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Research Article

Automated Detection of Alzheimer's Disease by Deepnet Framework

*Saran Kumar A[1], Vikash V[2], Deepak T[3], Gowtham M[4], Praveen V[5]

[1,2,3,4,5]Department of Computer Science and Engineering, Bannari Amman Institute of Technology, Erode, Tamil Nadu.

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*Corresponding author: Saran Kumar A
Department of Computer Science and Engineering, Bannari Amman Institute of Technology, Erode, Tamil Nadu.

Abstract

This study employs deep learning techniques to introduce an innovative way of identifying Alzheimer's disease early. Alzheimer's disease affects millions of people worldwide; a degenerative neurological condition that requires early detection for efficient management and timely medical intervention. Deep learning is used in our method to reveal intricate patterns as well as abnormalities associated with the diseases using clinical data combined with huge databases of medical images like MRI and PET scans. By analysing these multimodal datasets systematically, our approach can potentially identify some early signs of Alzheimer's disease, thereby helping doctors make more accurate and speedier diagnosis. Deep learning involvement in diagnosing Alzheimer's disease through the use of deep neural network (Deep Net) framework holds promise for improved patient outcomes as well as advancing understanding on this disorder by adopting early intervention and individualized treatment plans. Automated system development for Alzheimer's disease detection through Deep Net requires consideration of procedures and factors in general. Here we present a new automated method for detecting MRI changes occurring due to AD. The MRI is analysed using Multi Scale Analysis (MSA) technique to determine its fractals at six different scales. A deep learning with Inceptionv3 classifier uses the extracted fractals as features to differentiate between brain MRIs from healthy brains and those having AD. By applying leave-one-out cross-validation technique, high classification accuracy, sensitivity, specificity was achieved in categorizing brain MRIs involving images of both healthy and AD-affected brains. The results indicate that radiologists may consider this approach as an effective means of screening AD.

Keywords: *Alzheimer's disease; Amnestic; Amyloid; Biomarker; Dementia; Memory; Mild cognitive impairment; Neurodegeneration; Synaptic plasticity.*

1.INTRODUCTION

Alzheimer's disease is a neurological illness that progresses slowly and causes great damage [1]. It is a major global public health concern. Alzheimer's disease is predicted to become more common as the ageing population grows, making early detection and intervention more important than ever. Timely identification paves the way to immediate medical attention, which could reduce the intensity of symptoms and better sufferers' lives. In healthcare and medical imaging, deep learning, a form of artificial intelligence, has been helpful [2]. It also improves diagnosis and prognosis of Alzheimer's disease using large-scale medical image datasets such as positron emission tomography (PET) or magnetic resonance Imaging (MRI). This project seeks to explore the potential of inceptionv3 algorithms in a deep net framework for improving early detection of Alzheimer's disease, diagnosing more accurately and timely, and ultimately providing treatment as well as care for those suffering from this devastating condition. One major innovative aspect is that the image data is pre-processed so that input images are trained to distinguish between an Alzheimer's affected brain from a healthy one within its dataset. A highly precise procedure like this may lead to faster diagnosis thus resulting in improved care provision and treatment options in the long run thereby enhancing lives of these victims who suffer from such life-altering ailment called Alzheimer's disease [3].

2.PROPOSED WORK

2.1 EXISTING SYSTEM:

Alzheimer's is a neurological illness and affects the nerve cells especially those that are involved in memory and thought processes [4]. The early identification of AD raises ethical concerns because there is currently no known treatment for Alzheimer's disease (AD) and medications from therapeutic trials show to moderately reduce the illness's progression while having occasionally significant side effects. Therefore, medical image analysis has proven to be very useful due to its application in this setting for both treatment follow-up and diagnosis. These pictures can best be handled by use of Computer Assisted Diagnostic Systems (CAD). We suggested an application to identify Alzheimer's disorders in our work [5]. We employed three sections to identify the disease at an early stage: frontal to extract the hippocampal region (H), sagittal to analyze the corpus callosum (CC), and axial to deal with the cortical variation features (C). Support Vector Machine is the foundation of our classification technique (SVM). The suggested method produces an early AD diagnosis accuracy of 90.66%. We suggest using this programme to identify the illness early on [6].

