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ALZHEIMER DISEASE PREDICTION USING DEEP LEARNING

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ABSTRACT

In the area of medical research, the prediction of Alzheimer's disease using deep learning is of tremendous interest. It has been demonstrated that deep learning models, particularly convolutional neural networks (CNNs), are highly accurate at identifying Alzheimer's disease from MRI images. According to studies, CNNs can recognise complex features from MRI images and train themselves to distinguish between people with and without Alzheimer's disease. Large datasets of MRI scans are used to train the models, which are then used to boost their accuracy using a number of methods such data augmentation and transfer learning. Deep learning models for Alzheimer's disease prediction have the potential to dramatically advance the illness's early diagnosis and treatment, as well as support the creation of novel therapeutics.

Keywords: Alzheimer's disease, deep learning, early stage detection and diagnosis.

I. INTRODUCTION

Alzheimer's disease (AD) is a degenerative neurological disorder that causes short-term memory loss, psychosis, and delusional thoughts that are misdiagnosed as signs of stress or ageing. About 5.1 million Americans are afflicted by this disease. There is inadequate medical care for AD. A consistent medication schedule is required to manage AD. Since AD (1) is chronic, it might last for a long time or for the rest of your life. Therefore, in order to prevent significant brain damage, it is crucial to prescribe medication at the right time.Early diagnosis of this disease is a time-consuming and expensive process since we need to gather a lot of data, apply advanced algorithms for prediction, and include an expert physician. Because automated systems are immune to human mistake, they can be employed in medical decision support systems and are more accurate than human assessment. The use of pictures (MRI scans), biomarkers, and other techniques has been applied to prior studies on AD. To explore this disease, researchers used (chemicals, blood flow), as well as numerical data taken from MRI scans. As a result, they could determining whether or not a person was insane. Automating Alzheimer's diagnosis will decrease further human interaction in addition to cutting down on diagnosis time. Automation also lowers overall expenses and yields more precise results. For example, we can predict whether a patient is demented by analyzing MRI scans and applying prediction techniques. If a person has early-stage Alzheimer's Disease, they are considered demented. By doing so, we can achieve better accuracy. When a person has Alzheimer's Disease in the early stages, they can usually function without any assistance. In some cases, the person can still work, drive, and partake in social activities. Although this is the case, the person may still feel uneasy or suffer from memory loss, such as not remembering familiar words and locations. People close to the individual notice that they have difficulty remembering their names. By conducting a detailed medical interview, a doctor may identify problems with memory and concentration in the patient.

- It's challenging to remember the correct word or name are common difficulties in the early stages of Alzheimer's disease.
- Finding it challenging to remember people's names when you first meet them.
- Working in a social or professional environment every day can be difficult.
- Forgetting a recent passage you read in a book or another source.
- Having problems locating or losing a pricey item.
- Planning and organising tasks and activities is getting more and more challenging.

As the disease advances, Alzheimer's symptoms persist longer. Dementia affects a person's capacity to communicate, adapt to their surroundings, and eventually move. They find it far more challenging to express their pain with words or phrases.

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As people's memory and cognitive abilities continue to deteriorate, they can require significant support with daily tasks. At this point, people may:

- Need round-the-clock support with everyday tasks and personal care.
- They lose awareness of their surroundings and previous events.
- Your physical capabilities, including walking, sitting, and eventually swallowing, may change as you age.
- Interacting with others is getting harder and harder.
- An increase in infections, particularly pneumonia.

II. METHODOLOGY

Memory loss and increasing cognitive decline are symptoms of Alzheimer's Disease (AD), a neurodegenerative condition. For effective treatment and management, early disease diagnosis and prediction are essential.

Deep Learning (DL) is a branch of machine learning that has been effective in tackling challenging issues in speech recognition, computer vision, and natural language processing, among other areas. By examining clinical data and medical imaging, DL can be used to predict AD.

In this paper, the methodology is explained in three modules.

