Predicting Severity Of Parkinson's Disease

Under the guidance of:-
Prof. Mrs. Kirti Wanjale

Madhavi Nagapurkar (71714526D)
Onkar Kumbhar (71714513B)
Parag Kaldate (71714444F)
Subhranil Bala (71714274E)

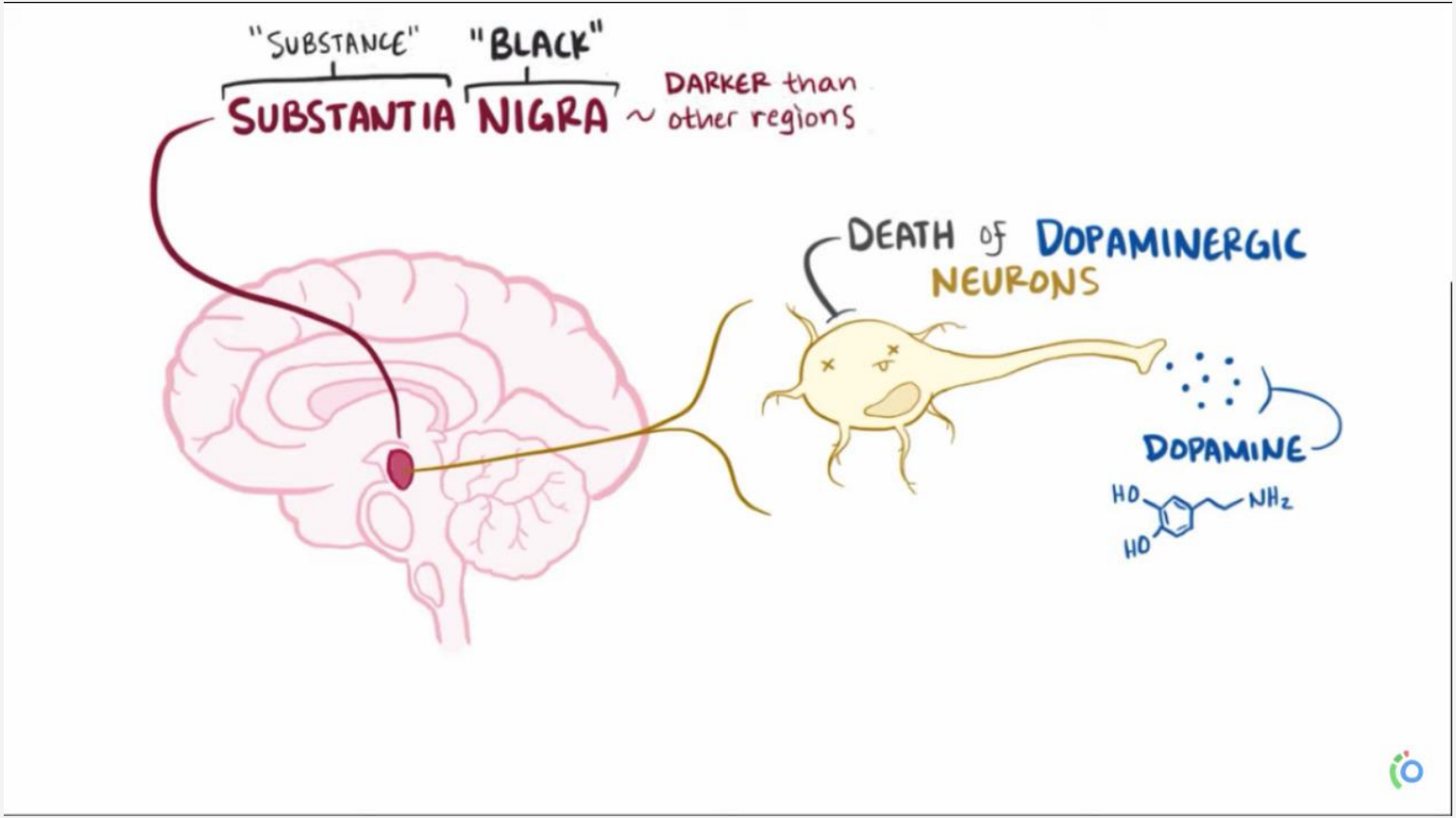
- Aim :

To Predict Severity Of Parkinson's Disease Using Deep Learning.

