CUSTOM CONVOLUTIONAL NEURAL NETWORK METHOD BASED ALZHEMEIR'S DISEASE CLASSIFICATION

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Abstract - **Disease diagnosis is the process of deciding the illness caused by person's symptoms. Indistinct of certain symptoms and indicators are most difficult issue for making diagnosis. Disease identification is the preeminent step to cure the stage called initial condition of disease. Several expert system techniques have been developed by several experts to constructively identify Alzheimer's disease. Machine learning plays a biggest role in the expressly programmed robots . The formation of a model using machine learning algorithms may predict the diagnosis the outset of disease and provide treatments. Initial diagnosis of Alzheimer's disease can reduce the mortality rates caused by any illness and it can be appropriately treatment. Based predictive model technologies for illness prediction the majority of medical scientists are thus attracted to emerging machine learning.**

Keywords: Alzhemeir,s disease classification, Machine Intelligence, Convolutional neural - Network Algorithm, Model interpretation ,CNN Data Model.

I. INTRODUCTION

The human body's main organ is the brain. Since most alterations to the brain are permanent in severe situations, it is vital to treat brain illnesses. Loss of cognitive and functional thinking is referred to as dementia.

Alzheimers's disease is the primary cause of neurocognitive disorder which in their dark ages, Alzheimer's initially demonstrated [1] the people around the world are

over 5.5 million individuals are consider to be affected by Alzheimer's issues, loss of memory and attitude changes are all signs of Alzheimer's disease. The symptoms of the non-memory element include difficulties locating words, eyesight problems, poor judgement, and impaired thinking. Blood, cerebrospinal fluid, and pictures of the brain are biological indicators [2]. Mild, moderate and severe are some of the classifications of alzheimer's disease.

Early-onset Alzheimer's disease has some hereditary components, while late-onset Alzheimer's is caused by a complicated sequence of changes in the brain. Other factors include genetics and environment. In a healthy lifestyle Alzheimer's disease may be identified by changes occuring in body fluid and changes in the brain. The aberrant aggregates (amyloid plaques), tangled bundles of fibres (Tau Tangle), and loss of connectivity between nerve cells in the brain and some of the chemicals or proteins are discovered in Alzheimer's disease [3].

II. RELATED WORKS

DISEASE DETECTION BASED ON IMAGE PROCESSING

Image processing techniques may be used to MRI images to determine the chance of early Alzheimer's disease diagnosis. Image processing methods such as intensity adjustment, K-means clustering and the region-growing approach are used to extract the white matter and grey matter from MRI scan. The measurement of brain volume may be done using the same method [2].

In order to extract the Region of Interest from a picture, many image segmentation methods are used in image processing. The K-means clustering strategy, region expansion, split and merge, thresholding and watershed are some of the image segmentation

methods. These segmentation method is used to identify flaws in radiographic weld images such as porosity, lack of fusion, incomplete penetration and wormholes. This method is used to identify troublesome locations also. The process of industrial radiography, computer vision, optical character recognition and medical imaging are all make substantial use of them [3].

The mostly used clustering techniques is K-means algorithm. Image quality can be improved by enhancement of first partial stretching technique with the discussion of a modified version of the k-means approach . The initial centre of the cluster is built using a process called subjective clustering, which produces the prospective value of the data point. Utilizing the generated centre, pictures are segmented using the k-means algorithm [4].

In order to solve the drawbacks of the machine learning algorithm technique, the deep learning architecture is recommended for AD detection. It may detect occurrence of AD as well as Moderate cognitive impairment (MCI). Stacked auto encoders and soft max output layers to recognise the preliminary stage of AD and MCI using deep learning methods. This method may perform detection using domain-specific prior knowledge with the help of numerous training classes and fewer labelled training samples. [5]. A brain tumour is the major disorders that might be fatal. Image processing may be quite helpful for the identification process. The method for finding brain tumours is what this work aims to deliver. Thus, the K-means approach is used to identify tumours. When the algorithm runs K points and all of the points chosen from MRI image with the least degree of variance in their intensities start to migrate in the direction of their corresponding centroid. The tumour is clearly visible in the MRI after all clusters have been finished [6]. The Alzheimer's disease can be detected and diagnose by the method called Bi-Cubic interpolation .

A dead and live tissue in a brain MRI may be differentiated using pixel intensity [7]. The structure of the brain may alter naturally, thus disease is not always necessary for this to happen. As a result, it is challenging to discriminate between disease-related brain deformation in image processing. The deformation reasons may be established using the mathematical model. The elasticity of brain is used to correct the distortion on non-pathological grounds. [8].

