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Detecting Parkinson Disease in a Patient by Best Accuracy Using Machine Learning Approach

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Abstract: Parkinson's disease is the most prevalent neurodegenerative disorder affecting more than 10 million people worldwide. There is no single test which can be administered for diagnosing Parkinson's disease. Because of these difficulties, to investigate a machine learning approach to accurately diagnose Parkinson's, using a given dataset. To prevent this problem in medical sectors have to predict the disease affected or not by finding accuracy calculation using machine learning techniques. The aim is to explore machine learning founded techniques for Parkinson disease by prediction outcomes in best accuracy with finding classification report. The analysis of dataset by supervised machine learning technique(SMLT) to capture several information's like, variable identification, uni-variate analysis, bi-variate and multi-variate analysis, missing value treatments and analyze the data validation, data cleaning/preparing and data visualization will be done on the entire given dataset. To propose, a machine learning-based method to accurately predict the disease by speech and tremor symptoms by prediction results in the form of best accuracy from comparing supervise classification machine learning algorithms. Additionally, to compare and discuss the performance of various machine learning algorithms from the given transport traffic department dataset with evaluation classification report, identify the result shows that the effectiveness of the proposed machine learning algorithm technique can be compared with best accuracy with precision, Recall and F1 Score.

Keywords: Dataset, Machine Learning-Classification Method, Python.

INTRODUCTION

Machine learning is to predict the future from past data. Machine learning is a kind of artificial intelligence (AI) that offers computers with the ability to learn without being explicitly programmed. Machine learning focuses on the development of Computer Programs that can change when exposed to new data and the basics of Machine Learning, implementation of a simple machine learning algorithm using python. Process of training and prediction includes use of specialized algorithms. It feed the training data to an algorithm, and the algorithm uses this training data to give predictions on a new test data. Machine learning can be unevenly parted in to three categories. There are supervised learning, unsupervised learning and reinforcement learning. Supervised learning program is both given the input data and the corresponding labeling to learn data has to be labeled by a human being beforehand. Unsupervised learning is no labels. It provided to the learning algorithm. This algorithm has to figure out the clustering of the input data. Finally, Reinforcement learning dynamically interacts with its environment and it receives positive or negative feedback to improve its performance.

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Data scientists use many different kinds of machine learning algorithms to discover patterns in python that lead to actionable insights. At a high equal, these dissimilar measures can be classified into two sets based on the way they "learn" about data to make predictions: supervised and unsupervised learning. Classification is the method of predicting the class of given data facts. Classes are sometimes termed as targets/ labels or groups. Classification predictive modeling is the task of approximating a mapping function from input variables(X) to discrete output variables(y). In machine learning and statistics, classification is a supervised learning approach in which the computer program learns from the data input given to it and then uses this learning to classify new observation. This data set may simply be bi-class (like identifying whether the person is male or female or that the mail is spam or non-spam) or it may be multi-class too. Some examples of classification problems are: speech recognition, handwriting recognition, bio metric identification, document classification etc.

Parkinson's Disease

Parkinson's disease (PD) is a neurodegenerative disorder, and millions of people suffer from it all over the world. The incidence of PD increases with the age growth, about 6.3 million people are suffering from this disease. Notably, in a developed country, the number of patients with PD has increased significantly in recent years. However, there are no methods which can measure the PD progression efficiently and accurately in its early stages. The last known drug for Parkinson's disease was found in 1967.

Common symptoms of PD are,

- Muscular rigidity (inflexibility of muscles)
- Shivering (vibration in upper and lower limbs or jaws)
- Speech problem,
- Expressionless face
- Bradykinesia (slow movements)
- Lethargy
- Postural instability (depression and emotional changes)
- Involuntary movements
- Dementia (loss of memory)
- Thinking inability
- Sleeping disorders

Various stages of Parkinson's disease are,

- Primary - Due to unknown reasons
- Secondary - Dopamine deficiency

Hereditary- Genetic origin

PROPOSED SYSTEM

This analysis is not meant to be providing a final conclusion on the reasons leading to medical hospitals of detecting Parkinson's it doesn't involve using any inferential statistics techniques/machine learning algorithms. Machine learning supervised classification algorithms will be used to give the given dataset and extract patterns, which would help in predicting the likely affected or not, thereby helping the hospitals for making better decisions of detecting disease in the future. Multiple datasets from different sources would be combined to form a generalized dataset, and then different machine learning algorithms would be applied to extract patterns and to obtain results with maximum accuracy.