Hippocampus, Corpus Callosum, and Cortex are the three areas that were extracted using segmentation in our programme, which made use of the Region of Intert ROI. Subsequently, SVM-based classification steps are followed (Support Vector Machine) [7].

2.2 PROPOSED SYSTEM:

The core of the suggested system is the creation and application of the InceptionV3 algorithm, which is based on deep learning and is especially designed for the early detection of Alzheimer's disease. This novel method makes use of the powerful powers of deep learning—specifically, InceptionV3—to carefully examine and categorize medical pictures, including MRI and PET scans, together with relevant clinical data. Fundamentally, the system is designed to identify complex patterns and anomalies linked to Alzheimer's disease, hence promoting early identification and assistance [8]. To facilitate early detection and intervention, the main goal is to discover complex patterns and abnormalities linked to Alzheimer's disease. The system has a powerful image processing built in to efficiently preprocess the input images. What makes this method distinct from others is the algorithm's ability to differentiate between a healthy brain and one infected by Alzheimer's disease by itself. This computer-based classification augments accuracy, contributes towards swift decision-making for immediate actions so as to lower the diagnostic burden on healthcare practitioners. On this note, the proposed technique employs large and intricate datasets in these records and images. For better comprehension of the condition for detection of subtle clues that might precede actual clinical features. It is an anticipatory intervention policy which has a potential to enhance their quality of life as well as overall healthcare experience by giving them earlier access to support and treatment while diagnosed with Alzheimer's disease in its early stages. In other words, therefore, this suggested system signifies furthering Alzheimer's diagnosis while concurrently reaching at personalized medicine. Its purpose is to get clinicians such that it will become a useful tool in helping them quickly identify who may be potentially affected by Alzheimer disease in future [9]. Therefore, this will lead to improved patient outcomes and greater awareness about this intricate neurological ailment (Refer figure 1).

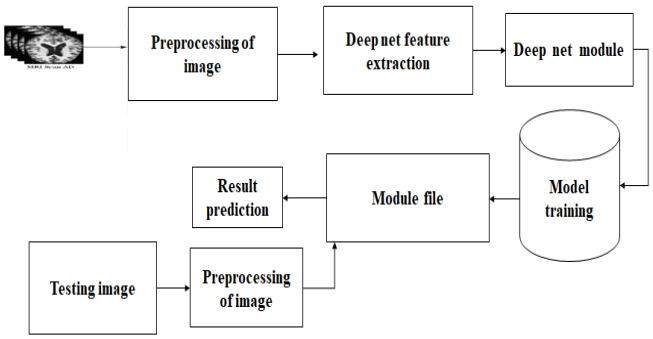


Figure 1: Block diagram of proposed system

2.3 ALGORITHM:

INCEPTION V3:

InceptionV3 is the most sophisticated deep learning system used in image recognition. CNN by Google's researchers is a major milestone in computer vision. It represented a complete change of focus from looking for more effective and precise models of image classification. Its distinctive design philosophy gives it an exceptional architecture that contains multiple inception modules making it possible to correctly capture and process information on different scales, all within one layer. This technique maximizes computational resources spent while improving accuracy of the model providing

practicality. Since its introduction, InceptionV3 has been at the forefront in various fields including auto-driven cars, medicine and agriculture [10]. In short, practitioners as well as scientists find this an important tool due to its adaptability plus efficiency which contributes to evolution of AI thereby leading to visual perception or interpretation and other intricate applications (Refer figure 2).

2.4 WORKING PROCESS:

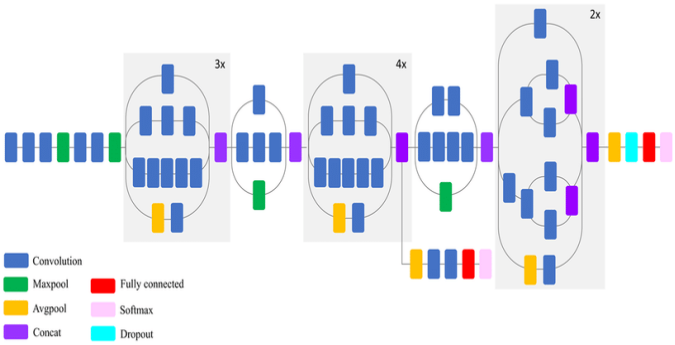


Figure 2: InceptionV3 Architecture

Input Layer:
The size is always fixed, with three RGB color channels for all input photos, usually 299 by 299 pixels.

