CROSS VALIDATED HARD ENSEMBLE MLP CLASSIFICATION TECHNIQUE TO DETECT PARKINSON'S DISEASE

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ABSTRACT: The movement of the human body is controlled by a drug known as "Dopamine". The lack of which may not communicate the information to the brain cells and results in damage of brain cells. This is considered as vital symptom of "Parkinson's Disease". The impact of this disease on the nervous system is increasing with the stress lives of the human beings. This is highly impacted in areas, where health care is not provided up to the minimum facilities. So, for the better living of the human beings, a health care system is needed, which can identify the symptoms of this disease at early stages. So that, a life of human being can be saved. This paper has studied various systems that are developed to identify the Parkinson's disease using various popular algorithms in ML & DL. Most of the systems have acquired good accuracies but still there are few gaps identified in this paper. These gaps are resolved using ensemble techniques of machine learning and obtained an accuracy of 97.02%.

Keywords: Feature Extraction, Health Care, Voice Analysis, Classification, Evaluation Metrics

1. INTRODUCTION:

It's a bit sad to know that nearly 10 million people throughout the world are affected from the survey done by the medical associations till 2020. Out of which, most of the people are either middle aged or old aged people. The impact of the stress is making the neurons not to produce dopamine element, which gradually affecting the brain cells and damaging the neverous system and a major impact of this disease is voice impairment. The figure 1 represents the overall classification of machine learning algorithms

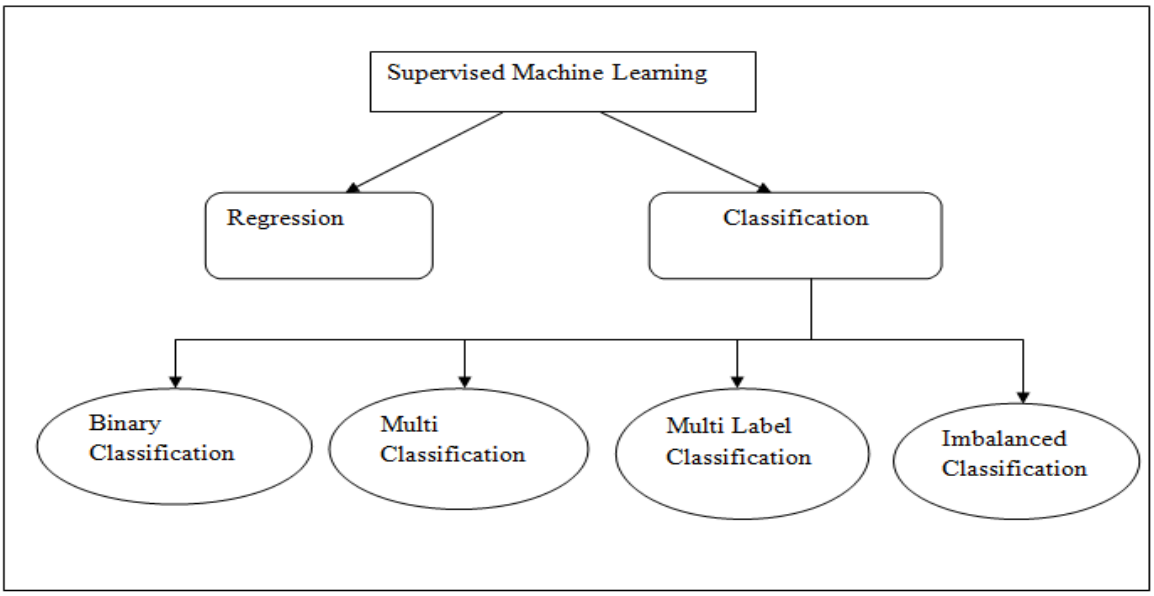

Figure 1: Classification of Supervised Machine Learning Algorithms

A model is said to be learning if it performs well when compared to its previous encounter to a similar problem. When a machine learns with a little help through the data, like labels or tags to the data, then it is called a supervised learning. Here, the model needs to accurately specify the data or foresee the results. With the help of the labels, the system could learn from the data and use its knowledge to encounter a new information.

