DEMENTIA PREDICTION USING SUPERVISED MACHINE LEARNING

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Abstract— **Dementia is a medical condition characterized by the rupture of blood vessels in the brain, resulting in brain damage. Symptoms may arise when the supply of blood and other essential nutrients to the brain is disrupted. Dementia is a major neurological disorder affecting millions of people worldwide. Early diagnosis of dementia is crucial for better management and treatment of the disease. Here, we explore the use of supervised machine learning (SMLT) algorithms to predict dementia from demographic, clinical, and cognitive data. The dataset used in this study includes information from a large sample of individuals diagnosed with dementia and a control group of healthy individuals. We compare the performance of four popular machine learning algorithms which are Decision tree classifier, Gradient boosting classifier, XGB classifier, Gaussian NB in predicting dementia. Our results show that the XGB Classifier algorithm outperforms other algorithms, achieving an accuracy of 94.36% in classifying individuals with dementia and healthy controls. After that we created a live website which predicts the disease is demented, non-dimented or converted. For that gaussian NB accuracy was accessed as a model file in deployment model.**

Keywords—Dementia, SMLT, Decision tree classifier, Gradient boosting classifier, XGB classifier, Gaussian NB, Demented, Non-demented, Converted.

I. INTRODUCTION

Dementia develops when the blood supply to certain parts of the brain is compromised or reduced, which prevents the cells in those parts of the brain from getting the nutrients and oxygen they need, which causes them to die. A medical emergency such as dementia necessitates immediate medical care. Early detection and proper treatment are crucial to prevent further harm to the affected area of the brain and potential complications in other parts of the body. According to the World Health Organization (WHO), there are fifteen million dementia sufferers worldwide, and one of them passes away every four to five minutes. According to the Centers for Disease Control and Prevention, dementia is the sixth most common cause of death in the US (CDC). A noncommunicable disease called dementia claims the lives of 11% of people. Approximately 795,000 Americans regularly experience the incapacitating symptoms of dementia [2]. It is the fourth most common cause of death in India.

There are two types of dementia: ischemic and hemorrhagic. A weak blood vessel bursts and bleeds into the brain in a

hemorrhagic dementia, while clots block drainage in a chemical dementia. By having a healthy, balanced lifestyle. Dementia may be avoided if a person avoids harmful habits such as smoking and drinking, keeps a normal body mass index (BMI), ordinary blood sugar levels, and excellent heart and kidney function. It is critical to predict dementia, and it needs to be treated right away to prevent irreparable harm or death The suggested method is to create a machine learning algorithm for brain dementia classification. The process begins with data collection, where previous data concerning brain dementia is gathered. In the healthcare domain, data mining is a common method for processing massive amounts of data. The timely detection of dementia can significantly improve patient outcomes. Deep learning has become a valuable tool in healthcare as it reduces manual effort and minimizes errors when using an optimized model. The dataset is carefully analyzed, and proper variable identification is performed, including both regression analysis and independent variable discovery. The most suitable machine learning techniques are applied to the dataset to uncover underlying patterns. After testing various algorithms, the best performing one is selected to predict the desired outcome.

II. RELATED WORKS

A methodology to forecast Alzheimer's disease patients using their brain MRI images was put out by Nripendra Narayan Das et al. [1]. The standard MRI data from Alzheimer's disease Neuroimaging Project will be used to test his hypothesis (ADNI). He obtained Mri Scanned images from two types of Alzheimer's patients: mildly mentally impaired and non-impaired. Using Grey Level Co-Occurrence Matrix (GLCM) and Random Forest mapping, the shape and dimensions of other major brain regions, including the temporal lobe, occipital lobe, frontal lobe, and insular, are ascertained. Several machine learning algorithms were employed to predict the presence of illness. The accuracy is 96.4% when applying a random forest classification system, with a region of 82.1% for ROC-AUC.

