PREDICTING THE SEVERITY OF PARKINSON'S DISEASE USING DEEP LEARNING

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Abstract : *Parkinson's disease is a central nervous system disorder in which dopamine generating cells present in the substantia nigra (a part of our brain) get damaged or perished. Due to a deficiency of dopamine, which acts as a neurotransmitter in our body, symptoms of Parkinson's disease are caused. The change in vocal speech is one of the major symptoms shown and can be used to detect this disease. In this paper, there is an implementation and proprietary comparison of various machine learning models. The proposed model comparison shows that ANN is the comparatively better ML model to detect and predict Parkinson's disease which has accuracy for total UPDRS is 83.56 % and for motor UPDRS is 85.135 % which are the scales for measuring the severity elaborated further. We have utilized "Sklearn", "TensorFlow" and "Keras" python AI libraries to actualize all the ML models. It sums up that the accuracy generated by the proposed model is 84.45 % which is substantially higher than the research work done so far.*

Key Words : *ANN, Parkinson disease, Keras, Tensorflow, Adam, UPDRS.*

Introduction : Parkinson's disease is the second most common neurological disarray. It affects dopamine generating nerve cells in the midbrain. The cause of which is still unknown, but various factors involved are certain genetic mutations and environmental changes. Dopamine is a chemical that acts as both hormone and neurotransmitter and due to deficiency of this chemical, there are certain repercussions like tremors, bradykinesia, rigid muscles, impaired posture, and speech changes. Research shows that vocal changes can be observed approximately five years before the actual diagnosis of the disease. Therefore, it is one of the major symptoms of this disease and hence we have used this symptom to detect and predict the disease. There is no proprietary methodology for the prognosis of PD which led the researchers to apply machine learning for the same. Implementation of various machine learning models like multiple linear regression, polynomial regression, random forest, decision trees, SVR and ANN is done. A comparative study of the results of the implementation of these models is done and we have come up with various conclusions.

Objective/s : Main objective of our project is to detect Parkinson's disease by processing the voice recordings which we will take as input from the user. If the disease is detected we will predict the severity of the disease i.e severe or not severe based on a threshold value.
i.e.

1) To Predict Severity Of Parkinson's Disease Using a Deep Learning approach which will help in controlling the disease symptoms at early stages.
2) To Introduce a simpler way to predict severity of Parkinson's disease.
3) To detect parkinson's disease by processing the voice recordings of patients using Machine learning.

Description of Project Work / Experimentation : We have developed an Android Application with fundamental features that provides a simple minimalistic UI to analyze the severity of Parkinson's Disease for the affected people. The patient first has to record their voice by reading the passage in the app. Then the voice recording will be saved under their account credentials in Firebase cloud storage. After that, they have to send the recording to the server which has been set up locally through Lampp. We have also developed a Python watchdog module that keeps tracking a specific folder whenever there is any file created in it. As soon as the recording gets transferred to the folder through the local server, the watchdog module executes the server-side python script which consists our Artificial Neural-Network which first of all extracts 16 biomedical features out of the voice recording through certain libraries, after the preprocessing is done which brings us to the final stage of calculating the result numbers though the Net. Last but not the least the numbers are stored directly in the user's account in firebase which can be accessed through the app.