Preprocessing Layer:
It also ensures that the input images have standardized and normalized form to support their usage in processing.

Convolutional Layers:
- Extractor of features from input images is achieved through several convolutions within InceptionV3.
- Trained on filters which can detect patterns of different sizes across the entire image.

Inception Modules:
- One standout feature of InceptionV3 architecture is the inception module. It encompasses a combination of convolution operations having different sizes.
- Every inception module contains max-pooling processes and includes 1x1, 3x3, and 5x5 convolutions.
- Within a layer network with many convolutions at various scales, rich hierarchical properties can be efficiently exploited.

Pooling Layers:
Pooling layers often have feature maps subsampled after each round of convolutional processing to reduce spatial dimensions while retaining important information.

Fully Connected Layers:
- The fully connected layers are essential in the network to carry out higher-order reasoning and combine information that has been deduced.
- The model may learn intricate associations between features thanks to the extensive connections that these layers often comprise between neurons.

Output Layer:
- Typically, the soft max layer at the top of the network generates probability distributions across all potential classes.
- This layer comprises nodes that represent classes, and the output values indicate the probability of each class being represented by the input image.

3.RESULT
The Objective of the study was to increase the model's accuracy for Automated Detection of Alzheimer's disease. Several tests were carried out, and the outcomes are detailed below.

3.1 Accuracy of the Classification Models:

The results of the recommended work were contrasted with those of related works. The results showed that the accuracy levels achieved by the recommended work were on par with or even higher than those of other relevant works. For example, the planned work using CNN - Inception V3 has an accuracy of 90.5%, which is higher than the 86.6% accuracy of the previous corresponding work using CNN - MobileNet V2.

A test set of 1000 photos was used to assess the categorization model's accuracy. The results are displayed below (Refer figures 3,4,5).

According to the findings, MobileNetV2 model had the best levels of accuracy. The accuracy levels of the ImageNet model were lower.

