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DETECTION OF ALZHEIMER's DISEASE USING DEEP LEARNING TECHNIQUE

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Abstract:

Alzheimer's disease which is said to be a brain disorder, gradually destroys memory and thinking ability and to accomplish the simple tasks. Alzheimer's disease is found in mid-60s in people and also occurs between age group of 30 and 60 which appears to be rare. It is caused due to dementia in older people. At present there is no cure for this disease yet there are still new treatments that are evolving. We have developed a solution for this that predict if the disease is present or not using Deep learning algorithm. We have developed this model that also finds out the severities of the disease that can be non-demented, very mild demented, mild demented and moderately demented. Inception V3 Algorithm is used to produce an accurate results. It is an image recognizing model which has a greater accuracy than ImageNet dataset. Algorithm is made of symmetric and asymmetric building blocks that includes convolutions, average pooling, max pooling, concatenations, dropouts, and fully connected layers. This project helps us in predicting the Alzheimer's disease with high accuracy rate than the existing ones.

Keywords — **Deep Learning, dementia, Inception V3, ImageNet, pooling, convolution.**

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I. INTRODUCTION

Alzheimer's disease is said to be a neurological illness which causes our brain cell to shrink. Alzheimer's disease is the most prevalent cause of dementia, which is characterized by a progressive loss of cognitive, behavioral, and social abilities that impairs a person's capacity to operate independently. Alzheimer's disease affects around 5.8 million persons in the United States of America who are 65 or older. 80% are

75+. Of the approximately 50 million persons with dementia worldwide, 60 to 70 percent are expected to develop Alzheimer's disease. The sickness begins with the forgetfulness of recent events or discussions. Alzheimer's disease develops memory problems. Medications will improve or delay the progression of symptoms for a short time. These treatments can help persons with Alzheimer's disease preserve function and independence for a period of time. There is loss of brain function which can be loss of fluid, starvation. Alzheimer's disease is characterized by memory loss. One such thing is we can't recall events is a first symptom. Memory problems worsen as the disease develops, and other symptoms emerge.
To begin, a person with Alzheimer's disease may notice that they are having trouble remembering things and organizing their thoughts. A family member and friend can identify the case eventually.

II. RELATED WORKS

A. Dual Attention Multi-Instance Deep Learning for Alzheimer's Disease Diagnosis with Structural MRI:

Structural magnetic resonance imaging (sMRI) is frequently utilised for the diagnosis of brain neurological diseases, and it may represent brain differences[5]. Only a few locations in sMRI images demonstrate evident structural changes, which are highly correlated with clinical characteristics, due to local brain shrinkage. As a result, improving the identification of discriminative characteristics in sMRI-based brain illness diagnosis is a major problem[10]. We propose a dual attention multi-instance deep learning network (DA-MIDL) for the early diagnosis of Alzheimer's disease (AD) and its prodromal stage mild cognitive impairment to address this problem (MCI).

The DA-MIDL system is made up of three main components:

1) Patch-Nets with spatial attention blocks for extracting discriminative features within each sMRI patch while enhancing the features of abnormally changed microstructures in the cerebrum.

2) an attention multiinstance learning (MIL) pooling operation for balancing the relative contribution of each patch and yielding a global different weighted representation for the entire brain structure.

3) an attention-aware global classifier for learning the integral sMRI data. The baseline sMRI scans of 1689 participants from two separate datasets are used to test our proposed DA-MIDL model (i.e., ADNI and AIBL).

B. A Fully Actuated Robotic Assistant for MRI-Guided Precision Conformal Ablation of Brain Tumors:

The creation of a fully operational robotic helper for MRI-guided precision conformal surgical excision of brain tumours employing an interstitial high intensity needle-based therapeutic ultrasound (NBTU) ablator probe is described in this work[11]. The robot has an eight-degree-of-freedom (DOF) remote centre of motion (RCM) manipulator, five for aligning the ultrasound thermal ablator to the target lesions and three for inserting and positioning the ablator and its cannula to achieve the required ablation profile[6]. The 8-DOF fully actuated robot can be operated in the scanner bore during imaging, eliminating the need to move the patient in and out of the scanner during the process, potentially cutting procedure time and streamlining workflow.

