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# Improve the Prediction of Functional Outcome in Ischemic Stroke Patient

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*Abstract:* Machine Learning is the computerized approach to analysing computational work that is based on both a set of theories and a set of technologies. And, being a very active area of research and development, there is not a single agreed-upon definition that would satisfy everyone, but there are some aspects, which would be part of any knowledgeable person's definition. Machine Learning is a sub-field of Artificial Intelligence which concerns with developing computational theories of learning and building learning machines. The goal of machine learning, closely coupled with the goal of AI, is to achieve a thorough understanding about the nature of learning process, about the computational aspects of learning behaviours, and to implant the learning capability in computer systems. Machine learning has been recognized as central to the success of Artificial Intelligence, and it has applications in various areas of science, engineering and society.

***IndexTerms*** **– Deduplication, Security, Storage, Communication**

## I. INTRODUCTION

Parkinson's disease (PD) is a long-term degenerative disorder of the central nervous system that affects the central motor system. The early symptoms in the disease are shaking, rigidity, slowness of movement, and difficulty with walking. There might be a possible of thinking and behavioural problems to occur[1]. Dementia becomes common in the advanced stages of the disease. Dementia is a broad category of brain diseases that cause a long-term and gradual decrease in the ability to think and remember. Common symptoms of Dementia disease include emotional problems, difficulties with language, and a decrease in motivation [2]. Other symptoms of Parkinson's disease include sensory, sleep, and emotional problems. The main motor symptoms are collectively called "parkinsonism", or a "parkinsonian syndrome". The cause of Parkinson's disease is generally unknown, but involves both genetic and environmental factors. Those with a family member affected are more likely to get the disease themselves. There is an increased risk in people exposed to certain pesticides and who have had prior head injuries. But there is a reduced risk in tobacco smokers and those who drink coffee or tea[3]. The motor symptoms of the disease result from the death of cells in the substantia nigra, a basal ganglia structure located in the midbrain. The reason for this cell death is poorly understood, but involves the build-up of proteins into Lewy bodies in the neurons. Lewy bodies are abnormal aggregates of protein that develop inside nerve cell contributing to Parkinson's disease, Lewy bodies dementias and other disorders. Diagnosis of typical cases is mainly based on symptoms, with tests such as neuroimaging being used to rule out other diseases. As there is no cure for Parkinson's disease, the initial treatment is typically with the antiparkinsonian medication levodopa (L-DOPA), with dopamine agonists being used once levodopa becomes less effective[4]. Logistic regression is designed for this purpose (classification), and is most useful for understanding the influence of several independent variables on a single outcome variable. It works only when the predicted variable is binary, assumes all predictors are independent of each other, and assumes data is free of missing values. Support Vector Machine is a supervised machine learning algorithm that is mainly used for classification problems[5]. A hyperplane is a line that splits the input variable Prediction Model for Parkinson's Disease BE, Dept. of CSE/BNMIT Page 3 2018 - 2019 space. In SVM, a hyperplane is selected to best separate the points in the input variable space by their class, either class 0 or class 1. Artificial neural networks (ANN) or connectionist systems are computing systems vaguely inspired by the biological neural networks that constitute animal brains. The neural network itself isn't an algorithm, but rather a framework for many different machine learning algorithms to work together and process complex data inputs. An ANN is based on a collection of connected units or nodes called artificial neurons, which loosely model the neurons in a biological brain. Convolutional network is a state of art in deep learning feedforward networks alternated between convolutional layers and max-pooling layers, topped by several fully or sparsely connected layers followed by a final classification layer. In the convolutional layer, there are filters that are convolved with the input where each filter is equivalent to a weights vector that has to be trained.

## II. LITERATURE REVIEW

Parkinson's disease is a neurodegenerative disorder that is characterised by slowness of movement. About 60% of the neurons get degenerated by the time the disease is diagnosed. A predictive model for Parkinson's disease will be developed using Naive Bayes and Backpropagation algorithms. Backpropagation is a method used in artificial neural networks to calculate a gradient that is needed in the calculation of the weights to be used in the network. Naive Bayes classifiers are a family of simple probabilistic classifiers based on applying Bayes' theorem with strong independence assumptions between the features.