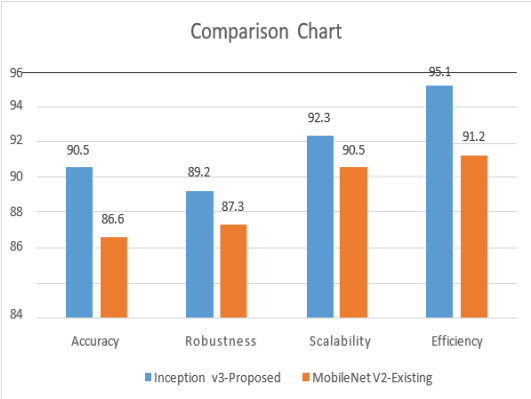


Figure 3: Performance metrics for Inception V3 and MobileNet V2

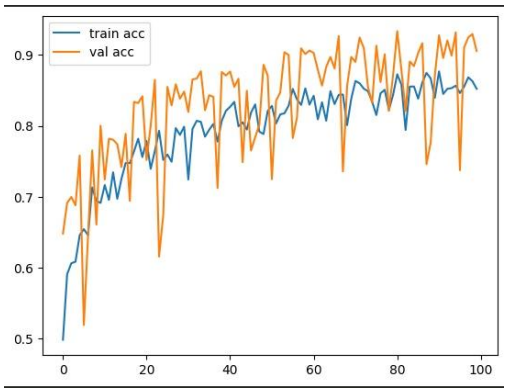


Figure 4: Comparison Chart for Training accuracy and validation accuracy

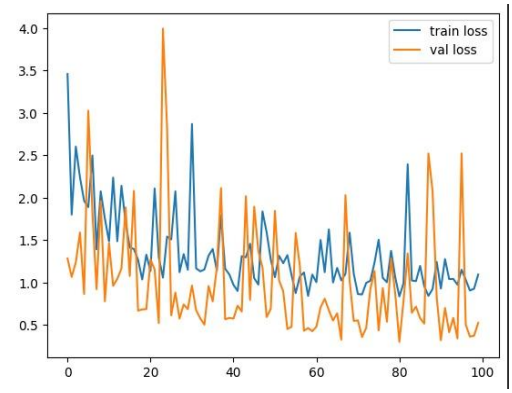
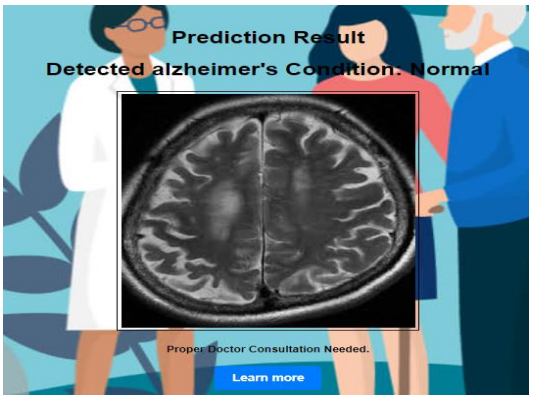
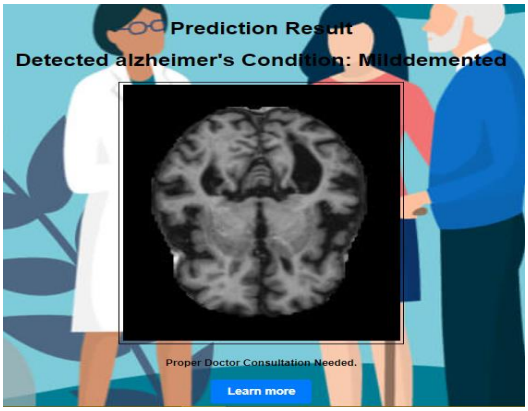
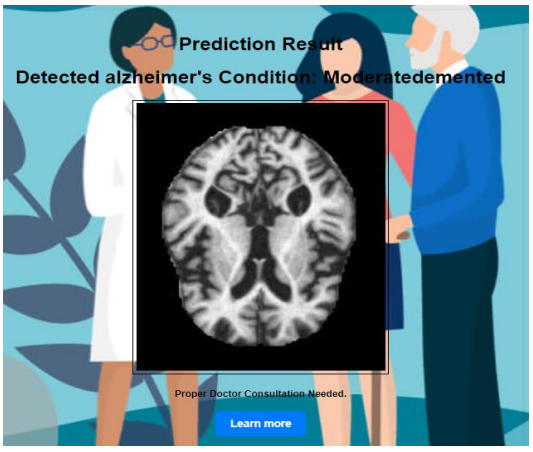


Figure 5: Comparison Chart for Training accuracy and validation accuracy

3.2 Outputs







4.CONCLUSION

In summary, our work represents a major advancement in the use of deep learning for early Alzheimer's disease diagnosis. We have built an algorithm that has the potential to find patterns and irregularities related to the disease based on the massive datasets of clinical data and medical photos. Our novel image processing method differentiates between a brain that is healthy and a brain that has Alzheimer's disease, offering researchers and medical practitioners a useful tool. Early detection is a critical component of Alzheimer's therapy and our approach offers quick intervention and patient-specific care. As we continue to build on our knowledge about Alzheimer's disease, and perfect our deep learning approaches, we come closer to making the lives of those impacted by this challenging condition better.

4.1 FUTURE ENHANCEMENT

- Privacy measures in medical data should be developed when private medical data are used. There has to be more emphasis on strong data encryption while taking into consideration the changes that take place in data security laws.

- A real-time monitoring system that continuously reviews patient information for early detection of change in brain health or cognitive performance should be installed. Those who are at risk or in early stages may find it particularly helpful.
- Examine how wearable technology and mobile apps might be combined to collect and monitor data. Patients may be able to actively engage in their own care and provide insightful data for analysis as a result.
- Provide a prognostic model that can both diagnose Alzheimer's and forecast how quickly the illness will advance. This can assist in customizing care regimens and patient assistance for individuals at varying phases of the illness.

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