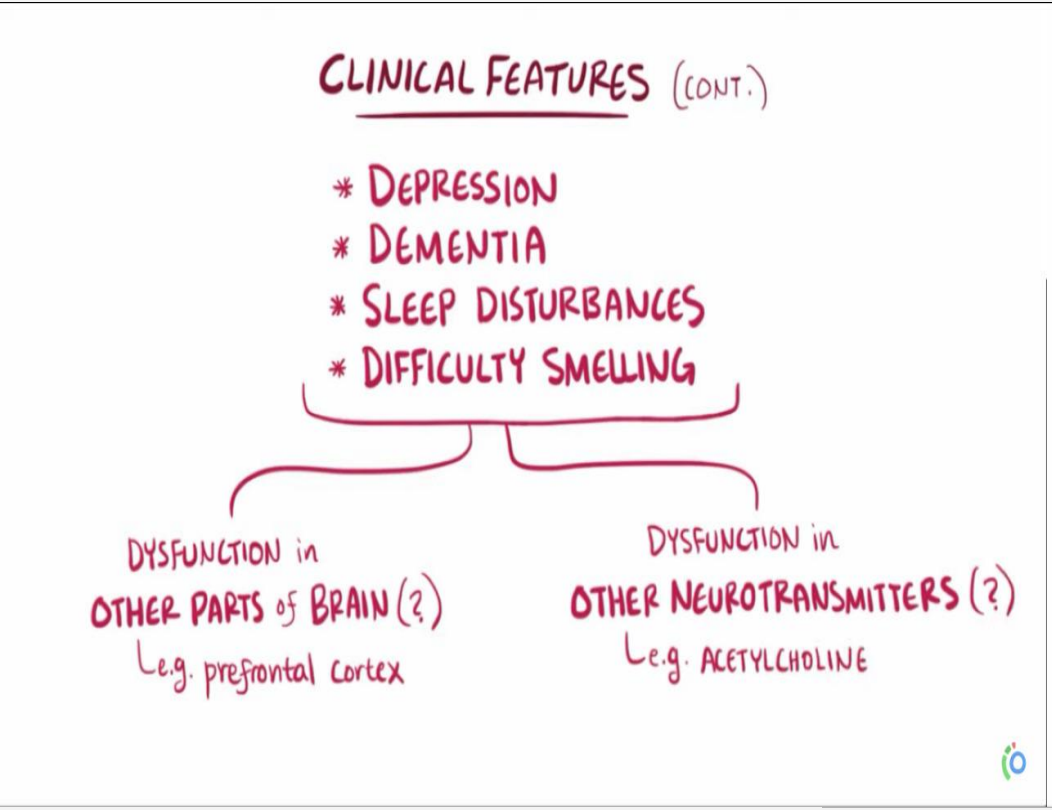
- Objectives :

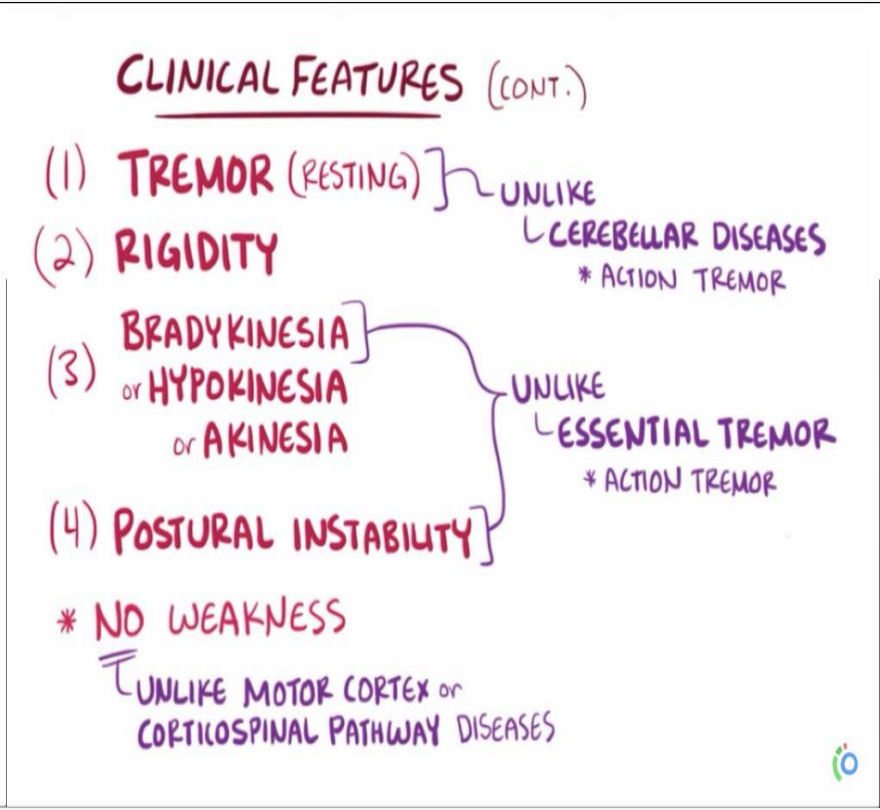
1) To Introduce simpler way to predict Parkinson's disease.
2) to detect parkinson's disease by processing the voice recordings of Patient.

What is Parkinson's disease?



Symptoms


CLINICAL FEATURES (CONT.)
* DEPRESSION
* DEMENTIA
* SLEEP DISTURBANCES
* DIFFICULTY SMELLING
DYSFUNCTION in OTHER PARTS of BRAIN (?)
e.g. prefrontal cortex
DYSFUNCTION in OTHER NEUROTRANSMITTERS (?)
e.g. ACETYLCHOLINE


CLINICAL FEATURES (CONT.)
(1) TREMOR (RESTING)
(2) RIGIDITY
UNLIKE CEREBELLAR DISEASES
* ACTION TREMOR
(3) BRADYKINESIA or HYPOKINESIA or AKINESIA
(4) POSTURAL INSTABILITY
UNLIKE ESSENTIAL TREMOR
* ACTION TREMOR
* NO WEAKNESS
UNLIKE MOTOR CORTEX or CORTICOSPINAL PATHWAY DISEASES

CLINICAL FEATURES

TREMOR

* INVOLUNTARY SHAKINESS *

"PILL-ROLLING"

"RESTING TREMOR"
- Present at rest
- Diminishes with MOVEMENT

RIGIDITY

* STIFFNESS *

"COGWHEEL RIGIDITY"

+ STOOPED POSTURE
+ ALMOST EXPRESSIONLESS

Project Idea:

- The studies have shown that maximum patients with PD show rupture in vocal speech for the detection of PD.
- So during the initial phase, the diagnosis could proceed with speech as a field of study in detecting PD apart from tremor, muscle stiffness, lack of movements, etc.
- Since the speech following disorders is noticed – Viable pitch,iteration of words and syllables, exalt in speech, unintended pauses, and strident breath.
- It is observed that the disorder in the speech is found five years before the diagnosis of the patient with PD.