Advantages

- To save doctors risk and increasing patient appointments.
- Easy to predicting the diagnose Parkinson with doctors can detecting the patient testing result time is reduced.

LITERATURE SURVEY

A literature review is a body of text that aims to review the critical points of current knowledge on and/or methodological approaches to a particular topic. It is secondary sources and discuss published information in a particular subject area and sometimes information in a particular subject area within a certain time period. Its ultimate goal is to bring the reader up to date with current literature on a topic and forms the basis for another goal, such as future research that may be needed in the area and precedes a research proposal and may be just a simple summary of sources. Usually, it has an organizational pattern and combines both summary and synthesis.

A summary is a recap of important information about the source, but a synthesis is a re-organization, reshuffling of information. It might give a new interpretation of old material or combine new with old interpretations or it might trace the intellectual progression of the field, including major debates. Depending on the situation, the literature review may evaluate the sources and advise the reader on the most pertinent or relevant of them. Loan default trends have been long studied from a socio-economic stand point. Most economics surveys believe in empirical modeling of these complex systems in order to be able to predict the loan default rate for a particular individual. The use of machine learning for such tasks is a trend which itis observing now. Some of the surveys to understand the past and present perspective of loan approval or not.

Review of Literature Survey

Title: Data Mining Techniques to Detect Motor Fluctuations in Parkinson's disease

Author: Paolo Bonato, Delsey M. Sherrill, David G. Standaert

Year: 2004

To identify motor patterns of primary and secondary movement disorders in PD, such as tremor, rigidity, dyskinesia, akinesia, and dystonia in a manner that is both objective and automatic. In addition to successfully classifying these disorders for the purpose of assessment, data mining has the potential of increasing our understanding of these disorders. Surprisingly little information is available today in the research literature on the study and comparison of specific motor patterns from the full complement of movement disorders in advanced PD, and on factors that contribute to variability among patients and within the same patient over time.

Title: Detecting Parkinsons' Symptoms in Uncontrolled Home Environments: A Multiple Instance Learning Approach

Author: Samarjit Das, BreoganAmoedo, Fernando De la Torre

Year: 2012

To demonstrated the use of multiple instance learning for detecting PD motor symptoms in uncontrolled home environments. Our work addressed the formulation of PD symptom detection from weakly labeled data as a semi-supervised multiple instance learning problem. The features were carefully chosen to address the subject and symptom specific nature of the problem. We show promising preliminary results on four days of monitoring performed with two PD subjects. In future work, we plan to increase our subject pool and utilize optimal feature selection strategies under MIL frameworks for developing robust person-specific models. These techniques can potentially be adapted to various other physiological sensing and monitoring applications as well.

Title: Analysis of Visually Guided Tracking Performance in Parkinson's disease

Author: Yi Liu, Chonho Lee, Bu-Sung Lee, James K.R. Stevenson

Year: 2014

To investigate visually guided tracking performance of both dyskinesia and non-dyskinesia PD patients and verify that they can be differentiated using data mining technique based on their performance monitored under different tracking conditions and attempt to reveal the most effective tracking conditions (i.e., dataset attributes) to classify the PD patients into two different groups, and demonstrate that the highest classification accuracy is when using dataset attributes of fast-speed and with-noise tracking conditions and study how data mining and statistical analysis complement each other by looking at clustering results (e.g., distance between cluster centroids) and statistical significance (e.g., p-value on t-test) of tracking performance.

To utilize two data mining techniques, K-means clustering algorithm and Decision tree classification algorithm. For K-means, we used RMS tracking error as attributes to cluster two groups in unsupervised fashion, in which we found that under fast Speed and with noise conditions, it is effective to cluster these into two groups. Moreover, to studied how data mining and statistical analysis complement each other by looking at clustering result (e.g., DCC) and statistical significance (e.g., p-value of t-test) of the tracking performance dataset. In addition, For the decision tree, we used subjects' characteristics to classify two groups with NDPD/DPD label, and the accuracy is 68.4% with leave-one-out cross validation which is lower than the accuracy of tracking performance clustering, 77.8%, so clinically tracking performance assessment is better than demographic characteristics while differentiating NDPD and DPD.

