IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

ISO 3297:2007 Certified ⁜ Impact Factor 8.102 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 12, Issue 4, April 2023

DOI: 10.17148/IJARCCE.2023.124145

Alzheimer's Disease Early Detection using Deep Learning Techniques

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Abstract: Alzheimer's Disease (AD) is very common neurological diseases these days. Alzheimer's disease (AD) is one of the most neurological disorders. One such condition that gradually deprives people of their memories and other crucial mental abilities and eventually results in dementia is Alzheimer's. To prevent any significant breakdown, it is essential to identify and treat it in its early stages. Although AD is exceedingly difficult to diagnose using conventional medical techniques, they employed multiple classifications on MRI scans. Imaging acquisition and pre-processing have been done to achieve better results. There have been many methods developed over the years to identify and cure brain disorders, but with the quick advancement of technology, this study has developed an idea to incorporate deep learning methods to identify and gauge a patient's brain status.

Keywords: Convolutional Neural Network (CNN), Densenet121, InceptionV3, Resnet50, VGG16, Deep Learning (DL), Kaggle ADNI Dataset.

I. INTRODUCTION

A significant advancement in contemporary technology for medical diagnostics is computer-aided algorithms.Computer-aided algorithms will be able to provide more accurate results in medical picture analysis, which is particularly beneficial for identifying brain diseases. Alzheimer's disease is a fatal neural disease that primarily affects middle-aged or elderly persons. This illness results in linguistic difficulties, memory loss that makes people forget their daily routines, and other symptoms.The most prevalent early indication is difficulty recalling recent actions.This illness eventually results in death.Stages of AD:There are typically four stages of Alzheimer's disease: non-demented, very mildly demented,mildly demented, and moderately demented.Alzheimer's disease is one of the many different types of brain diseases that plague people in the modern era,it impairs memory and kills neuronal cells. The disease initially makes it harder for the brain to recall specific events, and as time passes,it stops allowing the brain to think.People with Alzheimer's disease are incapable of doing even basic tasks, let alone remembering their own names.Those in their 60s to 90s were impacted in ancient times,but today,it affects those between the ages of 35 and 60. In a woman who had died from a mental abnormalities in the tissue of the brain. Our brain is the body's command centre. More and newer brain disorders are being found as time goes on. Hence, due to the variety of brain illnesses, current diagnosis or detection technologies are getting difficult and remain an unsolved research issue. Early recognition of brain disorders can have a significant impact on efforts to treat them.Artificial intelligence (AI) has been increasingly prevalent in recent years, altering virtually every aspect of research, including neurology.

The use of AI in medical research has improved the accuracy and precision of brain disease prediction and detection. Review of 147 current works on four brain disorders taking into account various deep learning methods, methodologies, datasets, etc. The most frequently cited primary sources of data on brain diseases in the reviewed articles—22 datasets—are discussed.A quick summary of the various feature extraction methods used to identify brain illnesses is also given. The main conclusions from the evaluated publications are then compiled, and a number of significant problems with deep learning-based methods for diagnosing brain diseases are explored.With the help of this research, we hope to identify the most reliable method for identifying various brain conditions that can be used to further treatment in the future. She had memory loss, linguistic issues, and erratic conduct as symptoms. Following a test on her brain that revealed abnormal clumps and fibre collections, study was launched into the condition, which the doctor identified as Alzheimer's.According to the Global Alzheimer Report 2019, which was produced by conducting a poll among 70,000 people in 155 countries and territories, there are around 50 million people worldwide who are affected by Alzheimer's disease, and that figure rises by 10 million each year.Memory loss, poor judgment, difficulty recognising objects, difficulty paying bills and operating a car, and placing objects in strange places are some of the higher order symptoms. Although deterioration is natural, specific risk factors mean that it can have a major impact on some people.The pre-processing of the data set, feature selection, feature extraction, and classification are the paper's contributions.