## III. METHODOLOGIES

The author proposes the use of machine learning techniques to predict the patient's functional outcome using information available at different points in time. To the best of the knowledge, there is no report of a pure machine learning approach to the problem of predicting the long-term functional outcome of a stroke patient, nor a comparison between such an approach and the previously mentioned scores. The approach differs from previous ones in that the prediction is meant to be performed by a computer and in that the model's features are learnt from data instead of selected by domain experts. The goal of the paper is to use machine learning techniques to predict the functional outcome of a patient three months after the initial stroke. The author starts by using only the information available at admission to train the classifiers. Then compare the results of the machine learning methods with the results given by the scores, which were designed by domain experts for this specific application. Afterwards, Analyse how the prediction improves as added more features collected at different points in time after admission. Furthermore, they aim to show how machine learning techniques can be successfully applied to clinical data without losing interpretability of the models, a characteristic which is extremely valuable for medical professionals.

Advantages of proposed system

- ✓ The resulting AUC can range up to 0.936 depending on the classifier used and on the point in time at which the prediction is made.
- ✓ Validated the use of scores when only data at admission is available and have shown that some machine learning models can be interpreted to derive new knowledge

## IV. IMPLEMENTATION

Implementation is the stage of the paper when the theoretical design is turned out into a working system. Thus, it can be considered to be the most critical stage in achieving a successful new system and in giving the user, confidence that the new system will work and be effective. Implementation is the realization of an application, or execution of a plan, idea, model, design, specification, standard, algorithm, or policy. Systems design is the process of defining the architecture, modules, interfaces, and data for a system to satisfy specified requirements. Systems design could be seen as the application of systems theory to product development. There is some overlap with the disciplines of systems analysis, systems architecture and systems engineering. The classification algorithms are implemented using Python with Python IDLE. Each of these algorithms has their own unique advantages and liabilities that can be overcome in form or other. A brief explanation of the algorithms chosen is described to understand the system architecture.

## V. METHODOLOGY

Naive Bayes Algorithm Naive Bayes classifier is a straightforward and powerful algorithm for the classification task. While working on a data set with millions of records with some attributes, it is suggested to try Naive Bayes approach.

Naive Bayes is a kind of classifier which uses the Bayes Theorem. It predicts membership probabilities for each class such as the probability that given record or data point belongs to a particular class. The class with the highest probability is considered as the most likely class. This is also known as Maximum A Posteriori (MAP).

The MAP for a hypothesis is:

MAP(H) = max( P(H|E) ) = max( (P(E|H)*P(H))/P(E)) = max(P(E|H)*P(H)) P(E) is evidence probability, and it is used to normalize the result.

It remains same so, removing it won't affect

Naive Bayes classifier assumes that all the features are unrelated to each other. Presence or absence of a feature does not influence the presence or absence of any other feature

Backpropagation Algorithm Backpropagation is another name given to finding the gradient of the cost function in a neural network. It is short for backward propagation of errors.

It is a classical feed-forward artificial neural network. It is a supervised learning method for multilayer feed-forward which is still used to inculcate large deep learning networks. It can also be used with gradient-based optimizer.

The basic concept behind this approach is to generate an expected output signal from a particular function by transforming internal weightings of input signals.

The system is trained in such a way that the difference between the envisioned output and system's output is used to modify its internal state. The basic reason behind using backpropagation is due to the complicated means of solving optimal weights because of which we use gradient descent.