Title: An Emerging Era in the Management of Parkinson's disease: Wearable Technologies and the Internet of Things

Author: Cristian F. Pasluosta, HeikoGassner, Juergen Winkler, Jochen Klucken

Year: 2015

Potential solution to this problem may arise from the lateralization of the healthcare structure. Following the analogy with the energy generation and distribution, we need to complement and extend centralized top-down medical institutions with mobile and laterally distributed micro healthcare systems. In this context, a top-down structure is required as doctoral training and specialization demands the oversight and approval of experienced physicians, whereas individual therapy requires supervision and execution of the patient diagnostics and therapy. Complementary, new wearable technologies and the IoT allow a broad distribution and application of individualized diagnostics and therapy (lateralization). We can envision this lateralization in two major ways: The development of a highly efficient laterally distributed platform such as wearable technologies and the Internet of Things (IoT) and the active engagement of patients in disease management. As we learn more about the pathological mechanisms driving disease progression and develop more individualized treatment paradigms for distinct disease entities, its management becomes more complex in nature. Modern molecular technology allows genetic screening for disease causing or risk-factor genes for complex disorders.

Title: Assessment and Visualization of Parkinson's disease Tremor

Author: J. Synnott, L. Chen, C.D. Nugent, and G. Moore

Year: 2010

The infrequent nature of these assessments has the potential to slow the adjustment of Medication and to limit the amount of data gathered about the patient's condition. Additionally, the clinical assessment methods used are subjective, which can ultimately result in inconsistencies in the collected data. Recent research has focused on the use of sensor technology to facilitate at-home remote monitoring of PD patients, enabling the collection of objective measurements detailing the progression of motor dysfunction and providing rich datasets with measurements taken at frequent intervals over extended periods of time. There has, however, been significantly less work carried out in the area of visualizing this data in a manner that is familiar to care providers and interoperable with existing clinical practice. The work presented in this paper aims to extend existing research by proposing a novel approach for the assessment and visualization of PD tremor in order to facilitate remote objective assessment.

EXISTING SYSTEM

Scan without evidence of dopaminergic deficit (SWEDD) are subjects clinically diagnosed as Parkinson's disease (PD) patients although the SPECT imaging does not show any negro-striatal abnormality. It defined five models of machine learning were used to carry out binary classification (healthy control/PD) using clinical assessment and image-derived features applied thereafter on SWEDD group as a potential application of motor and non-motors features in understanding Parkinson disease characteristic in this group. The nested cross-validation was an essential component to select reliable models. A high accuracy was achieved for the five models (75.4% - 78.4% for motor features and 71% - 82.2% for non-motor features) in binary classification (HC Vs PD). Accordingly, it demonstrates the suitability and usefulness of ML models to carry out binary classification of SPECT data. Cross all models applied on SWEDD group, 17.6% of patients were classified as PD motor disorder lookalikes, 27.4% were classified as having a beginning non-motor abnormality of PD and 3.9% were classified as having both motor and non-motor PD features. However, the interpretability of SWEDD predicted condition must be carefully considered. To demonstrate the feasibility of evaluating machine learning algorithms to classify PD subjects from HC. The nested cross-validation used in this work was an essential component to select reliable models.The five models were applied on SWEED as a potential application of motor and non-motor features in understanding Parkinson disease characteristic in this group. SVM model was applied on the PC1 and PC2 scores and non-motor features and provided a classification of SWEDD as follow: a 57% of SWEDD patients were classified as PD motor disorder lookalikes by the SVM_M model whereas 51% were classified as having a beginning non-motor abnormality of PD by the SVM_NM. Importantly, 27% of SWEDD patients were classified as mimicking both PD motor and non-motor disorder and abnormality cross the two models. RF model was applied on the two subsets of features (motor and non-motor) and provided a classification of SWEDD as follow: a 43% of SWEDD patients were classified as PD with motor disorder by the RF_M model and 54% were classified as having a beginning non-motor abnormality of PD

by the RF_NM. Cross the two models, 25% of SWEDD patients were classified as having both PD features. Similarly, K-NN model was applied on the two set of features and provided a classification of SWEDD as follow: a 25% of SWEDD patients were classified as PD motor disorder lookalikes by the K-NN_M model and 63% were classified as having a beginning non-motor abnormality of PD by the K-NN_NM model. Cross the two models, 24% of SWEDD patients were classified as having both PD features.

Drawbacks

- There are known disadvantages associated with the use of sampling to implement cost-sensitive learning. The disadvantage with under sampling is that it discards potentially useful data. The main disadvantage with oversampling, from our perspective, is that by making exact copies of existing examples, it makes over fitting likely.
- In fact, with oversampling it is quite common for a learner to generate a classification rule to cover a single, replicated, example. A second disadvantage of oversampling is that it increases the number of training examples, thus increasing the learning time.

MODULES DESCRIPTION

List of Modules

- Variable Identification Process/Create a dataset for speech and tremor
- Data Validation process
- Exploration data analysis of visualization
- Outlier detection process
- Comparing Algorithm with prediction in the form of best accuracy result.