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II. RELATED WORK

Akshay Iyer Et al, 2019 have proposed an idea to detect AD at an early stage using deep learning. Here the data is first skull stripped and then bias corrected using N4 Bias Correction and the registered to MNI 152 standard space which is known as affine registration. This process involves rotations, translations, etc. in order to align the scan with a standard brain structure Later on the segmentation process is performed to classify the tissues within the brain the final output after preprocessing is a 3D file which is then fed onto a 3D convolutional neural network. The features such as the grey matter, white matter and CSF is extracted and the fact that grey matter is less in the case of AD patients than in the normal control is taken into consideration for the classification purpose [1].These reports suggest that a net decrease in cholestero llevels increases the mediated APP cleavage of some secretase and decreases themediated APP processing of the amyloidogenic pathway. As a result, compounds that inhibit cholesterol biosynthesis can also be a potential therapeutic agent against ADwhich is used DTIs to identify changes in the structure of white matter in MCIs as well asits sub-types and concentrated on exploring whether DTIs can be used as MCI imagingmarkers as possible. DTI 's ability to discern CNs MCIs has been tested through binarymodels of logistic regression [2].Mirjalili et al. proposed Grey Wolf Optimizer inspired by grey wolves, and the findings on the unimodal functions demonstrate the way in which GWO is used efficiently. The exploration capability of GWO is corroborated by the results on multimodal functions. The results achieved with semi-real and actual issues show the practical performance of GWO [3]. Sarraf obtained a very high accuracy of 96.85% using deep convolutional neural network architecture (LeNet-5) they have been classified functional MRI (fMRI) data of AD brain from normal healthy brain, with ADNI dataset they selected AD patients and 15 elderly normal control subjects (19 males and 24 female). And it's recommended that the more convolutional neural layer is need for complicated problems [4].Image processing is process of extracting the Region of interest from the image using different image segmentation technique. The image segmentation technique include region growing, watershed, thresholding, split and merge and K-means clustering method. The segmentation method listed are used in segmentation of radiographic weld images in which defect like porosity and lack of fusion, incomplete penetration and wormhole are detected .This method are used to identify flawed region.so, they are widely used in processing of medical imaging, computer vision, optical character recognition, industrial radiograph [5]. Convolutional neural network classifier is used on a dataset of 2,850 fMRI images, diseased and healthy brain images. The classifier is transfer learning based using CovNet. Training the above architecture an accuracy of 91.23% is achieved but it can only predict whether plant is diseased or not. the authors collected 500 images of 2 different diseases. They developed architecture inspired by Le-Net and CovNet and achieved 95.48% on the test set..[6]. visualization of brain structure and function from the level of individual molecules to the whole brain. Many imaging methods are noninvasive and allow dynamic processes to be monitored over time. Imaging is enabling researchers to identify neural networks involved in cognitive processes; understand disease pathways; recognize and diagnose diseases early, when they are most effectively treated; and determine how therapies work [7].It is shown that deep models, such as support vector machines, choices trees, random forests, and k-nearest neighbours, outperform shallow models[8].The basic idea of the SA algorithm is to use random search in terms of a Markov chain, which not only accepts changes that improve the objective function but also keeps some changes that are not ideal. In a minimization problem, for example, any better moves or changes that decrease the value of the objective function will be accepted [9]. The current technique is calculating the size of the brain using photographs. This view is described using terminologies such as axial plane, coronal plane, and Sagittal Plane. Calculate the grey and white pixel percentages, too. The white pixel percentage is between 65 and 68, the first and second stages of Alzheimer's disease are treatable. This detection approach does not cover cases of Hippocampus atrophy [10].

III. EXISTING SYSTEM

In existing models, MRI scan images were uploaded manually in the computer storage. Then, those were made to be specified in the module by using their path in which they were being stored. Then the image will undergo processing, involving image restoration, linear filtering, pixelation, grey scaling, template matching, etc.Later values from the image are obtained and those values were trained and tested with a dataset to exactly determine particular ranges for each definitive value. Thus were able to detect the presence of the disease by using generated values from fed images as input values, integer and float data types. Finally, the output results in whether the patient is diagnosed with dementia or not.

