
MLD Project Phase 2

Topic: Dementia Prediction using ML

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1. Overview of the Topic Domain

We have chosen a dataset based on a diagnosis prediction of Dementia, that comes from the medical diagnosis background. Dementia is a vast category of neurodegenerative disorders that affect memory, cognition function, and everyday activities[1]. In simple words, it's a disease where people tend to forget their memory, and ability to remember and have difficulty even performing day-to-day activities. Some of the forms of this particular disorder are vascular dementia, Lewy body dementia, and frontotemporal dementia[1]. The most common disorder is Alzheimer's disease which is a severe condition and gets worse over time. Unfortunately, 55 million people are living with the condition worldwide, and 10 million new cases are being diagnosed each year [2].

The early diagnosis of dementia is critical and could lead to better management of symptoms and slowing down of the disease[3][5]. It is very crucial to address dementia as early as possible because the significance lies in the societal and economic burden. It is found that early interventions, cognitive therapies, and lifestyle changes have improved patients' quality of life.[3] The above importance and reasons stand valid because as per the World Alzheimer Report 2011 "The worldwide costs of dementia (US\$604 billion in 2010) amount to more than 1% of global GDP"[4]. Another surprising fact to understand the intensity is that, if dementia care were a country, it would be the world's 18th-largest economy[4].

2. How Dementia is Currently Diagnosed

Currently, some of the techniques to predict dementia in a person are using clinical evaluations, cognitive and neurological tests, psychiatric evaluations, and brain scans.[1] Montreal Cognitive Assessment(MoCA)[5] is a prominent way to diagnose dementia. The MoCA helps determine the cognitive impairment[5] and analyze the diagnosis of the disease. Another test to diagnose dementia is the Visual Association tests, which consist of identifying objects like as illustrations- for instance, A monkey holding an umbrella and asking and observing how the patient interacts. Later, they are asked to recall some of the details about the illustrations[6]. There is also a very famous and common test conducted known as The Drawing Test: In this, A person is asked to

draw a clock with an hour and minute hand which displays a specific time.[6] This tests the memory function of the person and can effectively help detect if that person has dementia or not.

The medical way of diagnosing Dementia is implementing Neuroimaging techniques which include mainly using MRI (magnetic resonance imaging) and PET (positron emission tomography) scans, which can be used to identify the specific structural changes in the brain that can indicate neurodegeneration and can help to diagnosis dementia[8]. However, the current medical diagnostic methods are often considered reactive rather than proactive, which then leads to late-stage diagnosis where the treatment and recovery are less effective on the patient [9].

3. AI in Dementia Prediction

Artificial intelligence has been made a lot better and significantly developed in the field of medical for better prediction and it has been used to predict dementia, especially for early detection and diagnosis. Various ways of machine learning models are being used to detect dementia which include Classification, Regression approach, and Deep learning use cases [10]. These methods are incredibly being trained on various datasets which include clinical data, cognitive test scores, and brain scans such as MRI, and PET to train the model and help detect dementia which might be somewhat hard compared to manually detecting dementia.[10]

As we researched more papers, we came across the prominent technologies present in the AI domain which by using ML helps detect dementia and its associated disease [Alzheimer] using convolutional neural networks (CNNs)[11]. It has been used and applied on MRI and PET scan data images to potentially identify different patterns that are linked to Alzheimer's disease and can help predict more accurately. It is also been seen that this specific technique which is CNN has surpassed the human expertise diagnosis in many image understanding tasks[11]

4. Review of Related Papers

We have researched a paper that is similar to our dataset and topic use case which was published in 2023 titled "Early Prediction of Dementia Using Feature Extraction Battery (FEB) and Optimized Support Vector Machine (SVM) for Classification" by Javeed et al.[12] which proposed a machine learning model for detecting early dementia using 2 different models, FEB and optimized SVM model. Throughout the phase, they used various feature extraction techniques to reduce the dimensionality of the dataset. They were able to achieve a notably improved 93.92% accuracy while addressing the class imbalance issues using the ADASYN (Adaptive Synthetic Sampling) technique. This model outperformed several other machine learning models in terms of precision, recall and F1 score which tells us that SVM has the advantage over all 12 other states of art models that predicted dementia.[12]

The other research paper is also based on a similar use case as our topic but aims to enhance the accuracy and performance of “Dementia Prediction Using Machine Learning”[14] where it focuses more on brain image processing and developing a predictive model using the OASIS (Open Access Series of Imaging Studies)[13] dataset. Given that nine supervised machine learning techniques were used which were Adaboost (AB), Decision Tree (DT), Extra Tree (ET), Gradient Boost (GB), K-Nearest Neighbour (KNN), Logistic Regression (LR), Naïve Bayes (NB), Random Forest (RF), and SVM (Support Vector Machine). Again, SVM outscored every other technique used with around 96.77% accuracy using the full feature set[14]. In the future, there might be a better-optimizing model with advanced feature selection and reduction techniques which could help in improving the efficiency and accuracy even further. This paper aligns well with our project which explores advanced machine learning techniques and might have similar results.

5. Hypothesis Statment

We hypothesize that using the open-source machine learning software [df-analyze] applied to our dataset Dementia_patient_health.csv may produce useful technology to predict whether the person has Dementia or not. Also, we hypothesize that by building different models based on different genders such as male and female, we could get different and significant insights and it can help us detect dementia based on those parameters. We would be taking into account different genders and analyzing them to predict and observe how the results differ based on different genders i.e. one model for Males and the other for Females.

6. References and Publications

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