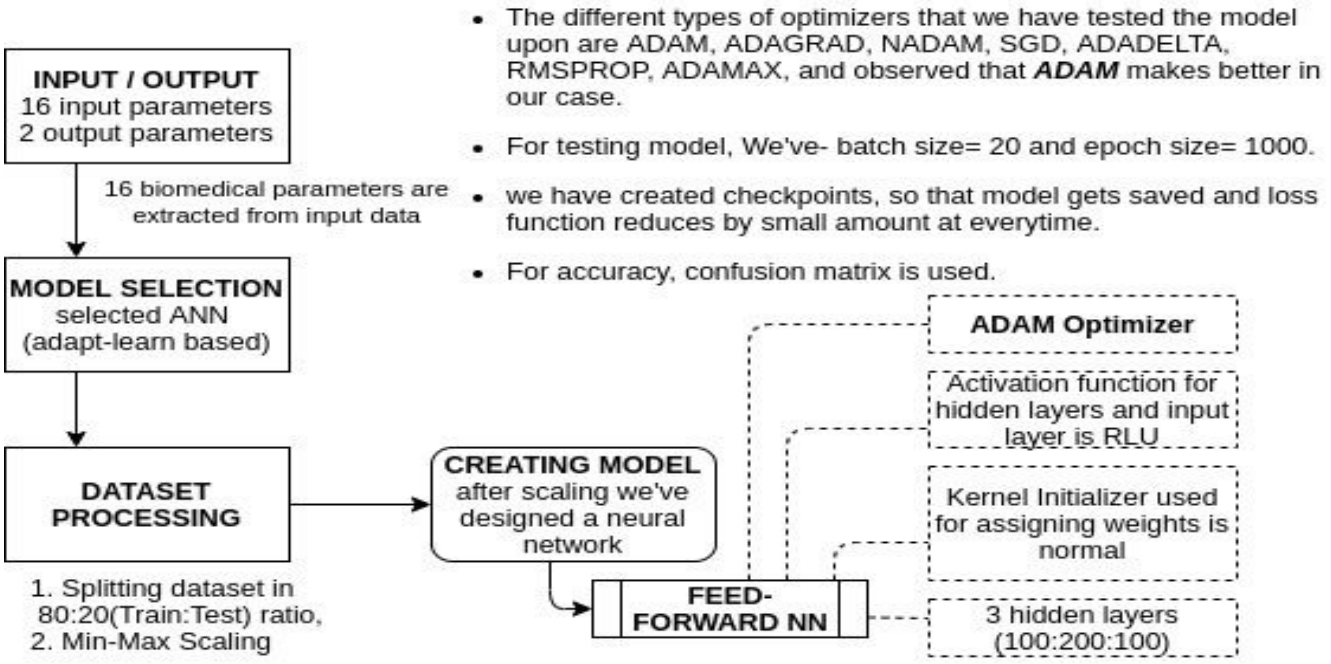

Fig 1: Process Work Flow Of Complete Project

1.Jitter(%)	*2.Jitter(Abs)*	*3.Jitter:RAP*	*4.Jitter:PPQ5*
4.Jitter:DDP	*5.Shimmer*	*6.Shimmer(dB)*	*7.Shimmer:APQ3*
9.Shimmer:APQ5	*10.Shimmer:APQ11*	*11.Shimmer:DDA*	*12.NHR*
13.HNR	*14.RPDE*	*15.DFA*	*16.PPE*

Table 1: Biomedical Input Parameters

Metric	Severe	Non-Severe	Scaling Range
Total-UPDRS	Above 25	0-25	0-176
Motor-UPDRS	Above 20	0-20	0-108