Classification employs an algorithm to appropriately categorize the test results. It recognizes certain components within the collection and tries to derive conclusions about their identification or definition. This could be performed on both labelled and unlabeled data as the process usually is introduced in order to identify the data points that fall under similar categories. The classes are previously defined to the system and its purpose is to classify a inputted new information to its respective target category. Thus, when a new data is added to the model, it must specify it and distinguish to its respective class.

We can not assume the data to be same or exact. Likewise, a machine that differentiates the inputted data under two categories is said to be binary classified. As the name defines, the data are classified in two categories, either yes or no, correct or incorrect, etc. This type of classification can be useful under in various real time applications in identifying whether the patient is diseased or not, a particular message is span or not etc. This category provides the basic idea of data in classification.

There is no rule that the data for a particular category can be confined just to two classes there may be many attributes with different properties. Then the problem arises in differentiating. Multiclass classification solves such problems and categories the data accurately irrespective of the number of classes. Usually as said, the labelled data will be fed, and the classes will be predefined but the developed model with the chosen algorithm must precisely classify the new data to its respective class.

2. LITERATURE SURVEY:

[1] The researchers of this paper have worked out on a medical interpretation for a serious disease, called Parkinson's disease which affects the brain cells of a person responsible for communicative movements. As said, this disease damages the cells that generate dopamine, a substance that helps in maintaining a communication among the brain cells. The main objective of this research paper is to identify this disease at its earlier stages so as to take necessary precautions in prior before it could get worse. The developed system in this research consists of a property extraction mechanism and a classifying module based on the voice signals of healthy people and PD patients as a comparative study. The designed feature selection phase was a combination of modules that concentrates on extracting the important properties and another in eliminating unnecessary features using a recursive approach. The authors have stated that, with the usage of coordination and dependencies trees (RTs), ANN and, SVM distribution mechanisms, they have achieved greater performance with 93.84% in deriving the patients that prone to PD compared to the standard technologies.

[2] In this research, the developers have focused on adequately identifying PD at a preliminary phase is indispensable for decelerating its advancements and offering patients the possibility of acquiring medication. Towards a certain end, the primary motor stage in PD should be monitored closely. A groundbreaking DL technique has been developed to early elucidate if an individual is impacted with PD or not dependent on pre-motor functionalities. In order to detect Parkinson's disease in its earliest stages, various indications were investigated in this work, considering Accelerated Eye Mobility and sensory loss, Cerebrospinal fluid statistics, and dopaminergic imaging indicators. Because of comparatively modest data, a contrast of the suggested intense learning model with twelve machine intelligence and ensemble learning techniques was made. Also, a boosting methodology for observing properties was implemented to detect PDs. The experimented information was collected from both healthy individuals and patients with early stages of PD for developing a better accurate model showing 96.45% of perfection.

[3] The authors here have explained that the patient with PD does not need to have similar symptoms and also identifying them at a particular stage is difficult. In this research, the developers have worked on rest tremor and vocal signals collected through mobile phones having the necessary sensors for their voice recording statements. Initially, the diseased peoples' data is collected and then the healthy people for designing an efficient ML framework for aiming to showcase greater results. Later, information from newly PD suspected patients' data is collected and necessary training algorithms were chosen. Individuals with Parkinson's disease are referred to a suitable neurologist for examination based on the models' majority vote. After obtaining feedback from patients upon receiving evaluated by a neurologist, the program may upgrade the framework by learning with the most recent data. In addition, the system frequently demands that the discovered patients provide new data in order to track the progression of their sickness. The proposed system had shown an exceptional performance by achieving highest accuracy with 99.8%

[4] In this research work, the authors have explained about the PD, its dreadfulness and how it affects the patients suffering with it. They have also stated that this disease might be more crucial regarding neural degenerative issues following Alzheimer's. Apart from standard researches over this issue, the experiments here were conducted over the pictures of respective scans of both the patients with PD and other healthy people. The researchers here have proposed deeper frameworks related to the experimental picture data and derive the properties from it. They have adopted another methodology that indicates the relative properties visually named LIME algorithm along with the chosen system. The researchers conclude that their developed framework have shown considerable outcome with respect to various performance measures that have been carried out over the collected data by showing 95.2% of accuracy, sensitivity of 97.5% and specificity of 90.0%. In order to make this model more dominant in performance, the researchers have stated that they used LIME algorithm that could accurately distinguish between the images of patients with PD and without PD.