C. Deep Learning for Multigrade Brain Tumor Classification in Smart Healthcare Systems: A Prospective Survey:

The grade detection of brain tumours is a difficult problem for radiologists in health monitoring and automated diagnosis. It is one of the most serious cancers in people of all ages. Several deep learning-based approaches for brain tumour categorization (BTC) have recently been published in the literature to aid radiologists in improved diagnostic analysis[13]. In this overview, we provide an in-depth evaluation of the surveys that have been published thus far, as well as newer deep learning-based BTC approaches. The key processes of deep learning-based BTC techniques, such as preprocessing, feature extraction, and classification, as well as their accomplishments and limitations, are included in our survey. We also conduct comprehensive experiments utilising transfer learning with and without data augmentation to explore the state-of-the-art convolutional neural network models for BTC[5]. In addition, this overview explains the benchmark data sets that were utilised to evaluate BTC. Finally, this study not only examines previous literature on the subject, but also takes a step forward to examine the future of this field and identify some research directions that should be pursued in the future, particularly in the area of personalised and smart healthcare.

D. Comparison of a standard resolution PET-CT scanner with an HRRT brain scanner for imaging small tumors within the head:

In order to assess the efficacy of conventional scanners for brain scanning, we compared a standard PET-CT scanner (Siemens Biograph TruePoint TrueV) with and without resolution modelling (RM) image reconstruction to a High Resolution Research Tomograph (HRRT)[14]. Both scanners were used to scan a modified Esser phantom and six neurofibromatosis 2 (NF2) patients with vestibular schwannomas (VS). On two consecutive instances, the phantom was filled with fluorine -18 (40 MBq, 4:1 contrast ratio) and scanned for 60 minutes. On three separate occasions, patients were given 200 MBq of fluorodeoxyglucose (FDG) and [18F] fluorothymidine (FLT) and scanned for three consecutive 30 minute periods, travelling between scanners[7].In compared to TrueV with and without RM, HRRT images had better contrast recovery for the smallest cylindrical inserts, albeit being noisier.In compared to TrueV with and without RM, the smallest cylindrical inserts had better contrast recovery. FDG and FLT uptake values were higher in VS lesions with the TrueV, which is consistent with more spill-in from the brain for FDG and bone marrow for FLT.

III. PROPOSED MODEL

Alzheimer's disease is a degenerative brain disease that impairs memory, thinking skills, and the ability to do even the most basic tasks. Alzheimer's disease is named after Dr. Alois Alzheimer. After a woman died of a rare mental condition in 1906, Dr. Alzheimer discovered changes in her brain tissue. Her symptoms included memory loss, verbal difficulty, and erratic behaviour. He identified many abnormal aggregates (now known as amyloid plaques) and tangled bundles of fibres in her brain after she died (now called neurofibrillary, or tau, tangles). The majority of patients with the condition in their mid-60s experience late-onset symptoms. Alzheimer's disease that develops between the ages of 30 and 60 is highly unusual. Alzheimer's disease is the most frequent type of dementia.

There is currently no cure for Alzheimer's disease, while substantial progress has been made in researching and testing new treatments in recent years. To address this, we devised a method that use a deep learning algorithm to predict the existence of disease, which entails a number of tests to arrive at a result. We can forecast the severity of the disease using this model, such as non-demented, very mildly demented, mildly demented, and moderately demented. A more advanced algorithm, such as Inception V3, is utilised to more reliably diagnose the presence of disease. On the ImageNet dataset, Inception v3 is an image recognition model that has been shown to achieve higher than 78.1 percent accuracy. The model represents the result of several ideas developed over time by a number of researchers. Convolutions, average pooling, max pooling, concatenations, dropouts, and fully linked layers are among the symmetric and asymmetric building components in the model.