Motivation:-

Various machine learning techniques have been used previously to detect Parkinson's disease but less work have been done on its severity. Change in voice of the patient is one of the common symptom which is unstructured in nature therefore deep neural networks is best suitable for its implementation.

Scope

1) Our application will take user's voice recordings as input each recording will be of size in the range of 3-5 KB.

2) Voice recordings will be pre-processed and then classified using classifier to predict the severity of the disease.

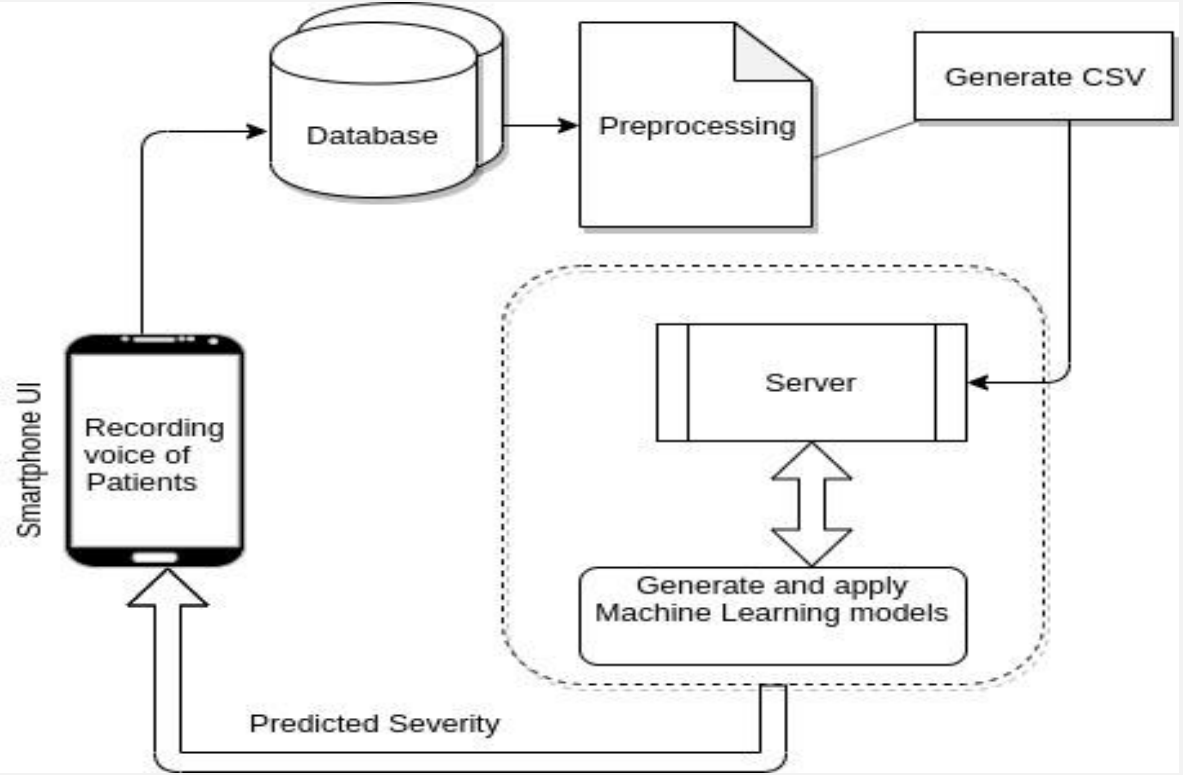
3) The Android application will use the in-built microphone in the Android mobile to record and take input from the user.

4) Our application won't give a complete diagnosis of the disease, it's output should not be taken as the final result, further consultation of the doctor should be taken.

Need of the Project

1) As conventional DAT - dopamine transporter (DAT) single photon emission computerized tomography (SPECT) imaging technique scan method is time-consuming and costlier.
2) It's common side-effects includes headaches, dizziness due to exposure radioactivity.
3) It is not easier to use.
4) Due to these repercussions, we were motivated to come up with more simpler version for prediction.

FLOW OF THE PROJECT



Cost And Effort Estimation

- Minimum Intel i5 – 5200U Processors @2.20 GHz and 8 GB Ram DDR4
- Transportation cost for collecting data from various hospitals.

- To gather confidential Patients data from hospitals.
- To make the application robust.
- To understand various concepts of machine learning before selecting the actual algorithm.
- To think of out of the box element to make it stand above all existing models.

