Single Deep CNN Features to Detect Neurodegenerative Diseases: Alzheimer's, Parkinson's and Dementia

Capstone Project (CSE 498)

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Contents

Introduction

Neurodegenerative diseases occur when nerve cells in the brain or peripheral nervous system lose function over time and ultimately die. Alzheimer's disease, Parkinson's disease, and dementia are most common examples of neurodegenerative disease. We can detect these three diseases with a single DL model through our work.

Problem Statement

Identifying neurodegenerative diseases with proper explanation using one model is quite challenging.

Problem Background

- The present neurodegenerative diseases detection system only detects one disease.

- Identifying neurodegenerative diseases is a deadly problem that needs to be solved.

- Due to the similarities in disease phenotypes, accurate detection of neurodegenerative diseases, including the context behind the detection is problematic.

Motivation

Detect the disease in early stage.

Detect three diseases with a single model.

To reduce wasting time & cost.

Objectives

Identifying present difficulty to work with neuroimaging data.

Build a DL model to detect three Neurodegenerative

Diseases named Alzheimer's, Parkinson's and Dementia.

Get decent accuracy using a suitable MRI dataset.

Comparing the existing architectures with the proposed

work for neurodegenerative diseases detection.

Literature Review

Author	Disease	Model	Dataset	Accuracy
M. Biswas et al. [1]	AD	Deep CNN	Kaggle	99.38%
A. W. Salehi et al. [2]	AD	CNN	ADNI	99%
Y. AbdulAzeem et al. [3]	AD	CNN based end-to-end	ADNI	97.5%
J. A. Akhila et al. [4]	DD	Feed Forward ANN	OASIS	97.5%
A. Bidani et al. [5]	DD	Deep CNN + TL	OASIS	81.94%
S. Murugan et al. [6]	DD	DEMNET	ADNI	95.23%
W. Wang et al. [7]	PD	LeNet-5	PPMI	97.92%
S. Sivaranjini et al. [8]	PD	AlexNet	PPMI	88.9%

