Dementia Predictor

Mrs. Supriya Suresh[1], Meghana M [2], Vaishnavi N Bhat[3]

[1]Assistant Professor,[2]Student,[3]Student

[1]Department of Computer Science and Engineering,

[1]K S School of Engineering and Management, Bengaluru, India

Abstract - This study aims to estimate the prognosis of dementia based on individual data analysis, taking into account several aspects that determine different characteristics. In addition, further measures are suggested for patients with pain, and advice on how to prevent the disease is also provided. The dataset consists of patient data collected using MRI scans. Support vector machines (SVM) and decision tree algorithms were used to analyze different aspects that influence the results and to better understand the results. This will help you better understand various machine learning algorithms and choose some important parameters to build a better model. Our model therefore not only predicts whether a person has dementia but also provides recommendations for further steps that people without dementia should take to prevent dementia.

Index Terms – Machine Learning(ML), Support Vector Machines(SVM), Decision tree.

I. Introduction

The application of integrated technologies in the medical field has recently had a direct impact on the productivity and accuracy of doctors. Prediction of various diseases is one of the main applications. The growth and development of health outcomes in healthcare purchasing and management has increased significantly. In recent years, dementia has become a major health problem for the elderly. Caring for patients with dementia has become a very difficult challenge in the 21st century, as the number of cases of dementia continues to increase. To detect dementia and other stages of dementia, such as Alzheimer's disease, researchers have used a variety of techniques, including Early-stage research.

Additionally, new techniques have been discovered for early prediction of dementia outcomes. With the development of new methods in the medical field, large databases are now being built that are accessible to medical researchers. However, most patients can accurately predict the course of their disease. Therefore, ongoing research is concerned with applying machine learning techniques to find and recognize models and relationships between them from large datasets. The information is analyzed to provide valuable insights to improve models that support disease prediction and more accurately predict patient health status.

II. Literature survey

[1] A Comparison of machine learning methods for survival analysis of high-dimensional clinical data for dementia prediction.
Clinical trials and cohort studies, such as those conducted in the field of dementia research, can contain sophisticated and complex data. These datasets are high-dimensional, meaning they contain a large number of variables or characteristics relative to the number of observations. Because of this trait, typical statistical approaches may not be feasible due to the large number of coefficients that need to be estimated. This analysis method is further complicated by the possibility of censored, heterogeneous, and missing information in these datasets. To address these issues, techniques for modeling and analyzing such complicated data must be developed. Additionally, the stability of models is crucial, as it determines the reliability and confidence in the results. An algorithm's stability reflects its sensitivity to variations in the training set, where a small change in the data could cause a significant change in the algorithm's performance. Therefore, researchers are actively searching for strategies that might overcome these challenges in order to deliver strong and stable analysis for decision-making in the clinical research and healthcare sectors.

[2] A machine learning approach for the differential diagnosis of Alzheimer and vascular dementia fed by MRI selected features.
Amyloid-β plaques and tau-related neurofibrillary tangles accumulate in progressive neurodegenerative disorders, such as Alzheimer's disease (AD), mostly affecting the prefrontal and mesial-temporal regions of the brain. The pathology causes the brain's tissues and neuronal circuits to significantly shrink and atrophy, which results in memory impairment and severe cognitive decline. For AD to be managed and treated effectively, an accurate diagnosis is essential. Diffusion tensor imaging (DTI) and resting-state functional magnetic resonance imaging (rs-fMRI), two advanced MRI techniques, have shown promise in the diagnosis of dementia. By combining machine learning (ML) techniques with MRI-derived indicators, such as quantitative MRI (qMRI), researchers have successfully identified AD patients from older persons in good health. Moreover, it has been demonstrated that ML and qMRI can be used to forecast the course of a disease and the point at which moderate cognitive impairment (MCI) will develop into Alzheimer's disease (AD).

[3] Dementia prevention, intervention and care:2020 report of the Lancet Commission
Incorporating three modifiable risk factors into the nine-factor life-course model created by the 2017 Lancet Commission on dementia intervention, prevention and care may prevent or delay up to 40% of dementia cases, according to new research. Specific interventions and public health activities should be part of the solution because prevention involves both individuals and policy. Maintaining a systolic blood pressure of 130 mm Hg or less in middle age, promoting the use of hearing aids, lowering exposure to air pollution, preventing head injuries, restricting alcohol consumption, abstaining from smoking, offering primary and secondary education to all children, lowering obesity and diabetes, and addressing other potential risk factors like sleep are some specific actions for risk factors across the life course. It is imperative to address inequalities and safeguard individuals suffering from dementia; in low- and middle-income nations, preventative efforts may result in the greatest decreases in dementia cases.