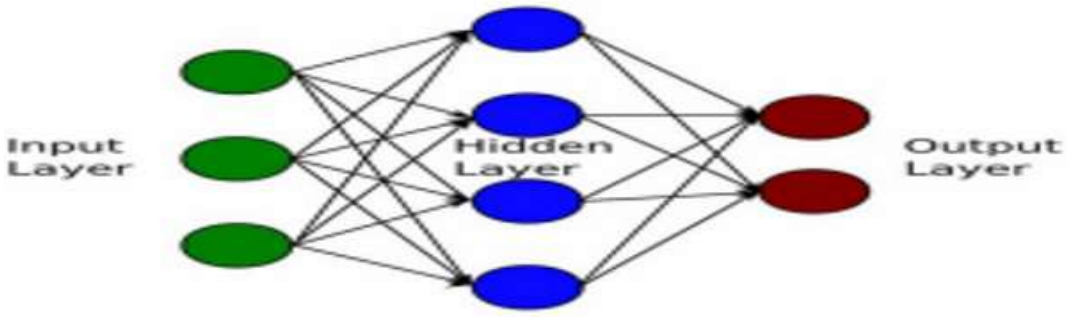


**Figure1: Artificial Neural Network**

It is an approach towards training the weights in a multilayer feed-forward neural network. A network structure is referred as one or more layers in which each and every layer is completely connected to the other layer. Backpropagation can be used for both classification and regression problems.The algorithm is based on the error-correction learning rule. It has two passes through the different layers of the network: a forward pass and a backward pass. In the forward pass, an activity pattern is applied to the input nodes of the network, and its effect propagates through the network layer by layer. Finally, a set of outputs is produced as the actual response of the network. During the forward pass the synaptic weights of the networks are all fixed. During the backward pass, the synaptic weights are all adjusted in accordance with an error-correction rule. The actual response of the network is subtracted from a desired response to produce an error signal. This error signal is then propagated backward through the network. The synaptic weights are adjusted to make the actual response of the network move closer to the desired response in a statistical sense. The weight adjustment is made according to the generalized delta rule to minimize the error.

## VI. SIMULATION RESULTS

Software testing is an investigation conducted to provide stakeholders with information about the quality of the software product or service under test. Software testing can also provide an objective, independent view of the software to allow the business to appreciate and understand the risks of software implementation. Test techniques include the process of executing a program or application with the intent of finding software bugs (errors or other defects), and verifying that the software product is fit for use.
The system is developed using Tkinter library for the GUI design, which provides a way to create forms, input fields, buttons. The Matplotlib library is used plot a graph for different voice parameter values in the report
Validation testing is a concern which overlaps with integration testing.
Ensuring that the application fulfils its specification is a major criterion for the construction of an integration test. Validation testing also overlaps to a large extent with System Testing, where the application is tested with respect to its typical working environment
Static and dynamic testing: Static testing is often implicit, as proofreading, plus when programming tools/text editors check source code structure or compilers (precompiles) check syntax and data flow as static program analysis. Dynamic testing takes place when the program itself is run.
Dynamic testing may begin before the program is 100% complete in order to test particular sections of code and are applied to discrete functions or modules.

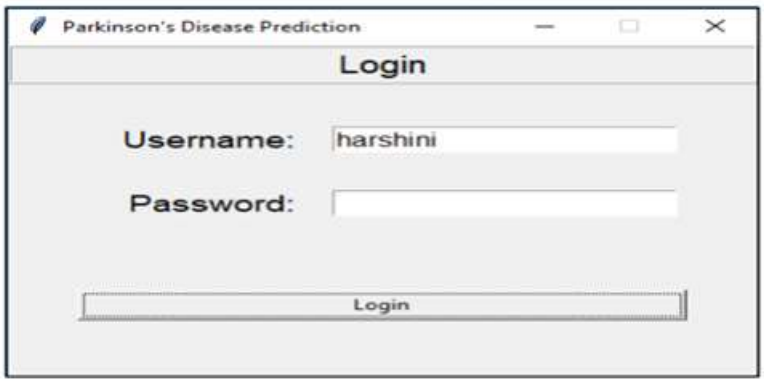


**Figure2: Login Window**

The Figure2 depicts a common login window for doctor and patient. The username and password are compared with the username and password stored in the database. Once the correct credentials are provided, the admin is taken to new window where the new patient can be created. The user can view his/her report after providing correct credentials


**Figure3: Create new patient**

The Figure 3 indicates the admin window where the doctor can create new patient profile. The Figure 4 represents how the doctor can open already existing patient profile. In creating a new patient, all the fields displayed are mandatory and must be entered.


**Figure4: Search Existing User**

The voice parameters window (Figure 5) represents a form containing all the voice parameters fields. The doctor enters each of the parameter value and then submits. The values can be reset by clicking the reset button. The back button provides a way to trace back to the previous window and the doctor can switch to a different patient profile or create a new patient profile. The report (Figure 6) represents the graphical plot of the various parameter values obtained from the spectrogram method. The report also contains the result of the prediction from the machine learning algorithm. The same report is provided when the user logs-in with his/her credentials. The user cannot perform anything other tasks but can only view the report