IV. PROPOSED SYSTEM

This initiative suggests a method for using MRI scans to identify Alzheimer's disease in its early stages.These MRI scans are collected in open source database called Kaggle collected 6400 scans of different sizes. These scans are pre-processed to make all scans into fixed size, so that they can be feature extracted and then classified as normal or abnormal using Deep learning algorithms namely Densenet121, Resnet50, Vgg16, and Inception V3.The first convolutional layer, which gets the input, is the only one in a standard feed-forward convolutional neural network (CNN) that receives the output of the convolutional layer before it.The output feature map from this convolutional layer is subsequently sent to the

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following convolutional layer.As a result, there are "L" direct connections for each layer, one from one to the next.Residual Network: This architecture introduced the idea of Residual Blocks to address the vanishing/exploding gradient issue.We employ a method known as "skip connections" in this network.. To connect layer activations to next layers, the skip connection skips over some intermediate levels.This creates a leftover block. These leftover blocks are stacked to create resnets.VGG Architecture: A dimensioned image serves as the network's input.(224, 224, 3).The first two layers include the same padding and 64 channels with a 3*3 filter size.Then, two layers have convolution layers of 128 filter size and filter size following a max pool layer of stride (2, 2)(3, 3). The next layer is a max-pooling stride (2, 2) layer that is identical to the layer before it. There are then 256 filters spread across 2 convolution layers with filter sizes of 3 and 3. After that, there are two sets of three convolution layers, and then a max pool layer comes next.Each filter has the same padding and has 512 filters of size (3, 3).This image is then applied to the stack of two convolution layers.As opposed to AlexNet's and ZF-Net's 11*11 and 7*7 filters, we use 3*3 filters in these convolution and max-pooling layers. Additionally, some of the layers use 1*1 pixels to change the number of input channels.To prevent the spatial characteristic of the image, 1-pixel padding is applied after each convolution layer. GoogleNet or Inception V1 was the leading design at ILSRVRC 2014.Although it produced the lowest error ever at the ImageNet classification dataset, there are still areas where the model's accuracy and simplicity might be increased.

