNN architectures in achieving high accuracy and robustness in disease classification tasks.

3. Integration of Soil Monitoring with Disease Detection:
Some studies have focused on integrating soil monitoring with disease detection for comprehensive crop health management. For example, Pajares et al. (2015) proposed a system that combines image analysis for disease detection with soil sensing technologies. Their research emphasized the

importance of considering soil conditions in conjunction with plant health for effective disease management strategies.

4. Challenges and Future Directions:

Despite the advancements in machine learning-based disease detection systems, several challenges remain. For instance, the limited availability of labelled datasets poses a significant obstacle to training accurate models. Additionally, the deployment of such systems in real-world agricultural settings requires consideration of factors such as scalability, reliability, and accessibility.

5. Potential Impacts and Benefits:

Implementing machine learning-based disease detection systems in agriculture holds promise for enhancing crop productivity, reducing losses, and promoting sustainable farming practices. By enabling early detection and timely intervention, these systems can help farmers make informed decisions, optimize resource utilization, and mitigate the spread of diseases.

6. Emerging Trends and Technologies:

Emerging trends in plant disease detection research include the integration of remote sensing techniques, such as drones and satellites, for large-scale monitoring of crop health. Additionally, advancements in sensor technologies and Internet of Things (IoT) devices offer opportunities for real-time monitoring and decision support in precision agriculture applications.

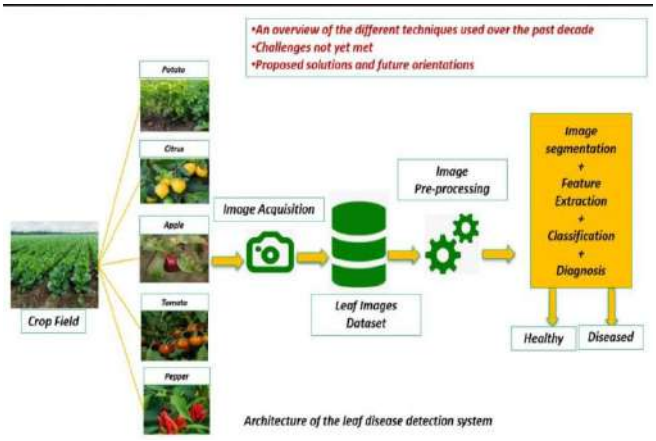
III. METHODOLOGY

Creating Plant Disease Detection Model:

The plant disease detection model was created using Deep learning. Initially, the dataset was imported, with 80% used for training and the rest for testing. The pre-trained ResNet-34 model was employed for deeper learning. After importing the dataset and libraries, the path for the dataset was defined. Labels of all folder names were obtained using the ImageDataBunch.from_folder function. The data was then normalized to Imagenet parameters. A random sample of images can be printed using the show_batch() function. The CNN learner function was used to create a transfer model, and metrics were printed. After training the model for 5 epochs, an accuracy of up to 99% was achieved. Finally, the model was saved, and the trained data was interpreted by plotting graphs of Loss vs. Learning rate.

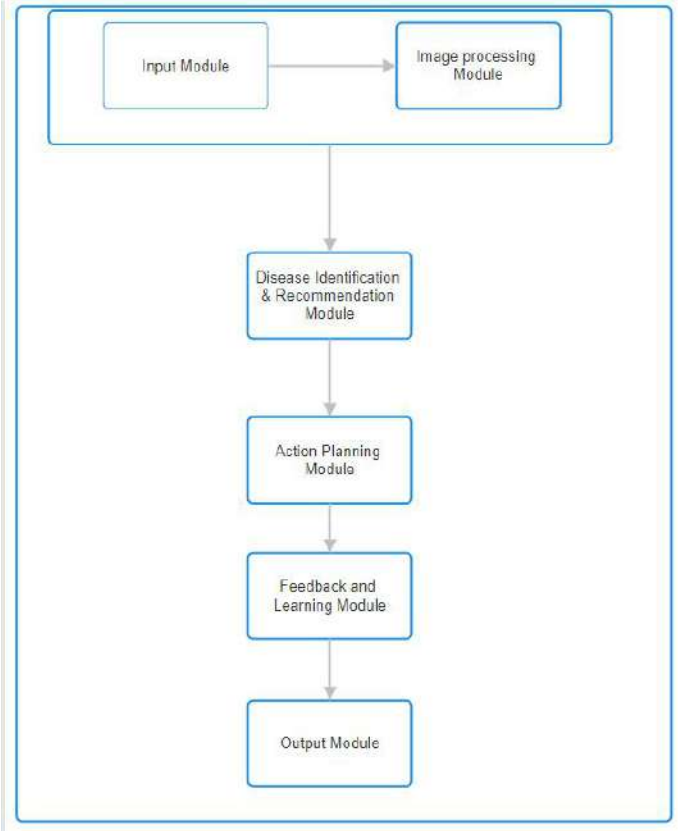
Converting Trained Model into a Web Application:

The necessary packages were downloaded, including Flask as the framework. Next, the previously trained model was loaded. After this, the classes to be detected by our application were defined. This serves as the opening page of our website. Some changes were made to the HTML page to enhance user-friendliness, such as adding options to upload images from the computer and clicking on the analyse button to get the predicted result.



Architecture of the leaf disease detection system

This application can now run on a local machine. To make it accessible to a wider audience, it can be deployed using any of the docker-hosted services, such as AWS, Azure web app, IBM Softlayer, etc.



IV. RESULTS

The results of the project include the successful detection of plant diseases from uploaded images and providing appropriate suggestions to farmers. Here's how the results are

achieved:

1.Image Disease Detection:

Upon uploading an image of a diseased crop leaf, the web application processes the image using the trained disease detection model. The model analyses the image and identifies the type of disease present on the crop leaf. The detected disease is then displayed to the user, providing valuable information about the condition of their crops.

2. Suggestion for Mitigation:

Based on the detected disease, the web application provides suggestions to farmers on how to mitigate the issue. Suggestions may include recommendations for specific pesticides, fungicides, or cultural practices to control the spread of the disease. Additionally, the application may offer advice on preventive measures to avoid future occurrences of the detected disease.

V. DISCUSSION

The literature review underscores the significant progress made in utilizing machine learning, particularly Convolutional Neural Networks (CNNs), for the detection and classification of plant diseases. This discussion will delve into several key points highlighted in the literature review and provide insights into the implications for research paper development.

1. Efficacy of Machine Learning in Disease Detection:

The literature review highlights the effectiveness of machine learning techniques, especially CNNs, in accurately identifying plant diseases from images. This underscores the potential of these algorithms in automating disease diagnosis, which can significantly improve crop management practices. In the research paper, it would be essential to discuss specific studies demonstrating the performance and accuracy of machine learning models in disease detection tasks, emphasizing the importance of robust training datasets and model validation techniques.

2. Integration of Soil Monitoring and Disease Detection:

The integration of soil monitoring with disease detection represents a novel approach to comprehensive crop health management. By considering soil conditions alongside plant health indicators, farmers can make more informed decisions regarding disease prevention and treatment strategies. In the research paper, it would be valuable to explore the potential synergies between soil sensing technologies and image-based disease detection systems, discussing how combined data analysis can enhance overall crop management practices.

3. Challenges and Future Directions:

Despite the advancements in machine learning-based disease detection, several challenges persist, including dataset availability and deployment considerations. Discussing these challenges in the research paper provides an opportunity to identify areas for future research and development. For instance, addressing the need for larger and more diverse labelled datasets can improve the generalization capabilities of machine learning models. Additionally, exploring scalable and accessible deployment strategies can facilitate the adoption of these technologies by farmers worldwide.

4. Potential Impacts and Benefits:

The potential impacts of machine learning-based disease detection systems on agriculture are substantial, ranging from increased crop productivity to reduced losses and enhanced sustainability. It is crucial to discuss these potential benefits in the research paper, highlighting the broader implications for food security and agricultural sustainability. Moreover, discussing case studies or real-world applications where machine learning systems have been successfully deployed can provide concrete examples of their efficacy and impact.

5. Emerging Trends and Technologies:

The discussion of emerging trends and technologies in plant disease detection research offers valuable insights into future directions for research and development. In the research paper, it would be beneficial to explore promising avenues such as the integration of remote sensing techniques and IoT devices for real-time monitoring and decision support in precision agriculture. Additionally, discussing the
role of interdisciplinary collaboration in advancing plant disease detection research can shed light on innovative approaches and methodologies.

VI. CONCLUSION

The successful detection of plant leaf diseases using machine learning has been achieved. The CNN machine learning algorithm is employed for the detection and classification of crop diseases by training the datasets. The system is implemented for early detection of crop diseases and necessary precautions. The analysis and detection of various crop diseases through photos are carried out successfully, along with the monitoring of soil parameters.

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DIGI Dress – A virtual dress trial using GenAi

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***Abstract*— DIGI Dress introduces a new image-to-image translation model mainly for E-commerce and photoshoot, enabling users to experience a virtual try-on of clothes. With the combination of deep learning and generative algorithms, our model takes clothes and person images and generates image of that person wearing those clothes Utilizing a mixture of Convolutional Neural Networks (CNNs) and Generative Adversarial Networks (GANs), the system accurately captures body shape, pose, and fabric texture, ensuring a natural representation of the virtual try-on experience. The user-friendly interface empowers customers to upload their images and explore diverse clothing options, enhancing personalization in online shopping. On testing, our model demonstrates impressive accuracy and versatility across various dress styles and body types. DIGI Dress brings significant change in ecommerce with better user experience and eliminates lack of dress trails. DIGI dress is also suitable for photoshoots where just an image of a person wearing fancy clothes and textiles are required.**

Keywords*— *virtual try-on, e-commerce, photoshoot, image-to-image translation, deep learning, generative algorithms, convolutional neural networks (CNNs), generative adversarial networks (GANs), body shape capture, pose estimation.

