PREDICTION OF ALZHEIMER'S DISEASE USING DEEP LEARNING

A Report submitted

in partial fulfillment for the Course

DEEP LEARNING

by

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CERTIFICATE

This is to certify that the project report entitled **Prediction of Alzheimer's disease using Deep Learning** submitted by **K.Krishna Vamsi, Kausthubha Jilla, Ch. Varun Teja and E. Vision Kumar Reddy** to the KL University Hyderabad Campus, in partial fulfillment for theCourse DEEP LEARNING, of the degree of **B. Tech in Computer Science and Engineering** is a bonafide record of project work carried out by him/her under my/our supervision. The contents of this report, in full or in parts, have not been submitted to any other Institution or University for the award of any degree or diploma.

Mrs. Sumitra Mallik
Supervisor

Mrs. Sumitra Mallik
Course Co-Ordinator

Counter signature of HOD with seal

DECLARATION

I declare that this project report titled **Prediction of Alzheimer's disease using Deep Learning** submitted in partial fulfillment of the Course DATASCIENCE of **B. Tech in Computer Science and Engineering,** is a record of original work carried out by me under the supervision of **Mrs. Sumitra Mallik**, and has not formed the basis for the award of any other degree or diploma, in this orany other Institution or University. In keeping with the ethical practice in reporting scientific information, due acknowledgements have been made wherever the findings of others have been cited.

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Prediction of Alzheimer's Disease using Deep Learning

Abstract

In this paper, we apply various deep learning models and techniques to analyze and predict the presence of Alzheimer's disease using Image datasets and also by categorical and numerical datasets. Here, we try to find out the symptoms of the disease using categorical dataset and predict the disease through images of the brain. With the help of numerical dataset, we try to obtain the conditions and the reasons of Alzheimer's disease occurrence. Some of the Deep learning models such as Artificial Neural Network (ANN), Convolutional Neural Network (CNN) and Pre-trained Models such as ResNet50 model, Ensemble learning along with Logistic Regression, Decision Tree Classifier, Support Vector machine etc. algorithms are implemented.

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1. INTRODUCTION

Alzheimer's Disease:

Alzheimer's Disease is an irreversible, progressive brain disorder that slowly destroys memory and thinking skills and eventually the ability to carry out the simplest tasks.

Symptoms:

Requires a Medical diagnosis

Memory Loss and confusion are the main symptoms.

People may experience:

- Cognitive Behavioural
- Mood
- Psychological
- Inability to combine muscle
- movements, jumbled speech, or loss of appetite.

It is the cause of 60-70% of cases of dementia.

Experts haven't determined a single cause of Alzheimer's disease but they identified certain risk factors, including:

- Age: Most people who develop Alzheimer's disease are 65 years of age or older.
- Family History: If you have an immediate family member who has developed the condition, you're more likely to get it.
- Genetics: Certain genes have been linked to Alzheimer's disease.

2. LITERATURE SURVEY

Stages of Alzheimer's Disease:

Stage 1. There are no symptoms at this stage but there might be an early diagnosis based on family history.
Stage 2. The earliest symptoms appear, such as forgetfulness.
Stage 3. Mild physical and mental impairments appear, such as reduced memory and concentration. These may only be noticeable by someone very close to the person.
Stage 4. Alzheimer's is often diagnosed at this stage, but it's still considered mild. Memory loss and the inability to perform everyday tasks is evident.
Stage 5. Moderate to severe symptoms require help from loved ones or caregivers.
Stage 6. At this stage, a person with Alzheimer's may need help with basic tasks, such as eating and putting on clothes.
Stage 7. This is the most severe and final stage of Alzheimer's. There may be a loss of speech and facial expressions.

Medical Diagnosis Procedures:

- MRI (Magnetic Resonance Imaging)
- CT-Scan
- PET Scan
- EEG Scan etc.

