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Custom Convolutional Neural Network Method Based Alzhemeir's Disease Classification

Ms .S. Madeline Arockiya Shiney
Master of Engineering,
Department of Computer Science and Engineering, KIT-Kalaignarkarunanidhi Institute of Technology (Affiliated to Anna University) Coimbatore, India.

Ms. R. Sumathy
Assistant Professor ,
Department of Computer Science and Engineering, KIT-Kalaignarkarunanithi Institute of Technology (Affiliated to Anna University) Coimbatore, India.

Abstract - *Disease diagnosis is the process of deciding the illness caused by person's symptoms. Indistinct of certain symptoms and indicators are most difficult issue for making diagnosis. Disease identification is the preeminent step to cure the stage called initial condition of disease. On the basis of prior training data machine learning is the field that may assist in predicting the illness diagnosis. Several expert system techniques have been developed by several experts to constructively identify Alzheimer's disease. Machine learning plays a major role in the expressly programmed robots . The formation of a model using machine learning algorithms may predict the diagnosis the outset of disease and provide treatments. Early diagnosis of Alzheimer's disease can reduce the mortality rates caused by any illness and it can be appropriately treatment. Based predictive model technologies for illness prediction the majority of medical scientists are thus attracted to emerging machine learning.*

Keywords: *Alzhemeir,s disease classification, Machine Intelligence, Convolutional neural -Network Algorithm, Data preprocessing ,CNN Data Model.*

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I. INTRODUCTION

The human body's main organ is the brain. Since most alterations to the brain are permanent in severe situations, it is vital to treat brain illnesses. Loss of cognitive and functional thinking is referred to as dementia.

Alzheimers's disease is the primary cause of neurocognitive disorder which in their dark ages, Alzheimer's initially demonstrated [1] the people around the world are

over 5.5 million individuals are consider to be affected by Alzheimer's language issues, loss of memory and attitude changes are all signs of Alzheimer's disease. The symptoms of the non-memory element include difficulties locating words, eyesight problems, poor judgement, and impaired thinking. Blood, cerebrospinal fluid, and pictures of the brain are biological indicators [2]. Mild, moderate and severe are some of the classifications of alzheimer's disease.

Early-onset Alzheimer's disease has some hereditary components, while late-onset Alzheimer's is caused by a complicated sequence of changes in the brain. Other factors include genetics and environment. In a healthy lifestyle Alzheimer's disease may be identified by changes occuring in body fluid and changes in the brain. The aberrant aggregates (amyloid plaques), tangled bundles of fibres (Tau Tangle), and loss of connectivity between nerve cells in the brain and some of the chemicals or proteins are discovered in Alzheimer's disease [3].

After ten years of the establishment or initial stage of the Alzheimer's disease, the symptoms start to show the buildup of amyloid plaques and protein tau tangles causes healthy neurons to cease functioning, at which point their connections to neighbouring neurons are severed, and they eventually die. The hippocampus, a critical component of memory formation in the brain, will be the first area to be damaged. The brain impacted by this chemical that starts to shrink slowly as it spreads to other areas, and by the time it reaches its ultimate stage, the whole brain has shrunk greatly [1]. The goal of the study is to identify the Hippocampus area and brain volume using brain MRI.

II.RELATED WORKS

DISEASE DETECTION BASED ON IMAGE PROCESSING

Image processing techniques may be used to MRI images to determine the chance of early Alzheimer's disease diagnosis. Image processing methods such as intensity adjustment, K-means clustering and the region-growing approach are used to extract the white matter and grey matter from MRI scan. The measurement of brain volume may be done using the same method. The MATLAB application is used to statistically and clinically analyse from top to bottom (axial plane) , from front to back (coronal plane) and side to side (sagittal plane) of the brain MRI [2].