MODULE 1: Data collection and Deep Learning algorithm training. importing data images from a disc and reading the data.

MODULE 2: Applying resampling algorithms and extracting the dataset.

MODULE 3: Application Pre-trained transfer learning model and evaluation metrics based on accuracy, loss, auc, and f1score.

MODULE 1

- reading and importing data from open and public sources.
- The dataset is made up of MRI scans from the Kaggle Dataset.
- The data contains four classes of photographs, all of which are included in the Training Set- 5120 photographs and1280 test images are included.
- In the dataset, pictures were scaled down to 224x224 pixels.

MODULE 2

Dataset extraction for the Train folder, which is divided into four Demented categories.

- Data used to fit the model is known as the training dataset.
- The data used to verify the model's capacity for generalisation or for early termination during the training process is known as a validation dataset.
- Data used for reasons other than training and validating is referred to as a testing dataset.
- Use resampling techniques: Resampling is a technique for more accurately measuring the uncertainty of a population parameter and doing so affordably by employing a data sample.

MODULE 3

ResNet50, ResNet101, ResNet101V2, and ResNet50V2 deep CNN-based models were built to classify Alzheimer's disease from MRI scans into multiple categories.

- The straightforward ratio of successfully identified points to all of the points is called accuracy.
- Precision is the percentage of cases that are accurately classified out of all instances that are classified.
- Recall is the percentage of correctly classified instances out of all instances that were classified.
- The harmonic mean of recall and precision is the F1 score.

Precision equals TP/TP + FP

Recall is calculated as follows: Recall = TP/ TP+FP

F1 score=2+Precision+Recall / (Precision+Recall)

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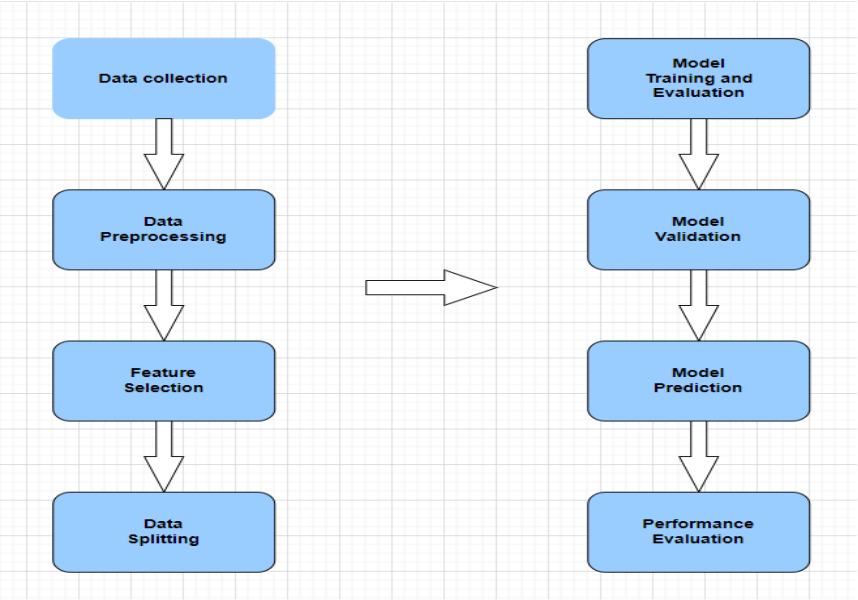

Figure 1: Proposed workflow

Figure 1 Describes the system workflow for predicting Alzheimer's Disease at early stage.

A technique for AD prediction using DL is as follows:

Data Collection: The first step entails gathering clinical information and medical pictures from AD patients as well as from healthy volunteers. Neuropsychological testing, PET scans, MRIs, and demographic data are some examples of this.

Preprocessing: In this step, the data that has been gathered is preprocessed using techniques including feature extraction from clinical data, normalisation, registration, and segmentation of medical pictures.

