EARLY DETECTION OF ALZHEIMER'S DISEASE USING DEEP LEARNING

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Abstract

Alzheimer's disease is a most common and widespread neurodegenerative disease. It causes cognitive impairments includes thinking, remembering, understanding, completing task, memory loss and so on. It is the sixth leading cause of death world wide only after heart disease and cancer .Despite being one of the most frequently studied diseases in medicine and healthcare, nervous disorder has no known treatment options that can slow or stop its progression. Treatment of disease symptoms is made easier when we can identify and categorise diseases early. Many studies employs machine Learning, CAD and statistical techniques are used to diagnose AD. In our proposed method early detection of Alzheimer's disease using Deep learning method. This method classifying disease more accurate using CNN architecture with MRI image.

Keywords

Alzheimer's disease, CNN, Deep Learning, MRI image.

I.Introduction

Alzheimer's disease is an irreversible, degenerative brain ailment that gradually impairs memory and thinking abilities as well as one's capacity for simply tasks.. In most persons With Alzheimer's disease begin to experience symptoms in their mid-60s.Experts believe that more than 5 million Americans may have Alzheimer's disease although estimates vary as a cause of death for older adults,It is the sixth leading cause of death worldwide only after heart disease and cancer .Dementia among older adults is brought on by it in terms of severity, dementia can range from the mildest stage,when it is just starting to interfere with a person's ability to function to the most severe level when the person is wholly dependent on others for basic activities of daily living.

When such conditions worsen socially and economically, new health care problems become more difficult to solve. For instance, it is anticipated that there will be a rise in the number of Canadians affected by dementia in the next decades, and that by 2031, the related health care expenses would double from where they were in the previous two decades, rising from $8.3 billion to $16.6 billion. [1]. This approach utilizes a CAD system in order to identify patients with Alzheimer's disease they examine the white matter,grey matter and cerebrospinal fluid using MRI and PET. To determine initial class centroids for picture clusters, the fuzzy e-means approach is employed instead of the probabilistic C-means algorithm. SVM is

utilised for classification using various kernel functions. [2].

Uses Sophisticated computer programmes and techniques in the areas of image processing and pattern recognition to identify characteristics of interest or regions of interest (FOI/ROI) in the MRI under observation when utilized properly the developed software is expected to concentrate on the crucial information while keeping a lid on the false negative rate systems,which are significantly better at spotting errors and may significantly aid the neurologist in understanding the physiological changes.There is currently a lot of research being done on a global scale about the classification and detection of different phases of neurogenerative disorders,including Alzheimer's disease[3]

Consider the MMSE (Mini-mental state Examination) as the input model for this issue. In this examination, people's ages, education levels, and other psychological characteristics are employed as major elements. In the event that patients' MMSE scores continued to decline. Alzheimer's illness estimation using the SVM and decision tree technique. then compared both systems' accuracy results [4]. This technique uses a 3D structural brain MRI dataset to distinguish between white and grey matter. choose important 2D slices for feature extraction in the cornal and axial directions. These slices were utilized in the feature extraction process to construct first order statistical features and PCA produced a significant feature vector from the feature vector. [5] ML techniques like Decision trees, Random forests, support vector machines and others were utilized to identify the proper parameters for a disease The parameters Accuracy and F1 score are used to assess this performance which is based on open access aeries of image studies(OASIS) data. [6]. The three top-scoring machine learning algorithm employed in this example to assess cognitive functioning based on demographic and neuropsychological data were SVM,Decision tree and Naïve Bayesdata from the ADNI study was applied using ten-folded cross-validation. [7]. MRI of the brain using the axial, coronal, and sagittal planes was performed using image processing techniques. In a brain MRI, the afflicted region is located using image segmentation. Alzheimer's disease, good cognition, and moderate cognitive impairment are all identified in a similar manner in affected individuals. [8]. utilised a deep learning method similar to what CNN had done in earlier phases of AD. Using 2D and 3D convolution, the initial stage of CNN architecture deals with structural brain scans in 2D and 3D from the Alzheimer's Disease Neuroimaging Initiative (ADNI) dataset. The following technique uses the VGG19 model and the transfer learning principle to benefit from a pre-trained model for medical picture categorization.[9]. In this study, deep learning and image processing methods for MRI and the OASIS collection were both employed to generate neuroimaging datasets. [10].This work applies a 23-layer CNN architecture to the first dataset for a sizable MRI training dataset in order to accurately detect brain tumors. It only deals with a little amount of data. an additional dataset with 23 layers To combat the overfitting issue that the 23 layers of the CNN architecture are facing, employ the VGG16 design. [11]. The CNN design, in conjunction with the VGG-16 and VGG-19 networks, is utilised to discover brain cancers. Use CRF-RNN instead of FCN for purposes of the last layer of categorization [12]. In this instance To increase accuracy, early Parkinson's disease identification was done utilising machine learning and deep learning on modest amounts of data. [13].A seven-way automatic multi-class skin cancer classification method using transfer learning [14].In this approach Deep neural network for precise outcomes in the early