Table 2: Output values

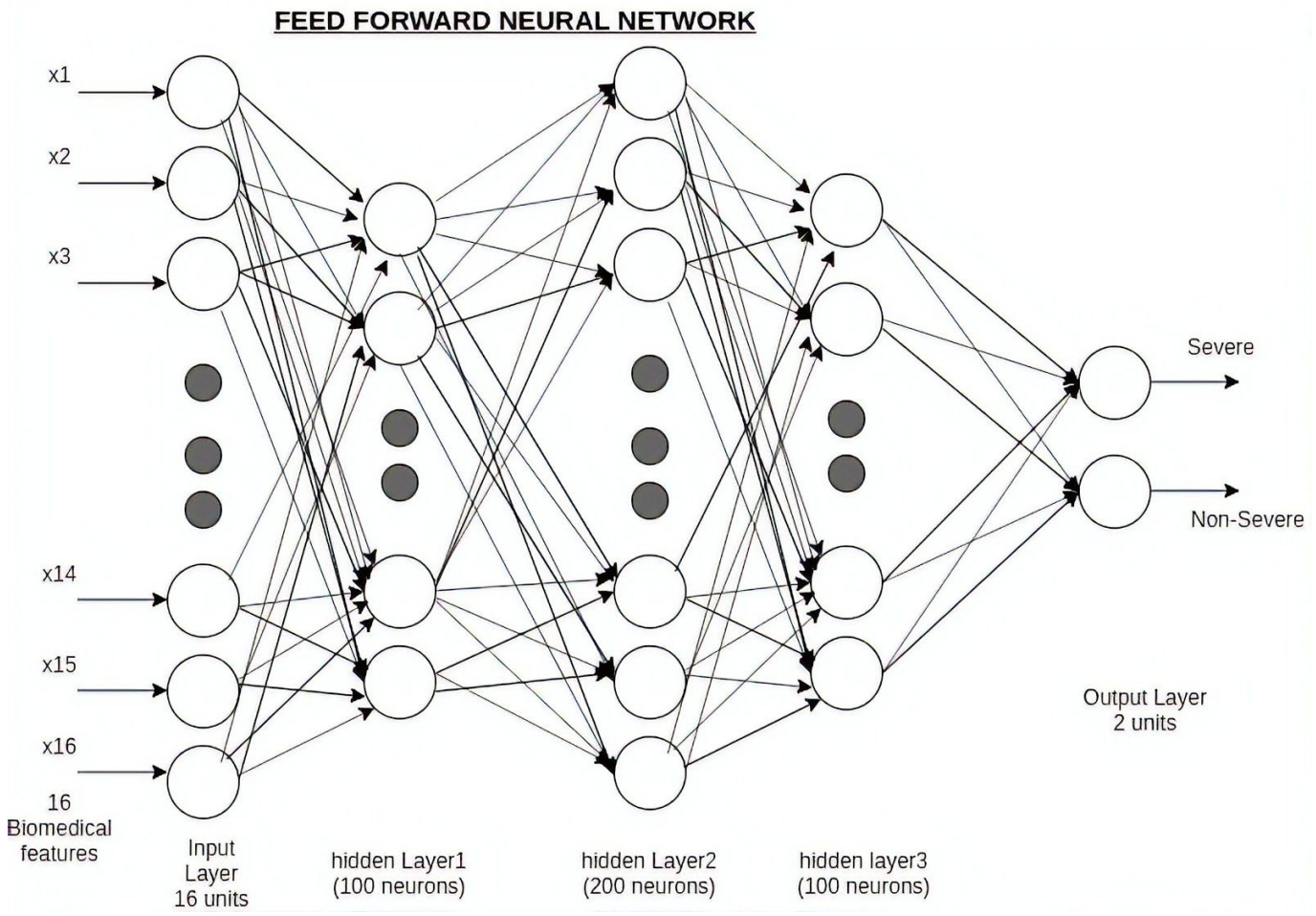

Fig 2: Artificial Neural Network Used In Our Project

Results / Expected Findings :

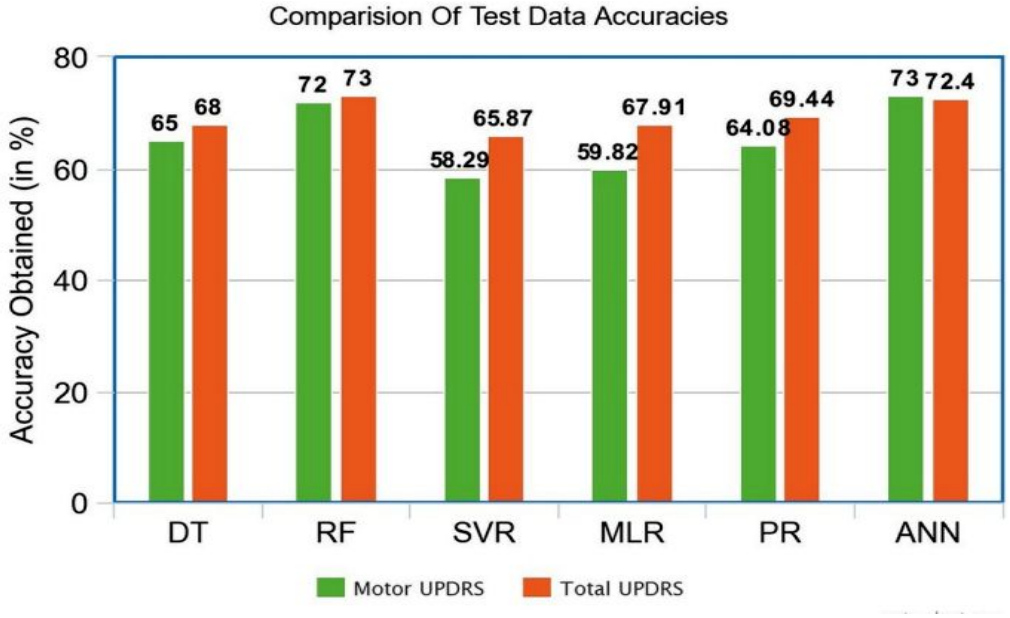

Fig 3: Comparison of accuracies of 5 different types of classifiers with Artificial Neural Network