In order to extract the Region of Interest from a picture, many image segmentation methods are used in image processing. The K-means clustering strategy, region expansion, split and merge, thresholding and watershed are some of the image segmentation methods. These segmentation method is used to identify flaws in radiographic weld images such as porosity ,lack of fusion, incomplete penetration and wormholes. This method is used to identify troublesome locations also. The process of industrial radiography, computer vision, optical character recognition and medical imaging are all make substantial use of them [3].

The mostly used clustering techniques is K-means algorithm. Image quality can be improved by enhancement of first partial stretching technique with the discussion of a modified version of the k-means approach . The initial centre of the cluster is built using a process called subjective clustering, which produces the prospective value of the data point. Utilizing the generated centre, pictures are segmented using the k-means algorithm [4].

In order to solve the drawbacks of the machine learning algorithm technique, the deep learning architecture is recommended for AD detection. It may detect occurrence of AD as well as Moderate cognitive impairment (MCI). Stacked auto encoders and soft max output layers to recognise the preliminary stage of AD and MCI using deep learning methods. This method may perform detection using domain-specific prior knowledge with the help of numerous training classes and fewer labelled training samples. [5]. A brain tumour is the major disorders that might be fatal. Image processing may be quite helpful for the identification process. The method for finding brain tumours is what this work aims to deliver. Thus, the K-means approach is used to identify tumours. When the algorithm runs K points and all of the points chosen from MRI image with the least degree of variance in their intensities start to migrate in the direction of their corresponding centroid. The tumour is clearly visible in the MRI after all clusters have been finished [6]. The Alzheimer's disease can be detected and diagnose by the method called Bi-Cubic interpolation .

A dead and live tissue in a brain MRI may be differentiated using pixel intensity [7]. The structure of the brain may alter naturally, thus disease is not always necessary for this to happen. As a result, it is challenging to discriminate between disease-related brain deformation in image processing. The deformation reasons may be established using the mathematical model. The elasticity of brain is used to correct the distortion on non-pathological grounds.

This helps to identify the variations in brain structure caused by pathogenic causes. This method is used to group the individuals according to conditions including schizophrenia which AD in healthy volunteers and normal-pressure hydrocephalus [8].

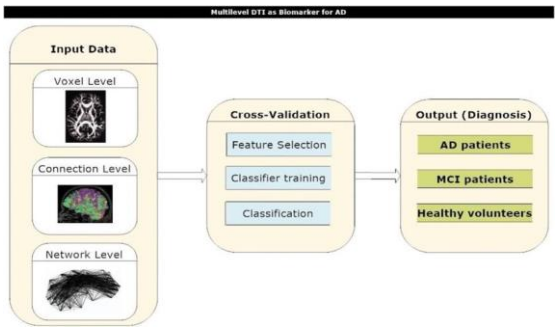
Some of more significant 3D MRI characteristics can identify the Alzheimer's and Parkinson's disease more accurately. Applying Particle Swarm Optimization, Bat Algorithm, Simulated Annealing pattern search and genetic algorithm are some of evolutionary optimization algorithms to AD improves detection precision. While applying this algorithm helps in Feature extraction for superior results and accuracy.

The present method, according to reference [9], is predicated on the notion that Alzheimer's results in a certain level of brain volume reduction. The quantity of what matter (Tau Tangle) increases as the patient's Alzheimer's disease worsens, and since there is no communication between the neurons, brain cells continue to degenerate and the brain's volume decreases. The present method relies on measuring the different angles by volume of the Brain. This viewpoint is referred to as having axial, coronal and sagittal planes. Also computes the ratio of white and grey matter. The primary and secondary stages of Alzheimer's disease are treated when proportion of white matter is between 65 and 68. Hippocampal atrophy is excluded from this detection method [10]. Both the damaged area in the brain's centre and the surrounding region, which is crucial in the illness, may be used to identify Alzheimer's. Hippocampal injury and an enlarged vascular area are involved [11].