diagnosis of Alzheimer's disease and picture identification as well [15].

The research is centred on timely identification of cancer of the liver, also called as hepatic cancer. Image processing techniques are used to enhance computed tomography (CT) scans of liver tumors. A CNN-based preprocessing strategy is employed for noise reduction, followed by segmentation and feature extraction for improved image quality and accurate tumor identification[16].The prognosis of renal tumors is determined by their histologic subtype. In late many years, there has been an expansion in the quantity of little renal incidentalomas because of the expanded utilization of stomach imaging. The majority of these unintentionally discovered tumors are renal cell carcinomas, which necessitate more aggressive treatment due to their potential for malignancy. Conservative treatment is required for 20% of these benign lesions. Dedicated diagnostic renal imaging is necessary for the characterization of renal tumors in order to simplify treatment planning. Nuclear, computed tomography, multiparametric magnetic resonance, ultrasound, and oncocytoma as well as subtypes of renal cell carcinoma can all be identified and distinguished from one another[17].Using a complex neural network such as (DCNN) which is designed to be aware of organ and tumor boundaries is one proposed method for accurately segmenting kidneys and kidney tumors from CT scans. An encoder-decoder architecture is used in this CNN, and an edge-aware loss term-supervised boundary branch is the proposed method was evaluated[18].Using CNN transfer learning, CT scans are used to categorise cancerous or non-cancerous kidney tumors. Unlike earlier transfer-learning research that solely trained the final layer, the datasets utilised in this study revealed that training layers representing around half of theinitially learned model performed better. The classification accuracy was also significantly improved by patient-level models. Nearly every patient with malignant renal tumors was identified. Such an acknowledgment capacity could dispose of the requirement for patients recognized as harmless to go through obtrusive methods[19]. The anatomopathological heterogeneity of kidney malignancies is characterized by the histological type, nuclear grade, and tumor stage, which are crucial prognostic factors. Although renal biopsy is a safe procedure, it may not provide all the necessary histological information. This has led to increased interest in abdominal CT scans, as they not only diagnose the tumor but also provide information about its characteristics and evaluate loco-regional and venous extension. Abdominal CT scans have become the standard test for evaluating renal tumors. [20]

II.PROPOSED METHODOLOGY

The process of detecting Alzheimer's disease has still challenging to find at earlier stage due to lot of issue.In this proposed method to find a Alzheimer's disease to classify the disease in image accurately using deep learning in CNN architecture. Using Transfer learning model in ResNet-50 model helps to solve the classification problem.It has possible to upload a patients MRI image in our programming to find the disease automatically. It helps to find the symptoms of the disease at earlier to prevent the treatment of the disease. Splitting Training data,Validation data and Test data to find loss and accuracy of the disease