As a result, this project aids in more accurately predicting the disease than previous models.

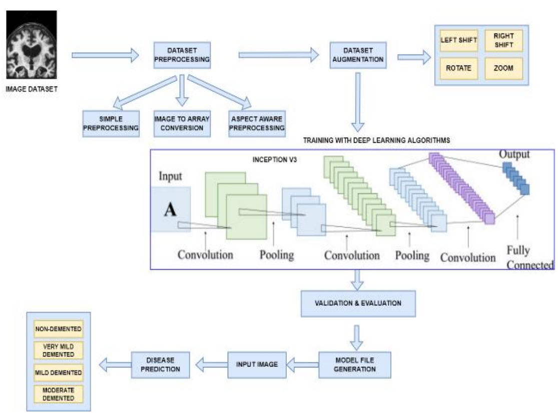

Fig 1. Architecture diagram for proposed solution

IV. IMPLEMENTATION

A. Data Collection:

We will collect data for this project, which will then be fed into deep learning algorithms for training. The accuracy improves as the dataset size grows. The datasets will be collected via the websites Kaggle and UCI.

A data set is a collection of information. Deep Learning has emerged as the preferred way for tackling a wide range of difficult real-world situations. It is, without a doubt, the most effective strategy for computer vision jobs. Deep learning's power in computer vision is demonstrated in the image above. A deep network can segment and identify the "key points" of every person in an image with enough training. These deep learning robots, which have been doing admirably, require a lot of fuel, which is data. Our model performs better when there is more tagged data available. Google has even experimented on a huge scale with a collection of 300 million photos to see if more data leads to greater performance. When using a Deep Learning model in a real-world application, it is necessary to feed it data on a regular basis in order for it to improve. And data is, without a doubt, the most valuable resource in the deep learning era.

Scraping From the Web:

Because of the amount of human work needed, manually finding and downloading photographs takes a long time. The task most likely requires the detection of common objects. As a result, the term "web scraping" is coined. It also becomes the object's class name. Every pixel in the image must be used. It's advisable to use some of the many excellent picture annotation tools that are already available. Deep extreme cut is similar to deep extreme cut, except that just the four extreme points around the object are used. This will result in some good segmentation and bounding box labels. Another possibility is to use an image annotation GUI that already exists.

Third-party:

Because data has become such a valuable commodity in the deep learning era, numerous start-ups have begun to offer their own image annotation services, in which they will collect and classify the data. Given a description of the data and annotations that are required. Mighty, a company that specialises in self-driving car picture annotation and has grown to be a major player in the field, was also present at CVPR 2018. Payment AI is less specialised than Mighty AI, and it can annotate images from any domain.

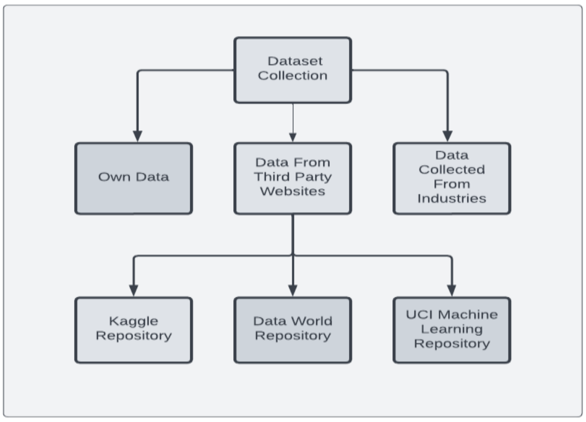

Fig 2. Data Collection

B. Data Pre-processing:

In the last several years, deep learning has fully entered the mainstream. Deep learning makes use of neural networks with a large number of hidden layers (dozens in today's state of the art), as well as a big amount of training data. These models have been very useful in acquiring insight and reaching human-level accuracy in perceptual tasks such as vision, voice, and language processing. Several decades ago, the theoretical and mathematical underpinnings were laid. The availability of large data sets/training examples in numerous domains, as well as advances in raw computational power and the rise of efficient parallel hardware, have mostly contributed to the rise of machine learning.