Deep Learning Techniques and Models:

- Artificial Neural Networks (ANN)
- Convolutional Neural Networks (CNN)
- ResNet50 Pre-trained Model (CNN Based)
- Ensemble Learning (Logistic Regression, Bagging Classifier, Support Vector Machine)
- Logistic Regression
- Decision Tree Classifier
- Support Vector Machine (SVM)
- Random Forest Classifier

3. ANALYSIS:

3.1 Datasets Analysis

Image Dataset:

4 class of MRI Segmentation Images

Images: 5121 Images
Train – Test Split: 4098 - 1023

Classes:

1. Mild Demented
2. Very Mild Demented
3. Non-Demented
4. Moderate Demented

Numerical Dataset (OASIS Longitudinal Dataset):

Row Count: 374
Feature Count: 15
Train – Test split: 262 – 112

Classes:

1. Demented
2. Non-Demented
3. Converted (Initially Detected as Non-Demented after further diagnosis detected as Demented)

Survey Dataset:

Row Count: 40960
Feature Count: 24
Train – Test split: 30720 – 10240

Classes:

1. Anxiety
2. Depression
3. Loneliness
4. Stress
5. Normal

3.2 Problem Statement

The given problem statement is about how to detect or predict a person is having Alzheimer's disease or not through Images and data collected through diagnosis and surveys. The images are the MRI Segmented scans of parts of brain and categorized into 4 classes and through surveys, the persons were asked to give information about their health conditions and other prospects.

3.3 Proposed Solutions

Deep Learning Techniques implemented on Image Dataset:

1. Artificial Neural Networks (ANN)
   Activation Functions used: ReLu, Sigmoid.
2. Convolutional Neural Networks (CNN)
   Activation Functions used: ReLu, Softmax.
   Optimizer: Adam Optimizer
   Callbacks: Early Stopping Technique
3. ResNet50 (CNN based)
   Activation Functions used: ReLu, Softmax.
   Optimizer: rmsprop Optimizer
   Callbacks: Early Stopping Technique
4. Ensemble Learning
   - Bagging Classifier
   - Voting Classifier
   - Logistic Regression
   - Decision Tree Classifier
   - Support Vector Machine (SVM)

Algorithms implemented on Numerical Dataset (OASIS Longitudinal):

1. Logistic Regression
2. Decision Tree Classifier
3. Random Forest Classifier
4. Support Vector Machine (SVM)

Algorithms implemented on Survey Dataset:

1. Logistic Regression
2. Decision Tree Classifier

From the above implementations we obtained:

- Symptoms which lead to Dementia and eventual Alzheimer's
- Prediction of Alzheimer's through Images and Numerical data.
- Trends which are major factors of causing or factoring in developing of Alzheimer's.

