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MACHINE LEARNING TRACKER FOR MENTAL HEALTH APPROACH

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ABSTRACT

One of the most pernicious consequences of COVID-19 on society is how it has impacted worldwide mental health, creating new problems and aggravating existing ones. When the few resources are geared for the pandemic, mental health issues and therapy typically take a backseat. Therefore, it's important to monitor any psychological issues before they spiral out of control. The goal of this study is to develop a machine learning-based mental health tracker that primarily focuses on cognitive mental disorders. The MMSE test, which offers a quantifiable measure of cognitive impairment and a way to track cognitive changes over time, is one of the screening methods used to make sure that issues are discovered early. Clusters are created using the K-means clustering algorithm with the potential for dementia incidence.

Keywords -*Artificial intelligence, K-means clustering, machine learning, and the Mini-Mental State Examination.*

1. INTRODUCTION

A widespread issue is a mental illness. More than 300 million individuals worldwide, or 4.4% of the population, experience depression. People with serious mental illnesses can pass away up to two decades sooner than expected due to physical ailments that could have been avoided. Issues including alcohol/drug abuse, abuse & violence motivated by gender are all impacted by mental health. Thus, failure to address mental health has repercussions for entire societies. However, the response thus far has been woefully insufficient in terms of both resources and political will [1].

Due to a reduction in their physiological function, noninfectious cognitive impairment is the most significant risk factor among aged persons. Alzheimer's disease, dementia, and vascular dementia are the results of cognitive impairment. A mental impairment known as dementia has a profound impact on daily life. Given that dementia affects numerous aspects of cognitive function, a person with the disease always needs assistance with daily tasks. The demographic shift will inevitably result in dementia, which damages brain cells. Dementia can include a range of cognitive impairments, from none to severe cognitive deterioration.

In addition to image analysis, it is possible to predict dementia utilizing administrative, questionnaire, and clinical data. The suggested method makes use of the MMSE, a 30-point questionnaire that assesses cognitive impairment, as well as K-means clustering, a machine learning approach for classifying data by constructing clusters. It's just a simple screening procedure. An algorithm for unsupervised learning is K-Means clustering. This approach uses unsupervised learning and doesn't need a labeled training set. Using machine learning, this technique separates the clusters into various clusters, grouping like objects together and placing dissimilar ones in various clusters [2]. The goal of our project is to develop a machine learning-based system that can predict the users' cognitive and mental health.

II.RELATED WORK

Physical and mental wellnesses are equally important. Although it is not frequently discussed, cognitive decline is a key factor in determining how long people can live in good health. Some of the works on cognitive problems are mentioned here in order to address this issue.

For a more precise classification of cognitive decline, Revathi et al [3] proposed a 2-stage model. In the first stage, the classifier algorithm is used to apply a chosen collection of features to the population in order to detect the risk. Multinomial logistic regression is used on the results of the Cognitive Ability Test in the second stage. The authors suggested data mining approaches and performed a poll on ADHD, which is also a cognitive mental health problem known as ADHD (Attention Deficit Hyperactivity Disorder). The purpose of this project is to forecast ADHD concerns using data mining approaches[4].

During COVID-19, Samir Bandyopadhyay et al[5] introduced a system that employs deep learning from children's fears that are unseen to see. This technique can be used to optimize for first-order gradient-based optimization of stochastic objective functions because it is based on adaptive predictions of lower-order moments. In this method, the classification strategy utilizes deep neural networks. Pre-processing procedures are employed to clean up the data after it has been collected. A website that uses data mining to predict mental health is being developed by Laijawala et al[6]. The system's primary goal is to create a website where users may fill out a form with data and receive results on prospective or existing mental illnesses in response to their input. The treatment's predictive label is made up of values in terms of Yes and No.

A machine learning model for the prediction of mental health issues in children has been created by Sumathi and Poorna[7]. Professionals would use this model. When the model is given recognized evidence or symptoms as input, it helps us pinpoint the issue.

A web-based poll was undertaken by Matthew H.E.M. Browning et al[8] to look at how COVID-19 affected a group of university students psychologically. On the data, logistic regression was used after data reduction and imputation. The findings assisted in classifying the pupils into 3 categories according to their psychological risk.

Ashley E. Tate et al [9] developed a model for foretelling adolescent mental health issues using machine learning approaches. On the preprocessed data, they applied neural networks, random forests, logistic regression, support vector machines, and XGBoost. To evaluate the model's performance, AUC was employed. Positive and negative predictive values were computed from the top-performing model.

Machine learning techniques were utilized by Moore et al [10] to forecast the course of Alzheimer's disease based on demographic inputs. Random forest is applied to the pre-processed data to predict the diagnosis, ADAS-13 score, and normalized ventricles volume. Although effective, this approach validation does not make any assumptions about the input series dynamics.