[4] Toward a theory-based specification of non-pharmacological treatments in aging and dementia.

Non-pharmacological treatments (NPTs) have the potential to be beneficial not only in treating clinical symptoms but also in primary and secondary prevention of dementia. NPTs offer numerous benefits, including widespread acceptance, few adverse effects, and significant and simultaneous compatibility with pharmaceutical treatments and other NPTs without significant interference problems. The various clinical stages of the illness, such as dementia, moderate cognitive impairment (MCI), and even cognitively normal people who are at danger of dementia, can all be treated with NPTs. So, as age-related neurodegenerative disorders progress, NPTs may have a significant effect on wellbeing, cognition, and quality of life. NPT offers several different types of interventions, such as dietary therapies, physical therapy, cognitive training, art therapy, and memory therapy. An influential Previous Meta-Analysis defined NPTs as "any theoretically based, nonchemical, focused, and replicable intervention, conducted with the patient or the carer, which potentially provided some relevant benefit". The low quality of the majority of the data supporting multiple NPTs has been consistently highlighted by this and numerous previous comprehensive examinations of NPTs in dementia and ageing. To raise the calibre of the evidence supporting NPTs, more focused, reliable, and well-reported research as well as stricter methodological guidelines are required. This will assist in validating the extent and upper bounds of the advantages connected to various NPT kinds.

[5] **Statistical methods for dementia risk prediction and recommendations for future work: A systematic review.**

Over the past decade, many algorithms have been developed to predict dementia risk and identify people at high risk. In recent years, his three meta-analyses and systematic reviews summarizing models for predicting dementia risk have been published. After obtaining the operating characteristic analysis, the sensitivity, specificity, and area under the curve of published dementia risk models were examined. The main focus was on evaluating the variables included in the model and its predictive performance. It was concluded that none of the published models can be recommended for predicting dementia risk due to methodological flaws in the study procedures and the models used to create the models. Issues such as the problem of assessment intervals for people at risk, the inability to distinguish between subtypes of dementia, the lack of external and internal validation of the models, and above all the uncertainty regarding the analytical techniques used were also highlighted. Methodological flaws identified in the model were also considered, such as lack of external validation and insufficient predictive power (area under the curve >= 0.74) for different populations, including diabetic, middle-aged, and elderly patients.

III. Support Vector Machine

Support Vector Machine (SVM) is a type of supervised machine learning algorithm that can be used for classification and regression analysis. Determine the hyperplane that best partitions the classes in your data using a set of training examples. Support Vector Machines (SVMs) manage high-dimensional data sets and can analyze both linear and nonlinear correlations between variables.

Steps involved in this algorithm:

1. *Data collection and preparation:*

Collect a labeled dataset where each data point is associated with a class label. Make sure your data is preprocessed and features are scaled accordingly.

2. *Split the data:*

The dataset that is obtained is split into a training dataset and a testing dataset. The training set is used to train the SVM model, and the test set is used to evaluate its performance.

3. *Select a kernel function:*

Select a kernel function that transforms the input features to a higher dimensional space. Common kernel functions include linear basis functions, polynomial basis functions, and radial basis functions (RBF or Gaussian functions).

4. *Configuring hyperparameters:*

SVM has hyperparameters such as cost parameter (C), kernel type, and kernel-specific parameters. Choose appropriate values for these hyperparameters. In some cases, you may need to perform hyperparameter optimization using techniques such as cross-validation.

5. *Train the SVM model:*

Train the SVM model using the training data. The model learns to identify the optimal hyperplane that best separates the classes.

6. *Balancing Optimization:*

Depending on the nature of your problem, you may need to balance precision and recall. Adjust the hyperparameters accordingly to optimize the model for your specific needs.

7. *Evaluate the model:*

Evaluate the performance of the trained model using the test set. Common evaluation metrics include precision, precision, recall, and F1 score.

8. *Optimize the model:*

If the performance is not satisfactory, you may need to optimize the model by optimizing the hyperparameters or using feature engineering techniques.

9. *Make predictions:*

Once you are satisfied with your model, you can use it to make predictions about new data you have never seen before.

IV. CONCLUSIONS

An exploration on the methods used for the prediction and analysis of dementia can be done using various factors and features. All these prediction methods mostly include algorithms of machine learning. Using the Support Vector Machine algorithm a probable accuracy of 96.7% can be obtained.

V. REFERENCES

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