3.2PREPROCESSING

III.BLOCK DIAGRAM

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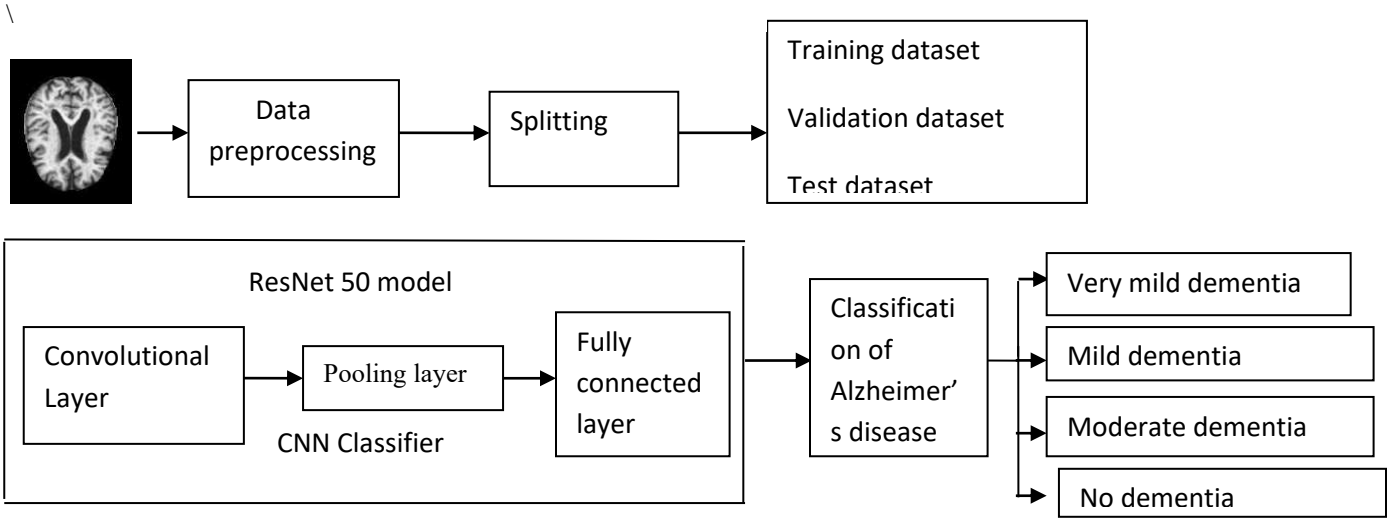

Fig 1 Block diagram of Alzheimer's diagram

3.1MRI SCAN

MRI stands for Magnetic Resonance imaging. It is a type of medical imaging that produces finely detailed pictures of the inside organs of the body using radio waves and a strong magnetic field. Compared to other imaging methods like X-rays or CT scans,MRI is safer It is non-invasive and uses no ionizing radiation. The patient lies down on a table that glides with in a cylindrical machine during an MRI.protons in the body's tissues align with the machines's powerful magnetic field, which it produces around the patient. The protons then generate signals that are picked by the system and used to produce detailed images when radio waves are sent through the body.MRI can be used to diagnose a wide range of conditions, including tumors,injuries,infections,and neurological disorders.It is especially helpful for orthopaedic and sports medicine applications since it may be used to see soft tissues like muscles,tendons and ligament. one of the most sophisticated medical imaging methods now used is MRI.

In our methods we can classified in to three classes

- Training Dataset
- Test Dataset
- Validation Dataset

The acquired photos go through preprocessing to enhance the image quality,stop unwanted distortion,and remove noise .The input image will vary in size,thus in order to preserve uniformity .The resolution and quality of the images downloaded from the internet varied along with their formats.Final images that would be utilized as a dataset were treated to gain uniformity and improve feature extraction. Preprocessing data in the deep learning workflow takes other forms when preparing raw data into a network-acceptable format. For example, Image input can be resized to correspond to an image input layer's size. Additionally, it preprocesses data to improve desired features or minimize artifacts that might bias networks.