Deepa, D et al .[2] This study used Magnetic Resonance Imaging (MRI) inputs to identify dementia disease, which led to speedier disease prediction and the contribution of the disease's evolution. By employing this technique, which involves screening dementia disease data and inducing machine learning classifiers, it is feasible to identify and predict the specific dementia of humans. With the use of neuroimaging technology and prediction at a very early stage using the data accumulated for dementia patients, this effort focuses on developing an evolving framework to identify dementia disease effectively.

Carlton Chu et al.[3] employed a Bayesian learning approach called the Gaussian Process (GP) model, which is closely related to the traditional variance component estimation. By maximizing "marginal likelihood" or "evidence of the data," the The Bayesian approach allows the model to autonomously ascertain the hyperparameters of the model.. Without further cross-validation, the relevance of various grey matter (GM) areas is automatically weighted in the training procedures using marginal likelihood maximization. Two groups of individuals with Huntington's disease and healthy controls were subjected to the algorithms. Automatic feature selection increased classification accuracy for the first dataset from 70% to 73% and for the second dataset from 58% to 69%.

A multimodal imaging genetic method for predicting the progression of moderate cognitive impairment patients to Alzheimer's disease was presented by Roman Filipovych et al. [4]. He applied multimodal pattern recognition techniques to identify neuro-imaging and multigenic classification algorithm between healthy individuals and Alzheimer's disease patients. Then, in a linear fashion, he created a composite imaging-genetic score for patients with moderate cognitive impairment to predict the development of Alzheimer's disease. Eventually, the Alzheimer's Disease Neuroimaging Project demonstrated that better Alzheimer's disease prediction was achieved by combining polygenic and neuroimaging data.

According to Hongming Li et al. [5], Multimodal biochemical, imaging, and neuropsychological markers have shown encouraging results for separating dementia disease patients from elderly people with normal cognitive function. It is still challenging to foresee who and when among those with mild cognitive impairment would acquire dementia, though The researchers observed that pattern classifiers trained on longitudinal data outperformed those trained on cross-sectional data. To leverage this finding, they designed a deep learning model utilizing recurrent neural networks to capture both the informative representation and temporal changes in cognitive assessments over extended periods for individual subjects. These cognitive assessments were then combined with baseline hippocampal MRI to develop a prognostic system.

AMOL K. KADAM ed al [6] The initiative aims to identify among stroke victims their acquaintance with the risk of having a stroke and the factors that influence it. The study has used ML techniques like Random Forest Classification, Decision Tree Classification, Logistic Regression, KNN, and SVM to accurately predict outcomes based on a variety of parameters.

Dharvi Soni et al.[7] The paper's objective is to describe a number of deep learning and machine learning techniques, as well as their advantages, and to choose a future research path

for stage-by-stage Alzheimer stage prediction. By screening data on Alzheimer's disease and inducing Machine Learning classifiers, it is possible to use this technology to diagnose and predict the specific dementia in adults.

Govindarajan [8] managed the data assembled from Sugam Multispecialty Hospital. More than 500 patient records and a variety of intriguing class names for two important types of strokes were included in the collection. These methods were employed along with Support Vector Machine (SVM), Artificial Neural Network (ANN), Logistic Regression, Decision Tree, Bagging, and Boosting. Out of the aforementioned Machine Learning Algorithms, they had the highest accuracy (95%) with the ANN Algorithm.