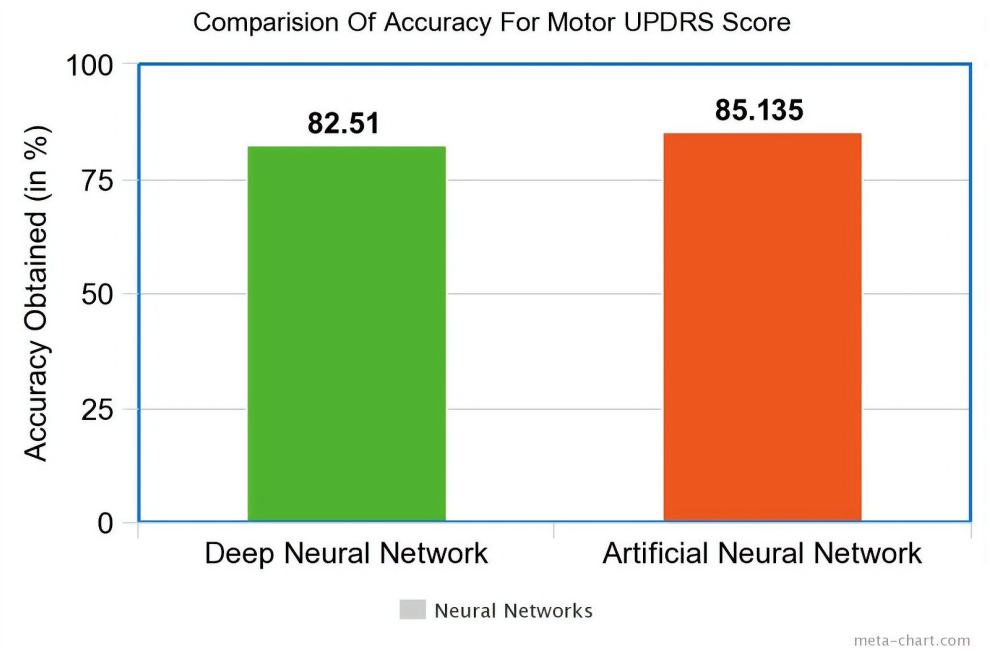

Fig 4: Comparison of Motor UPDRS Accuracies of DNN and ANN

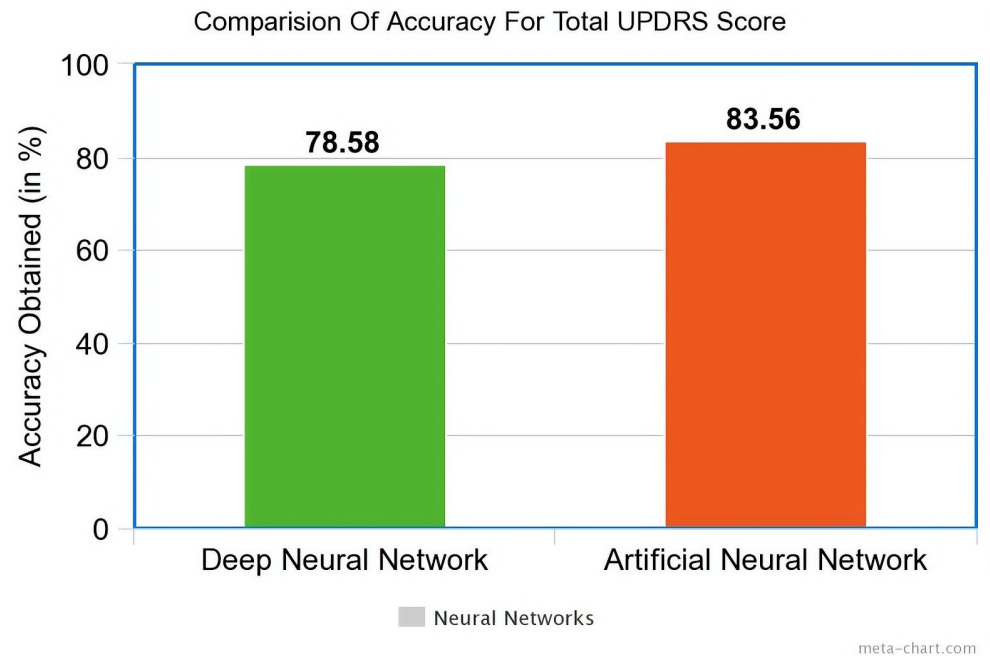

Fig 5: Comparison of Total UPDRS Accuracies of DNN and ANN

Conclusions : In this paper, we have implemented an ANN which is the feed- forward neural network. It is found to be providing exceptional results in predicting the severity of Parkinson's disease when compared with other regression models. The model seems to use its capabilities to adapt and learn to its full potential. It can analyze the nonlinear patterns within the dataset with great ease. With the use of Ann, we have also taken into consideration all the problems that might come in future modifications which other models do not provide very efficiently. It also allows greater flexibility in training and testing phase cases when there is an abundant change in the dataset due to which other models collapse but Ann seems to have a better handling mechanism for this as it provides humans like understanding behavior.