The following stage is to build a DL architecture to forecast AD. Convolutional neural networks (CNNs), recurrent neural networks (RNNs), or a mix of the two can be used for this. The preprocessed data should be used to train the DL model using the proper hyperparameters.

Model Evaluation: Various measures, including accuracy, sensitivity, specificity, and area under the curve (AUC), should be used to assess the trained DL model.

Feature Importance Analysis: This analysis can be carried out using methods like permutation importance or Shapley Additive explanations (SHAP) to determine the most significant features that contribute to AD.

Model Deployment: The model can be used to forecast AD on fresh, untested data after it has been trained, assessed, and tested.

In conclusion, DL-based AD prediction is a promising method that can aid in the early detection and management of the illness. The methodology for AD prediction requires careful data collection, preprocessing, DL model development, evaluation, and feature importance analysis.

III. MODELING AND ANALYSIS

We resize the photos to fit within the [0, 1] range. then, we can observe that the size increases for each convolutional layer, from 16 to 32 to 64. When making convolution, the kernel must be in the centre of all the pixels that it sees, so if we do not add padding it cannot convolute the edges so we will lose some information. The parameter 3 is the kernel size; frequently it is 3, but we can see 5 as well. We specify the padding as the same, which means when the convolution occurs we put all around the image 0 pixels. The max pooling has a 2 by 2 matrix size, parses the images to obtain the maximum value between 4 pixels, and so forth. Finally, to prevent overfitting, we add a dropout layer that will randomly remove some neurons. Next, we add a flatten layer to combine everything into a single-dimensional array. All layers except the final one have constant activation, but the final layer must have as neurons the total number of classes.

The Dataset is classified into four categories. They are Demented, Non Demented , Mild Demented and Very Mild Demented.

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Demented :

- Difficulty recalling personal history
- Travel or money management challenges
- Less emotional expression
- Disengagement from difficult situations; no reports of memory issues

Non Demented :

- No complaints of memory problems
- No signs of cognitive impairment

Mild Demented :

- Reduced ability to focus
- Task difficulty at work
- A little denial and worry about the deficiencies

Very Mild Demented :

- Complaints of memory issues, such as losing things or forgetting people's names.
- No indication that there are problems at work or in social situations