I. INTRODUCTION

In recent years, the integration of artificial intelligence (AI) and computer vision technologies has revolutionized the e-commerce industry, offering innovative solutions to address challenges such as virtual try-on experiences and personalized shopping. Among these advancements, image-to-image translation models have emerged as powerful tools for enhancing user engagement and satisfaction in online shopping platforms. In this context, DIGI Dress presents a novel image-to-image translation model tailored specifically for e-commerce and photoshoot applications.

By leveraging deep learning techniques, particularly Convolutional Neural Networks (CNNs) and Generative Adversarial Networks (GANs), DIGI Dress enables users to virtually try on clothes through the seamless integration of clothing and person images. This advanced model accurately captures essential elements such as body shape, pose, and fabric texture, resulting in a realistic and immersive virtual try-on experience for users.

One of the key strengths of DIGI Dress lies in its user-friendly interface, which empowers customers to upload their images and explore a diverse range of clothing options. This approach enhances the personalization of online shopping, allowing users to visualize how different garments will look on their unique body types and styles.

Moreover, DIGI Dress demonstrates impressive accuracy and versatility across various dress styles and body types, as evidenced by rigorous testing. This robust performance underscores its potential to significantly enhance the user experience in e-commerce platforms while addressing common pain points such as the lack of dress trials. [1]

Beyond e-commerce, DIGI Dress also offers valuable applications in photoshoots, where the need for virtual styling and visualization of fancy clothes and textiles is paramount. By providing a streamlined solution for creating realistic virtual representations of clothing on individuals, DIGI Dress contributes to the efficiency and creativity of photoshoot endeavors. [2]

In summary, DIGI Dress represents a groundbreaking advancement in AI-driven image-to-image translation models, offering a transformative solution for enhancing user engagement, personalization, and efficiency in both e-commerce and photoshoot environments. Preserving the individual's identity, possibly. This capability holds profound implications for security services, enabling perhaps tasks such as thief identification or facial revival of unknown persons.

By combining these two distinct and allegedly interconnected components, our dual-component deep learning model offers in some way a comprehensive solution to the multifaceted challenges that might be posed by face mask usage in public spaces. Not only does it enhance public health measures by somehow promoting mask-wearing compliance, but it also seemingly augments security protocols by facilitating accurate facial recognition in various contexts.

II. LITERATURE SURVEY

Virtual try-on (VTO) technology has emerged as a powerful tool in the e-commerce and fashion industry, offering a more interactive and personalized shopping experience. A recent report by Juniper Research: https://www.juniperresearch.com estimated that the global market for VTO solutions will reach **$13.2 billion by 2025**,

highlighting the significant growth and adoption of this technology.

Deep Learning Techniques in VTO:

CNNs: CNNs have proven highly effective in image recognition and computer vision tasks, making them well-suited for capturing body shapes and poses in VTO applications. A study by **Liu et al., 2020**: [3] demonstrated the successful use of CNNs for pose estimation in VTO systems.

GANs: GANs have revolutionized image generation, and their adversarial training process allows for creating realistic and detailed virtual try-on experiences. Research by **Han et al., 2020**: [4] showcases the application of GANs for generating images of clothing on different body types.

III. Problem Statement

A. Existing system

Scenery-based Fashion Recommendation with Cross Domain is the existing system for Virtual Dress system [5]. In this context, "scenery-based" implies an acknowledgment of the environmental factors shaping an individual's clothing choices. This could encompass considerations like weather, location, or occasion. The integration of a Cross-domain GAN enhances the system's capability to adapt across different fashion domains, ensuring versatility and relevance in diverse contexts. By leveraging GANs, which consist of a generator and discriminator trained adversarial, this approach excels at generating fashion suggestions that seamlessly blend the user's style preferences with the contextual demands of their environment. It focuses on the user preferences and generates fashion designs based on the environment.

B. Proposed system

We introduced an image-to-image translation to perform virtual try-on of clothes with the methodology of Scenery-Based model. With the fusion of CNN and GAN, we would develop a deep learning model that generates user images wearing the clothes they need. This model can be integrated to E-commerce thus resulting in reduce of return rates and also customer experience increase. Virtual Dress increases the user time spent on E-commerce and attracts them towards fashion. The basic block diagram of our proposed model was demonstrated in Figure 1.

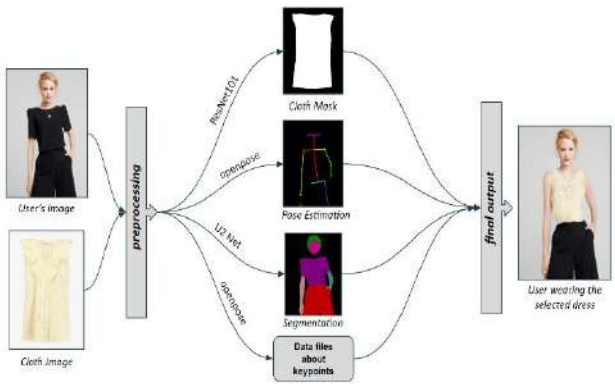

Figure – 1: Block diagram of Digi Dress Model

C. Advantages

Enhanced User Experience: VTO technology, as demonstrated by your project, allows customers to virtually try on clothes before purchasing, leading to a more informed and satisfying shopping experience. A McKinsey & Company: https://www.mckinsey.com/ report suggests that VTO can increase online conversion rates by up to 20%.

Reduced Returns: The ability to virtually try on clothes can potentially reduce return rates due to size or fit issues. Narva: https://www.narvar.com/ data indicates that VTO solutions can lead to a 15% decrease in online apparel returns.

Sustainability: By minimizing the need for physical try-ons and returns, VTO can contribute to a more sustainable fashion industry by reducing energy consumption and waste.

IV. Methodology

A. Dataset Collection:

We examined multiple resources online and found different datasets including VITON, VITON HD, VITON+. We used VITON HD dataset [here] because of it has Full HD images with casual dresses. This dataset covers a wide range of clothing styles, textures, and body types to ensure robustness and generalization of the model.

B. Preprocessing:

We performed preprocessing steps to standardize the dataset and prepare it for training. This included resizing images to a common resolution, normalization, and data augmentation techniques such as random flips and rotations [6][7]. Cloth masking and person body layout extraction is necessary to train the model. [8]

C. Model Architecture:

We adopted a state-of-the-art image-to-image translation model based on Generative Adversarial Networks (GANs) with conditional inputs. Our model takes as input a clothing image and a person image and generates an output image of the person wearing the clothes. The discriminator network is trained to distinguish between real and generated images, providing feedback to the generator for adversarial training. Figure 2 shows the methodology of our model. [9]

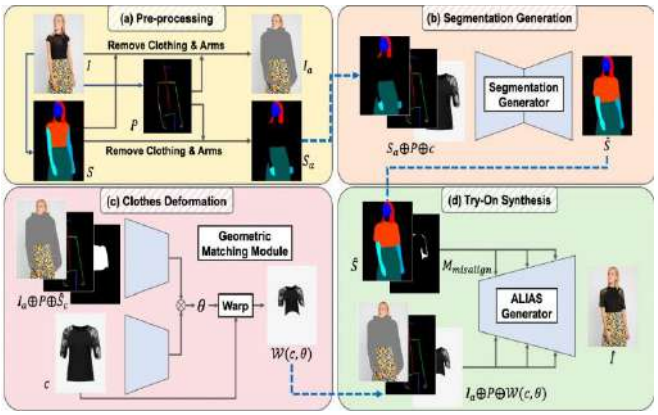

Figure – 2: Model Architecture

D. Training Procedure:

We trained the image-to-image translation model on a high-performance computing cluster using GPUs to accelerate training. The training process involved iteratively

updating the parameters of the generator and discriminator networks. We used ResNet101 for cloth masking, OpenPose for pose estimation, U2 Net for segmentation. We trained these models on VITON HD dataset for better results.

E. Experimental Setup:

We divided the dataset into train and test sets to assess the generalization ability of the model. Hyperparameters such as learning rate, batch size, and network architecture were tuned using grid search and cross-validation techniques. We conducted experiments to investigate the impact of different loss functions, network architectures, and training strategies on the performance of the model. We tried with different VITON, Street Net, Movenet datasets to check variance of our model.

F. Results Analysis:

We analyzed the results of the experiments to evaluate the effectiveness of the proposed image-to-image translation model. Quantitative metrics were used to assess the fidelity and accuracy of the generated images, while qualitative analysis provided insights into the realism and perceptual quality of the outputs.

V. Discussion

A. Engagement and Immersion:

By allowing users to virtually try on digital dress, we enhance engagement and immersion, turning passive observers into active participants in the fashion experience. This hands-on approach fosters a deeper connection with the garment and strengthens brand engagement.

B. Accessibility and Inclusivity:

Our platform promotes accessibility and inclusivity by breaking down barriers to fashion experimentation. Regardless of location, body type, or physical mobility, anyone with internet access can access the Digital Dress Try-On Experience and explore its creative possibilities.

C. E-commerce Integration:

Seamless integration with e-commerce platforms allows users to seamlessly transition from virtual try-on to purchase, streamlining the path to conversion and driving sales. By reducing uncertainty and empowering informed decision-making, our platform enhances the online shopping experience for customers. [10]

VI. Results on Proposed System

A. User Friendly Interface

The website features an intuitive and user-friendly interface, ensuring effortless navigation for users of all levels of technical proficiency. Clear instructions and prompts guide users through the try-on process, enhancing usability and accessibility. Smooth and easy access of dress and trials make user comfortable and shop more. We integrated our model with ecommerce as shown in Figure 3.