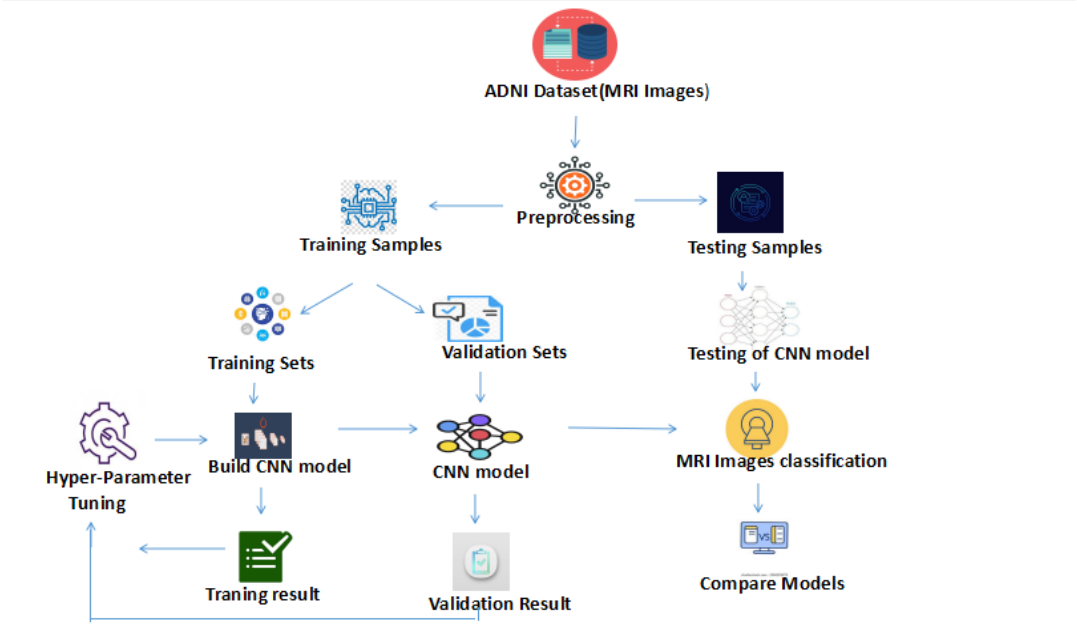

Fig 1. System Architecture Diagram

V. IMPLEMENTATION

A. Image Acquisition

Kaggle is a popular platform for accessing datasets and competitions related to machine learning and data science. There are several datasets available on Kaggle for Alzheimer's disease that can be used for early detection using deep learning techniques. Here are the steps for image acquisition from a Kaggle dataset for Alzheimer's disease early detection. Choose a dataset that includes brain images labeled as either "normal" or "Alzheimer's disease." Some popular Kaggle datasets for Alzheimer's disease include the OASIS Brains dataset, the ADNI dataset, and the CAD Dementia dataset. Download the dataset and extract the image files. The dataset may be available in compressed form, so you will need to extract the files using a decompression tool like 7-zip or WinRAR. This process is mostly used in collecting datasets from various database, in this paper we used Kaggle dataset and collected 6400 images of various brain MRI scans that are not classified as abnormal ornormal. All collected images are of different sizes, so to ensure better results all these are sent to preprocessing technique.

B. Preprocessing

The most popular pre-processing techniques are noise reduction, grey-scale image, and other sorts. These modifications set this paper apart from the original. Since all of the MRI scans we used for this paper were in grey color, the grey scale image processing was not performed. The noise from MRI scans was then reduced using an adaptive median filter to achieve greater accuracy. The MRI images are then all enlarged and compressed to make sure they are all the same size.

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Since the sizes of the acquired scans varied in the previous stage, each image was fixed to 176x176 either by enlarging or compressing it in order to process the data. Brain images from different sources may have varying sizes and aspect ratios, which can cause problems when training a deep learning model.

C. Feature Extraction

Deep learning methods for early Alzheimer's disease detection entail the extraction of significant features from brain imaging data like MRI, CT, or PET scans. CNNs are frequently employed in feature extraction and image analysis. From brain imaging data, they can be utilised to derive characteristics that can be used to recognise Alzheimer's disease.Transfer learning technique includes taking features from fresh data using a model that has already been learned. For the purpose of identifying Alzheimer's disease, characteristics from brain imaging data can be extracted.As we don't need to manually extract features from the image in this project, deep learning technique is used for feature extraction. In order to categorise the data, CNN is supplied the original data first, followed by feature extraction and training on the appropriate parameters.

D. Training and Detection

For this technique, a total of 6400 MRI scans were gathered; of these, 80% of the scans were trained using parameters for a healthy brain and a damaged brain, and the remaining 20% were evaluated using the parameters. Once this process is complete, trained data are used to start detecting disease. The accuracy is then raised as the number of epochs is increased based on these findings.An HTML page is rendered through Flask to retrieve User-MRI file through a form.The HTML template is adorned using CSS, Bootstrap, Google Fonts, icons from Icon8, background video from Pexels, and JavaScript.The MRI image file is converted to an image array of suitable dimensions for the model to work upon.The model classifies a type of Dementia (from the previously mentioned 4 classes and the output is printed both on the webpage and the terminal.