Cost And Effort Estimation: COCOMO Model

COCOMO Model used is Basic COCOMO Model.

$$E = a(KLOC)^b$$

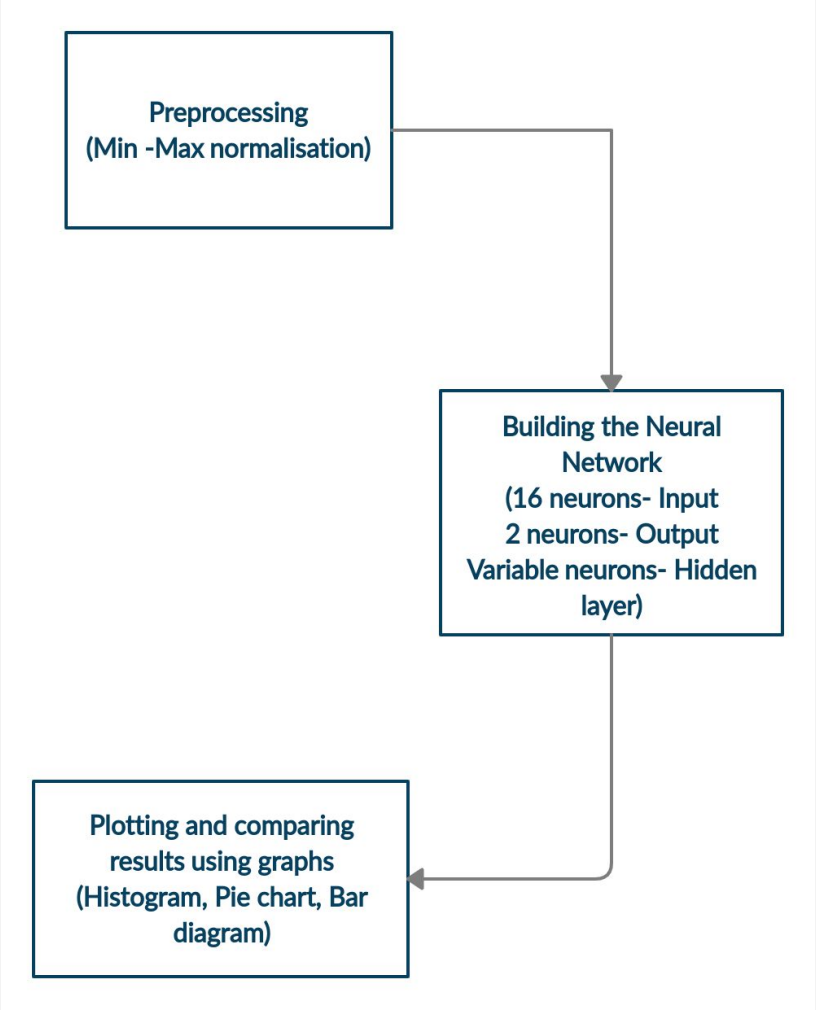
Category of our software project : Organic