3.3Training Dataset

The set of samples used to train a machine learning model is known as the training dataset in deep learning. These examples shows input data(features) and the output labels that go with it. To reliably predict the output labels for new, unforeseen data, a deep learning model must be trained to discover the underlying patterns and relationship in the input data. Performance a deep learning model depends greatly on the quantity and caliber of the training dataset..A bigger more varied dataset can assist the model in

developing more reliable, broadly applicable representation of the input data. On the other hand a smaller or skew dataset to over fitting or inadequate generalization to new data. Several elements such as the model architecture chosen, training algorithm, and hyper parameters, might influence the performance of the deep learning model in addition to the dataset's size and quality To achieve the best performance ,it is crucial to properly select and prepare the training dataset as well as to adjust the model's parameters.

3.4Validation dataset

A validation dataset is a portion of data that is withheld from the training set and is used to assess how well a machine learning model performed while it was a being trained. A validation dataset's goals are to provide an objective assessment of the model's performance and to aid in avoid over fitting.

3.5Test Dataset

A test dataset in machine learning is a dataset used to assess how well a trained model performed. The training dataset, which is used to train the model, is different from the test dataset. Using a test dataset serves the objective of estimating the generalization error of the model, or the error that the model is anticipated to make when used to generate predictions on fresh, unforeseen data. The test dataset need to be a good representation of the data that will be used to test the model's predictions. The examples should be varied enough to cover the range of variations that the model is likely to encounter in real-world data. It should include examples of each class or label that the model is expected to predict. The model's predictions are contrasted with the test dataset's ground truth labels when a model is being evaluated using it. Metrics like accuracy, precision, recall, F1 score, or area under the curve (AUC) for binary classification tasks are frequently used to assess the model's performance.

3.6 CONVOLUTIONAL NEURAL NETWORK

A common deep learning approach for image and video recognition is the convolution neural network (CNN). The network is constructed to automatically and adaptively learn spatial feature hierarchies from the input data .Using convolution filters or kernels to extract local information from the input image is the fundamental concept behind a CNN. Each convolution filter applies a convolution operation on the input image to create a feature map. Then, these feature maps are sent through a number of pooling layers, which cut the feature maps' spatial dimensions while keeping the most crucial data. A sequence of fully connected layers is then applied to the output of the pooling layers in order to classify the input image. Typically, a Relu activation function is used in the CNN's last layer to provide a probability distribution over all conceivable classes. Due to its capacity to automatically learn and extract characteristics from images, CNNs haven become increasingly used in computer vision task like segmentation, object detection and image categorization. Various tasks like segmentation, object detection and picture categorization. various applications such as speech recognition and nature language processing have also made use of them

3.7ResNet-50 Architecture

ResNet-50 stands for Residual Network 50. It plays a main vital role in numerous computer vision (CV).It was an innovative neural network established at 2015.It has a consists of 50 layers. 45 convolution layer, 2 for min pooling layer, 2 for Average pooling layer and 1 for fully connected layer.In this ResNet 50 model use activation function as Relu.

Skip connection

In this Skip connection insert a input to get a result of convolution block

In this algorithm to train the model to get the output 'z'. It trains on ResNet model F(Y).It gets F(Y) = 0.So that Z=X.

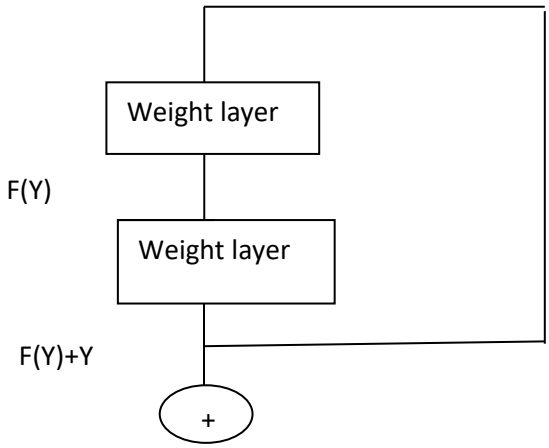

Fig 2 Block diagram of ResNet50Architecture

Skip connection is directly connected to the layers so it skips layer over some model. It results also not similar for the reason of skip connection. Eliminate skip connection input Y multiplied weight of the layer add it bias also.