[5] This paper not only worked on PD but also another neural degenerative critical issue named PSP. The authors have urged about the seriousness of such problems because of its adverse affects and comparatively lower recognition and awareness about it. Innovatively, the researchers here have worked on collecting the data from the patients with PSP, PD and other healthy people through a wearable sensor that captures the information while those people are performing their subjective mobility tasks[7-10]. This sensor, as stated stores it information in the form of an array which will be inputted for the developed ML machine. The experiment was conducted by designing the ML frameworks LR and RF. The sophistication of the array is determined by the application; for testing reasons, a high specificity is required, implying that a more comprehensive array is better; however, for following illness surveillance, a finer granularity may be adequate. The proposed framework had shown a greater sensitivity of 86%, specificity of 90% regarding PSP from PD and for PSP for HC, 90% and 97% of sensitivity and specificity respectively.

3. PROPOSED SYSTEM:

The proposed system based on the features selected from the genetic algorithm, it implements the multi layer perceptron. Multiple layers are added to the neural network and a bias value to classify the patients. To minimize the error rate, the weights are adjusted using equation (1)

$$New_{Weight} = old_{weight} + l_{rate} * (original\_value - predicted\_value) + bias \quad (1)$$

The designed model identifies a static learning rate, l_{rate} which is measurement to define the adaptability of the model to new environment, in which it is undergoing training. The difference between the original value and predicted value is considered as the error rate. A constant value known as "bias" is added to normalize the values of input. An 8- layered neural network is designed in which one layer act as "input", one layer act as "output" and remaining 6 layers acts as "hidden layers". All these layers are defined with dense functionality, in which every input is passed through every unit of every layer. The MLP architecture is famous for its composition of activation function that performs affine transformation to convert the complex activities into simple linear ones. So that accurate

systems can be build with in logarithmic time. The overall architecture of the model is represented in figure 2.

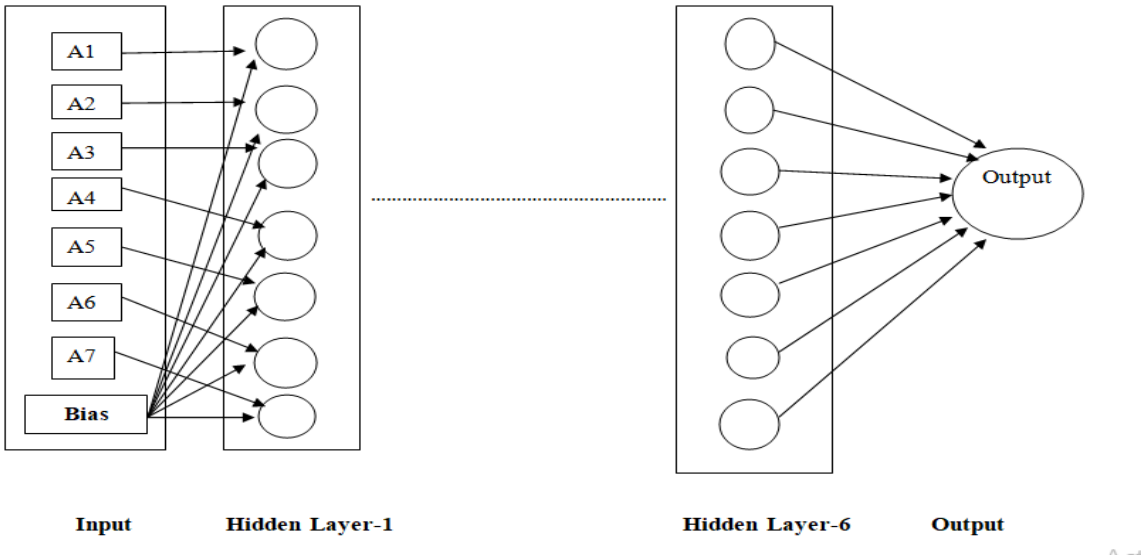

Figure 2: 8- Layered Architecture of MLP

The back propagation defined for this function is a crucial factor to adjust the weights and it has defined few conditions like learning rate as "0.3", momentum as "0.2", all the instances are divided into a batch size of 100 with epoch size as "20".