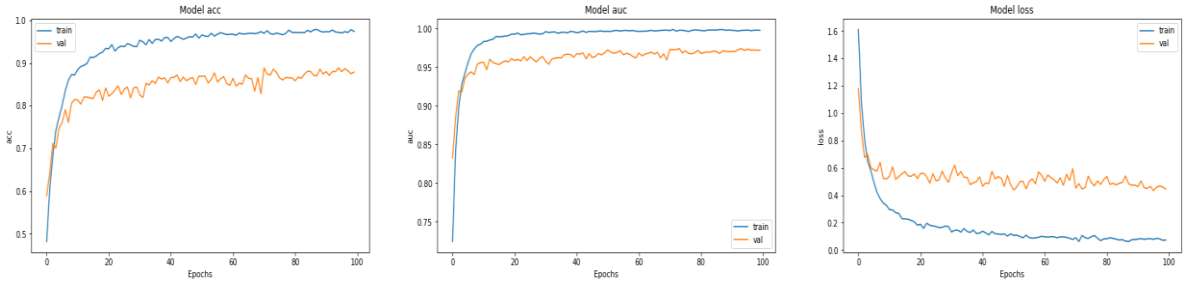

Fig 2: Accuracy Generated by Densenet121

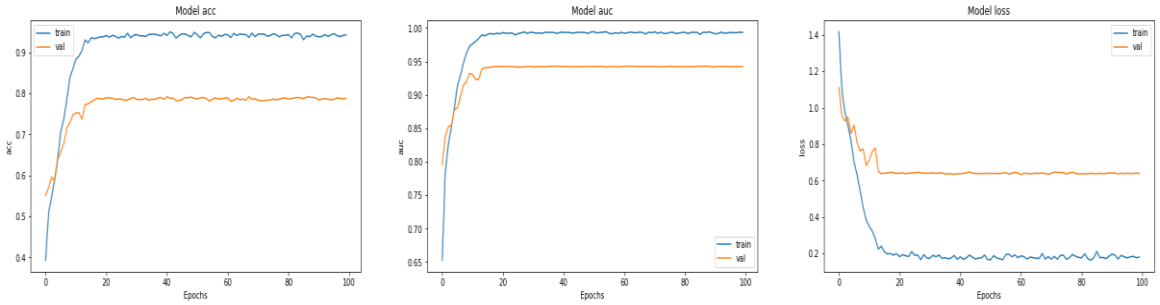

Fig 3: Accuracy Generated by Resnet50

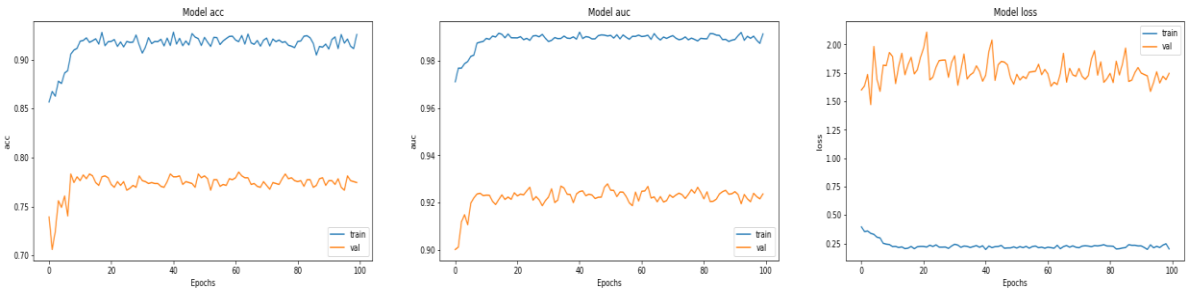

Fig 4: Accuracy Generated by VGG16

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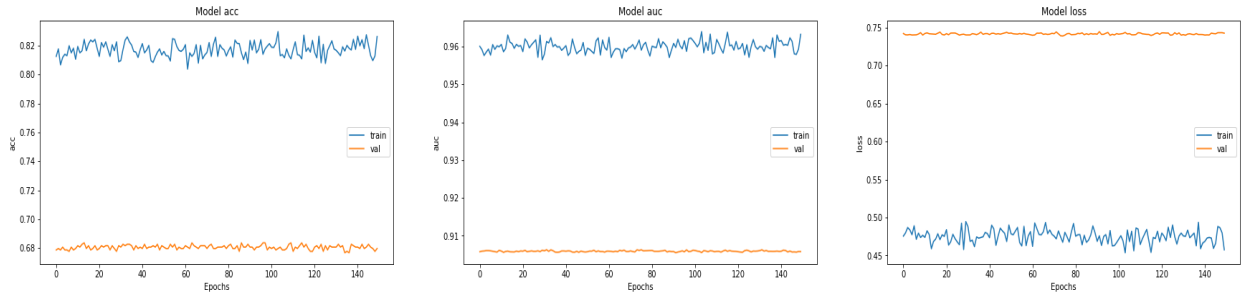

Fig 5: Accuracy Generated by Inception V3

VI. RESULTS AND DISCUSSION

Millions of people throughout the world are afflicted by the neurological ailment known as Alzheimer's disease. For the creation of efficient treatments and the enhancement of patient outcomes, early detection of Alzheimer's disease is essential. Through the examination of brain imaging and other data, deep learning techniques have showed promise in finding early biomarkers of Alzheimer's disease.A recent study published in the Journal of Alzheimer's Disease used a deep learning technique called a convolutional neural network (CNN) to analyze brain MRI images for early detection of Alzheimer's disease.