III. PROPOSED SYSTEM

In initial stages of Alzheimer's disease detection Machine learning is one of the most important in the health care sector. The relevance and popularity of machine learning, a branch of artificial intelligence, have increased considerably during the last 20 years [13]. Machine learning algorithms are given data so they can understand the connection between input and output. Machine learning has several methods for predicting Alzheimer's disease. The techniques like Decision tree, support vector machine, naive bayes and

logistic regression are utilised to build the model [14]. In the Mat lab, the implementation is finished. The health care sector contributed a lot of data to the search and development of a technology that may predict sickness at an early stage for the benefit of the public.



IG 1: PROCESS OF PROPOSED SYSTEM

A. DEEP LEARNING

A variety of nonlinear transformations are used in deep learning also it is the subset of machine learning. It employs a variety of algorithms that can understand how to interpret incoming data utilising several processing layers with intricate architecture. There are several deep learning architectures including convolutional neural networks (CNN), deep auto-encoders and recurrent neural networks (RNN). The technique has been used to a variety of fields, including voice recognition, natural language processing, and medicine [15]. Recent data can be stored in the internal memory of RNN using deep learning algorithm. In RNN design memory units often include linkages to one another that transport data from one execution to the next. To adapt the context of the current input RNN changes the characteristic of the current forward process [16]. Similarities across succeeding slices are caused by the assumption that the area of interest in MRI medical imaging is often dispersed over many neighbouring slices. Inter-slice contexts may be extracted by RNN as sequential data from the input slices [17]. To address complicated issues and to perform a classification of large number of datasets is the convolutional neural network (CNN) in deep learning approach is used. Convolution, max-pooling, fully linked and the output layer are the four primary layers of the model [18]. Each convolutional layer produces a feature map of varying sizes and pooling layers reduces the number of feature maps that must be conveyed to the next layers. The fully connected layer then produces output as a prediction of the right class [19].

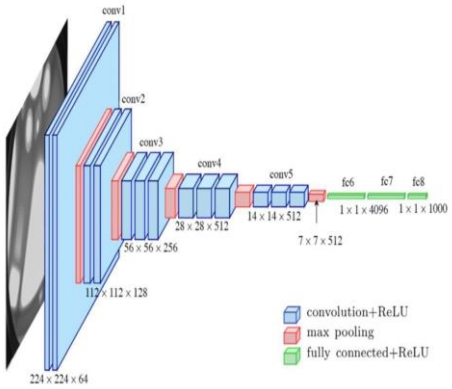


FIG 2: CNN STRUCTURE

B. DATA COLLECTION

We begin by collecting the greatest dataset of images from brain MRI scans. On Kaggle and dataverse, we began by searching for MRI scans associated with images of Alzheimer's disease. We chose the dataset with the most likes or recommendations out of many datasets that had a lot of high-quality pictures and models. When looking for the best datasets, we came across Kaggle's Alzheimer's Dataset (4 class of Photos), which had approximately 6,400 images. The dataset's top images were picked, then they were combined and categorised. The acquired pictures and dataset were used to frame and save the data in csv files.

C. DATA PREPROCESSING

In this stage, the data was cleaned and pre-processed using a variety of data-mining methods. This includes handling missing data, extracting features, transforming features, and other related tasks. We discovered 9 rows with missing data in the SES column . There are two approaches to this problem. Dropping the rows with empty values is the most straightforward method. Imputation [21], which entails substituting the missing values with their equivalent values, is the alternative method for filling up the gaps. We only have 140 measurements so if we impute the model ought to perform better in imputation the median value is used and the some of the rows with missing values are deleted in the SES property. Before extracting or analysing the data we used this exploratory data analysis technique to estimate the correlations in order to directly represent the connection of the data using a graph. Later on the information may be utilised to understand the data's nature and choose the best approach for analysis.

D.FEATURE SELECTION

In this study selection of feature is used to analyse clinical data from samples that contain thousands of individuals with Alzheimer's disease. Filter methods, wrapper methods and embedding methods are three techniques are available for feature selection [22]. The filter method is a typical technique employed during the pre-processing step. Another technique that cores the feature subset is the use of wrapper methods. The filter and wrapper techniques are combined in the embedded method.