Values of a= 2.4 and b= 1.05

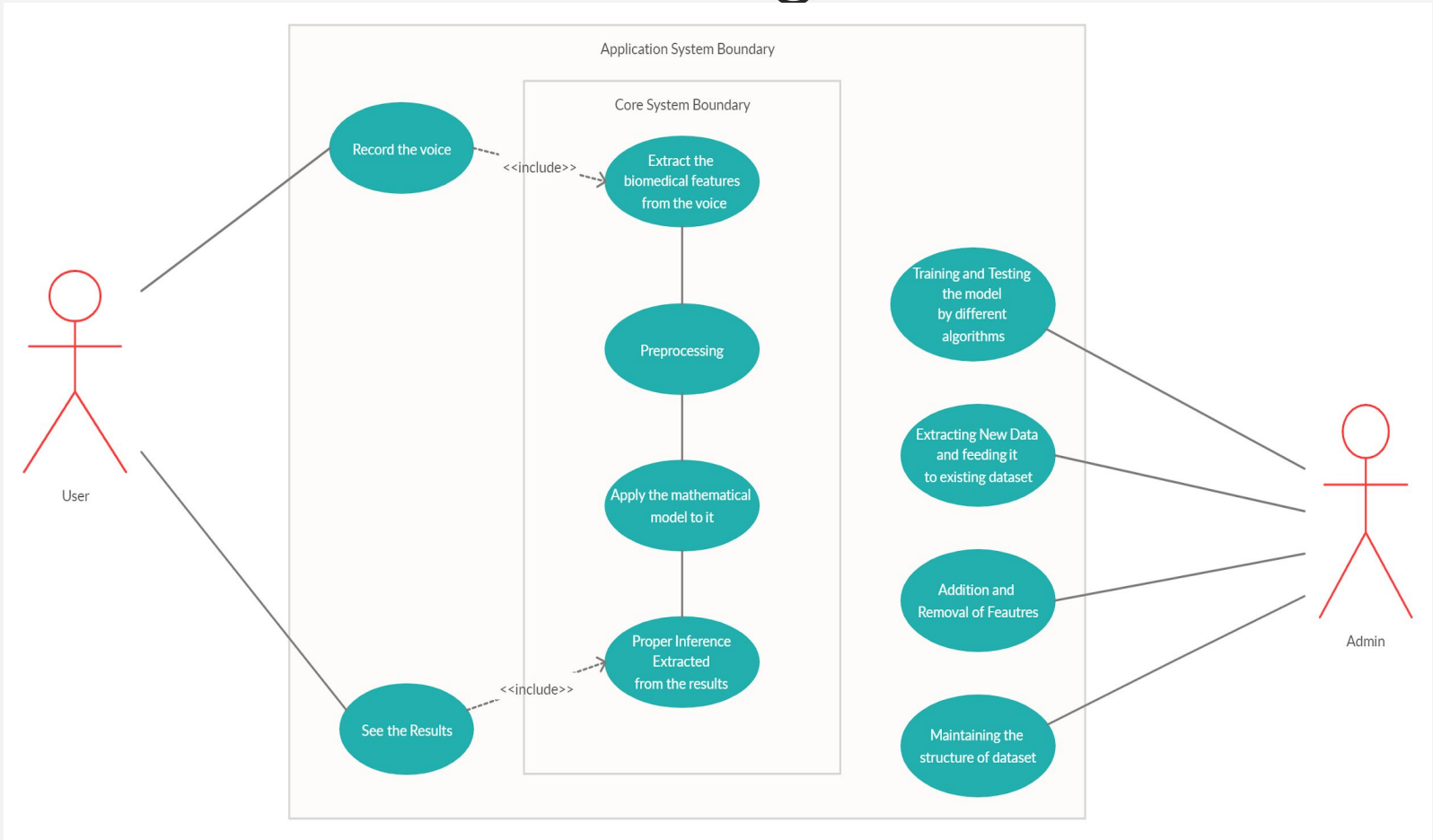
Assumed value of KLOC= 0.5

$$E=2.4(0.5)^{1.05}$$
$$=1.159$$

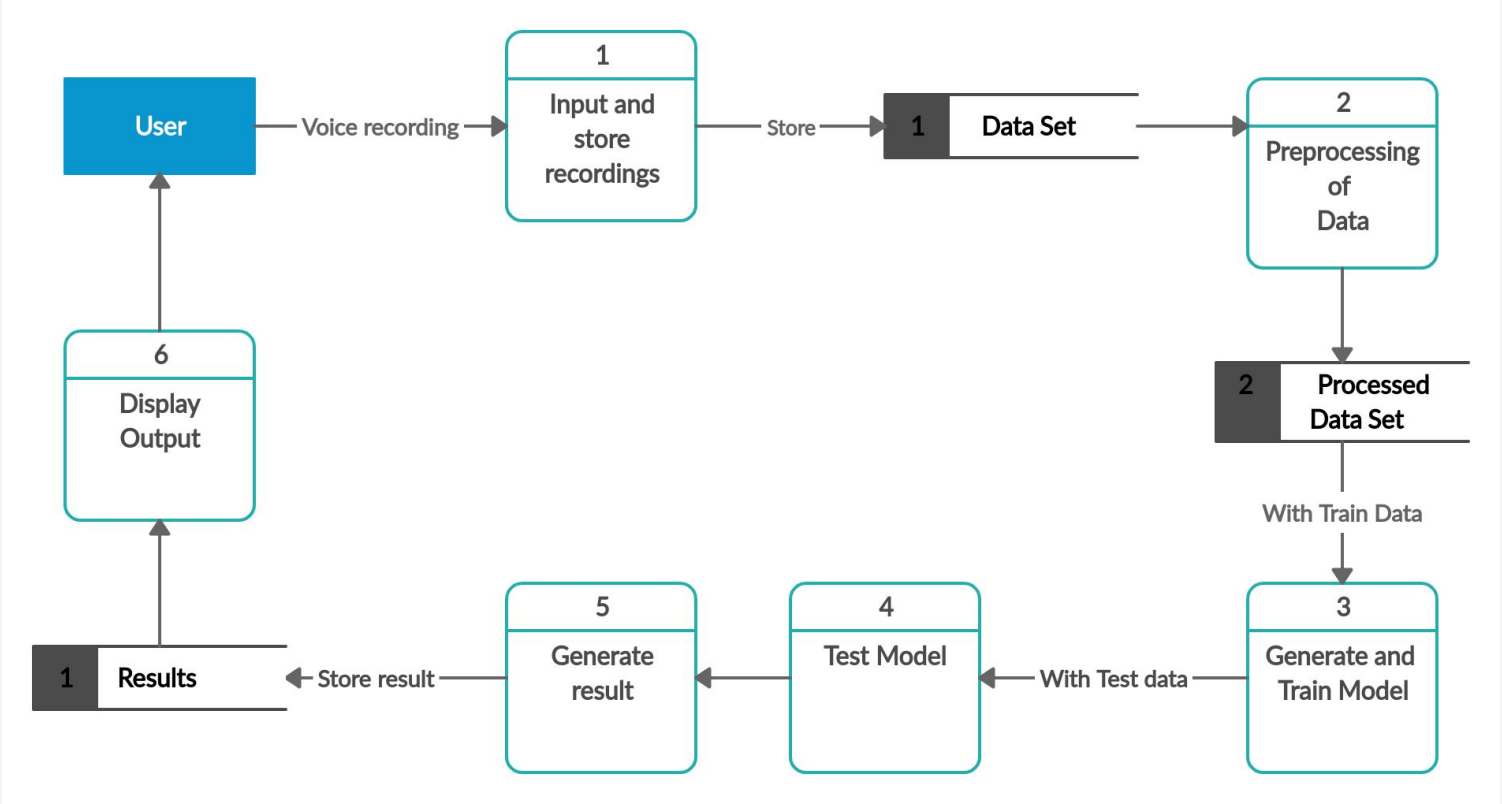
Mathematical Model



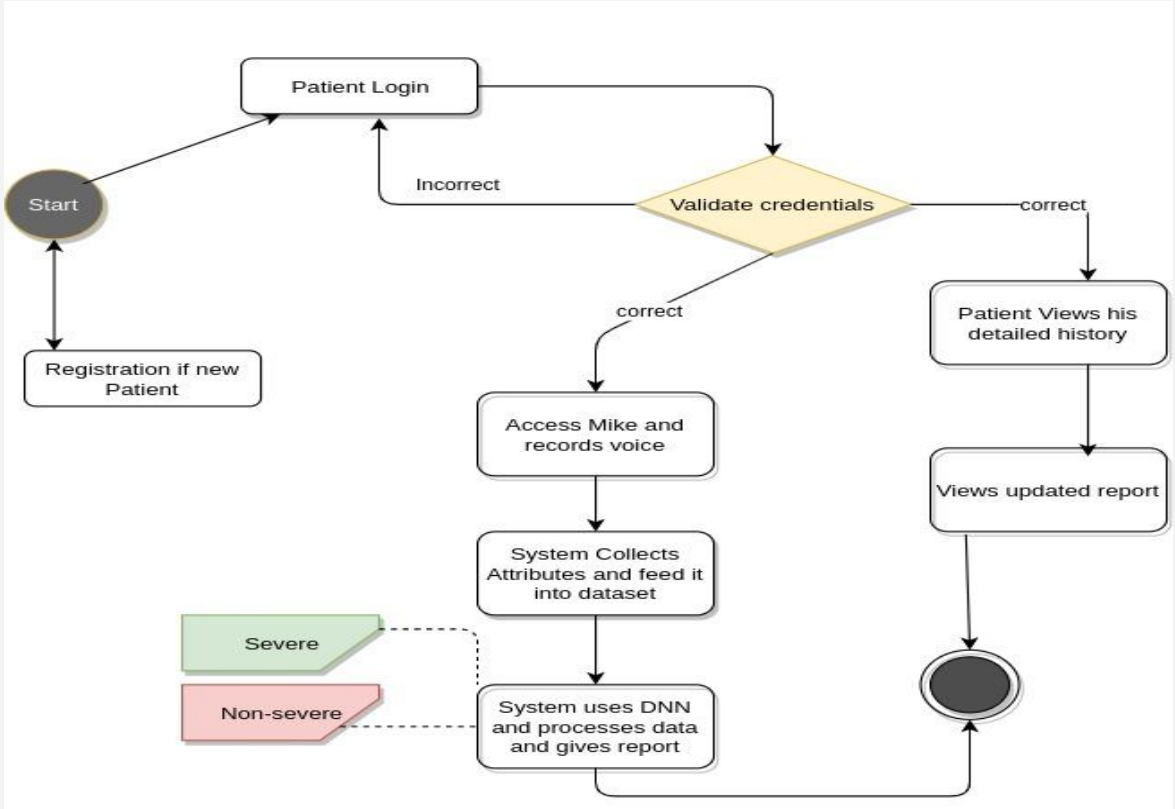
Use Case Diagram



Data Flow Diagram



Activity Diagram



Platforms used :

Front-end :

An Android Application (Smartphone).

Back-end :

IDE : Spyder, Android Studio
Database : Firebase, Sqlite.

Programming Languages:- Python,Java,JavaScript,XML

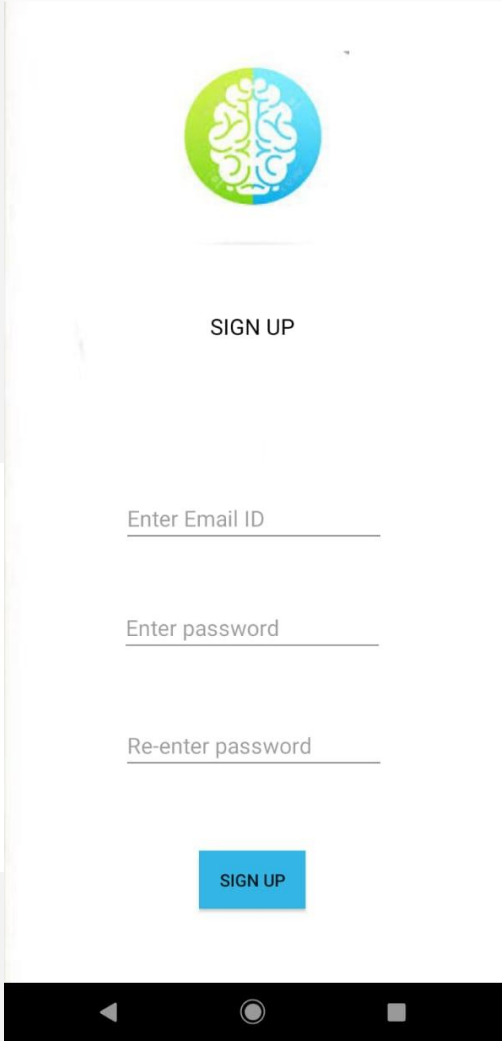
Survey Paper Under Review:

- We have studied almost 38-40 Research-papers in this area.
- Submitted our paper to ***ESCI2020/IEEE/AISSMS*** conference (12-14 MARCH 2020)
- Waiting for Acceptance.

Android App

Steps to use the application

- Sign Up Using Google Account
- Logging in App
- Recording the Voice
- Predicting results



Cloud Function
for Firebase

Home

Press and hold to record audio

9:47

console.firebase.google.com/

BE Project

Storage

Files Rules Usage

gs://be-projec Upload file

Name

audio_recording.3gp

Firebase

Artificial Neural Network Configuration:-

- Feed Forward Neural Network
- 1 Input Layer , 3 Hidden Layers , 1 Output Layer
- 16 neurons - 100 neurons - 200 neurons - 100 neurons - 2 neurons
- 1000 epochs
- **Adam Optimiser** for Backpropagation
- Loss function used is **Mean Square Error**
- **CheckPoint Function** Used for Saving Model
- Batch Size :- 32
- Input and Hidden Layers :- **Rectified Linear Activation Fn**
  Output Layer :- **Linear Activation Fn**