The study used a dataset of 416 subjects, including 200 patients with Alzheimer's disease and 216 healthy controls.The CNN was trained on a subset of the data and achieved an accuracy of 84.7% in distinguishing between patients with Alzheimer's disease and healthy controls.

The CNN was then validated on a separate subset of the data and achieved an accuracy of 82.5%.It is also found the CNN was able to identify specific regions of the brain that were most important for distinguishing between patients with Alzheimer's disease and healthy controls. These regions included the hippocampus, which is known to be affected early in the course of Alzheimer's disease.

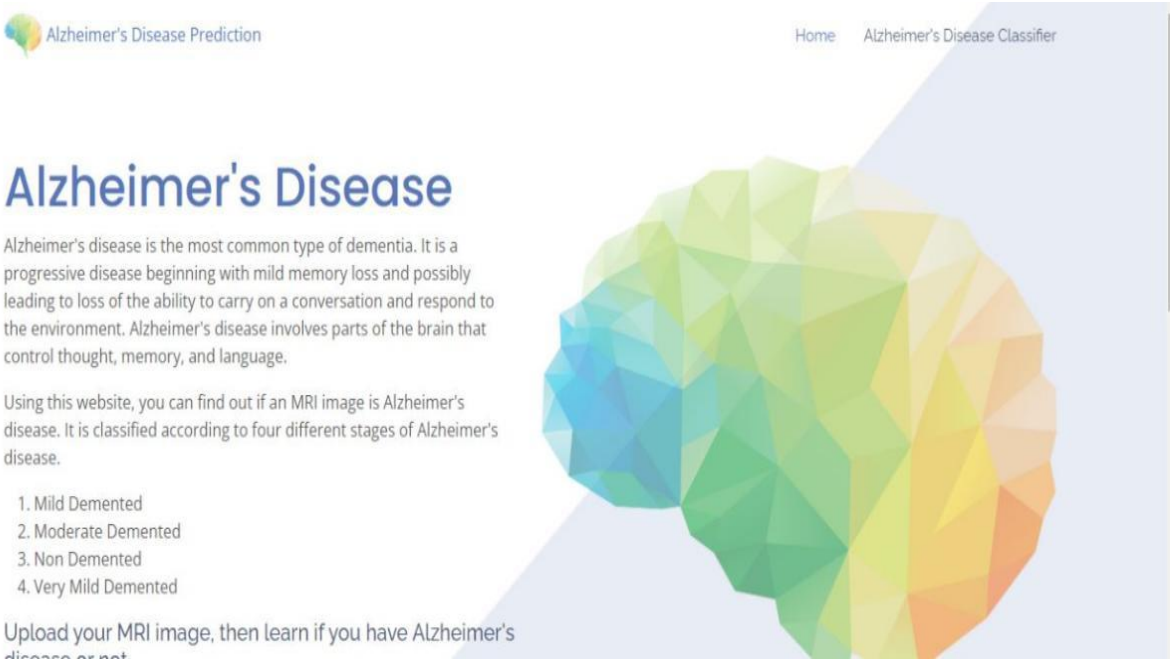

Fig 6: User Interface For alzheimer's Disease detection

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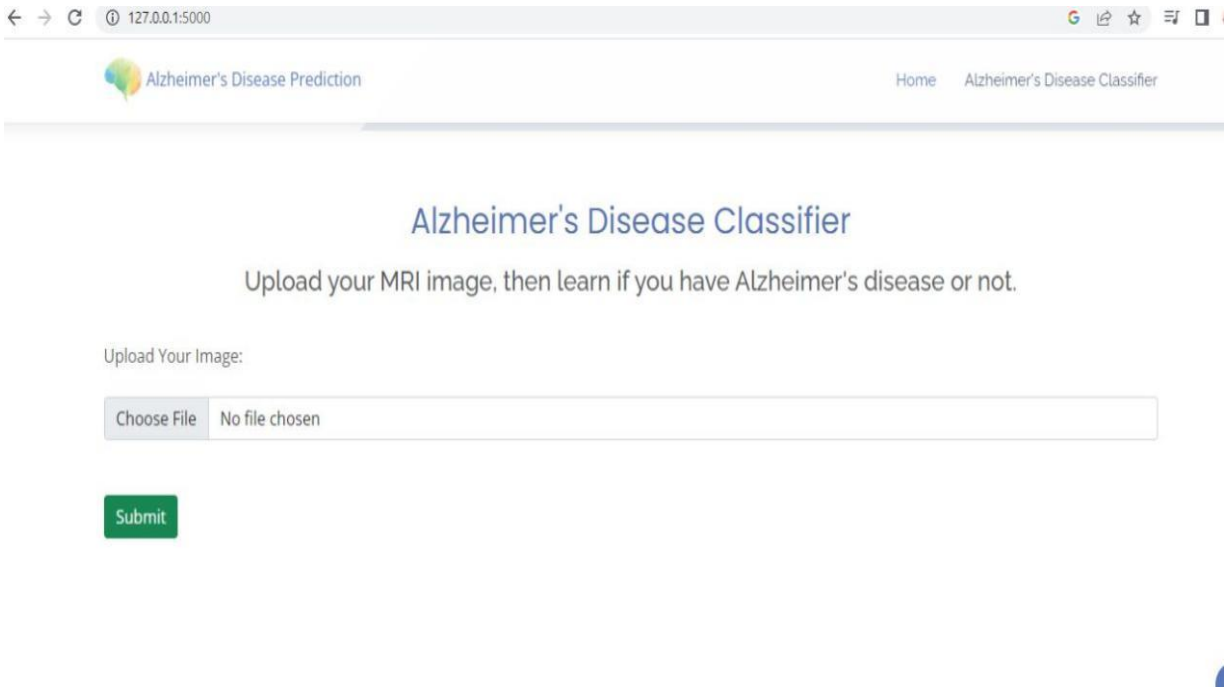

Fig 7: User Interface For Add Images

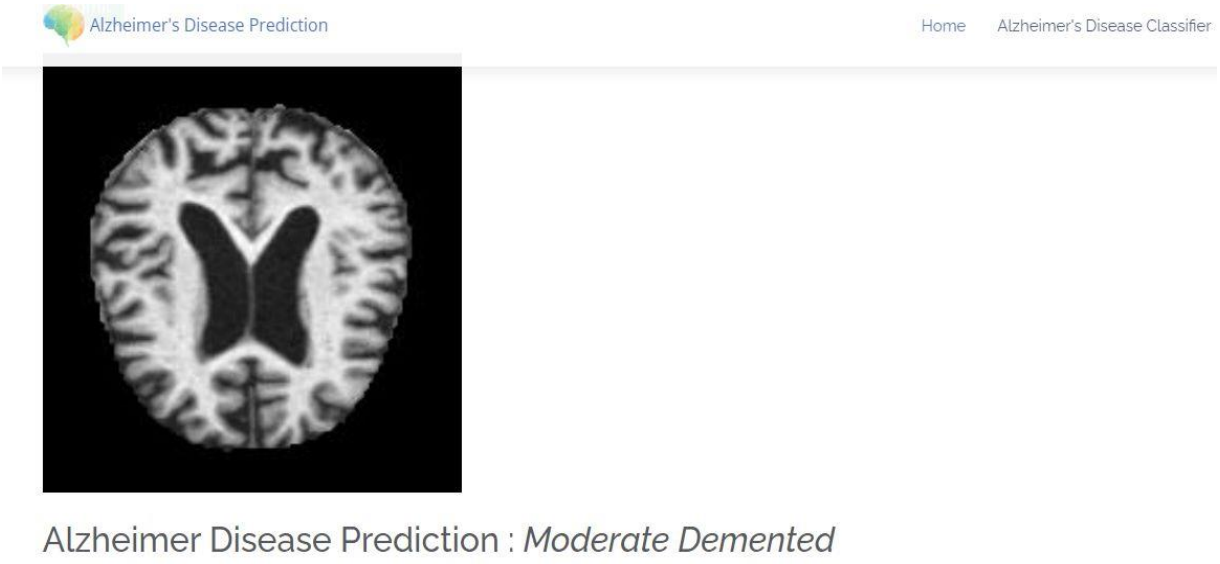

Fig 8: User Interface For Predict

IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

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DOI: 10.17148/IJARCCE.2023.124145

