RESEARCH ARTICLE OPEN ACCESS

Machine Learning Based Health Prediction System Using IBM Cloud

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Abstract:

Adaptable Critical Patient Caring system is a key concern for hospitals in developing countries like Bangladesh. Most of the hospital in Bangladesh lack serving proper health service due to unavailability of appropriate, easy and scalable smart systems. The aim of this project is to build an adequate system for hospitals to serve critical patients with a real-time feedback method. In this paper, we propose a generic architecture, associated terminology and a classificatory model for observing critical patient's health condition with machine learning and IBM cloud computing as Platform as a service (PaaS). Machine Learning (ML) based health prediction of the patients is the key concept of this research. IBM Cloud, IBM Watson studio is the platform for this research to store and maintain our data and ml models. For our ml models, we have chosen the following Base Predictors: Naïve Bayes, Logistic Regression, K Neighbors Classifier, Decision Tree Classifier, Random Forest Classifier, Gradient Boosting Classifier, and MLP Classifier. For improving the accuracy of the model, the bagging method of ensemble learning has been used. The following algorithms are used for ensemble learning: Bagging Random Forest, Bagging Extra Trees, Bagging K Neighbors, Bagging SVC, and Bagging Ridge. We have developed a mobile application named "Critical Patient Management System - CPMS" for real-time data and information view. The system architecture is designed in such a way that the ml models can train and deploy in a real-time interval by retrieving the data from IBM Cloud and the cloud information can also be accessed through CPMS in a requested time interval. To help the doctors, the ml models will predict the condition of a patient. If the prediction based on the condition gets worse, the CPMS will send an SMS to the duty doctor and nurse for getting immediate attention to the patient. Combining with the ml models and mobile application, the project may serve as a smart health care solution for the hospitals.

I. INTRODUCTION

Critical Patient Caring or monitoring System is a process where a doctor can continuously monitor more than one patient, for more than one parameter at a time in a remote place and also can have control over medicine dosage [1]. Development and evaluation of the ICU decision-support

systems would be greatly facilitated by these systems. Devices such as vital sign monitors, mechanical ventilators and dialysis machines, and some others more are used to support critical patients whose bodies need time to recover and repair. Most of the machines are managed manually by supervising the patient's condition and test reports. So, we thought to automate the process and decision-making ability with the help of modern technology, especially the auto deployable machine learning models and cloud computing. Machine learning models can predict the near future condition of the patients, whether their condition will increase or decrease, whether they need any immediate support or not. To generalize our models and data, we have selected IBM Cloud as a PaaS which altogether spans public, private and hybrid environments [2]. As initially, we cannot deploy our models directly, we had to use IBM Cloud, IBM Watson Studio for storing, testing and deploying our whole system.

II. LITERATURE REVIEW

Health sector seems to be one of the neglected fields in terms of usage of technology in Bangladesh [4]. Although other sectors have adequately taken this advantage, health sector seems to be lagging behind. Government projects to integrate technology into the health sector has mostly failed.

Due to inefficient handling of patients during an emergency, most of the cases result in death or permanent physical/mental damage to the patients, the main reason being the attending physician’s inability to monitor the patient’s vitals immediately[5].

The main method of communication is a mobile phone when the doctor is absent, resulting in a communication mismatch. Our research installs the mechanism where the doctor can monitor the patients vitals remotely, taking full Proceedings of the advantage of Machine Learning to prescribe an advanced course and Cloud Computing to access the patients vitals from any remote location. So, doctors can monitor multiple patients with in a short span of time. Patients‟ relatives can get regular updates without having to visit the hospital every now and then. The ml models run within the cloud service and also trains with the auto-deployed data, the CPMS also can access the Cloud services through Blue mix [3]. The most significant of this paper carries the auto deployable machine learning model within the cloud storage with note worthy accuracy. Also, testing and tuning approaches and parameter choosing, setting for different machine learning algorithms. A Plethora of Health Risk Systems is available in the literature. However, Most of the research in the initials days focused on developing Disease Risk Prediction Models using Machine Learning for a single candidate Disease.

These were mostly the Binary Classification problems which given a medical records dictates whether a person is suffering from specified disease or not.

Problems of this sort are called as Single Label, Single Class Classification Problems. Limitations of existing system: Emergence of adversarial based methods for existing algorithms often produces unsatisfied results.

III. PROPOSED SYSTEM

To automate the process and predict diseases more accurately machine learning methods are gaining popularity in research community. Machine Learning methods facilitate development of the intelligence into a machine, so that it can perform better in the future using the learned experience.

Machine learning methods application on electronic health record dataset could provide valuable information and predication of health risks. Preliminary investigation examine project feasibility, the likelihood the system will be useful to the organization.

The main objective of the feasibility study is to test the Technical, Operational and Economical feasibility for adding new modules and debugging old running system. All system is feasible if they are unlimited resources and in finite time. There are aspects in the feasibility study portion of the preliminary investigation: Economical Feasibility; Operational Feasibility; Technical Feasibility

IV. ECONOMIC FEASIBILITY

A system can be developed technically and that will be used if installed must still be a good investment for the organization. In the economical feasibility, the development cost in creating the system is evaluated against the ultimate benefit derived from the new systems. Financial benefits must equal or exceed the costs.

The system is economically feasible. It does not require any addition hardware or software. Since the interface for this system is developed using the existing resources and technologies available at NIC, There is nominal expenditure and economical feasibility for certain.