Trzepacz et al [11] have developed the Montreal Cognitive Assessment (MoCA) to enable earlier detection of mild cognitive impairment (MCI). The Study analyzes the healthy control (HC) and Alzheimer's disease (AD) dementia cases to evaluate MMSE and MoCA score distributions using logistic regression. It concludes that the relation between MoCA and MMSE was more similar for dementia cases.

III.PROPOSED SYSTEM

We suggest developing a system to create a straightforward machine learning-based system that forecasts the users' cognitive mental health and advises seeking professional treatment when necessary. Clustering is employed in visualization thanks to the machine learning algorithm K-mean. This technique facilitates the formation of clusters for MMSE score and age comparisons-means clustering, which gives 90% accuracy and is used in the suggested method. For implementation, our model makes use of universally accessible Python libraries. The model is lighter and speedier, as a result, saving the consumers' time. The comparison between age and MMSE scores is clearly shown by the clustering carried out using k means.

The suggested system gives the test-taker a set of instructions before asking them to respond to the MMSE questions that are displayed on the screen. The scores are then calculated based on the patient's responses. The results are added afterward and shown alongside recommendations. If the patient's score is less than 17, they may have serious cognitive impairment. If the patient's score falls between 18 and 23, they may experience mild to moderate cognitive impairment. The patient is unlikely to have any cognitive dysfunctions if the score is higher than 23. After being uploaded to the dataset, the patient's data is processed using the machine learning technique K-Means clustering, which provides us with a precise classification [12]. This technique aids in the formation of data clusters, allowing us to examine which age group is most likely to be impacted. For reliable findings, the moderator of the test must accurately assess the patient[7]. Figure 1 depicts the suggested mental health tracker system's flow.

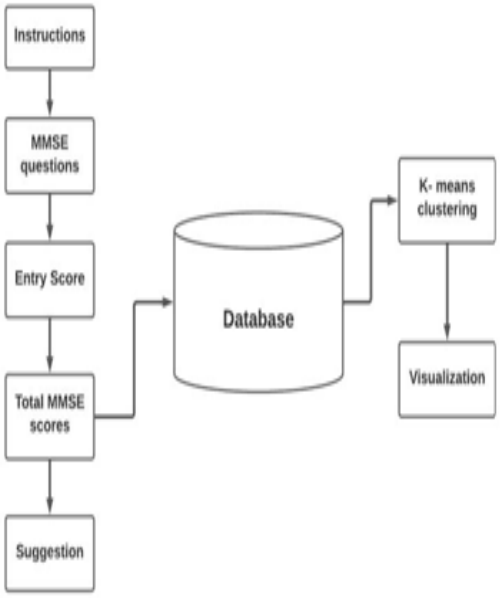

Figure 1. Proposed Mental Health System

Cognitive deterioration might range from mild to severe. The main causes are medication, blood vessel issues, depression, and dementia. The most prevalent kind of dementia, which is characterized by a significant decline in mental capacity, is Alzheimer's disease. A person's cognition is made up of numerous brain processes that are engaged throughout all facets of his existence. His ability to acquire new things as well as his memory, intellect and language are all present. A cognitive ability exam is used to determine the degree of cognitive impairment in a subject. With the aid of a complete review that was conducted to screen the cognitive function, we use the WHO-approved test questionnaire and a number of questions to assess the decrease in mental function.

This module given in Figure 2. shows the MMSE exam questions. The assessor should grade the responses given by the patient and the directions. Below each question, there will be a box where you can input your score. This box only accepts integers. A couple of the example MMSE questions and their weighted scores are shown in the table below.

Table 1

S.No	Questions	Weighted Score
1	What is the year?	1
2	What is the Season?	1
3	What is the day?	1
4	What is the date?	1
5	What is the month?	1
6	Name three unrelated Objects. Allow one second to each. Then ask the patient to repeat all three after you said them	3
7	Count backward from 100 to seven. One point may be given to each correct answer	5
8	Show the patient a pencil, and ask the patient what it is. Repeat for a wristwatch.	2
9	Ask the patient to follow a three-stage command	3
10	Ask the patient to copy a design	1

This module is used to display the total MMSE [5] score and the expert suggestion based on the total score.

IV.CLUSTERING AND CLASSIFICATION

An iterative unsupervised algorithm is the K Means algorithm. This creates clusters that keep related objects close together and dissimilar objects apart[13]. The number of clusters K must first be specified in order for the k means algorithm to function. Next, shuffle the dataset before selecting K random data points at random for the centroids without replacing them. Up till the centroid doesn't change, the iteration continues. Depending on the age and MMSE score, we will create three clusters here (which is allocated based on the performance of the patient in the questionnaire). The goal of this module is to cluster the dataset and draw a conclusion[14]. Figure 2 displays the dataset excerpt.