The approaches like Correlation coefficient, Information gain and Chi-Square of feature selection that have been used most often and successfully in this study.

Coefficient of Correlation

The formula for the covariance between the two variables X and Y is [X , Y = Cov (X,Y)XY]

The linear connection between two variables is measured by their covariance. The discovery of a link between the different phases of Alzheimer's using correlation coefficients is simple. The data is gathered from so many different sources it becomes very susceptible to outliers is the common issue with the strategy.

When the attribute D is chosen, the entropy of the lower node is deducted from the entropy of the higher node to produce the Information Gain value.

Gain (D)=I(s1,s2,s3,..n)E.

(Feature D) We may investigate categorical variables using the Chi-Square approach.

Chi-Square = (Observed Expected) 2 Expected

E. INTERPOLATION

The area which is in the primary brain MRI is not eventually adequated to be utilised for pixel-owned feature identification. Therefore, interpolation is a method used in many image processing applications to improve images so that they are sufficiently smooth. In this instance, it is used to determine medical MRI images. The surface that has been interpolated is smoother than the same surface that has been generated by nearest neighbour and bilinear interpolation.

F. MODEL VALIDATION

The misclassified issue is mitigated through model validation. To determine the model's correctness and to train the ML model Cross Validation is used. To create a noise-free ML model is a difficult in undertaking. Thus in this study project cross validation is carried out which splits the whole dataset into 'n' equal-sized parts. Every iteration of the ML model uses the 'n-1' divisions to train. The mean of all 'n' folds is used to analyse the method performance. Ten-fold cross validation was used in this study to train and test the ML model ten times.

IV. OBSERVATIONAL ANALYSIS

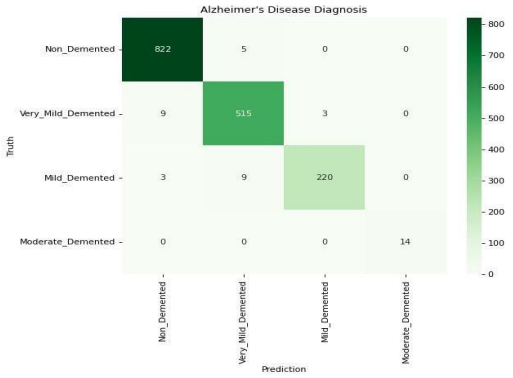


FIG 3: ACTUALS VS PREDICTED LABELS

Among the performance metrics we utilize score, recall, accuracy and precision. To classify the ideal set of parameters for the whole lot model we employ 5-fold cross validation. Testing was done on the CNN, InceptionV3, ResNet50, VGG16 and DenseNet121 models using the Alzheimer's Dataset (4 class of Images). As a consequence, we decide to modify our dataset and improve our CNN model in light of the findings.

Over-fitting and parameter tuning issues were discovered after the models had been generated using the resultant of number of measures and techniques. The confusion matrix can be perform evaluations can be either binary or multiclass in nature. A novel machine learning classifier was built and verified to predict and classify true Alzheimer's disease sufferers . Also a learning model was developed to identify those who were actually affected from a specific group. The assessment metrics for precision, recall, accuracy and F-score were calculated using these factors.

The proportion of people who are appropriately diagnosed with Alzheimer's by this research defines as recall (sensitivity) . The proportion of patients who are correctly diagnosed as not having the disease reveals how accurately Alzheimer's is diagnosed and the weighted average of recall and precision accuracy are recognised . A report outlining the results and the patient's current stages of Alzheimer's disease is presented to the patient. It is essential to recognise the stages since they are reliant on the reactions of the patients. Furthermore, understanding the stages helps clinicians to understand how the disease is affecting people.

The classifier generated 1600 predictions in total.