The network design as well as the input data type must be carefully considered when creating an effective neural network model. The colours Red, Green, and Blue are usually represented by three data channels (RGB) The most common pixel levels are [0,255]. Let's use the following values for this exercise.

- total number of images: 100
- 3 channels, pixel levels in the range [0–255]
- image width, picture height =100

Uniform aspect ratio: One of the first tasks is to make sure that all of the photographs are the same size and aspect ratio. The majority of neural network models assume a square-shaped input image, which means that each image must be evaluated for squareness and cropped accordingly. Cropping can be used to choose a square portion of an image, as illustrated in the example. When cropping, we normally focus on the central portion.

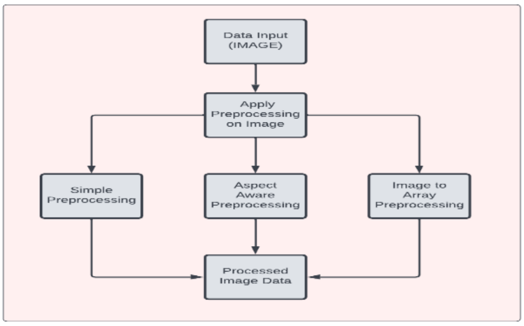

Fig 3. Data Pre-processing

C. Annotating Images:

Image annotation is the process of labelling or classifying an image using text, annotation tools, or both to indicate the data features we want our model to recognise on its own in machine learning and deep learning. We are adding metadata to a dataset when we annotate an image. Image annotation, sometimes known as tagging, transcribing, or processing, is a sort of data labelling. We may also annotate videos in real time, in a stream, or frame by frame.

We may use the photographs to train our model using supervised learning by annotating them with the features we want our machine learning system to recognise. The most typical uses of picture annotation are to distinguish objects and borders, as well as to segment images for purposes such as meaning or whole-image understanding. To train, evaluate, and test a machine learning model for each of these applications, a large amount of data is required.

An image annotation can be one of three sorts.
Image Classification - Image classification is a type of image annotation that looks for comparable things displayed in photos throughout a dataset.

Object Recognition/Detection - Object recognition is a type of image annotation that aims to accurately name one or more items in a picture by identifying their existence, location, and number. By repeating this approach with new images, we may train a machine learning model to recognise objects in unlabeled images on its own.

Segmentation - Segmentation is a more advanced application of picture annotation. This method can be used to examine the visual content of photos in a variety of ways to identify how items in an image are similar or different. It can also be used to spot changes over time.

D. Inception V3 Algorithm Training:

After the dataset has been collected and preprocessed, it will be put into Deep Learning algorithms for training. Advanced algorithms, such as Inception V3, are utilised to more correctly diagnose the existence of cancer. Inception V3 is utilised to train the datasets in this research.

1. Following the feature extraction procedure, these features are sent into a deep learning algorithm, which trains the features and produces accurate results.

2.Inception-v3 is a convolutional neural network design from the Inception family that uses Label Smoothing, Factorized 7 x 7 convolutions, and an auxiliary classifier to transport label information lower down the network, among other improvements.

3.Accuracy curves produced by GPU operations with similar configurations are matched by Inception v3 TPU training sessions.

On v2-8, v2-128, and v2-512 settings, the model has been successfully trained. The model has improved in accuracy.