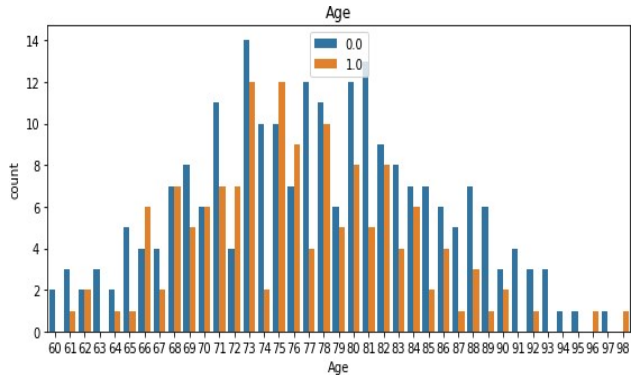

Fig 1: Age Factor

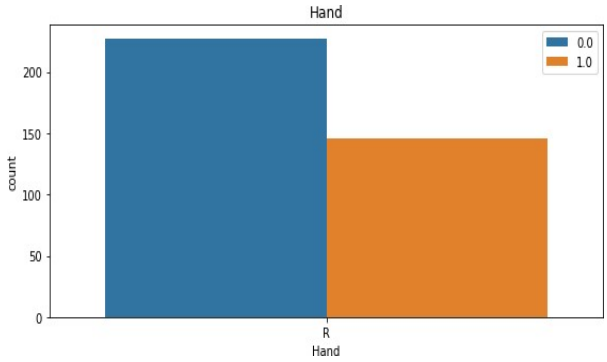

Fig 2: Hand Ratio

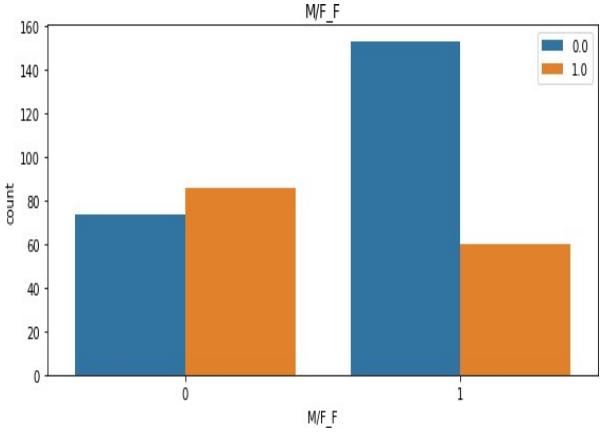

Fig 3: Male vs Female Disease Development Ratio

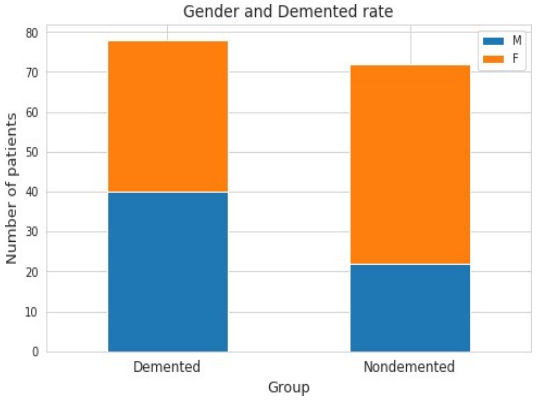

Fig 4: Male vs Female with Demented Condition

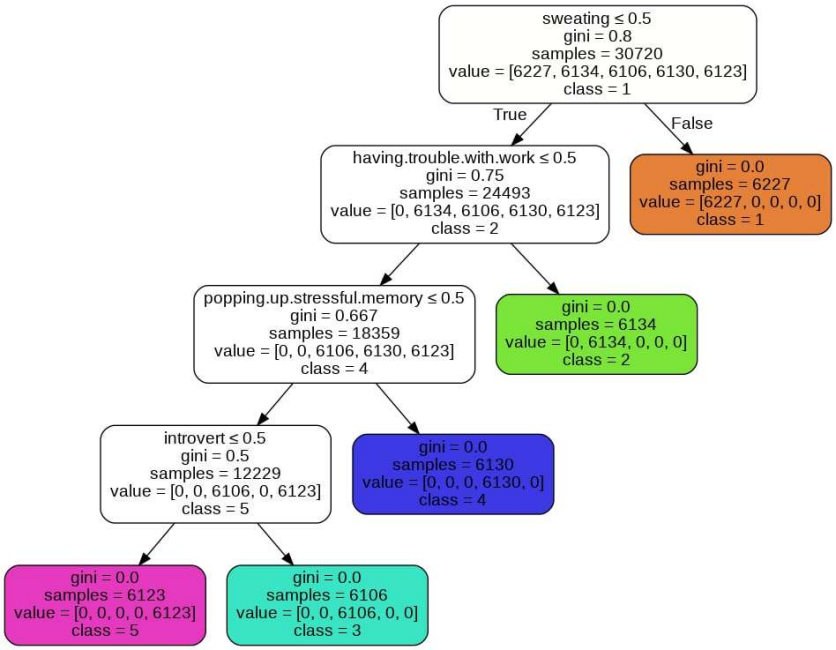

Fig 5: Decision Tree Classifier with symptoms Detected

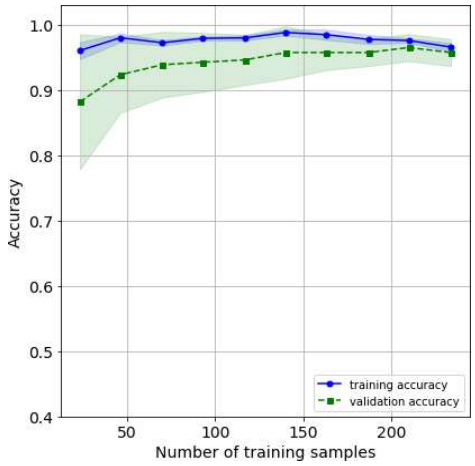

Fig 6: Logistic Regression Training vs Validation Curve

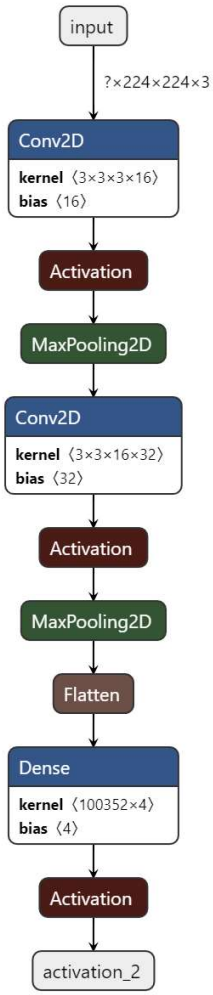

Fig 7: Convolutional Neural Network Visualization

4. DISCUSSION

Here we can see that through different models and algorithms we obtained results as follows:

Image Dataset:

S No	Models / Algorithms	Accuracies
1	Artificial Neural Networks (ANN)	81%
2	Convolutional Neural Networks (CNN)	82%
3	ResNet50	77%
4	Ensemble (Decision Tree and Bagging Classifier)	71%
5	Ensemble (Voting Classifier)	74%
6	Ensemble (AdaBoost)	73%

Numerical Dataset:

S No	Models / Algorithms	Accuracies
1	Artificial Neural Networks (ANN)	90%
2	Logistic Regression	96%
3	Decision Tree Classifier	97%
4	Support Vector Machine	83%
5	Random Forest Classifier	96%

Symptoms Detected:

- Sweating
- Having trouble with Work
- Popping up Stressful Memory (Stress)
- Introvert (Person's nature)

Improvements Done:

For some of the algorithms the improvements were done to tune the process:

Error Results:

S No	Models / Algorithms	Accuracies
