Alzheimer Detection System

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Abstract – *Neurodegeneration in addition to poor communication between neuron synapses lead to Dementia and Alzheimer's disease. Alzheimer's disease (AD), the most common form of dementia, damages the brain, resulting in impaired memory and ability to perform daily tasks due to damage to the brain. With the help of MRI (Magnetic Resonance Imaging) scans of brain images, with the help of artificial intelligence (AI) technology, we can diagnose and predict the disease and classify AD patients to determine if they will develop this deadly disease. future. To be. The main goal of all these actions is to save time and money for radiologists, doctors and nurses and to develop better predictive tools, information and diagnostics to assist patients with this disease. Recently, the usage of deep learning algorithms has been increasingly helpful in diagnosis of AD. This is because DL algorithms work on large datasets. In the paper, we have made use of convolution neural network to work with early detection and classifying of the disease. CNNs are popular because of their excellent performance in machine learning using a wide range of information.*

Key Words: *Neurological disorder, Alzheimer's disease, Deep learning, MRI, Convolutional neural network, Brain imaging.*

1.INTRODUCTION

The number of dangerous diseases has increased in recent years due to demographic shifts in developing and developed countries [1]. Except for some medications that halt the growth of the disorders, effective therapies for dementia and Alzheimer's disease are still elusive despite advancements in medical science. Therefore, preventing the spread of illnesses into their severe stages depends greatly on early detection [1,2]. Some of the serious diseases that have received a lot of attention in the mental health field are dementia and Alzheimer's disease. This is because of its prevalence in the elderly and its negative impact on the elderly's ability to perform daily tasks. Dementia is memory loss or impairment that prevents mental health from being maintained due to aging or illness. It is characterized by changes in mental and behavioral disorders or stroke. It is a syndrome that includes impaired memory, behavior and thinking and the loss of ability to perform daily activities [3,4]. Reports from World Health Organization (WHO) state that around 47 million people across the world live with dementia. It could reach 82 million by 2030. The root cause of dementia is neurodegeneration and poor connections in the brain, which leads to poor decision making skills. Non-neurodegenerative mechanisms cause vascular dementia. Alzheimer's disease (AD) is one of the most common and common forms of dementia, accounting for 60% to 70% of dementia cases. Age is a risk factor for AD, especially in people over the age of 65. AD is more commonly found in women than men. However, the aetiology of AD has not been correctly determined by the medical personnel.. The main idea is based on the combination of extracellular Aβ peptide and hyperphosphorylated tau protein in brain cells. These two patterns are biomarkers called amyloid plaques (aggregation of beta-amyloid fragments of neurons) and tangles (intracellular accumulation of tau protein in the form of twisted filaments).

1.1 Common Symptoms

Memory Loss:

The most common symptom of Alzheimer's disease is memory loss. These include forgetting recent events, forgetting names and faces, misplacing items, and repeating questions.

Difficulty in planning and problem solving:

Alzheimer's patients often have problems planning and solving problems. This can cause problems with tasks such as paying bills, managing finances, and completing daily tasks.

Speech Problems:

Alzheimer's patients may have difficulty finding the right words to express themselves or to understand what others are saying.

Mood and behavioural changes:

Alzheimer's disease can cause changes in mood and behaviour, such as depression, anxiety, irritability, and apathy.

1.2 Neuroimaging Modalities:

The use of MRI to diagnose Alzheimer's disease has been the subject of research for many years. MRI (magnetic resonance imaging) is a non-invasive technique that provides detailed information about the brain. It is widely used in clinical practice in the diagnosis and follow-up of Alzheimer's disease. Neurons and synapses are lost in the brain, and some brain areas shrink. MRI can detect these changes.

2. DATA USED

The data is being sourced from Alzheimer diagnosed dataset and around 6000 images were used for the model training. The dataset comprises of four types of classes non-demented Alzheimer, very mild demented Alzheimer, mild demented Alzheimer and moderate demented Alzheimer.

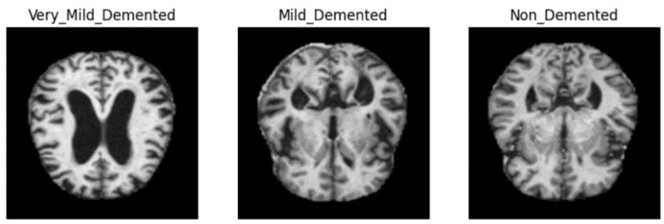

Fig 1: Input Images

3. PROPOSED MODEL

In this section, we discuss our proposed model that consists of CNN model and the following steps.