Problem Analysis

1

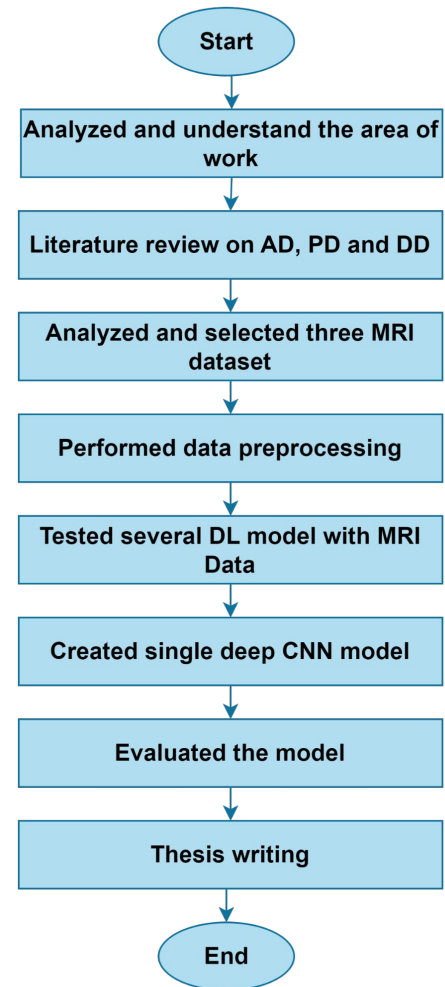The existing approaches can detect one disease at a time.
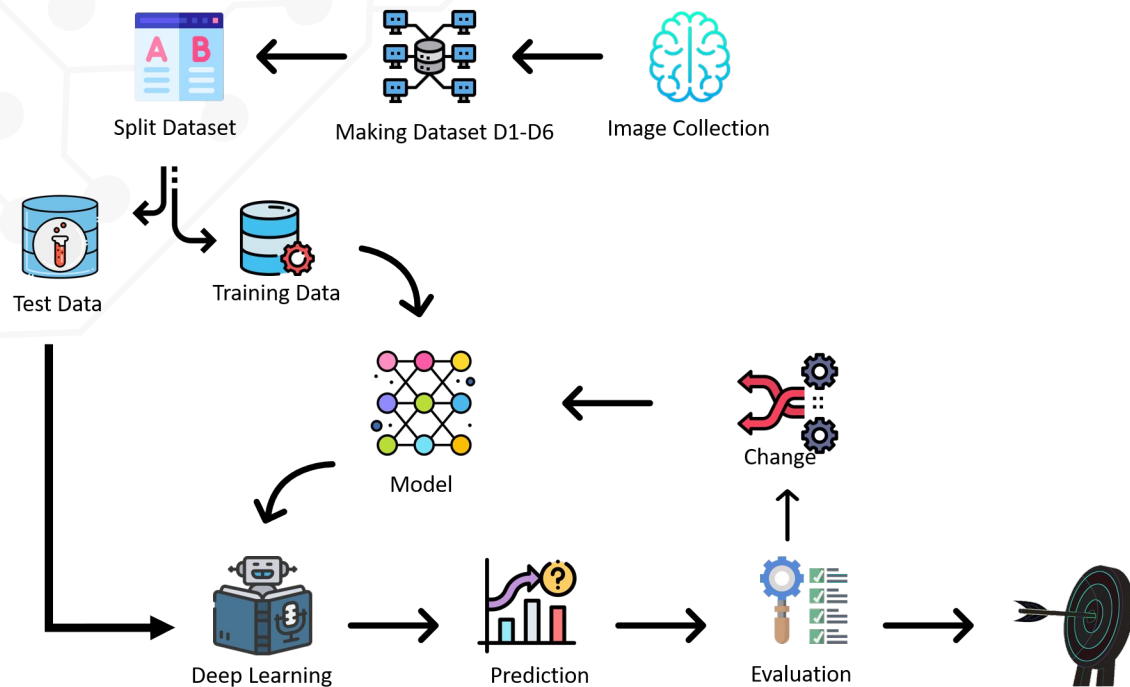
2

Costly and time consuming.

3
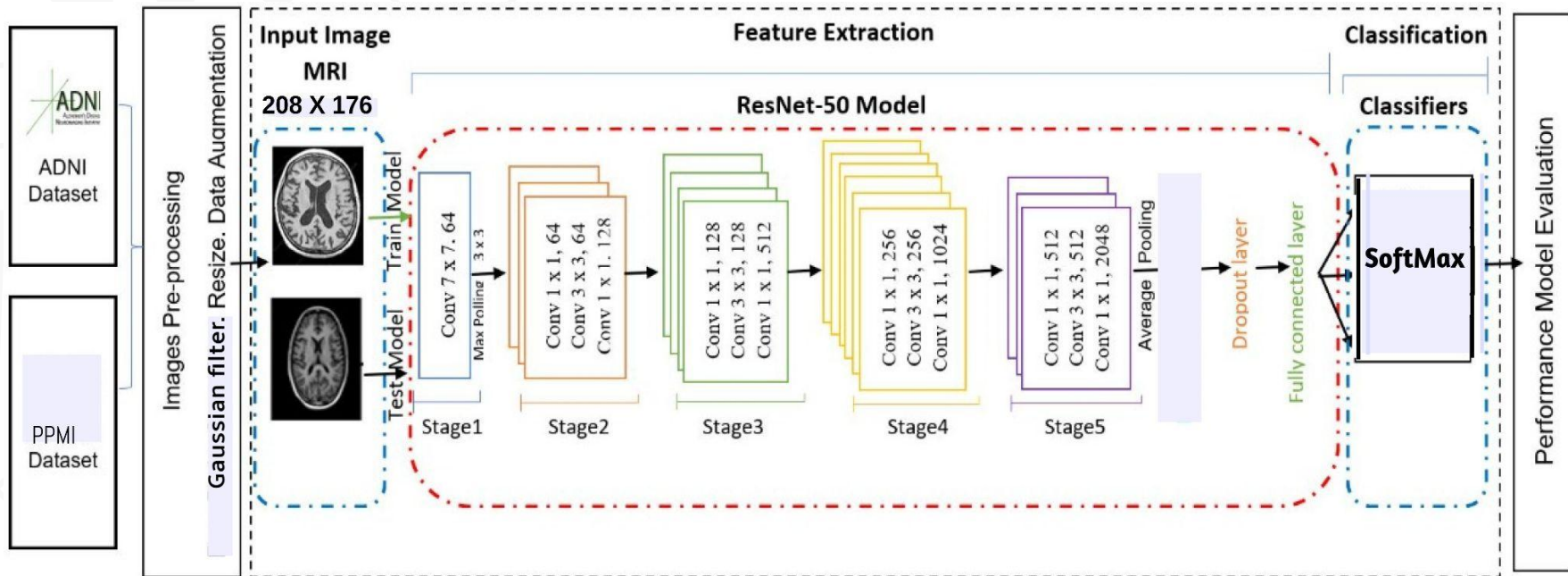
Accuracy rate is not satisfactory.