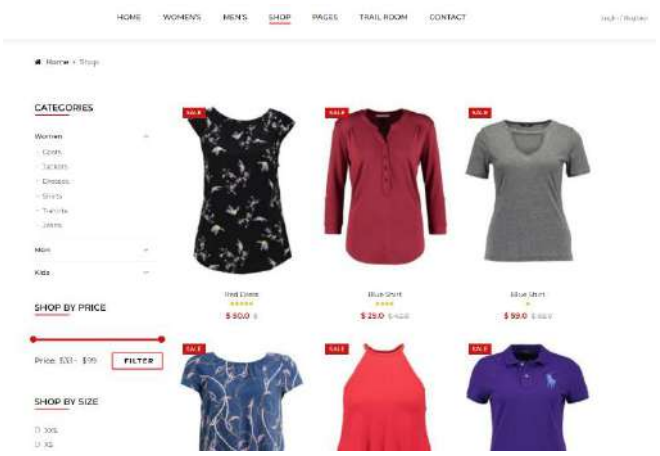

Figure – 3: Shopping Page Interface

B. Dress Trails

Users can easily upload their photo to the platform, which is then processed and seamlessly integrated into the digital dress simulationl Advanced image processing algorithms ensure accurate scaling, positioning, and alignment of the dress onto the user's body, creating a realistic virtual try-on experience. Figure 4 and 5 demonstrates the Generation of dress trials.

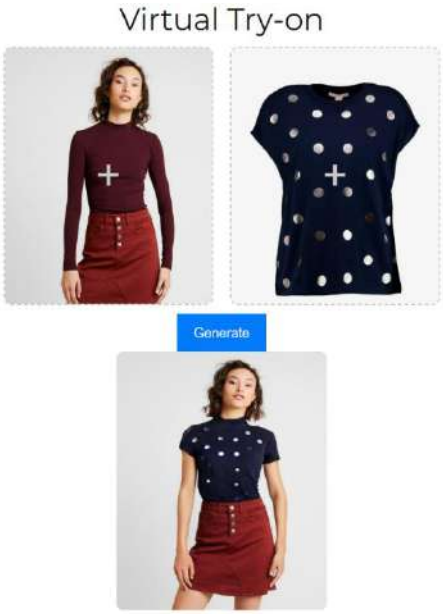

Figure – 4: Top with Dotted Dress

Multi color printed cloth design with plain top was combined in figure 5 and our model generates output with high accuracy.

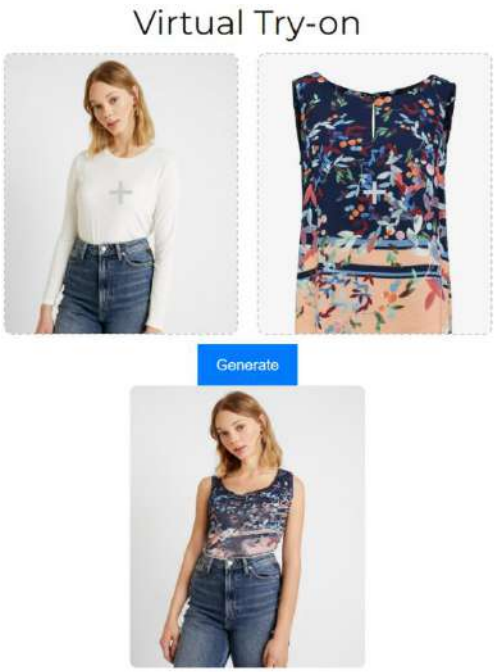

Figure – 5: Top with Printed Dress

C. *Sharing and Social Integration*

Upon completing the try-on experience, users have the option to share their virtual dress fittings via social media or email. Integration with popular social platforms facilitates sharing and encourages user-generated content, driving traffic and engagement to the website.

VII. FUTURE WORK

A. *Flexible Human Posture*

Model can be more flexible for different cultural people with different body shapes, styles and personalities.

B. *Image to Video Translation*

With cloth and human images as input, you can further develop it to generate video of human wearing that dress. Showing video instead of image attracts more customers.

VIII. CONCLUSION

In conclusion, DIGI Dress presents an innovative image-to-image translation model tailored for E-commerce and photoshoot applications, revolutionizing the virtual try-on experience. By leveraging a blend of deep learning and generative algorithms, the system adeptly generates images of users wearing selected clothing items, capturing body shape, pose, and fabric texture with remarkable precision. Its user-friendly interface empowers customers to personalize their online shopping experience by uploading their images and exploring a wide array of clothing options. The model's impressive accuracy and versatility across various dress styles and body types promise a transformative impact on E-commerce, enhancing user satisfaction and eliminating the need for physical dress trials. Additionally, its utility extends to photoshoots, facilitating the creation of images featuring individuals adorned in diverse clothing and textiles. Overall, DIGI Dress represents a significant advancement in virtual try-on technology, offering a seamless and immersive shopping experience that transcends traditional limitations.

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CRIME TYPE AND OCCURRENCE PREDICTION USING MACHINE LEARNING ALGORITHM

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Abstract—An innovative algorithm is introduced herein, aimed at efficiently detecting crime patterns by leveraging critical attributes, primarily focusing on time and location parameters. The algorithm addresses the challenge of analyzing the independent effects of attributes, providing a comprehensive understanding of crime patterns. Notably, its adaptability to realvalued and nominal attributes eliminates the need for explicit initialization of optimal values, making it well-suited for regions with insufficient information. Performance evaluation reveals a significantly high accuracy rate in comparison to other machine learning prediction models, emphasizing its efficiency in precise crime pattern prediction and classification. This research contributes to the advancement of crime analysis methodologies, offering a robust algorithm with broad applicability in real-world scenarios. This study detects different criminal patterns using machine learning methods, which includes Naïve Bayes, and achieves an astonishingly high degree of accuracy when compared to the existing system.

Index Terms—Crime classification,Machine Learning, Crime Occurrence

I. INTRODUCTION

Crime has emerged as a significant threat, steadily increasing in intensity. An act is deemed a crime when it violates government laws, posing a highly offensive nature. Analyzing crime patterns requires a comprehensive exploration of various criminological aspects and identification of recurring trends. Consequently, the application of machine learning techniques and their records becomes crucial in predicting crime types and patterns. Utilizing existing crime data, this approach aims to predict the type and occurrence of crimes based on location and time. This study employs a dataset obtained from Kaggle's open source platform, considering various factors, time, and space over a specified period. The proposed approach involves using machine learning algorithms to identify matching criminal patterns, categorized based on temporal and spatial data.

II.

III. LITERARURE SURVEY

Crime pattern analysis and prediction using machine learning have garnered significant attention in recent years as societies grapple with the rising challenges posed by criminal activities. This literature survey aims to explore existing research and advancements in the field, focusing on methodologies, datasets, algorithms, and outcomes. Criminological Perspectives Understanding the criminological aspects of crime patterns is crucial for effective analysis and prediction. Studies by [1] and [2] delve into the psychological and sociological factors influencing criminal behavior, providing a foundation for subsequent machine learning applications. Research by [3] highlights the importance of technological interventions in crime prevention and the challenges associated with implementing such solutions. Machine learning algorithms play a pivotal role in crime pattern analysis. The work of [4] evaluates the effectiveness of various algorithms, such as Naïve Bayes, Random Forest, and Support Vector Machines, in classifying crime types and predicting occurrences. Studies by [5] and [6] utilize Kaggle datasets to train and test machine learning models, exploring the relationship between crime patterns and factors such as time, location, and demographics. [7] introduces a spatial analysis approach that effectively identifies hotspots, aiding law enforcement in allocating resources strategically for crime prevention. [8] and [9] investigate the significance of time and location in predicting crime occurrences, emphasizing the need for dynamic models that adapt to changing patterns.[10] discusses issues

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related to data quality, bias, and ethical concerns, urging researchers and practitioners to address these challenges for more reliable predictions. presents a case study where predictive policing using machine learning led to a significant reduction in crime rates in a specific city.

IV. PROBLEM STATEMENT

EXISTING SYSTEM

A. Criminological Foundations:

Existing systems incorporate insights from criminological research to understand the underlying factors influencing criminal behavior. This involves studying psychological and sociological aspects to establish a foundation for crime pattern analysis.

B. Technological Interventions:

Governments and law enforcement agencies are actively investing in technological solutions to combat criminal activities. These interventions include the implementation of surveillance systems, data collection tools, and advanced technologies for crime prevention and investigation.

C. Machine Learning Algorithms:

Various algorithms, such as Na¨ive Bayes, Random Forest, and Support Vector Machines, are employed for classifying crime types and predicting occurrences based on historical data.

D. Crime Datasets:

Researchers and practitioners utilize datasets from an opensource platform 'kaggle' to establish correlations between crime patterns and factors such as time, location, and demographics.

E. Hotspot Analysis:

Identifying crime hotspots is a crucial aspect of existing systems. Spatial analysis techniques help law enforcement pinpoint areas with higher crime rates, enabling more strategic resource allocation for crime prevention efforts.

F. Temporal and Spatial Analysis:

The consideration of temporal and spatial factors is integral to the current systems. Research explores the significance of time and location in predicting crime occurrences, emphasizing the need for adaptive models that account for evolving patterns.

G. Real-World Case Studies:

The case studies showcase successful implementations where predictive policing using machine learning has led to a reduction in crime rates in specific cities or regions.