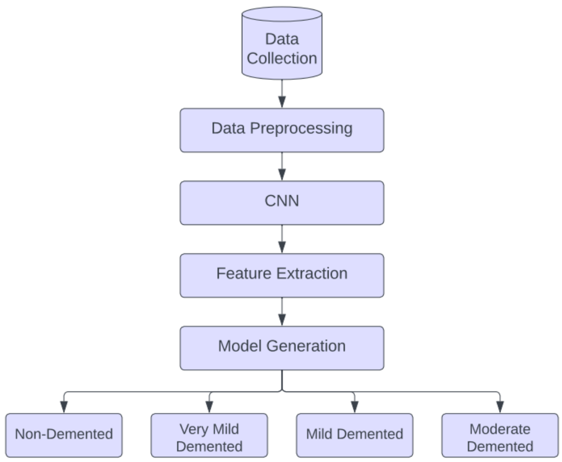

Fig 2: Proposed System Architecture

3.1 Data preprocessing

Preprocessing is used to improve image data by removing unwanted distortions and improving certain views that are important for further processing. Tagging is a type of image manipulation that combines multiple scenes into a single image. It aids in resolving issues with overlapping pictures' size, contrast, and image rotation. Combining the picture data from many photos and transforming them to the same coordinate system is known as image registration. It has several applications in clinical and medical research. Images taken for medical purposes can be collected from the same person at the same time using multiple models, or from different persons using different models. For optimum results, it's crucial to convert the MRI pictures in the file to the same width and height as they differ in size. Since the input image size of the CNN model is 224×224 pixels, this research reduces the MRI image to 224×224.

3.2 Convolution Neural Network

Convolution neural networks are a subset of deep neural networks which make use of convolutional layers for processing inputs for the included images. The convolutional layers of CNN compute the output of neurons connected to specific regions in the input and apply convolutional filters to the input. It assists in extracting spatial and temporal information from images. A weight-sharing method is used in CNN's convolutional layers to reduce the overall number of parameters.

3.2.1 Feature Extraction

This work uses a CNN-based model to extract key features without human interference. The proposed architecture consists of four convolutional layers, a max-pooling layer, dropout, flatten and a fully connected layer. The output ranges from non-demented to moderately demented.

3.2.2 Layers

Convolutions

Using a kernel size of 45*45*45, convolution operations are performed on an image of 8-block size. There are two convolutional layers employed, and the first filter has 32 3*3 kernels. The kernel's size denotes a neuron's receptive field, reinforcing the neurons' local link to the prior volume.

Rectified Linear Unit and Softmax

The Activation function of ReLU is defined [11] and the Softmax function let the model to express the inputs as a discrete probability distribution. In ReLUs the training time is significantly faster as compare to sigmoid units and hyperbolic tangent [12].

Pooling Layer

The aggregation function max-pooling is used to obtain the maximum value, as determined by the kernel size, input hxw size, and stride. The pooling approach effectively summarises the outputs of adjacent groups of the inputs in addition to reducing the inputs' dimensions [9]. When the picture size is very huge, this layer really performs down sampling, which minimises the spatial dimensions while maintaining valuable information and also reduces the number of parameters [10] in this work 1 max pooling layer is used.

Dropout

The output of neurons with a ratio dropout, or prob-ability of r, is adjusted to 0 by the usage of dropout layers in the hidden layers. The forward pass and the backpropagation processes are not affected by the neurons that dropped out. Two dropout layers, with ratios of 0.25 and 0.5, have been added to the design that we suggest.

Full Connected Layer

The last layer, which we refer to as the FC layer, is fully connected; each of its neurons is connected to the layer above it, and it also enhances the training performance of CNN models since we flattened our matrix into a vector form and fed it into the fully connected layer. [19]. All activations in the layer below it are fully connected to this layer.

4. OUTPUT

The output consists of the MRI scan with the assigned label.

Labels can be from very mild, mild, moderate and non demented. Output can get verified by a neurosurgeon and add in to acccuracy of model.