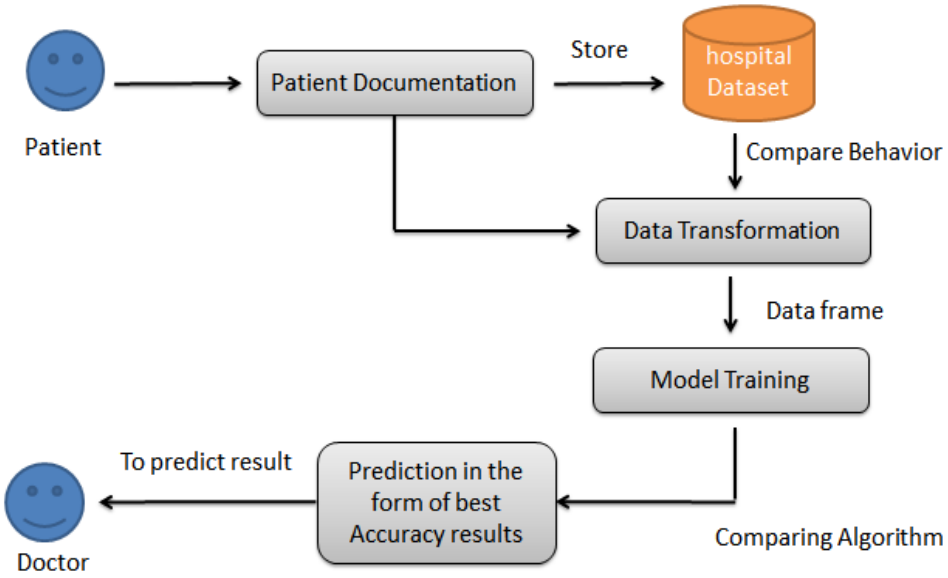
In the example below 5 different algorithms are compared:

- Logistic Regression
- Random Forest
- K-Nearest Neighbors
- Decision tree
- Support Vector Machines

ARCHITECTURE DESIGN SPECIFICATION

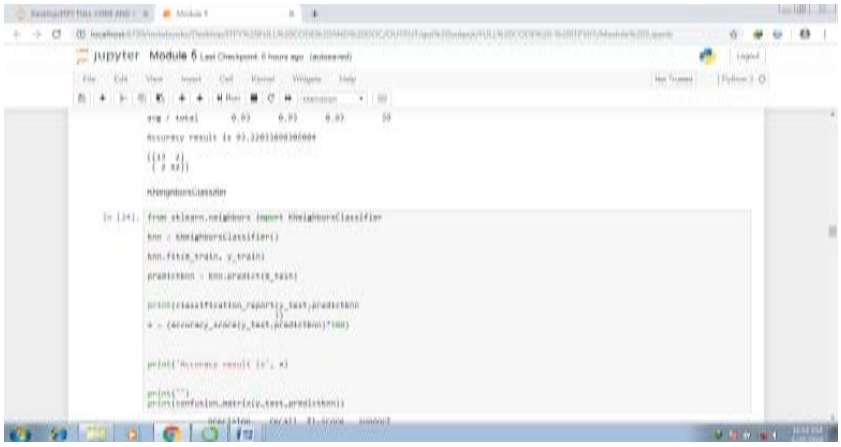
Design is meaningful engineering representation of something that is to be built. Software design is a process design is the perfect way to accurately translate requirements in to a finished software product. Design creates a representation or model, provides detail about software data structure, architecture, interfaces and components that are necessary to implement a system.