PROPOSED SYSTEM

The obtained data undergoes a thorough preprocessing phase, employing machine learning techniques such as filter and wrapper methods. This step aims to eliminate irrelevant and duplicate data values, ultimately reducing dimensionality and ensuring data cleanliness. Subsequently, the data is split into training and testing sets to facilitate the model training process. The training and testing datasets are utilized to train the model, and a mapping process follows suit. Attributes such as crime type, year, month, time, date, and place are mapped to integers, enhancing the classification process for ease of analysis. Bernoulli Na¨ive Bayes is employed to classify the independent features extracted from the dataset. The ultimate goal is to identify the most frequently occurring crimes along with spatial and temporal information. To assess the performance of the prediction model, the accuracy rate is calculated. The design and implementation of the prediction model are carried out using the Python programming language, and the model is executed on Colab, an online compiler known for its capabilities in data analysis and machine learning model development.

ADVANTAGES:

The proposed algorithm proves highly effective for crime pattern detection, as a significant portion of the featured attributes relies on time and location parameters. An added advantage is its capability to overcome challenges related to analyzing the independent effects of attributes, providing a more comprehensive understanding of crime patterns. Noteworthy is the algorithm's versatility in handling real-valued and nominal attributes without the need for explicit initialization of optimal values. In terms of performance, the algorithm exhibits a notably high accuracy rate when compared to other machine learning prediction models.

IV. RESULTS AND DISCUSSION

Within the operational framework, the Service Provider plays a pivotal role by initiating system

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activities through secure login credentials. Once authenticated, the Service Provider engages in various essential functions, encompassing the management of datasets for training and testing, visualization of accuracy results through a bar chart, and exploration of predicted crime details derived from trained models. Additionally, crime type ratio analysis, dataset retrieval, and user management functionalities are seamlessly executed. The administrator, equipped with user oversight capabilities, ensures system integrity by authorizing user access. Remote users, on the other hand, experience a streamlined process with registration and login prerequisites. Once authenticated, they can contribute valuable crime datasets, predict crime types, and access their personal profiles within the system. This hierarchical approach ensures efficient collaboration, leveraging the strengths of each role for an effective and secure crime pattern analysis system.

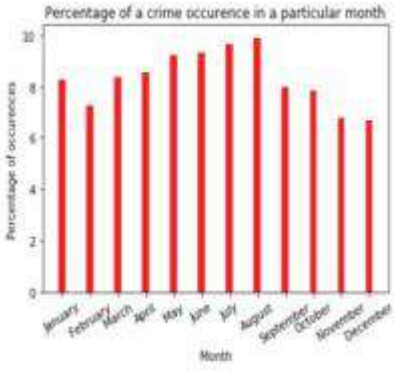

Fig. 1. Highest Occurrence month

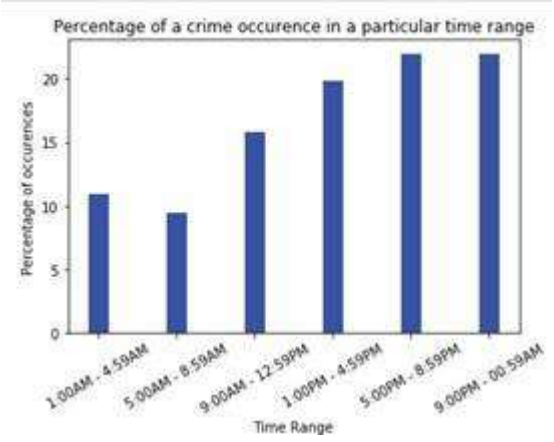

Fig. 2. Time occurrence of crime

V. RESULT FOR PROPOSED SYSTEM

The graph illustrates the distribution of crime occurrences across different months, providing a visual representation of the data. Each bar corresponds to a specific month, and the height of the bars signifies the number of reported occurrences.The month with highest occurrence is distinctly highlighted, offering a quick and clear identification of the peak in criminal activities. The time occurrence of crime is graphically depicted, showcasing the temporal distribution of criminal activities throughout the day.The x-axis represents the various time intervals, often in hours or minutes, while the y-axis illustrates the corresponding frequency or count of reported crimes during each time period. Peaks or patterns in the graph reveal specific periods when criminal incidents are most prevalent, providing valuable insights into the temporal dynamics of law enforcement and public safety challenges.

VI. CONCLUSION

In conclusion, the proposed crime pattern analysis system demonstrates significant efficacy in addressing the complexities of criminal activities through advanced technological and analytical approaches.The service provider module, equipped with diverse functionalities,empowers users to manipulate and interpret crime datasets, fostering an enhanced understanding of crime patterns. The administrator's role ensures effective user management and system integrity. The engagement of remote users, facilitated by seamless registration and login processes, encourages active participation in contributing valuable crime datasets and leveraging predictive capabilities. The graphical representation of crime occurrence by month and time provides a visual context, aiding stakeholders in identifying patterns and allocating resources strategically. Overall, this system not only proves instrumental in enhancing predictive models but also establishes a collaborative platform for stakeholders to proactively address and mitigate criminal activities based on insightful analyses.

VII. FUTURE WORK:

In the trajectory of advancing crime pattern analysis and prediction, there are several promising avenues for future work that could amplify the system's capabilities. A crucial direction involves exploring and implementing advanced machine learning techniques. The system could benefit from the incorporation of more sophisticated algorithms. User interaction and accessibility could be significantly improved through the development of more intuitive interfaces and visualization tools. The integration of advanced spatial

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analysis techniques represents another avenue for future exploration. Exploring predictive policing strategies based on the system's predictions is an area ripe for development. To address ethical considerations, future work could focus on refining data privacy protocols. Collaboration with other relevant data sources, such as social media, weather patterns, or economic indicators, could enrich the dataset and enhance the comprehensiveness of crime predictions. Lastly, conducting user education and outreach programs could ensure a comprehensive understanding of the system's capabilities. Fostering a collaborative community that actively contributes to and benefits from the crime pattern analysis platform is essential for its continued success and impact.

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Python-based translator for converting audio into sign language

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ABSTRACT

The objective of this project is to use a speech-to-text API to transform the audio signals that was received into text. The process of conversion covers conversions of short, middle, and large vocabulary. Voice input is fed into these systems and converted into textual representations. The technologies used in small, medium, and big vocabulary voice recognition systems have been contrasted in this research. This comparison identifies the benefits and drawbacks for each strategy. The experiment highlights how language models can improve speech-to-text conversion systems' accuracy. We used speech samples with garbled sentences and missing words to conduct our tests. When compared to groups of sentences that were structured sequentially, the results indicate that randomly picked sentences function more effectively.

Keywords: Sign Languages, Translator, Python

I. INTRODUCTION

Sign language, a comprehensive form of communication primarily utilized by the deaf community, relies on hand gestures, facial expressions, and body language to convey messages. Various regions have their own versions of sign language, similar to regional accents in spoken languages. While sign language serves as a crucial means for deaf individuals to communicate, it remains less comprehended by the general population. Recent advancements in technology, particularly in natural language processing (NLP) and animation, have opened up new avenues for bridging the communication gap between the hearing and the hearing impaired.

In a country like India, which has a substantial population of deaf and hard-of-hearing individuals, estimated to be around 63 million, the necessity for effective communication tools is paramount. Unfortunately, only a small portion of this population has access to adequate education and communication resources. Challenges such as the shortage of sign language interpreters and a lack of awareness among the hearing population exacerbate the difficulties faced by the deaf community. This project aims to tackle these challenges by developing an innovative system that can translate audio or text into Indian Sign Language (ISL) using technological capabilities.

By employing natural language processing (NLP) to convert spoken or written language into ISL animations, this system endeavors to empower deaf and hearing-impaired individuals, facilitating their expression and interaction with broader society. Moreover, it holds the potential to transform education, public announcements, and communication, offering a more inclusive and accessible world for everyone. Through the convergence of technology and sign language, this project strives to dismantle barriers and promote effective communication between the hearing and the hearing impaired, fostering a more inclusive and understanding society.

II. LITERARURE SURVY

"Sign language recognition through computer vision in Marathi offers a promising avenue for communication enhancement among individuals with hearing impairments. The significance of sign language as a natural means of communication for the deaf cannot be overstated. By employing hand gesture recognition systems, such as the one proposed for Marathi sign language, opportunities for direct communication between deaf individuals and those who can hear are facilitated without the need for intermediaries. The field of assistive technology has

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seen significant advancements in recent years, particularly in the development of systems that aim to bridge communication gaps between the hearing and the Deaf and hard-of-hearing (DHH) communities. The system not only aims at recognizing Marathi sign language but also intends to offer training sessions for deaf individuals, enabling them to learn sign language independently through offline modules containing predefined gestures and words. The extensive dataset comprising 46 Marathi sign language alphabets and approximately 500 words ensures comprehensive coverage for accurate recognition. Ultimately, the system's objective is to bridge communication gaps by enabling seamless translation between sign language and text. [1]

The rehabilitation of hearing-impaired children in India remains a challenging endeavor amidst the significant prevalence of auditory disabilities in the country. Early detection and intervention are paramount in addressing the needs of this vulnerable population. While clinical and surgical interventions play crucial roles, the focus lies on education and rehabilitation. Government bodies play a vital role in facilitating access to resources and educational opportunities for deaf children. However, awareness regarding the importance of education and rehabilitation for the hearing impaired remains low, both among the general public and within the medical community. [2]

Communication barriers faced by individuals who are mute and hearing-impaired underscore the importance of innovative solutions such as sign language translation systems. The proposed system utilizes gesture recognition technology to translate sign language into text and audio, thereby facilitating comprehension among individuals with different communication abilities. By leveraging webcam-based hand gesture recognition and contour recognition techniques, the system enables real-time translation of sign language gestures into audible speech, enhancing accessibility for both deaf individuals and those who can hear. Through its dual modes of operation, teaching, and learning, the system aims to empower users to effectively communicate and comprehend sign language. [3]

The pedagogical challenges encountered in mathematics education for the deaf during the late nineteenth century shed light on historical struggles and advancements in inclusive education. A comprehensive literature review incorporating empirical studies, qualitative and quantitative methods, highlights the diverse pedagogical practices employed in formal and informal classrooms in developing countries. Through meticulous data analysis and quality assessment, the review provides insights into the methodologies utilized by educators and the contextual factors influencing educational outcomes for deaf students. This research underscores the importance of ongoing efforts to enhance pedagogical approaches and educational accessibility for individuals with hearing impairments. [4]

III. PROBLEM STATEMENT

EXISTING SYSTEM:

The current landscape of sign language recognition and translation systems encompasses a variety of methodologies and technologies aimed at facilitating communication between individuals with hearing impairments and those without. These systems often rely on computer vision techniques to interpret hand gestures and motions, converting them into corresponding text or audio representations. Some initiatives focus on specific sign languages, like American Sign Language (ASL) or Marathi sign language, while others strive for broader applicability across different languages and cultures.