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	A	B	C	D	E
1	Number	Name	Gender	Age	MMSE score
2	7	Yogidhaa A	F	11	26
3	20	Jayashree	F	16	29
4	9	Srinidhi	F	17	28
5	81	OAS1_007	F	18	30
6	86	OAS1_008	F	18	26
7	95	OAS1_009	F	18	28
8	123	OAS1_012	M	18	25
9	149	OAS1_016	F	18	27
10	194	OAS1_021	M	18	27
11	253	OAS1_028	F	18	27
12	3	Nanditha	F	19	27
13	4	Abinayaa A	F	19	29
14	114	OAS1_011	M	19	27
15	207	OAS1_023	F	19	29
16	288	OAS1_032	M	19	25
17	294	OAS1_032	M	19	28

Figure 2 Data set Snippet

V. RESULT AND ANALYSIS

In the proposed system three clusters are used. The right amount of clusters in K-Means will be chosen using the elbow strategy. The Elbow Method, depicted in fig 3, is one of the most popular methods for determining the ideal value of k.

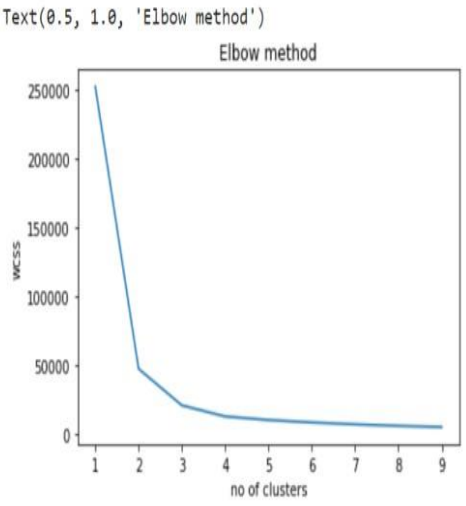

Figure 3. Elbow method

The elbow method mentioned above indicates that 3 and 4 clusters are best in this situation. Depending on the data points, a data collection may occasionally have more than one ideal value. The aforementioned images compare the dataset's display of whether the recommended number of clusters is 3 or 4, respectively. Figures 4 and 5 depict the development of clusters among different age groups.

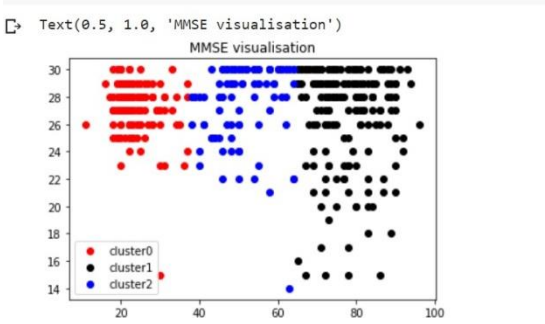

Figure 4. MMSE (K=3)

We see that severe dementia most frequently affects adults over the age of 60 and very seldom affects people under the age of 50. the representation of the dataset with k=4 and a maximum of 4 clusters. Two additional categories are created for people above the age of 60. This suggests that the age group over 60 in the sample that follows is similarly afflicted by this condition. The distinction isn't as obvious as it was before the age of 50[15]. It is clear that a machine learning-based mental health tracker was successful in identifying cognitive diseases with early onset.

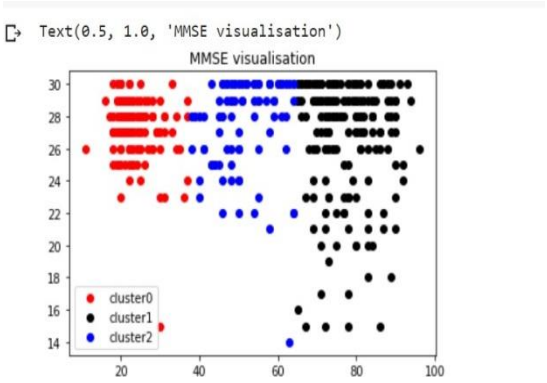

Figure 5 MMSE(K=4)

VI. CONCLUSION

With the help of the MMSE and the K means learning algorithm, we have presented a cognitive mental health detector. Based on the experimental findings, we would anticipate that 90% of those tested would be correctly classified as not having dementia, while 10% would be false positives and might be referred for further testing; 85% of people with dementia would be correctly identified with the MMSE, while 15% would be incorrectly classified as not having dementia[11].We can infer from the k means

clustering picture that older people are more likely to experience cognitive impairment.45 of the 409 values in the dataset had mild to moderate dementia, while 7 have severe dementia. This technique will make it easier to determine which age group will be affected most frequently and to recognize cognitive impairments at an early stage.

The method currently simply compares age and MMSE score for dementia. However, studies have revealed that other chronic illnesses, such as diabetes and high blood pressure, can have an impact on the early onset of cognitive deficits. Our mental health tracker aims to reach a wide age range, which reduces the stigma attached to mental health issues. To reduce the high risk of developing the condition, the tracker will help identify dementia in adults in its earliest stages. Therefore, the suggested system's subsequent step will be to forecast how chronic illnesses may result in cognitive deficits.

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