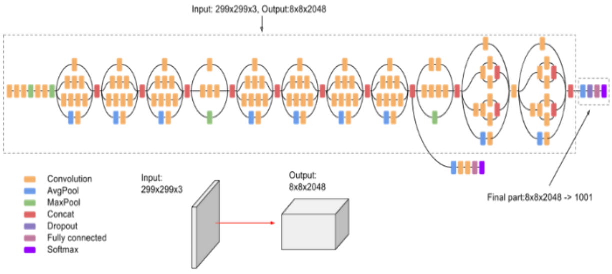

Fig 4. Training with algorithm

E. Validation and Evaluation:

The dataset was split into two portions after the Inception V3 algorithms were applied: one for training and the other for testing. The training set receives 75 percent of the dataset, whereas the testing set receives 25%. On the training set, train the model, and on the test set, validate the model. After the training data has been collected, the trained model file is created, and the testing data is fed into it. When an input image is submitted for the illness prediction process, the feature is extracted as a model file, and it predicts disease existence. The output result will be checked with actual data to see if the disease is present or not. If the data is correct, it will be accurate; if it is incorrect, it will not be accurate. Finally, it will be able to diagnose the prevalence of disease with extreme resolution.

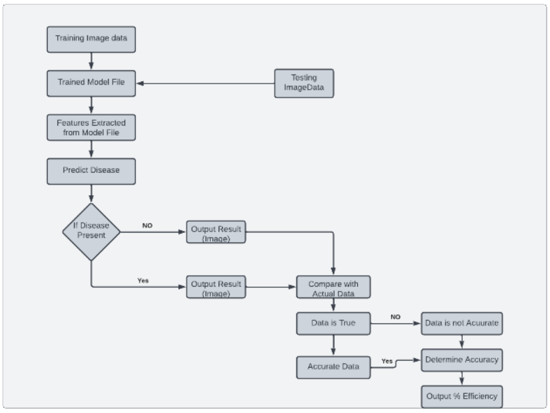

Fig 5. Validation and Evaluation

F. Disease Prediction:

The major goal is to anticipate the prediction efficiency that will be advantageous for Alzheimer's disease patients, and the percentage ratio will be reduced. In most cases, the disease can be treated with effective therapy in the early stages. As a result, it is critical to detect the condition at an early stage for the benefit of the patients.The primary goal of this study is to identify the best prediction model. The final trained model file has been created after validation and evaluation. When given an input image, it will predict the disease and verify to see if the data is correct. As a result, we can simply and accurately forecast the existence of disease.

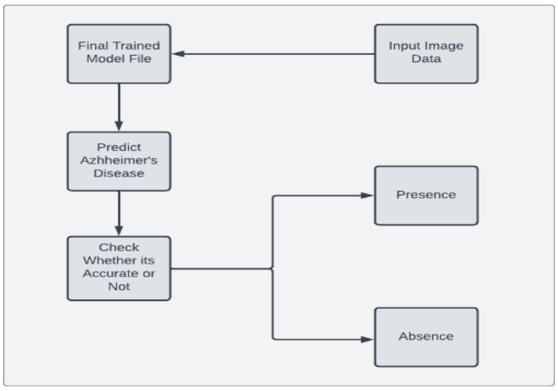

Fig 6. Disease Prediction

Advantages In Proposed System

1. A reliable method for predicting Alzheimer's disease.
2. Accurate diagnosis aids doctors in making more accurate predictions.
3. The best results are obtained using Inception V3 algorithm

V. CONCLUSION

The experiment was successful in predicting the presence of Alzheimer's disease and determining its kind. We can anticipate the severity of the disease using this model, which includes non-demented, very mildly demented, mildly demented, and moderately demented patients. As a result, this project aids in the more accurate prediction of disease than previous models.

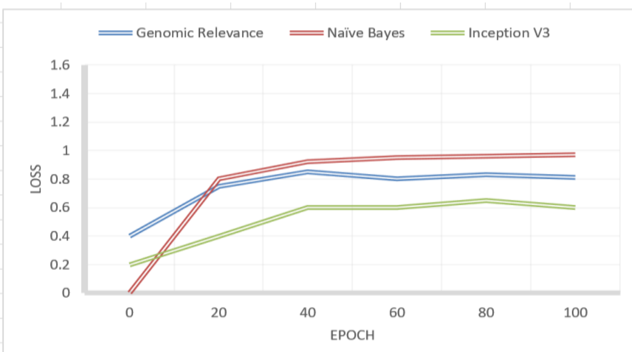

Fig 7. Frequency to Pixel Graph

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