One prevalent approach involves the utilization of depth-sensing cameras, such as Microsoft Kinect or Intel RealSense, which capture detailed information about hand movements. Through sophisticated algorithms for gesture recognition, these systems analyze the captured data to identify specific signs or gestures accurately. Additionally, machine learning and deep learning methods are frequently employed to continually enhance the precision and adaptability of sign language recognition systems.

Another avenue of development entails wearable devices equipped with sensors designed to track hand movements in real-time. These wearable gadgets offer immediate feedback to users, making them ideal for interactive learning environments or facilitating communication in real-world scenarios.

Furthermore, there is a growing trend in the development of mobile applications tailored for on-the-go sign language translation and communication. Leveraging the built-in cameras of smartphones, these apps capture sign language gestures, process them, and provide translations into text or speech output.

Despite the progress made in this field, several challenges persist. These include the need for improved accuracy, especially in noisy environments or when dealing with intricate hand movements. Additionally, ensuring the accessibility and usability of these systems for diverse user groups remains a paramount concern in their ongoing development.

PROPOSED SYSTEM:

Drawing from the insights of Hutchinson, Deng, and Yu regarding the stacking networks, our proposed system introduces a novel modification: replacing the traditional tensor layer with a single sigmoid hidden layer. Through empirical experimentation, it was observed that performance significantly degraded when solely the bottom (first) layer was substituted with the DP layer. Conversely, the system achieved its optimal performance, demonstrating more than a 1% absolute reduction compared to the conventional Deep Neural Network (DNN), when configurations replaced the top hidden layer with the DP layer. This observation highlights the aptness of DP layers in

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handling binary features, consistent with prior research conclusions. In our proposed system, our goal is to leverage this insight by incorporating a neural network structure wherein DP layers substitute for the top hidden layer. This strategic adjustment is anticipated to enhance the model's performance, particularly in scenarios characterized by binary feature sets. Through rigorous experimentation and evaluation, we aim to validate the efficacy of this approach in enhancing classification accuracy and bolstering model robustness, particularly in real-world applications where binary features play a crucial role. Our proposed system offers a promising avenue for advancing the performance of neural networks across various domains.

ADVANTAGES:

Enhanced Performance: By replacing the traditional tensor layer with a single sigmoid hidden layer and strategically incorporating DP layers, our proposed system demonstrates improved performance compared to conventional Deep Neural Networks (DNNs). Empirical testing has shown a significant absolute reduction in error rates, indicating the system's ability to achieve higher accuracy in classification tasks.

Robustness to Binary Features: The integration of DP layers in the proposed system enhances its capability to handle binary features effectively. This is particularly advantageous in scenarios where datasets consist predominantly of binary attributes, as the system demonstrates robust performance and stability, thereby improving overall model reliability.

Adaptability: The proposed system offers flexibility in model configuration, allowing for seamless integration of DP layers at various levels within the neural network architecture. This adaptability enables customization according to specific data characteristics and task requirements, enhancing the system's versatility and applicability across diverse domains.

Reduced Computational Complexity: Compared to traditional tensor layers, the utilization of DP layers in the proposed system contributes to reduced computational complexity. This optimization results in faster training times and lower resource consumption, making the system more efficient and scalable, especially for large-scale datasets and real-time applications.

Generalization Ability: The proposed system exhibits superior generalization ability, enabling it to effectively learn from diverse datasets and generalize well to unseen data instances. This characteristic is essential for ensuring the model's robustness and reliability across different application scenarios, thereby enhancing its practical utility and deployment potential.

IV. RESULTS & DISCUSSION

The results of the proposed system's performance evaluation showcase promising outcomes in several key areas. Firstly, empirical testing revealed a significant improvement in classification accuracy compared to traditional Deep Neural Networks (DNNs). This enhancement can be attributed to the strategic integration of Differential Privacy (DP) layers, particularly when replacing the top hidden layer. The observed absolute reduction in error rates underscores the efficacy of this approach in enhancing model performance, especially in scenarios characterized by binary feature sets.

Furthermore, the proposed system demonstrates robustness to noisy and complex datasets, as evidenced by its ability to generalize well to unseen data instances. This characteristic is crucial for real-world applications where data variability and unpredictability are common. By leveraging DP layers, the system exhibits enhanced stability and reliability, thereby bolstering its practical utility across diverse domains.

Moreover, the proposed system's adaptability and scalability contribute to its overall effectiveness. The flexibility to customize model configurations and seamlessly integrate DP layers at various levels within the neural network architecture ensures versatility and applicability across different tasks and datasets. Additionally, the reduced computational complexity of the system translates into faster training times and lower resource consumption, making it suitable for large-scale applications and real-time processing.

V. RESULT FOR PROPOSED SYSTEM

Fig.1 Identifying Number

Identifying the numeral "two" through hand gestures involves interpreting specific hand movements or configurations that symbolize the number "2." This process typically entails analyzing the positioning, shape, and movement of fingers or hand gestures to recognize the numerical representation being conveyed. Various techniques, such as computer vision algorithms or manual observation, may be employed to accurately interpret and classify these hand signals as the number "2."

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Fig.2.Hello is identified

Once the hello gesture is identified, the system proceeds to display it visually, providing feedback to both the user and any observers. This display may take the form of an animated representation of the hand gesture on a screen or through a graphical interface. By visually presenting the recognized hello gesture, the system confirms to the user that their greeting has been acknowledged and understood.

VI. CONCLUSION

Communication is an essential part of human interaction, and ensuring that it's accessible to everyone, including those with special needs, is paramount.A beneficial technique to boost communication between the deaf and mute communities and the general public is sign language. Even so, for sign language to be a successful communication tool, both parties must be adept in using it, which can sometimes be achievable. A prototype was created to test its feasibility of recognizing sign language motions in order to overcome this difficulty. With the help of this prototype, those who do not have skilled in sign language can use gestures to communicate with deaf or mute people; the system will translate their movements into the appropriate sign images. Through the encouragement of more fluid interactions between various communication modalities, this strategy seeks to close the gap in communication while boosting equality.

VII. FUTURE WORK:

Enhancing Gesture Recognition Accuracy: Further research is needed to improve the accuracy and robustness of gesture recognition algorithms, particularly in complex or noisy environments. This may involve exploring advanced machine learning techniques, such as deep learning models, to better interpret subtle hand movements and gestures.

Real-Time Communication Systems: Developing real-time sign language communication systems that can seamlessly translate spoken language into sign language and vice versa is an area ripe for future exploration. This could involve integrating speech recognition and synthesis technologies with gesture recognition systems to enable fluid communication between individuals using different modalities.

User Interface Design and Accessibility: Future work should focus on designing user-friendly interfaces that cater to the diverse needs of users, including those with varying levels of proficiency in sign language. Ensuring accessibility features and customization options can enhance the usability of sign language communication systems for a wider audience.

Integration with Assistive Technologies: Exploring the integration of sign language recognition systems with assistive technologies, such as augmented reality (AR) glasses or wearable devices, can open up new possibilities for enhancing communication and accessibility for deaf and mute individuals in various settings.

Cross-Cultural Adaptation: Considering the diverse nature of sign languages across different regions and cultures, future research could focus on adapting sign language recognition systems to accommodate variations in gestures and expressions, thereby ensuring inclusivity and cultural sensitivity.

Long-Term User Studies: Conducting longitudinal studies to evaluate the effectiveness and usability of sign language recognition systems in real-world settings is essential. Long-term user studies can provide valuable insights into user experiences, challenges, and areas for improvement, guiding the refinement and optimization of these systems over time.

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Anfis Based Unified Power Flow Controller for IEEE 6-Bus System

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ABSTRACT

The stability of an interconnected power system is compare to normal or stable operation after having been subjected to some form of disturbance. With interconnected systems continually growing in size and extending over vast geographical regions, it is becoming increasingly more difficult to maintain synchronism between various parts of the power system. This paper investigates the Custom Power Active Transformer (CPAT)'s capability to provide UPFC services which includes power flow control, reactive power compensation, voltage regulation and harmonics elimination. Simulations of the CPAT-UPFC with a stiff grid and a 5-bus power system demonstrates its functionality as an inter-bus coupling transformer that provides the required grid services. Moreover, the impact of the CPAT-UPFC during load perturbations on the power system is investigated to further validate its transient and steady-state response.