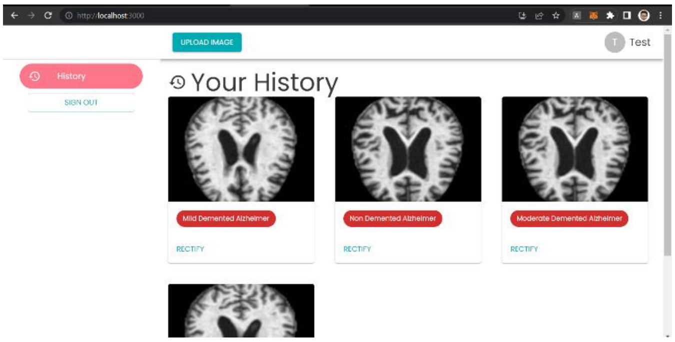

Fig 3: Output of the user Interface

5. RESULTS AND DISCUSSION

In this study, we employed MRI scan pictures that were characterized as having moderate dementia, non-dementia, or very mild dementia. We randomly selected 80% of the training data, while the remaining 20% were used to validate the model.

The CNN network has several layers, including a convolutional, activation, pooling, and fully connected layer. The activation layer applies the Rectified Linear Unit (ReLU) to increase the nonlinear properties in the CNN model because of its training speed. The first layer is the convolutional layer, which takes the input image using a kernel (ReLU) or filter and identifies the relationship between the image and their features (to identify whether the image is of an Alzheimer's patient or Normal). Since we flattened our matrix into a vector form and sent it into the fully connected layer, the fully connected layer ultimately enhances the training performance of the models. Using MRI images, CNN was employed in this study to identify and predict AD. at this model, we were able to train and test the model using 6000 photos while also achieving a test accuracy rate of 0.98% and a low proportion of test loss at a rate of 0.0667. We used four alternative epoch sizes throughout the model's testing and training in order to compare the findings and determine which one produced the most accurate outcome. With respect to all three epochs, we improved test loss and accuracy by employing 30 epochs. Table 1 depict the output and the number of epochs used in CNN.

SN	Epoch Size	Test Loss	Accuracy
1.	30	0.0667	0.9843
2.	20	0.0541	0.9789
3.	10	0.2385	0.9365

Table 1: Comparative Analysis of epoch size.

The accuracy and loss of the model's training and validation are shown in the following graph. In the following chart, training set is used to train the model, while the validation set is used to assess the model's performance.

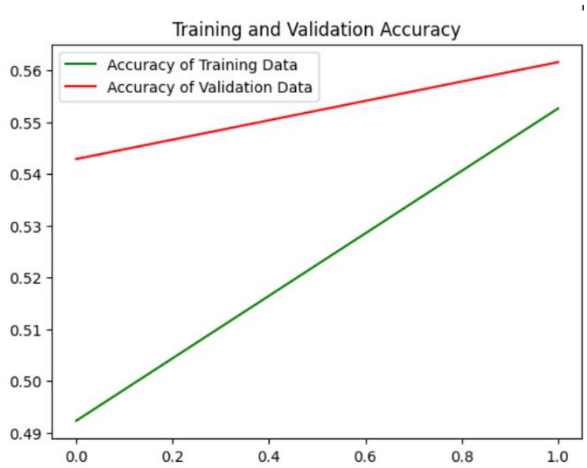

Chart 1: Accuracy of validation and test data

6. CONCLUSIONS

Recent developments in biomedical engineering have made the study and interpretation of medical pictures one of the primary research fields [14], [15]. The usage and use of DL is one of the factors contributing to this advancement in the analysis of medical pictures [16]. In the last year, DL has been mostly employed for classification, and AI-based approaches are used to automatically diagnose AD in its early stages to meet the main objectives of doctors [17]. In order to identify AD patients early, an automated framework and classification for AD utilizing MRI images is crucial. In this research, we use MRI scans to propose a convolutional neural network classification approach for AD. 98% accuracy is a huge accomplishment. A notable result was attained while dealing with an epoch size of 30, with an accuracy rate of 98%, out of all the outcomes with various epochs.

Future work is something we anticipate and hope to encourage. Consequently, the outcome might be further enhanced by using deep convolutional neural networks, which have recently demonstrated their usefulness in neuroimaging studies. As a result, the algorithm's capacity to identify AD would be greatly enhanced by the usage of deep CNN and large MRI scan pictures. Additionally, this deep learning technique offers invaluable information to the researcher in order to diagnose various types of diseases in addition to helping the doctor, carers, radiologist, and patients who are afflicted with this ailment.

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