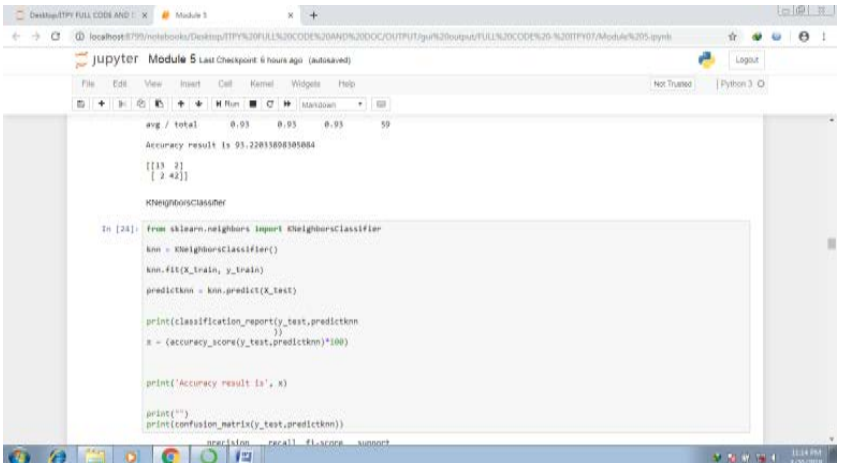
System Architecture



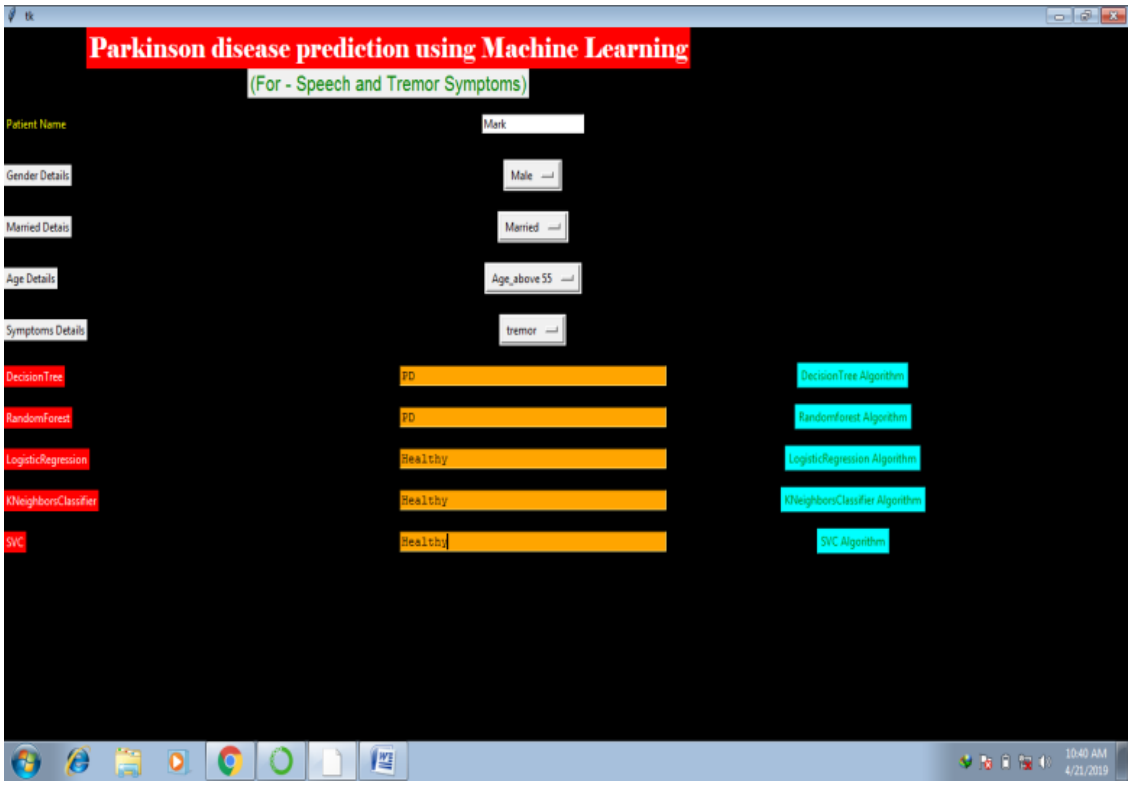
Design Architecture

SCREENSHOTS





OUTPUT



CONCLUSION AND FUTURE ENHANCEMENT

The analytical process started from data cleaning and processing, missing value, exploratory analysis and finally model building and evaluation. The best accuracy on public test set is higher accuracy score of Speech for KNN and Tremor for Random Forest algorithm. This brings some of the following insights about diagnose the Parkinson disease. Early diagnosis of Parkinson's is most important for the patient to reduce its impact. To presented a prediction model with the aid of artificial intelligence to improve over human accuracy and provide with the scope of early detection. With our proposed prediction model, we aim to make it easier for doctors to do precise diagnosis and prediction of PD, both of which have human limitations due to the method of detection of PD that is used now. It can be inferred from this model that, area analysis and use of machine learning technique is useful in developing prediction models that can help a doctor reduce the long process of diagnosis and eradicate any human error.

Future Work

- Hospitals want to automate the detecting the disease persons from eligibility process (real time) based on the account detail.
- To automate this process by show the prediction result in web application or desktop application.
- To optimize the work to implement in Artificial Intelligence environment.

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