III. Proposed Methodology

Building a model using machine learning for the categorization of brain dementia is the suggested approach. The process starts with data collecting, where previous information about brain dementia is gathered. Data analysis is a popular method for processing vast amounts of information in the health care sector. If detected early enough, a brain dementia can save lives.
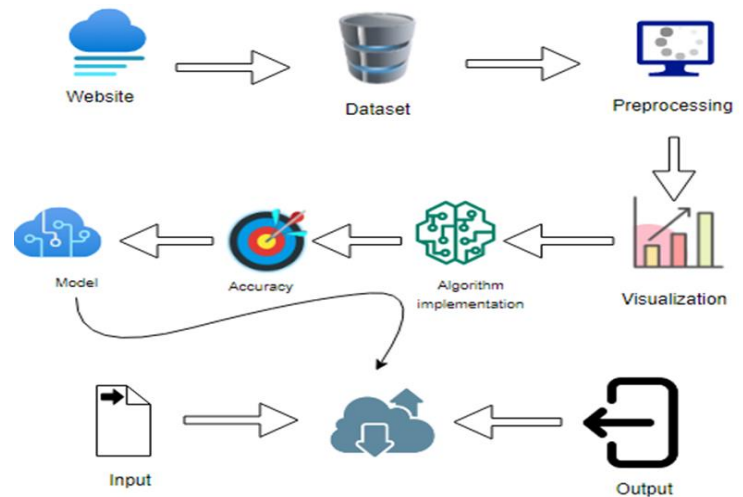

Fig 1. The System Architecture

A better model results in fewer errors, which saves lives, and machine learning is now used and used mostly in the healthcare industry. The dataset is subjected to a comprehensive data analysis, which includes the identification of the dependent and independent variables. On the dataset from which the data pattern is discovered, the appropriate machine learning algorithms are used. A better algorithm is utilized to anticipate the outcome after experimenting with several techniques.

The modules are:

A. Data Pre-processing

Loading the supplied dataset and importing library packages to investigate variable's identity by data type and shape and to assess duplicated and values that are missing. while fine-tuning models and using strategies to make the most of validate and test data while analyzing your models, you can use validation datasets, which are samples of data excluded from learning your model and used to gauge model competence.

The provided dataset must be renamed, columns must be deleted, and other data cleaning and preparation steps must be completed in order to analyze the uni-variate, bi-variate, and multi-variate processes depending on the dataset, several procedures and techniques will be used to clean the data. To boost the worth of datasets for analysis and decision-making, data cleaning aims to find and remove mistakes and anomalies.

Dataset:

The Dementia Prediction Dataset comprises of a total of 372 rows data of data with 13 columns and had attributes such as "Male/Female", "Hand", "Age" , "EDUC" , "SES" ,"MMSE" , "CDR" , "MR Delay" , "Visit" , "nWBV" , "eTIV" , "ASF" [9].

Fig 2. Dataset

B. Data visualization

Data visualizations can be used to convey and demonstrate important relationships using plots and graphs that are more visceral and attractive to stakeholders than measures of association or significance. Unless data is graphically represented, such as via charts and graphs, it might not always make sense. Fast visualization of samples of data and other objects is valuable in both statistical applications and applied machine learning. It will demonstrate how to use different plot types to examine your own information as well as the wide variety of plot types you'll encounter while illustrating information using Python.
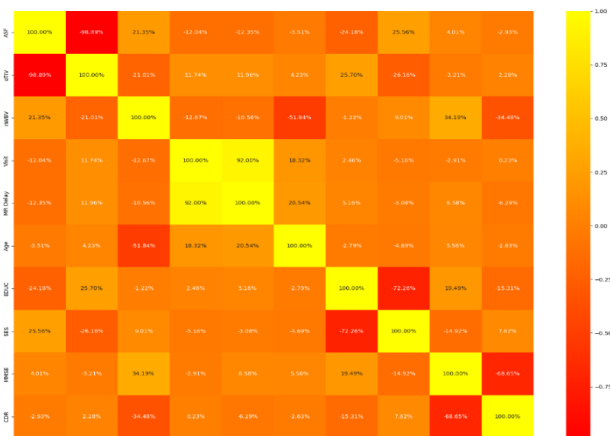

Fig 3. Data visualization

C. Training ML Models

To ensure the system produces the best results and is as accurate as possible, 4 distinct machine learning algorithms have been used in its implementation.