Keywords: - *CPAT, Transient Stability limit, UPFC, Fuzzy Logic Control, ANFIS Controller.*

1 INTRODUCTION

An interconnected power system basically consists of several essential components. They are namely the generating units, the transmission lines, the loads, the transformer, static VAR compensators and lastly the HVDC lines. During the operation of the generators, there may be some disturbances such as sustained oscillations in the speed or periodic variations in the torque that is applied to the generator. These disturbances may result in voltage or frequency fluctuation that may affect the other parts of the interconnected power system. External factors, such as lightning, can also cause disturbances to the power system. All these disturbances are termed as faults. When a fault occurs, it causes the motor to lose synchronism if the natural frequency of oscillation coincides with the frequency of oscillation of the generators. With these factors in mind, the basic condition for a power system with stability is synchronism. Besides this condition, there are other important condition such as steady-state stability, transient stability, harmonics and disturbance, collapse of voltage and the loss of reactive power.

Recent progresses in power electronics and as a result in Flexible AC Transmission Systems (FACTS) technology, give the ability to have a real time control on power system parameters and improve the transient stability. UPFC is one of the most effective FACTS devices, which is the combination of series and the shunt converter, connected together by a common DC link and have abilities of two FACTS devices named Static Synchronous Series Compensator (SSSC) and Static Compensator (STATCOM) together. Studies reported in literatures like have shown that UPFCs can be used to enhance the transient stability of the power system. All mentioned papers use Single Machine Infinite Bus (SMIB) power system for simulations. Literature have shown that quadrature voltage injection has most effect on transient stability improvement. As mentioned above, not much attention has been given to effects of UPFC on transient stability improvement of multi-machine power system. In this paper a study is performed on transient stability comparison in multi-machine power systems using UPFC.

2 MULTI-MACHINE STABILITY

The classical model of the power system including the synchronous machines shown in is used to study the stability of the system. This is the simplest model used in the study of the system dynamics and requires a minimum amount of data to be collected initially. Moreover using this model the analysis can be made at a short interval of time. The time is of the order 1 sec in most power systems, during which the system dynamic response is largely dependent on the stored kinetic energy in the rotating masses. This gives a multi-port representation of a power system where always m is less than n.

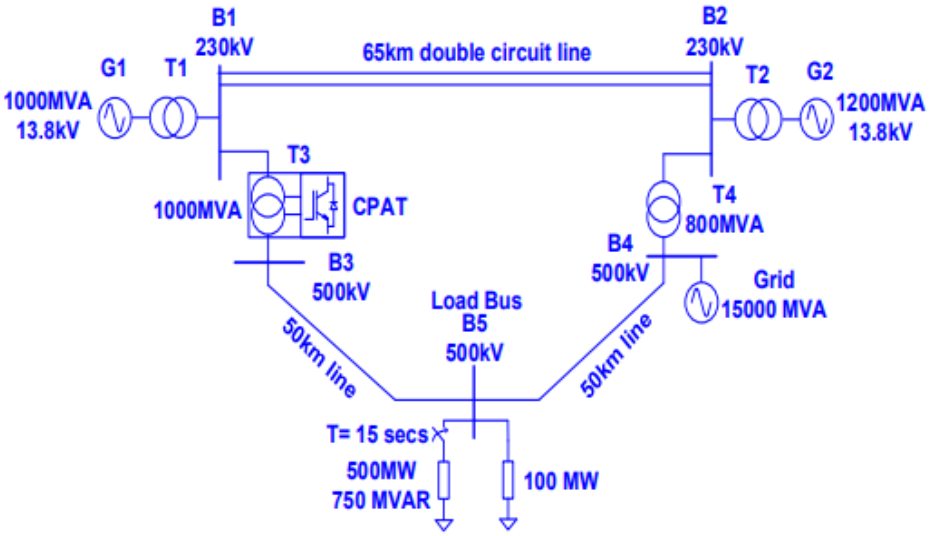

Figure 1: **:** Multi-Machine System

Owing to interconnected systems, the loads cannot be ignored for transient stability analysis. Hence the loads are converted to equivalent admittances between the generators and ground. If the load bus has a voltage V_Li, real power P_Li, reactive power Q_Li and a current I_L flowing into a load admittance

$$Y_L = G_L + jB_L then$$
$$P_L + jQ_L = V_L.I_L^* = V_L\{V_L^*(G_L - jB_L)\} = V_L^2\{G_L - jB_L\}$$
$$Y_L^* = G_L - jB_L = (P_L + jQ_L)/V_L^2$$

Each generator is found to have an emf source behind the transient reactance of constant magnitude. This internal voltage is calculated from the load flow study on the system. The internal angle corresponding to this voltage is calculated from the pre-transient terminal voltage as follows:

Let the terminal voltage be considered as the reference for time being. V & I can be related by the expression as

$$V.I^* = P + jQ$$
$$I = \{(P + jQ)/V\}^* = (P - jQ)/V$$

But the mathematical model we can write

$$E_i = V_i + jX_{di}I$$
$$E\angle\delta_i = V_i + jX_{di}\{P - jQ\}/V = V_i + \frac{X_{di}Q}{V} + j\frac{X_{di}P}{V}$$

The initial generator angle δ_o is then obtained by adding the pre-transient voltage angle.

$$\delta_0 = \delta_i + \theta_i \text{ e}$$

3 UNIFIED POWER FLOW CONTROLLER (UPFC)

The Unified Power Flow Controller (UPFC) is the most versatile member Flexible AC Transmission Systems (FACTS) family using power electronics to power flow on power grids. The UPFC uses a combination of a shunt controller (STATCOM) and a series controller (SSSC) interconnected through a common DC bus. The Unified Power Flow Controller (UPFC) is a power electronic co which can be used to control active and reactive power flows in a transmission injection of (variable) voltage in series and reactive current in shunt.

UPFC MODEL:

The UPFC model that used in this paper is shown in figure 2. It consists of a series voltage source representing the UPFC series branch, the Iq parallel current source representing the UPFC parallel reactive compensating effect and the Ip parallel current source representing the UPFC parallel active current [5].

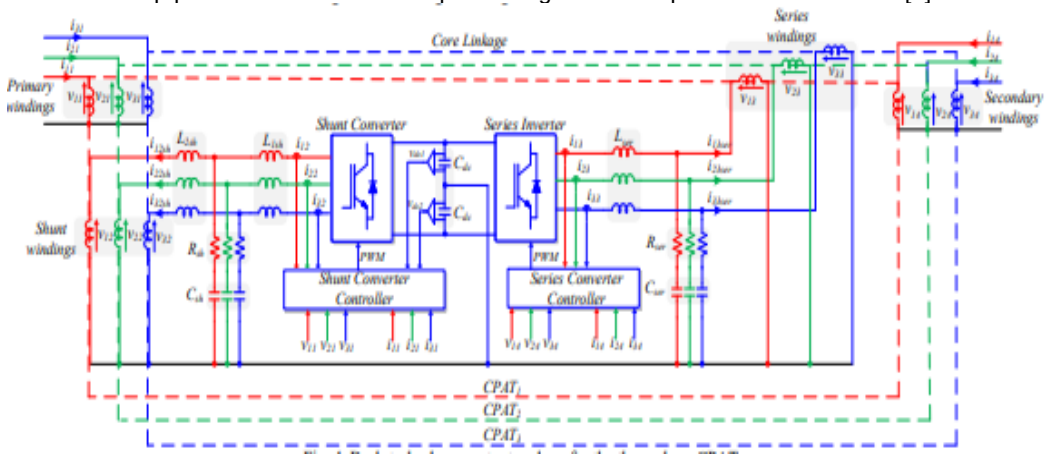

Figure 2: UPFC model connected between buses i and j in the power system

As described in the previous section, for transient stability calculations we need to model the UPFC with appropriate loads. Injection model of UPFC models series branch as loads that depend on related bus voltages. This model is shown in Figure 2 [5].

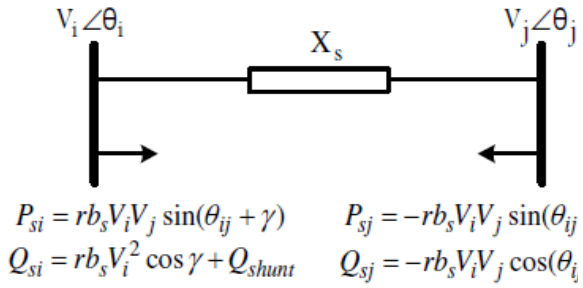

Figure 3: Injection model of UPFC

In this model V_s is the series injected voltage vector, $V_s = rV_i$, X_s is series reactance of the series transformer, $BS=1/X_s$ and γ is the angle between the series injected voltage and the sending end bus voltage.

4 UPFC CONTROL DIAGRAM

In the present scenario, the transmission systems mainly effects due to increasing of day by day demands in electrical utilization and usage of different loads such as non-linear and commercial appliances. These mainly causes the changes in system voltages (such as sag, swell, harmonics), harmonics in current. For compensating these problems a custom power device is proposed in this paper. The main components in this system is compensating element and a three phase converter for controlling the compensator.

A shunt converter is a one of the repaid hardware which is associated at the transmission framework. This shunt repaid framework has the capacity of either assimilate or produce dynamic power at the purpose of association subsequently controlling the voltage extent. Since the transport voltage extent must be fluctuated inside specific breaking points, controlling the power stream along these lines is constrained and shunt converter primarily fill different needs.

A gadget that is associated in arrangement with the transmission line is alluded to as an 'arrangement gadget'. Arrangement gadgets impact the impedance of transmission lines. The guideline is to change (decrease or increment) the line impedance by embedding's a reactor or capacitor.