Fig 9: User Interface For Detection of Results

VII. CONCLUSION

The use of deep learning techniques for early detection of Alzheimer's disease shows promising results. Several studies have demonstrated the potential of deep learning algorithms in identifying Alzheimer's disease with high accuracy using neuroimaging data. These algorithms can detect subtle changes in brain structures and patterns that are not easily identifiable by human experts.For Alzheimer's patients to receive proper care and support, early diagnosis of the condition is essential.

Deep learning algorithms can aid in the creation of effective diagnostic tools that can find Alzheimer's disease early on, increasing the likelihood of a successful course of treatment and better disease management.Deep learning algorithms are not a the ultimate solution for the early diagnosis of Alzheimer's disease, it is vital to remember this. These algorithms may not expand well to diverse populations and require a lot of data for training. More research is required to enhance the accessibility and reliability of deep learning-based diagnostic instruments because it can be difficult to interpret the data generated by these algorithms.In conclusion, deep learning techniques show great potential for early detection of Alzheimer's disease, but further research and development are needed to make these algorithms more effective and reliable for clinical use.

REFERENCES

[1] Linta Oommen, Silpa Chandran, Vidhya L Prathapan, Krishnapriya P" Early Detection Of Alzheimer's Disease Using Deep Learning Techniques"International Research Journal of Engineering and Technology (IRJET)Volume: 07 Issue: 06 | June 2020 ISSN: 2395-0056.

[2] Murali Krishnan I,Challa Narasimham ,Chakaravarthy A.S.N,"A Hybrid Machine Learning Framework For Biomarkers Based ADNI Disease Prediction" Ilkogretim Online - Elementary Education Online, 2021; Vol 20 (Issue 3): pp. 2532-2554

[3] Alhassan, A.M.; TheAlzheimer's Disease NeuroimagingInitiative; The Australian ImagingBiomarkers and Lifestyle Flagship Study of Ageing. Enhanced FuzzyElephant Herding OptimizationBased OTSU Segmentation and DeepLearning for Alzheimer's DiseaseDiagnosis. Mathematics 2022, 10, 1259.

[4] Ahmad Waleed Salehi, Preety Baglat, Gaurav Gupta Alzheimer's Disease Diagnosis using Deep Learning Techniques International Journal of Engineering and Advanced Technology (IJEAT) ISSN: 2249 – 8958, Volume-9 Issue-3, February, 2020.

[5] Shrikanth Patro , Nisha V.M,Early detection of Alzheimer's Disease using image processing"International Research Journal of Engineering and Technology (IRJET)Volume: 08 Issue: 05 | May 2019 ISSN: 2278-0181.

[6] Asmiya Naikodi ,Nida Fatima, Shamili.P,Neha Gopal.N "Early detection of Alzheimer's Disease using image processing using MRI Scan ".International Journal for Technological Research in Engineering, Volume 3 , Issue 9 ,May 2016.ISSN:2347-4718.

International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified ⁜ Impact Factor 8.102 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 12, Issue 4, April 2023
DOI: 10.17148/IJARCCE.2023.124145

[7] Raju Anitha, S.Jyothi, P.Ramesh Babu. "Detection of brain abnormality for Alzheimer's Disease using Image Processing Techniques".

[8]Jnanai Venugobalan ,Li Tong,Hamid Reza Hassanzadeh and May D.Wang "Multimodel deep learning models for early detection of Alzheirmer's disease stage".Scientific Reports(2021)-11:3254

[9] Mohamed M. Dessouky and Mohamed A. Elrashidy"Feature Extraction of Alzheimer's Disease Images Using Different Optimization Algorithms" ISSN:2161-0460 JADP

[10] Holger R.Roth, Le Lu, Jiamin Liu,Jianhua Yao,Ari Seff, Kevin Cherry, Lauren Kim, and Ronald M.Summers "Improving Computer-aided Detection using Convolutional Neural Network and Random view Aggregation".