- Decision tree
- Gradient Boosting Classifier
- XGB classifier
- Gaussian NB

The libraries which were used in training these models are

1) Pandas
2) Numpy
3) Matplotlib
4) SKlearn

D. Deployment

After training all the model a live website is created which predicts the possibilities of dementia. For this the machine learning model which gave high accuracy is used by accessing its as a model file in our python program. The tools used in this deployment model are

1. Front End:

Bootstrap, CSS (Cascading Style Sheets), HTML (Hyper Text Markup Language).

2. Framework:

Flask: Python API for web-applications.

3. Runtime Environment:

Jupyter notebook

E. Obtaining the results of the test

The last stage will be to use our web application to deliver exact and accurate results to the user, allowing them to proceed as needed in accordance with the results.

The system will finally produce the desired result after the approach, modules, algorithms, and codes have been implemented. The homepage will assist users in entering the information needed for the Dementia prediction system, and the GUI portion is designed to be user-friendly for regular people. The system has been developed utilizing four distinct ML algorithms, as specified in the Implementation, to obtain the best accuracy while using the dataset.

The results generated was:

- The lowest accuracy was given by Decision tree

classifier i.e. (86.91%)

- The Highest accuracy was given by XGB classifier i.e. (94.36%)

The following table shows the results of the evaluation parameters against the models. This was found using the optimal dataset split, which was 70% for training and 30% for testing.

Evaluation parameters	Accuracy Score	Recall Score	Precision Score	F1 Score
Decision Tree	86.91%	87%	86%	86%
Gradient Boosting	92.95%	92%	93%	92%
XGB Classifier	94.36%	94%	95%	93%
Gaussian NB	91.67%	93%	92%	92%

Table. 1 Accuracy Table

As shown in Figure 4, the suggested system helped us analyse the optimum manner to receive user inputs for the GUI implementation portion of our project. The XGB Classification, which has been trained with the datasets using the information supplied to the GUI for risk of stroke prediction, was employed, and the new data supplied by the user was checked against by the training sample.
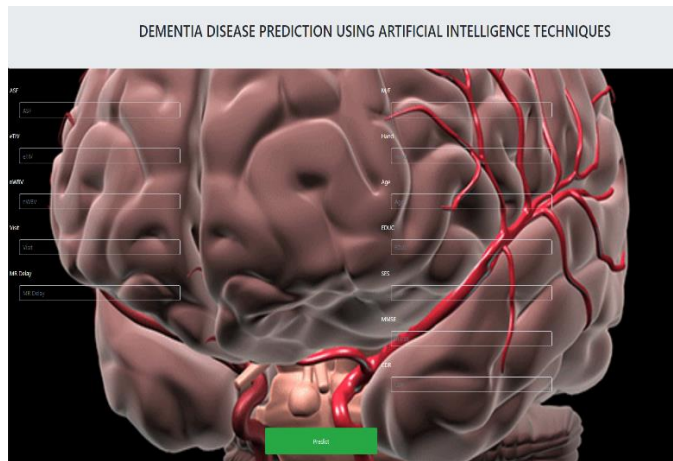

Fig. 4 Screenshot Of Website

IV.   Conclusion

After conducting a literature review, we learned about the various benefits and drawbacks of various research papers and proposed a system that predicts Dementia in a cost-effective and efficient manner by requiring few inputs from the user and predicting accurate results using trained Machine Learning algorithms. Thus, the Dementia Prediction was constructed employing four Machine Learning algorithms with the greatest accuracy of 94.36. Consequently, the system is intended to offer a straightforward yet effective Design of user interfaces with a sympathetic viewpoint towards its clients and patients. The system has room for growth in the future, which can lead to greater results and improved customer service. This will assist the user in saving precious time and empower them to take appropriate action based on the results provided..

The implemented system's future scope could include:

1.   Background knowledge from other datasets may help boost the accuracy of Dementia prediction models.

2.   We want to collect our institutional dataset for future benchmarking of these machine learning approaches for dementia prediction.

3.   We also want to do external validation of our proposed method as part of our next work.

V.   REFERENCES

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