4. RESULTS & DISCUSSION:

The proposed algorithm has compared the previous models mentioned in the literature survey and presented in table 1.

Table 1: Comparative Analysis on Results Obtained

Algorithm	Accuracy	Recall	Precision	F1-Score	AUC	Kappa
Naïve Bayesian	84.1	84.2	84.4	84.0	90.0	67.7
Decision Tree	86.1	86.1	86.3	86.1	92.6	71.8
J48	93.7	93.7	93.7	93.7	97.2	87.35
ADABOOST	84.1	84.2	84.2	84.2	93.1	68.1
8-Layered MLP	97.02	97.0	97.1	97.0	97.8	94.0

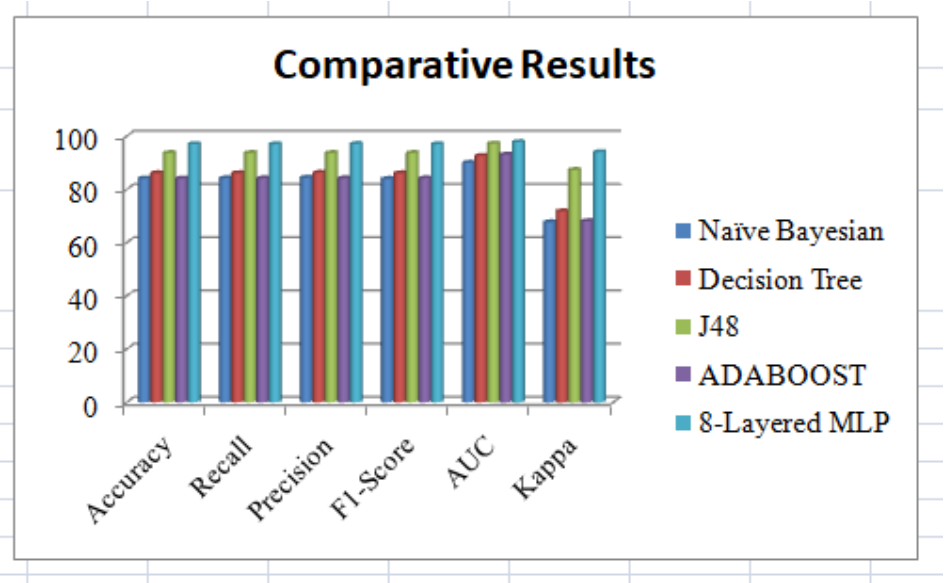

Figure 3: Comparative Results on Evaluation Metrics

From figure 3 it is a clear view that all the metrics of evaluation are good in terms of proposed algorithm and the second best model can be considered as J48, which is a type of tree based classifier. On the X-axis, the evaluation metrics are mentioned and on the y-axis, the percentage of measurement with an interval of 20 units is mentioned[6].

5. CONCLUSION:

The proposed research has obtained an accuracy of 97.02% by designing an ensemble machine learning approach based on the hard voting approach. This has achieved good efficiency but this article has identified few drawbacks that can be addressed in future research to develop good and accurate system by addressing the following gaps: a. many attributes exists for prediction purpose but all these attributes involvement will make the system complicated and time consuming. So in further research, the system can be implemented an efficient algorithm to reduce the features, which are correlated and impacts the prediction process highly. b. To work with the complex decision making process, further the system can identify the deep learning algorithm to design accurate system, which predicts the disease in less time and also to recommend the medication. c. Further, to work with customized layers, the system can hyper tune the parameters to best fit the layer values without training and getting the layers to best suit for the application.

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