Some of more significant 3D MRI characteristics can identify the Alzheimer's and Parkinson's disease more accurately. Applying some of evolutionary optimization algorithms to AD improves detection precision. While applying this algorithm helps in Feature extraction for superior results and accuracy.

The present method, according to reference [9], is predicated on the notion that Alzheimer's results in a certain level of brain volume reduction. The quantity of what matter (Tau Tangle) increases as the patient's Alzheimer's disease worsens, and since there is no communication between the neurons, brain cells continue to degenerate and the brain's volume decreases. The primary and secondary stages of Alzheimer's disease are treated when proportion of white matter is between 65 and 68. Hippocampal atrophy is excluded from this detection method [10]. Both the damaged area in the brain's centre and the surrounding region, which is crucial in the illness, may be used to identify Alzheimer's. Hippocampal injury and an enlarged vascular area are involved [11].

IV. PROPOSED SYSTEM

In initial stages of Alzheimer's disease detection Machine learning is one of the most important in the health care sector. The relevance and popularity of machine learning, a branch of artificial intelligence, have increased considerably during the last 20 years [13]. Machine learning algorithms are given data so they can understand the connection between input and output. Machine learning has several methods for predicting Alzheimer's disease. The techniques like Decision tree, support vector machine, naive bayes and logistic regression are utilised to build the model [14]. In the Mat lab, the implementation is finished. The health care sector contributed a lot of data to the search and development of a technology that may predict sickness at an early stage for the benefit of the public.

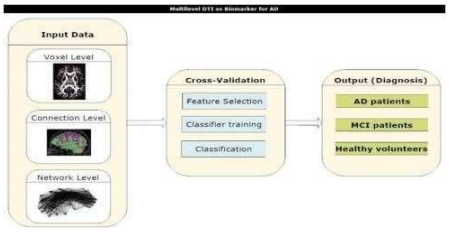

FIG 1: PROCESS OF PROPOSED SYSTEM

A. DEEP LEARNING

A variety of nonlinear transformations are used in deep learning also it is the subset of machine learning. It employs a variety of algorithms that can understand how to interpret incoming data utilising several processing layers with intricate architecture. There are several deep learning architectures including convolutional neural networks (CNN), deep auto-encoders and recurrent neural networks (RNN). The technique has been used to a variety of fields, including voice recognition, natural language processing, and medicine [15]. Recent data can be stored in the internal memory of RNN using deep learning algorithm. In RNN design memory units often include linkages to one another that transport data from one execution to the next. To adapt the context of the current input RNN changes the characteristic of the current forward process [16].

B. DATA COLLECTION

We begin by collecting the greatest dataset of images from brain MRI scans. On Kaggle and dataverse, we began by searching for MRI scans associated with images of Alzheimer's disease.

C. DATA PREPROCESSING

In this stage, the data was cleaned and pre-processed using a variety of data-mining methods. This includes handling missing data, extracting features, transforming features, and other related tasks. We discovered 9 rows with missing data in the SES column . There are two approaches to this problem. Dropping the rows with empty values is the most straightforward method.

D.FEATURE SELECTION

In this study selection of feature is used to analyse clinical data from samples that contain thousands of individuals with Alzheimer's disease. Filter methods, wrapper methods and embedding methods are three techniques are available for feature selection [22]. The filter method is a typical technique employed during the pre-processing step. Another technique that cores the feature subset is the use of wrapper methods. The filter and wrapper techniques are combined in the embedded method.

V. MODEL INTERPRETATION

The most powerful signals among the dispersed area of signal, as demonstrated in the saliency map in Figure 2 and 3. The finding supports the clinical inference that more caudal sections in theparietotemporal areas are predictive of AD and highlights their significance in the classification of an AD patient. The saliency map generally shows that the deep learning model took into account the entire brain while making the prediction, as shown in Figure 4, despite the fact that the patterns are not sufficiently specific to extract a single imaging biomarker that can be understood by humans.

In the deep learning model Saliency map is used to classify the Alzheimer illness is shown in Figure 5. A pixel's ability to forecast the Alzheimer disease class depends on how close it is to the "High" end of the colour bar in the image in Figure 6 based on the deep learning saliency map.