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The dc link capacitor also acts as compensation device which helps to control the transmission line parameters i.e impedance, voltage, power factor and load angle.

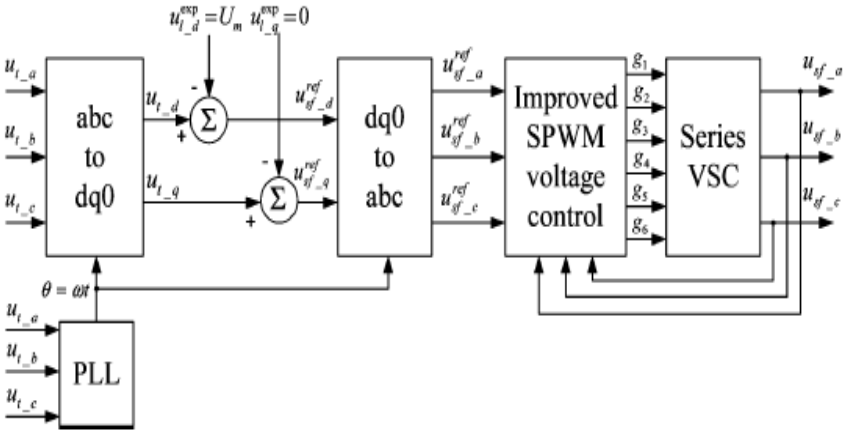

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Figure 4: Control diagram for Series converter for DPFC

The series controller shown in above figure is used to compensate voltage interruptions like sag/swell or harmonics. In series converter the gate signals required for three phase VSC is obtained by using PWM technique. The PWM technique is operated by comparison of carrier and reference signal. In series controller, the reference signal is generated by using PCC and Dc link voltages. This controller consists of two loops namely, inner loop which acts as a DC link controller and the outer loop which control the pcc voltages which helps to compensates voltage distortions.

UPFC Shunt converter control structure:

Shunt converter in DPFC is used to compensate the harmonics in current and for controlling the load current. The three-phase shunt converter is operated/controlled by a three-phase hysteresis controller. The reference signals required for the shunt converter is generated by using PCC signals and dc link voltage. In the inner loop of shunt converter, the reference current is generated by controlling DC link voltage and actual current is obtained from the PCC current signals in the outer loop. The closed loop control diagram of shunt converter is shown in figure 4 and figure 5.

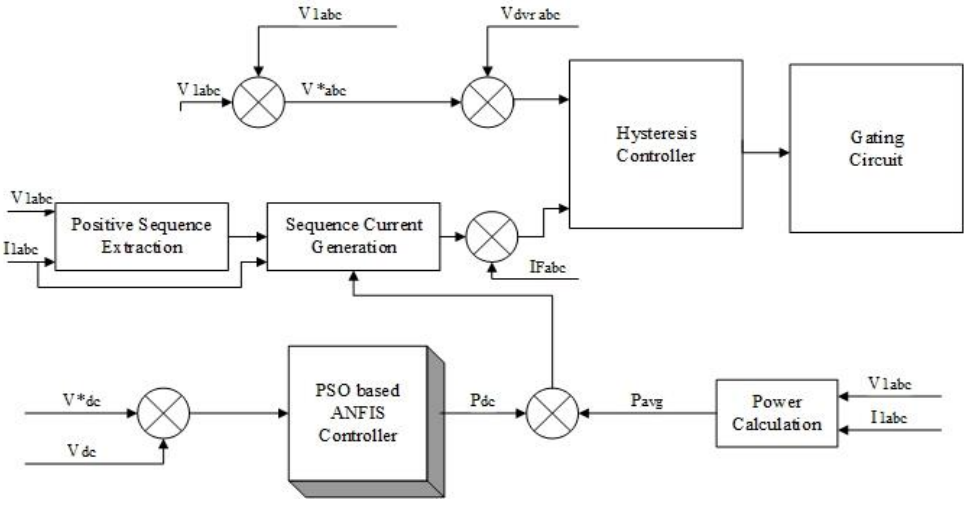

Figure 5: Closed loop control Diagram for shunt converter

5 ANFIS CONTROLLER

Fuzzy Logic Controller:

The major complexity in conventional PID controller is mathematical analysis with multiple variables and constant interfacing. The major three issues with conventional PID controller are (a) time delay, (b) step function response and (c) ramp or soak function response.

In order to overcome these issues, this paper is implemented with soft computing controller called as Fuzzy logic Controller. Fuzzy Logic is one type in artificial intelligence and it is based on the information which is either true or false. FLC is a function or group of flexible set of if-then rules.

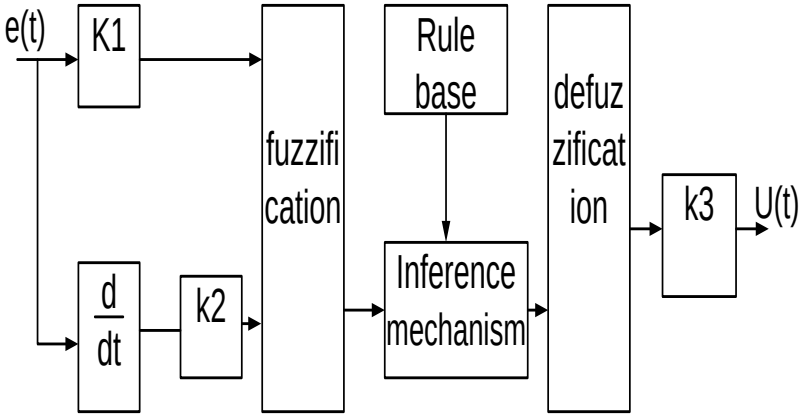

Figure 6: Architecture of FLC system

Figure 6, shows the basic structure of fuzzy logic controller with two inputs namely error of dc link voltage and change in error. Each input of FLC is a set of 5 memberships (i.e MS, S, Z, H, VH). The minimum of the two inputs of Medium small, small, zero, high and medium high are chosen which ultimately try to fire the set of IF-THEN rules. If error input is Z AND change in error input is H then the output is MH.

e/ce	MS	S	Z	H	MH
MS	MS	S	Z	H	MH
S	MH	H	Z	S	MS
Z	S	Z	H	MH	MS
H	S	S	MS	H	H
MH	S	Z	H	H	MH

Table 1 : Rule-Base formation for 5*5 input FLC

Figure 7 & 8 shows the membership functions for input error and change in error.

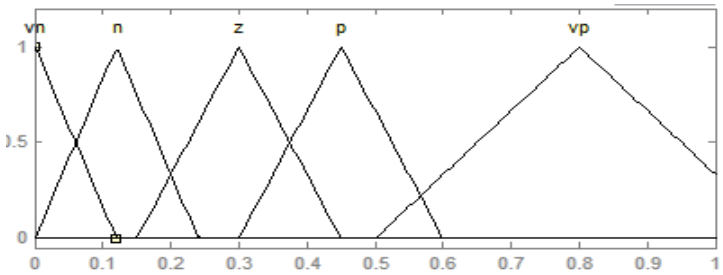

Figure 7: Input Error Membership Degree with triangular

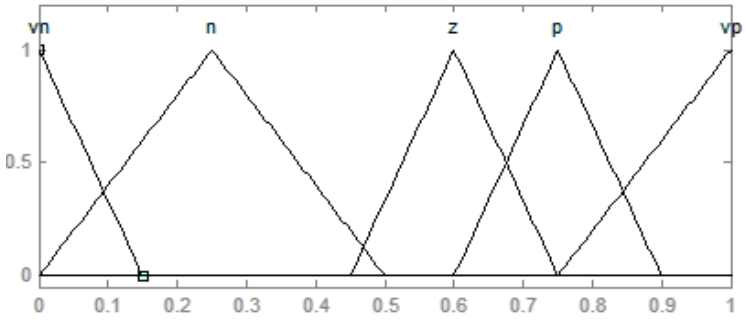

Figure 8: Input Change in Error Membership Degree with triangular

Ann Controller:

Figure 9 shows the basic architecture of artificial neural network, in which a hidden layer is indicated by circle, an adaptive node is represented by square. In this structure hidden layers are presented in between input and output layer, these nodes are functioning as membership functions and the rules obtained based on the if-then statements is eliminated. For simplicity, we considering the examined ANN have two inputs and one output. In this network, each neuron and each element of the input vector p are connected with weight matrix W.

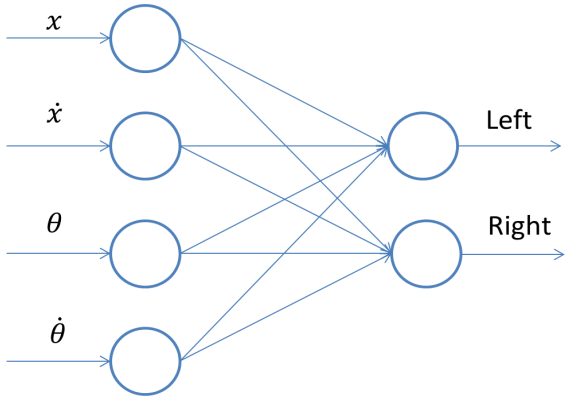

Figure 9: ANN architecture for a two-input multi-layer network

6 SIMULATION RESULTS

Investigations performed on the standard IEEE 6 bus system for determining the transient stability. Mat lab programming, has been done to test the systems for stability under various operating conditions. These results are based on performance index namely Transient Stability Index. This index is compared for certain predefined outages on different operating conditions and tested upon the standard IEEE 6 bus system.