The classifier correctly recognised 822 of the sample's patients, despite the fact that 827 of them were genuinely "Non-Demented."

Although 527 individuals in the sample were classified as "Very Mildly Demented," the classifier correctly recognised 515 of them.

In reality, 232 of the sample's participants were labelled as "Mildly Demented," but only 220 of them were correctly recognised by the classifier.

Despite the fact that 14 of the sample's patients were really "Moderate Demented," the classifier was able to correctly identify every patient.

The accuracy table for the deep learning models created using different CNN algorithms is shown in Figure 4.

Model	Accuracy
Custom CNN	%98.18
CNN	%86.48
DenseNet121	%88.36
InceptionV3	%76.80
ResNet50	%78.20
VGG16	%79.45

FIG 4: MODEL ACCURACY OF CNN METHODS

The accuracy graph, validation graph, and training and validation graphs for the deep learning models built using the best CNN model are shown in Figure 5.
The trained model was found to have a validation accuracy of 98.18 percent and a training accuracy of 97.18 percent using CNN after 24 epochs.

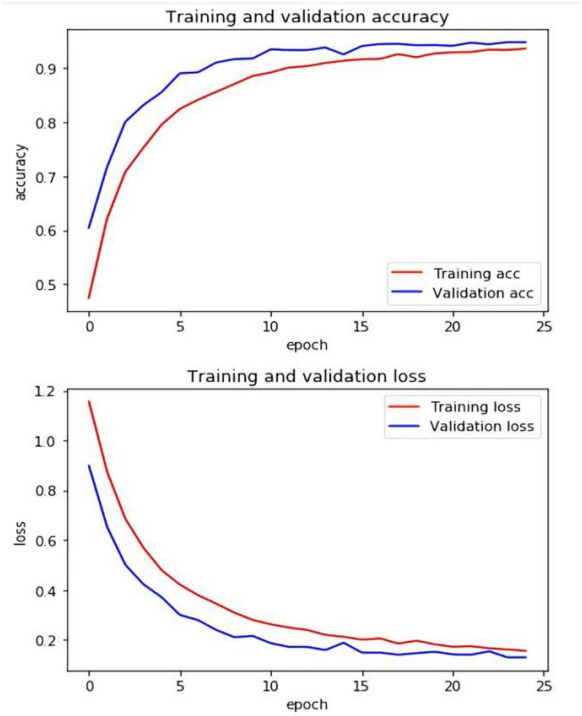


FIG 5: MODEL ACCURACY AND LOSSES OF CNN

VI.CONCLUSION AND FUTURE WORKS

Currently the treatment for Alzheimer's disease are not highly discovered. To lower the possibility given by early interference and the symptoms are more crucial to detect the disease. Using various machine learning algorithms and microsimulation techniques a number of attempts have been made to distinguish Alzheimer's Disease. In spite of everything, it is still complicate to pinpoint the pertinent characteristics that may diagnose Alzheimer's extremely early. Future study will concentrate on the extraction and analysis of appropriate data that are more likely to help in the pinpointing of Alzheimer's disease as well as on the taking out unessential and unnecessary characteristics from current feature sets in order to increase the accuracy of detection approaches. The system will train our algorithm to discriminate between normal persons and those with abnormal condition tends to Alzheimer's by using parameters like MMSE and Education.
This system uses the Python-based Flask framework to provide a web interface with a user-friendly graphical user interface (GUI) for easy usage by the general public.

REFERENCES

[1] 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.

[2] B. Karthikeyan , V. Vithiyanathan, B. Venkataraman , M. Menaka "Analysis of image segmentation of radiographic images". Indian Journal of Science and Technology "volume 5, Issue 11, November 2012. ISSN-0974-6846.