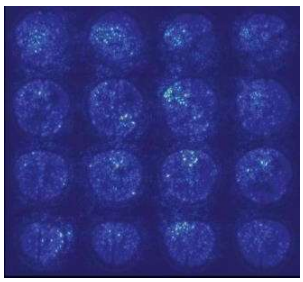

Figure 2: Saliency map of the Training Model of a 77-Year-Old

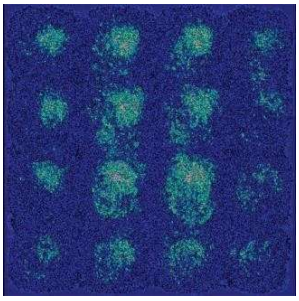

Figure 3: Average saliency map over 10% of the data of ADNI

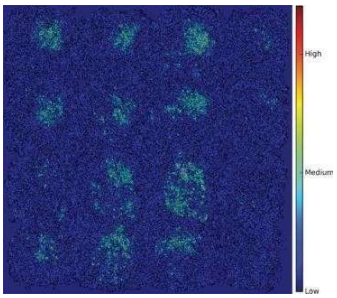

Figure 4: Average Saliency Map Over a Test Set of Independent Data

According to Figure 6, the characteristics recovered by the Inception V3 network divided the three classes into roughly three clusters after dimension reduction with t-SNE. Whereas the non-AD/MCI cluster was nearly pure, the MCIcluster included both non-AD/MCI and AD individuals, and the AD cluster included both the other two classifications. This sheds light on the model's behaviour during testing: Since almost all patients with AD were found in the AD cluster, we were able to detect AD with a high degree of sensitivity; in contrast, wewere able to detect non-AD/MCI with a relatively high degree of precision

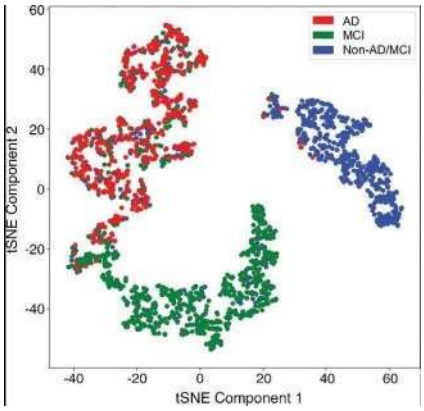

Figure 5: Visualization of Training Set After Dimension Reduction

Representation of the training set using t-distributed stochastic neighbour embedding after dimension reduction (t-SNE). The 1024 features produced by the Inception V3 network's final fully connected layer are represented by each dot.

Samples of Alzheimer's disease (AD) are denoted by red dots, those of mild cognitive impairment (MCI) by green dots, and those of neither class (non-AD/non-MCI) by blue dots.

VI. ACCURACY

Figure 6 shows the accuracy table of the deep learning models

Model	Accuracy
Custom CNN	%98.18
CNN	%86.48
DenseNet121	%88.36
InceptionV3	%76.80
ResNet50	%78.20
VGG16	%79.45

Figure 6: Model Accuracy of CNN methods

A graphical user interface (GUI) was also implemented using the Flask microframework to implement the training model developed in this project. The GUI was found to be very user friendly and intuitive and scales according to the device that accesses the web application. A few demo outputs obtained in the GUI is as showbelow in Figures 7-9.

Figure 7: Non Demented

Figure 8: Mild Demented

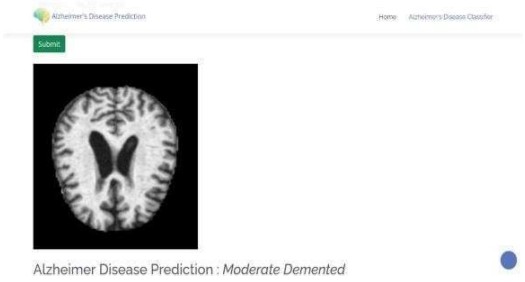

Figure 9: Moderate Demented

VII. CONCLUSION AND FUTURE WORKS

Currently the treatment for Alzheimer's disease are not highly discovered. To lower the possibility given by early interference and the symptoms are more crucial to detect the disease. Using various machine learning algorithms and microsimulation techniques a number of attempts have been made to distinguish Alzheimer's Disease. In spite of everything, it is still complicate to pinpoint the pertinent characteristics that may diagnose Alzheimer's extremely early. Future study will concentrate on the extraction and analysis of appropriate data that are more likely to help in the pinpointing of Alzheimer's disease as well as on the taking out unessential and unnecessary characteristics from current feature sets in order to increase the accuracy of detection approaches. The system will train our algorithm to discriminate between normal persons and those with abnormal condition tends to Alzheimer's by using parameters like MMSE and Education .This system uses the Python-based Flask framework to provide a web interface with a user-friendly graphical user interface (GUI) for easy usage by the general public.

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