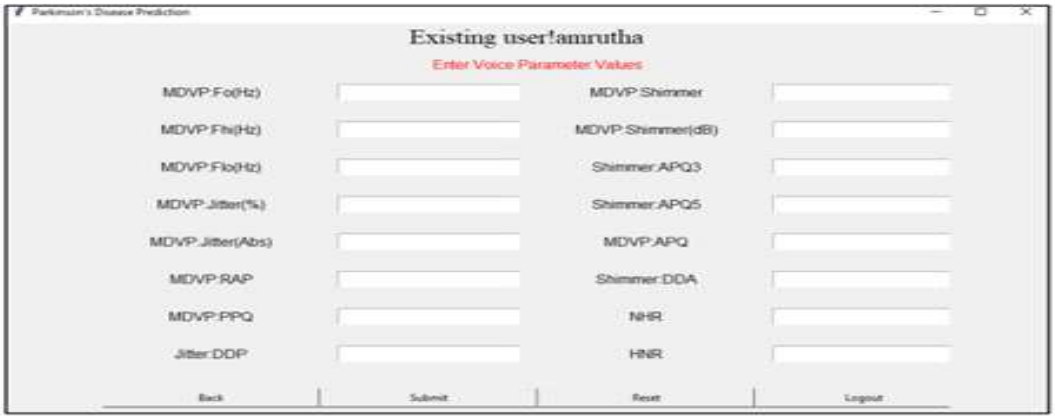


**Figure5: Voice Parameter Window**

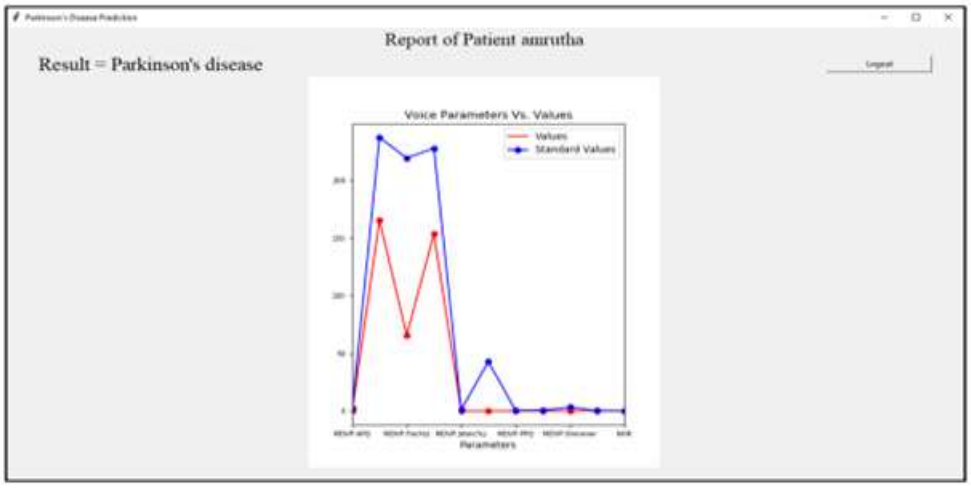


**Figure6: Result Window**

## VII. CONCLUSION

This paper has presented the results of predicting the 90-day outcome of stroke patients based on the data consisting of demographics, medical history and treatment records of ischemic stroke patients. The problem of prediction is treated first as the regression task of predicting the numeric score according to the modified Rankin Scale which measures the degree of disability in patients who have suffered a stroke. The resulting AUC can range up to 0.936 depending on the classifier used and on the point in time at which the prediction is made. Furthermore, have validated the use of scores when only data at admission is available and have shown that some machine learning models can be interpreted to derive new knowledge. Several efforts have been made by the medical community to create scores that can predict the patient's functional outcome using data readily available at admission. Among them, the Acute Stroke Registry and Analysis of Lausanne (ASTRAL), the DRAGON and the Totalled Health Risks in Vascular Events (THRIVE) scores. These scores are meant to be calculated immediately when the patient is admitted in order to inform the treatment decision. Since these scores are meant to be easily calculated by humans using data readily available when the patient is admitted to the emergency service, the resulting statistical models are greatly simplified to create integer-based scores. In practice this means the models' weights are discretised and the number of covariates is artificially reduced this result in a deterioration of the model's performance.

From a machine learning perspective, these scores can be viewed as rule-based classifier created by domain experts. All the aforementioned scores have been externally validated and report an AUC in the range of 0.70 to 0.80. Since these scores are all meant to inform treatment, none of them focuses on using data collected after the treatment to determine the functional outcome. In this setting, there is more information available that could be used to give a better prediction and to better inform the physician, patient, and relatives about the patient's functional outcome

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