Research Flow

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                    ┌─────────┐
                    │  Start  │
                    └────┬────┘
                         ▼
            ┌────────────────────────────┐
            │ Analyzed and understand the │
            │        area of work         │
            └─────────────┬──────────────┘
                          ▼
            ┌────────────────────────────┐
            │ Literature review on AD, PD │
            │           and DD            │
            └─────────────┬──────────────┘
                          ▼
            ┌────────────────────────────┐
            │ Analyzed and selected three │
            │        MRI dataset          │
            └─────────────┬──────────────┘
                          ▼
            ┌────────────────────────────┐
            │ Performed data preprocessing │
            └─────────────┬──────────────┘
                          ▼
            ┌────────────────────────────┐
            │ Tested several DL model with │
            │          MRI Data           │
            └─────────────┬──────────────┘
                          ▼
            ┌────────────────────────────┐
            │ Created single deep CNN model│
            └─────────────┬──────────────┘
                          ▼
            ┌────────────────────────────┐
            │      Evaluated the model     │
            └─────────────┬──────────────┘
                          ▼
            ┌────────────────────────────┐
            │       Thesis writing         │
            └─────────────┬──────────────┘
                          ▼
                    ┌─────────┐
                    │   End   │
                    └─────────┘
```

- Start
- Analyzed and understand the area of work
- Literature review on AD, PD and DD
- Analyzed and selected three MRI dataset
- Performed data preprocessing
- Tested several DL model with MRI Data
- Created single deep CNN model
- Evaluated the model
- Thesis writing
- End

Research Methodology

Image Collection → Making Dataset D1-D6 → Split Dataset → Test Data / Training Data → Model → Deep Learning → Prediction → Evaluation → Change

Proposed Model

Why did we use the resnet50 model?

ResNet-50 is a 50-layer convolutional neural network (48 convolutional layers, one MaxPool layer, and one average pool layer).

ResNet-50 has fewer filters and is less complex than a VGGNet.

ResNet-50 is significantly faster than a Vgg-19 Network with 19.6 billion FLOPs.

ResNet-50 model pre-trained machine learning model.

ResNet-50 model helps achieve higher performance even if the model is trained on a smaller dataset.

Some challenges in our project

Converting all disease images to the same format.

Finding a good model.

ResNet50 model arise an overfitting problem.

Ethics

For our work we got our datasets from Kaggle, PPMI & OASIS. Our collected datasets are open source. From their written description these datasets were approved to show openly. In that case, we can say we didn't break any law or regulation.

Impact on Society

It is essential in order to treat patients at an early stage.

It can also be used as a tool for raising awareness.

Sustainability

From previous works obtaining highest result we took inspiration and made a decision of using Deep Learning to get better result.

Through our proposed approach we can detect three diseases which wasn't been done yet so with huge hope, we think our work can fulfill the sustainability.

Conclusion

In our society, there are a significant number of senior persons who suffer from neurodegenerative diseases. Through this work, we can detect three diseases with a single model which will be beneficial for medical professionals & an extensive field of research.

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