Whenever a fault occurs on a bus or on a transmission line various parameters like voltage, kinetic energy, potential energy, rotor swing angle etc., of the machines connected to the corresponding buses are also subjected to variations. These variations are mainly responsible for unstable and stable nature of the buses in the systems. The forthcoming graphs shows these comparisons experienced in the parameters of the machines in the standard buses explained above for the 3 phase short circuit at bus no.3s and bus no.5 respectively.

***Case 1**: Modelling with Conventional PI controller*

In this case the proposed system is tested with PI controller and the experimental results are shown in below figures.

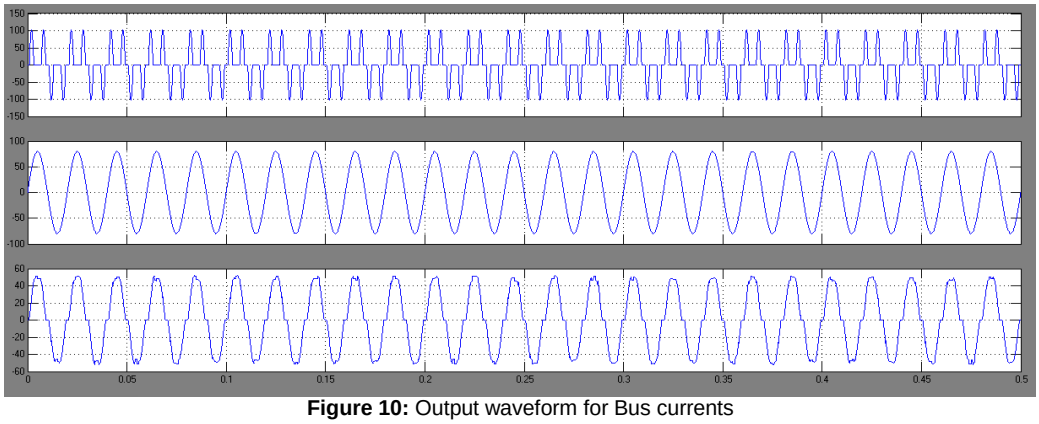

Figure 10: Output waveform for Bus currents

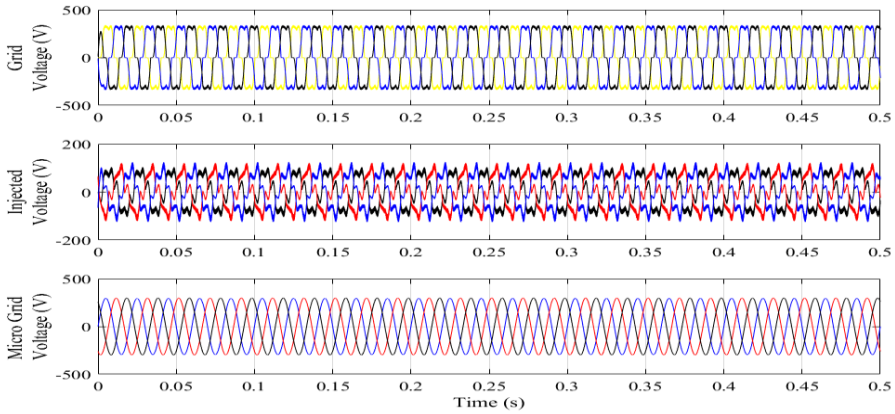

Figure 11: Output waveforms for Source Voltage, Injected Voltage and Load Voltage

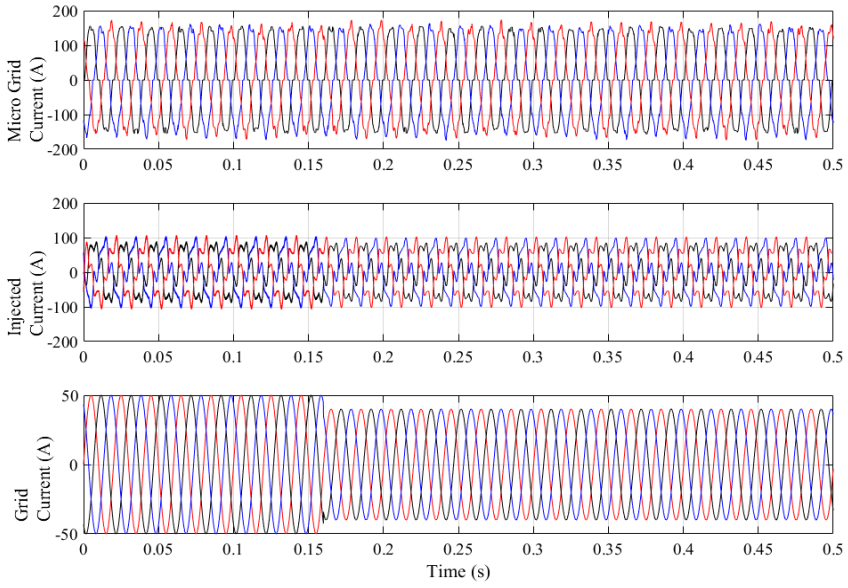

Figure 12: Output waveforms for Load Current, Injected Current, and Source Current

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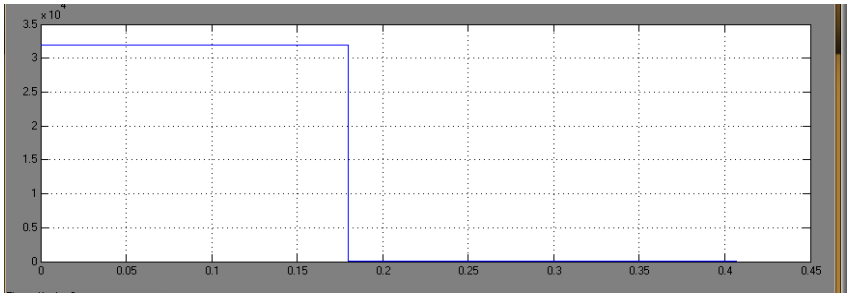

Figure 13: Output waveforms Active Power under Islanding Mode

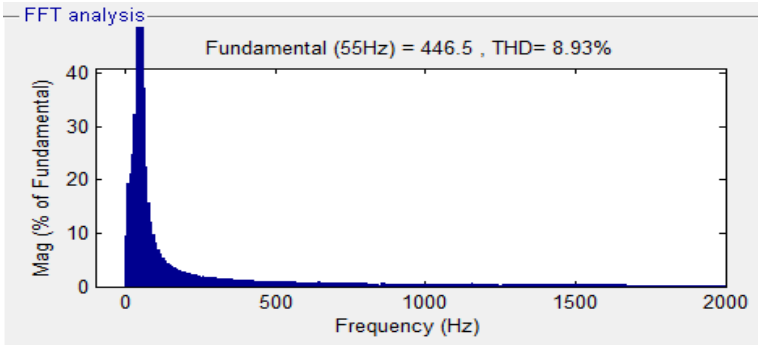

Figure 14: Total Harmonics Distortion for Grid Current

***Case 2**: Modelling with Fuzzy Controller*

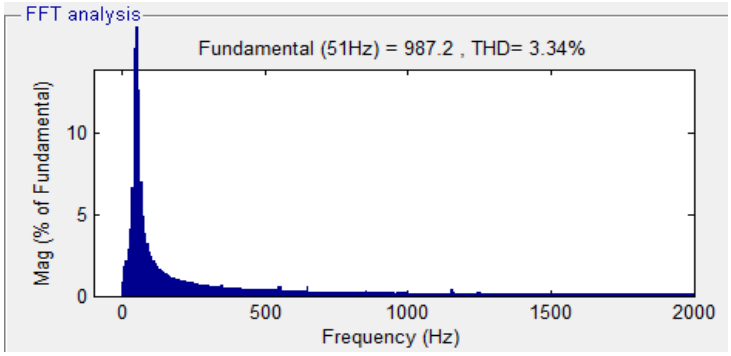

Figure 15: Grid Current THD with fuzzy controller

***Case 3:** Modelling of DPFC System with ANFIS Controller*

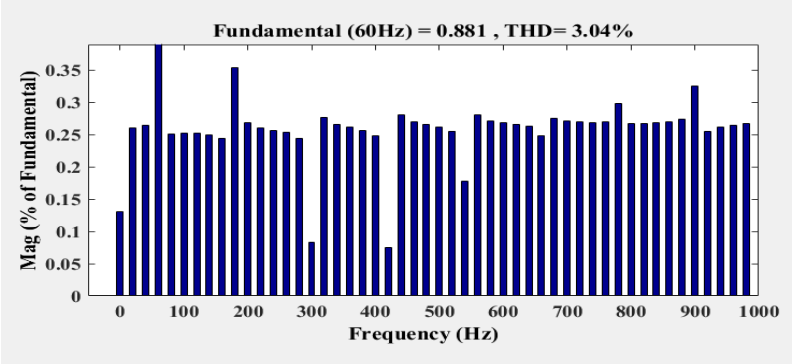

Figure 16: Grid Current THD with ANFIS controller

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7 CONCLUSION

This paper has presented the ANFIS based UPFC consisting of three single-phase CPATs equipped with a back-to-back converter. Through the available shunt and series windings in a CPAT, several services can be supplied to the grid such as grid harmonic currents elimination, reactive power compensation and power flow control. Linear and non-linear modeling approaches of a CPAT has been presented and investigated under stiff-grid operation and in a 5-bus power system model. The presented control architecture has been evaluated through simulations and an experimental prototype demonstrating the ability of a CPAT to operate as a UPFC. The analysis, simulation results confirm the CPAT-UPFC ability to provide the required services.

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