Add skip connection in the equation:

F(Y) + Y

ResNet-50 architecture having two types of block called as a Identity block and Convolutional block

In this identity block value 'Y' added to this layer:

Input size = output size

So this is not a case add a convolutional block it's easy way to make input size is equal to output size.

Two easy way to make make input size is equal to output size

First step: Input terms padding.

Second step: perform 1*1convolution.

[{(n+2p-f) /s}+1]^2

Performing 1*1 convolutional size of : (n/2)*(n/2)

IV.RESULT AND DISCUSSION

Early symptoms of Alzheimer's disease can be subtle and erratic, making diagnosis challenging. Forgetting things, having trouble solving problems, having trouble speaking, and being confused are some of the early signs of Alzheimer's disease. These signs of ageing or other illnesses can be mistaken for these symptoms.The symptoms of Alzheimer's disease, which include memory loss, difficulty with daily activities, changes in mood and behaviour, get worse as the condition worsens. However, even at this point, other By helping of doctor ,MRI Images and deep learning with CNN Architecture.Based on the input MRI image in proposed method is classified in to four type of dementia.

The four type of dementia are:

- Very mild dementia
- Mild dementia
- Moderate dementia
- No dementia

VERY MILD DEMENTIA

Very mild dementia, also referred to as mild cognitive impairment (MCI), is a condition in which a person's cognitive abilities noticeably deteriorate but not to the point where they interfere with day-to-day activities.

- Dementia that is very mild can cause the following few symptoms:
- Having trouble recalling recent conversations or events
- decision-making or problem-solving challenges
- Misplacing things Problems with language

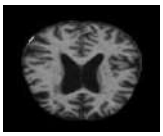

Fig 2 .MRI of Very mild dementia

MILD DEMENTIA

SSA person with mild dementia, also known as early-stage dementia, has a more pronounced cognitive decline than someone with very mild dementia. Mild

dementia impairs a person's ability to live independently and may limit their capacity for performing difficult tasks or remembering crucial details.that is mild can cause the following few symptoms:

- memory loss, especially with regard to recent events
- language difficulties, such as having trouble understanding others or finding the right words .
- difficulty making decisions or solving problemsmood or behaviour changes

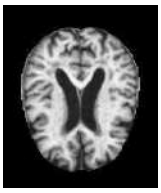

Fig 3 MRI of mild dementia

Moderate Dementia

The symptoms of moderate dementia have advanced past mild cognitive impairment but have not yet reached the severe stage of the disease. A significant decline in cognitive abilities, such as memory, language, and decision-making skills, may be seen in people with moderate dementia.

- Dementia that is moderate can cause the following few symptoms:
- Having trouble recalling recent conversations or events
- Language issues, such as difficulty using the right words and communicating clearly
- struggles with decision-making and problem-solving

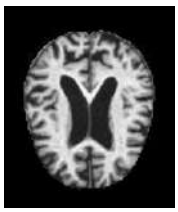

Fig 4 MRI of moderate dementia

NO DEMENTIA

Individuals with cognitive impairment but no dementiaWhose cognitive function is below average but who do not fit the criteria for dementia.

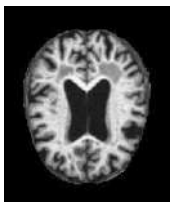

Fig 5 MRI of No dementia

V .CONCLUSION

In this ongoing study, we proposed a model for diagnosing Alzheimer's disease at an early stage using a deep learning algorithm to classify emotions. In deep learning, CNN is incredibly adept at identifying the appropriate features in each layer of an image to create a hierarchy of non-linear features that gets more complex. In our research, we have adapted Transfer learning CNNs for processing classification and have used a variety of preprocessing techniques, including resampling, resizing, cropping, converting RGB images to grey scale objects, and improving medical image processing. The effectiveness of each model was then evaluated against the results of a pretrained network using the performance metrics of accuracy loss and F1 score, with the pretrained model achieving respectable accuracy.

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