1	Logistic Regression	+/- 0.017
2	Decision Tree	+/- 0.049
3	Artificial Neural Networks (ANN)	+/- 0.92 (After 20 epochs)
4	Convolutional Neural Networks (CNN)	+/- 0.00612 (Early Stopping)
5	ResNet50	+/- -1.008 (Exponential Decay)

5. CONCLUSION

We would like to conclude that by the application of various Deep Learning models and algorithms, we can try to predict if a person has developed or on verge of developing Alzheimer's disease or not by MRI image scans, and medical procedures readings. By this project we have tried to improve existing works with application of deep learning models in prediction of Alzheimer's. Usage of pre-trained models like ResNet50 also helps in better prediction of the disease. Through survey, we came to know what conditions or factors help in developing the Alzheimer's disease. This symptoms detection helps in prevention of the disease early and when both the systems are used in conjunction, it can help in determining a person's condition at what stage a person is in.

We would also like to conclude that by using the above implemented models and algorithms, we can try to predict the symptoms and the stage of Alzheimer's disease through images and medical procedures readings. When both used hand-in-hand we can create a better prediction system for Alzheimer's Disease prediction.

6. REFERENCES

[1]. Alzheimer's Dataset (4 class of Images) - Kaggle

[2]. MRI and Alzheimer's - Kaggle

[3]. Alzheimer's Disease - Wikipedia