Dataset Configuration :

UPDRS Unified Parkinson's Disease Rating Scale Output (Taken in the form of UPDRS) :

motor_UPDRS	total_UPDRS

Severity Class Range

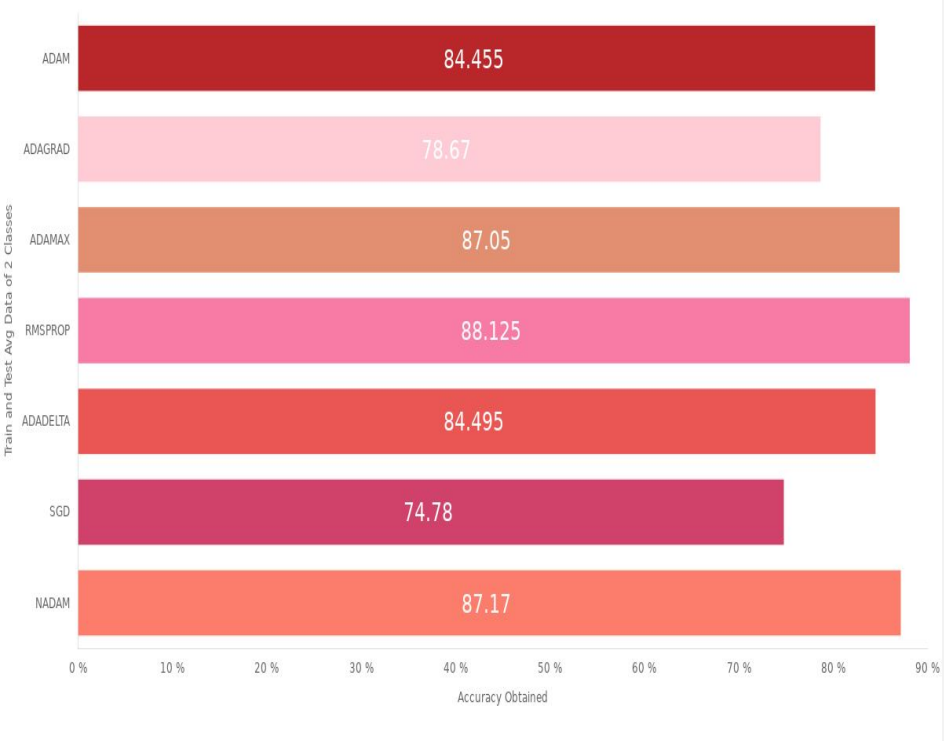
Metric	Severe	Non Sever
total_UPDRS	Above 25	0-25
motor_UPDRS	Above 20	0-20

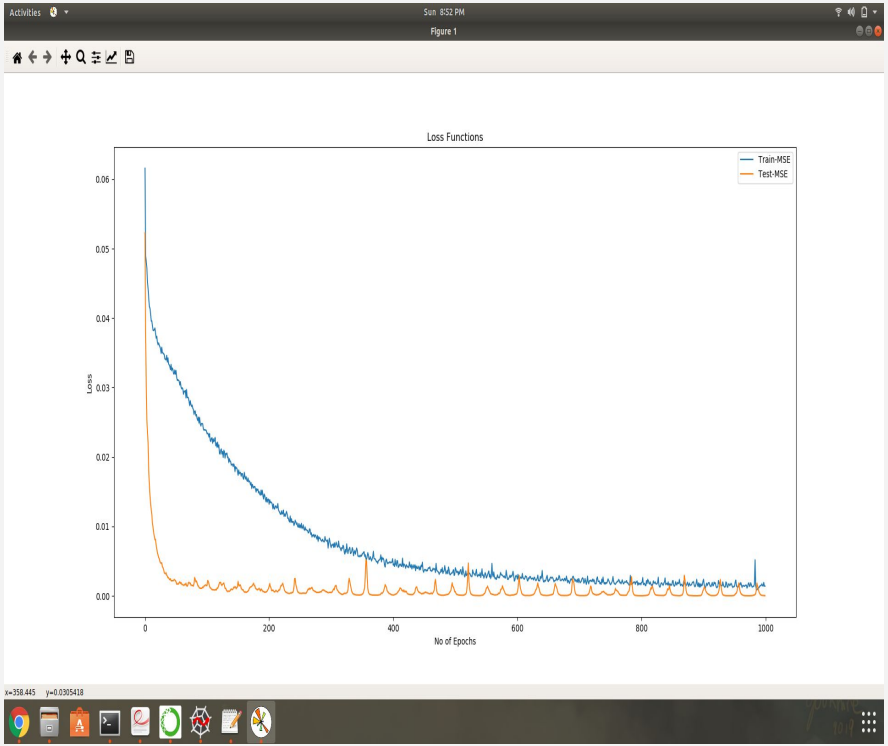
Contd.