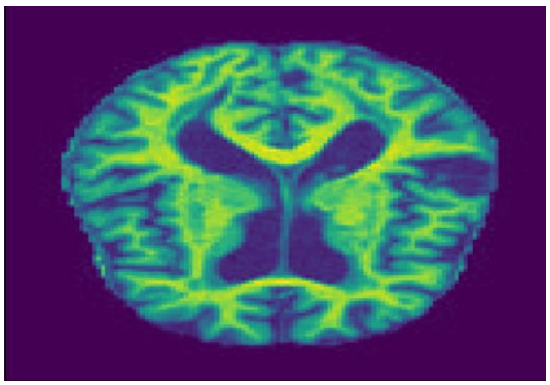

Figure 2 : Mild Demented

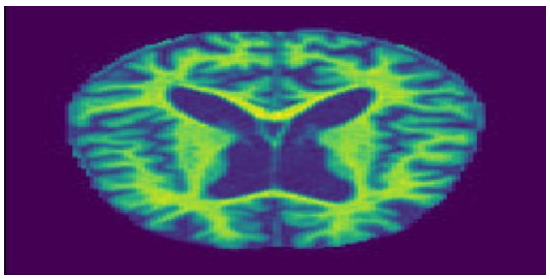

Figure 3: Moderate Demented

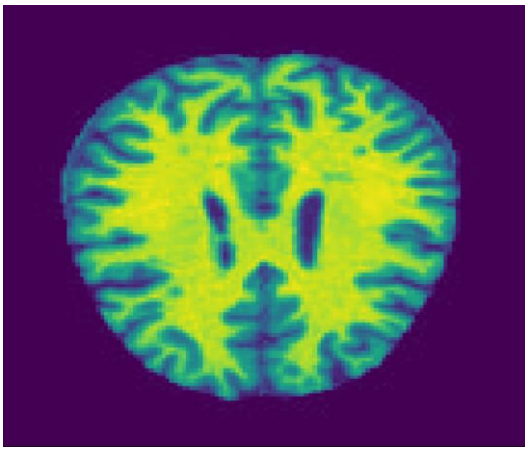

Figure 4: Non Demented

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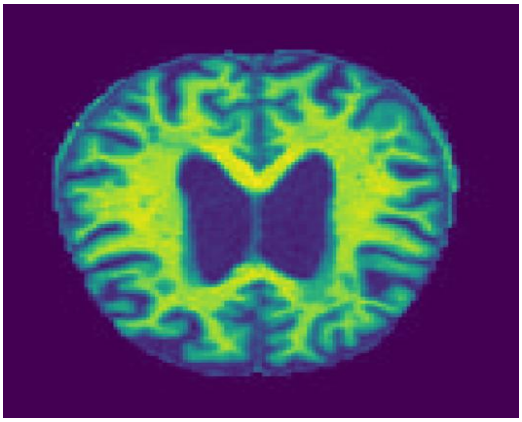

Figure 5: Very Mild Demented

IV. RESULTS AND DISCUSSION

Deep learning has demonstrated encouraging results in the prediction of Alzheimer's disease. It involves using extensive databases of clinical data and brain scans to train a deep neural network to identify patterns and predict the likelihood of getting Alzheimer's disease.According to reports, the deep learning model's accuracy is between 80 and 90%, which is a major improvement over conventional diagnostic techniques . The model's capacity to precisely forecast when Alzheimer's disease will begin can aid in early diagnosis, improving the course of therapy.Deep learning for Alzheimer's prediction is still in its infancy, and further research is required to confirm its dependability and accuracy. However, the advantages of this technology may greatly enhance Alzheimer's disease diagnosis.

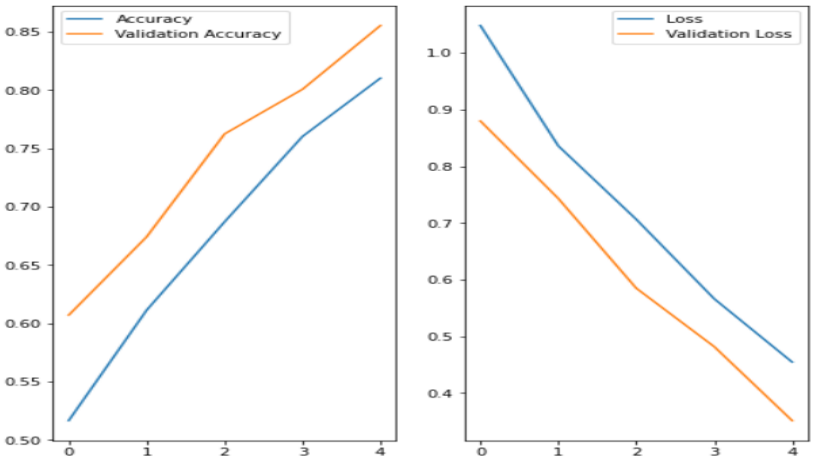

Figure 6: Accuracy/Loss Validation Graph

A deep learning model's performance during the training and validation phases is displayed using a visualization tool called an accuracy/loss validation graph. In this instance, it is used to assess how well a deep learning model predicts whether or not a patient has Alzheimer's disease.Two primary lines make up the graph. The accuracy of the model during training is shown on the first line, and accuracy during validation is shown on the second line. These lines are graphed against the number of iterations through the training dataset, or epochs.Both lines start out with low accuracy during the early epochs, which is to be expected given that the model is still developing. However, as the number of epochs rises, the model's accuracy on the training set rises while it stays the same or slightly declines on the validation set. When the model starts to memories the training data and performs poorly on new data, this is known as overfitting.The error of the model on the training set is shown by the loss line. The loss goes down as the number of epochs goes up, showing that the model is improving and getting more accurate. The loss on the validation data, however, may start to grow during overfitting, indicating that the model has to be adjusted to prevent this problem.The accuracy/loss validation graph, as a whole, aids researchers in evaluating the effectiveness of their deep learning model and pinpointing possible growth regions.