[3] Nemirakpam Dhanchandra, Khumanthem Manglem, Yembem Jina Chanu "Image segmentation using the k-means clustering algorithm and Subtractive clustering algorithm". Eleventh International multi conference on Information processing - 2015 764-771(IMCIP-2015). ELSEVIER

[4] Siqi Liu, Sidong Liu, Student Member, IEEE , Weindong Cai, Member IEEE, Sonia Pujol, Ron Kikinis , Dagan Feng ,Fellow IEEE "Early Diagnosis of Alzheimer's disease with Deep Learning"2014 IEEE 11th international Symposium on Biomedical Imaging (ISBI).31st July 2014.ISSN-1945-8457.

[5] Rohini Paul Joseph, C. Senthil Singh, M. Manikandan, "Brain Tumor MRI Image Segmentation and Detection in Image Processing". International Journal of Research in Engineering and Technology. eISSN:2319-1163|PISSN:2321-7308.
Raju anitha, S. Jyothi, P. Ramesh Babu. "Detection of brain abnormality for Alzheimer's Disease using Image Processing Techniques".

[6] John Martin, Alex Pentland, Member IEEE Computer Society, Stan Scholar off Member IEEE Computer Society and Ron Kikinis. "Characterization of Neuropathology Shape Deformations".

[7] Wenlu Yanga .f, Ronald L.M. Luib , Tony F. Chand, Shing- Tung Yau, Reisa Sperling, and Xudong Huang "Independent component analysis-based classification of Alzheimer\'s MRI data ".Maritime University, Shanghai, China Department of Mathematics.

[8] J. Ye , T. Wu , J. Li , and K. Chen , "Machine learning approaches for the neuroimaging study of Alzheimer's disease" Computer, volume- 44, no. 4, pp. 99–101.

[9] Malavika , Vanitha "Alzheimer Disease Forecasting using Machine Learning Algorithm", Department of Information Technology, Kumaraguru College of Technology, Coimbatore, India.

[10] Sidra Minhas, Aasia Khanum, Farhan Riaz"Predicting Progression from Mild Cognitive Impairment to Alzheimer's Disease using Autoregressive Modelling of Longitudinal and Multimodal Biomarkers." IEEE Journal of Biomedical and Progress.

[11] Javier Escudero, "Machine Learning-Based Method for Personalized and Cost-Effective Detection of Alzheimer's Disease", Member, IEEE, for the Alzheimer's Disease Neuroimaging Initiative.

[12] Sulaiman .N, Abdulsahib . G, Khalaf.O, Mohammed. MN. "Effect of Using Different Propagations of OLSR and DSDV Routing Protocols", In Proceedings of the IEEE International Conference on Intelligent Systems Structureing and Simulation. (2014), pp. 540–5.

[13] Weidong Cai, Sidong Liu ,Lingfeng Wen, Stefan Eberl, Michael J Fulham, Dagan Feng "3D Neurological Image Retrival with Localized pathologycentric CMRGLC Patterns"

[14] Tarek M. Hassan1, Mohammed Elmogy and El-Sayed Sallam , "Diagnosis of Focal Liver Diseases Based on Deep Learning Technique for Ultrasound Images", published online, springer, 2017.

[15] Siwei Ma, Xinfeng Zhang, Chuanmin Jia, Zhenghui Zhao, Shiqi Wang, and Shanshe Wang, " Image and Video Compression with Neural Networks: Review", IEEE Transactions On Circuits And Systems For Video Technology, 2019.

[16] Mohammad Hesam Hesamian, Wenjing Jia, Xiangjian He and Paul Kennedy, "Deep Learning Techniques for Medical Image Segmentation: Achievements and Challenges", Journal of Digital Imaging, Springer, 2019.

[17] Uday Pratap Singh, Siddharth Singh Chouhan, Sukirty Jain, And Sanjeev Jain", IEEE, 2019. Syed Muhammad Anwar, Muhammad Majid, Adnan Qayyum, Muhammad Awais, Majdi Alnowami and Muhammad Khurram Khan, "Medical Image Analysis using Convolutional Neural Networks: A Review", Journal of Medical Systems, 2019.