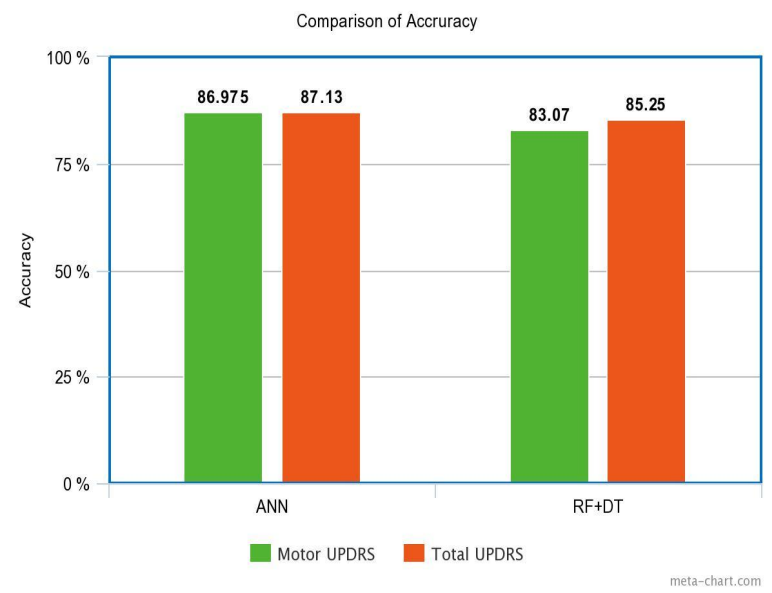
Input (Classified in 16 Parameters) :

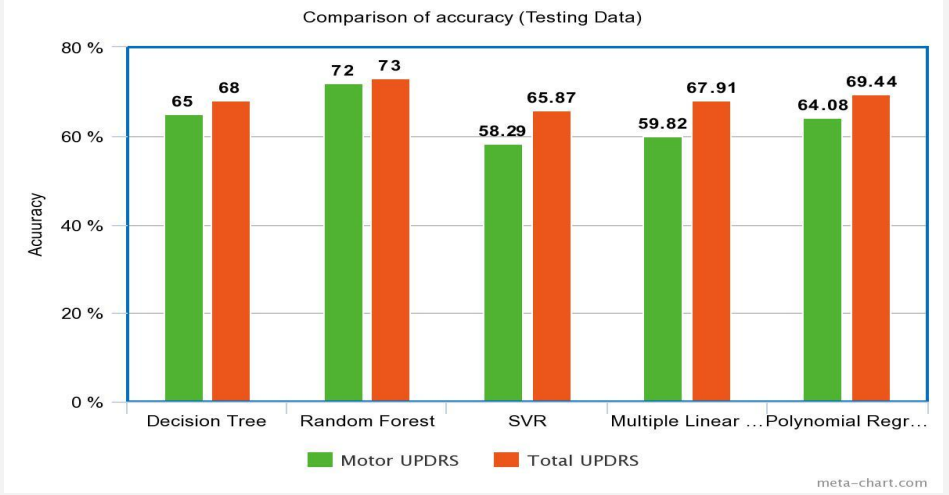
Jitter(%)	Jitter(Abs)	Jitter:RAP	Jitter:PPQ5	Jitter:DDP	Shimmer	Shimmer(dB)	Shimmer:APQ3
Shimmer:APQ5	Shimmer:APQ11	Shimmer:DDA	NHR	HNR	RPDE	DFA	PPE

Plots And Comparison

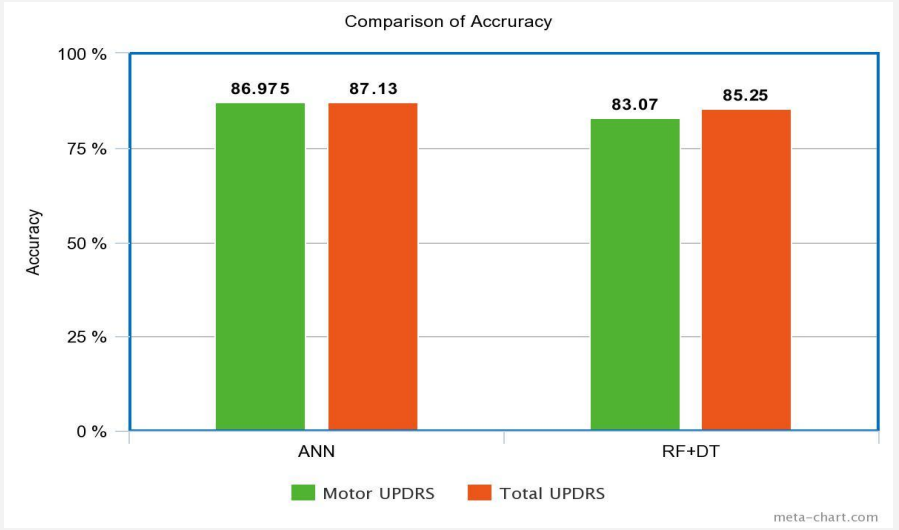








	ADAM	NADAM	ADADELTA	ADAGRAD	SGD	RMSPROP	ADAMAX
TEST MOTOR UPDRS	73.00	74.38	75.65	75.65	72.42	76.40	73.95
TEST TOTAL UPDRS	72.40	74.55	74.55	75.74	73.78	76.51	74.29
TRAIN MOTOR UPDRS	97.27	99.91	99.89	81.93	77.53	99.87	100
TRAIN TOTAL UPDRS	94.72	99.85	99.89	81.36	79.14	99.74	99.97



References:-

- [1] Das R. (2010) “A comparison of multiple classification methods for diagnosis of Parkinson disease”. *Expert Systems With Applications*”.
- [2] Genain N, Huberth M, Vidyashankar R. (2014) “Predicting Parkinson’s Disease Severity from Patient Voice Features.”
- [3] Benmalek E, Elmhamdi J, Jilbab A. (2015) “UPDRS tracking using linear regression and neural network for Parkinson’s disease prediction.” *International Journal Of Emerging Trends & Technology In Computer Science (IJETTCS).*

THANK YOU