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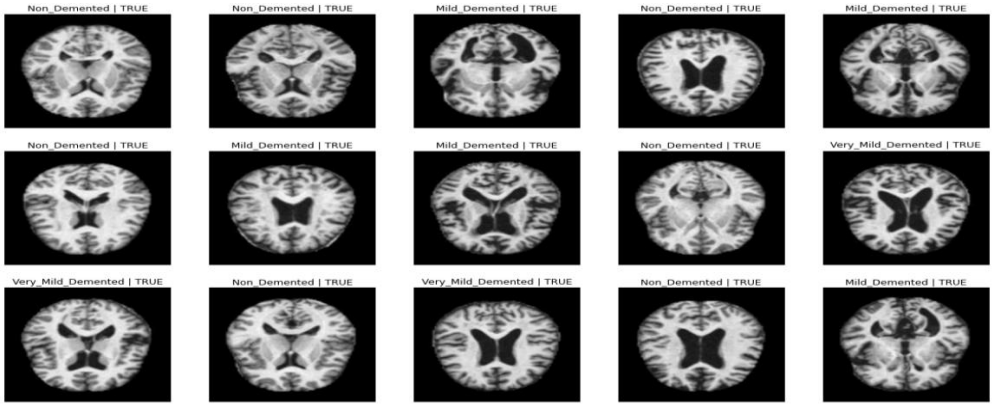

Figure 7: Result

Figure 7 Shows the category to which the MRI images belong is determined. The Four Categories are Demented, Non Demented, Mild Demented and Very Mild Demented.

IV. CONCLUSION

Overall, based on a high-level examination of the literature, we discovered that the published articles in this field tend to concentrate on two main fields of study: neuroimaging and image analysis, with the latter area seeing an increase in attention. Despite being viewed as exhaustive and thoroughly carried out, the effort adds little knowledge to the first AD detection because the majority of the chosen patients already had AD. This study analysed a number of significant AD datasets, diagnosis methods, and detection methods. This method can be used for neuroimaging studies at an early stage.

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V. REFERENCES

[1] Suhad Al-Shoukry , Taha H. Rassem and Nasrin M. Makbol , “Alzheimer’s Diseases Detection by Using Deep Learning Algorithms: A Mini-Review”, April 21, 2020.

[2] C. Kavitha, Vinodhini Mani, S. R. Srividhya, Osamah Ibrahim Khalaf and Carlos Andrés Tavera Romero, “Early Stage Alzheimer’s Disease prediction using Machine Learning Models”, 03 March 2022.

[3] E. Bullmore and O. Sporns, ‘‘Complex brain networks: Graph theoretical analysis of structural and functional systems,’’ Nature Rev. Neurosci., vol. 10, no. 3, pp. 186–198, Mar. 2009.

[4] S. Eickhoff, T. E. Nichols, J. D. Van Horn, and J. A. Turner, ‘‘Sharing the wealth: Neuroimaging data repositories,’’ NeuroImage, vol. 124, pp. 1065–1068, Jan. 2016

[5] A. Chaddad, C. Desrosiers, and T. Niazi, ‘‘Deep radiomic analysis of MRI related to Alzheimer’s disease,’’ IEEE Access, vol. 6, pp. 58213–58221, 2018.

[6] N. Bhagwat, ‘‘Prognostic applications for Alzheimer’s disease using magnetic resonance imaging and machine-learning,’’ Ph.D. dissertation, Graduate Dept. Inst. Biomater. Biomed. Eng., Univ. Toronto, Toronto, ON, Canada, 2018.