V. OPERATIONAL FEASIBILITY

Proposed projects are beneficial only if they can be turned out into information system. That will meet the organizations operating requirements. Operational feasibility aspects of the project are to be taken as an important part of the project implementation. Some of the important issues raised are to test the operational feasibility of a project includes the following: -

1.Is there sufficient support for the management from the users?

2.Will the system be used and work properly if it is being developed and implemented?

3. Will there be any resistance from the user that will undermine the possible application benefits?

This system is targeted to be in accordance with the above-mentioned issues. Beforehand, the management issues and user requirements have been taken into consideration.

So there is no question of resistance from the users that can undermine the possible application benefits.

VI. TECHNICAL FEASIBILITY

Thetechnicalissueusuallyraisedduringthefeasibilitystageoftheinvestigation includes the following:

Does the necessary technology exist to do what is suggested?

Do the proposed equipments have the technical capacity to hold the data required to use the new system?

Will the proposed system provide adequate response to inquiries, regardless of the number or location of users?

Can the system be upgraded if developed?

Are there technical guarantees of accuracy, reliability, ease of access and data.

The database's purpose is to create, establish and maintain a work flow among various entities in order to facilitate all concerned users in their various capacities or roles. Permission to the users would be granted based on the roles specified. Therefore, it provides the technical guarantee of accuracy, reliability and security. The software and hard requirements for the development of this project are not many and are already available in-house are available as free as open source. The work for the project is done with the current equipment and existing software technology. Necessary bandwidth exists for providing a fast feedback to the users irrespective of the number of users using the system.

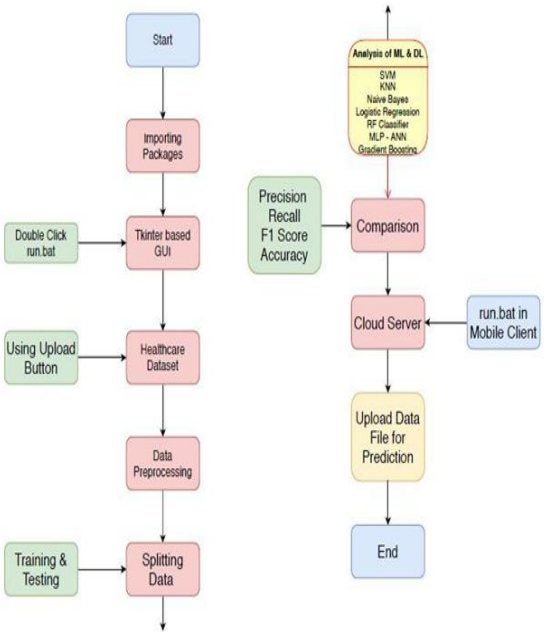

Fig.1 Flow Chart

VII Performance Testing

Functional testing conducted to evaluate the compliance of a system or component with specified performance requirements. It is usually conducted by the performance engineer.

VIII Black Box Testing

Black box testing is testing the functionality of an application without knowing the details of its implementation including internal program structure, datastructures etc.

Testcasesforblack box testing are created based on the requirement specifications. Therefore, it is also called as specification-based testing.

IX. RESULTS

Double click on'run.bat'file from'Cloud'folder to start cloud application and to as shown in fig.2

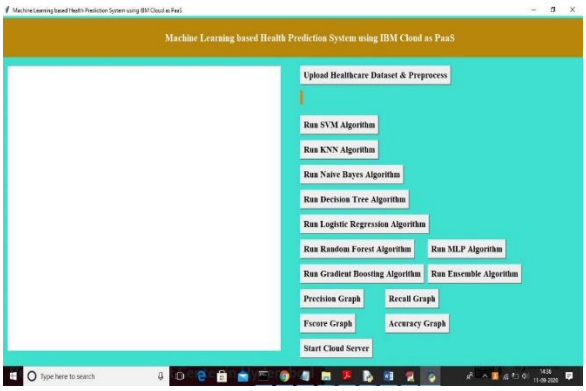

Fig.2 cloud application

In fig.2 we can see various buttons are there to run different machine learning algorithms and after building machine learning models we can click on „Start Cloud Server" button to start cloud and to accept request from client. Now click on

„Upload Healthcare Dataset & Pre-process‟ button to load dataset

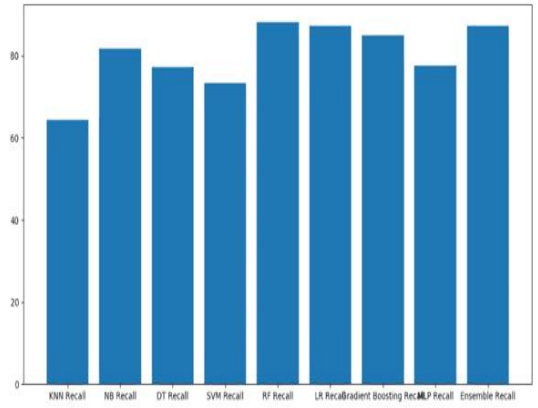

Fig.3 Data set definition

The above fig.3 dataset contains 303 records and application using 80% dataset records for training and 20% fortesting. Now data set train and test data set ready and now

click on Run SVM Algorithm button to apply SVM on train data set and then evaluate its performance on test data to calculate prediction accuracy

Fig.4 SVM prediction accuracy

In fig.4 SVM prediction accuracy on 20% test dataset is 75% and we can see precision, F Measure and Recall values also. Now click on „Run KNN Algorithm‟ button to generate KNN model

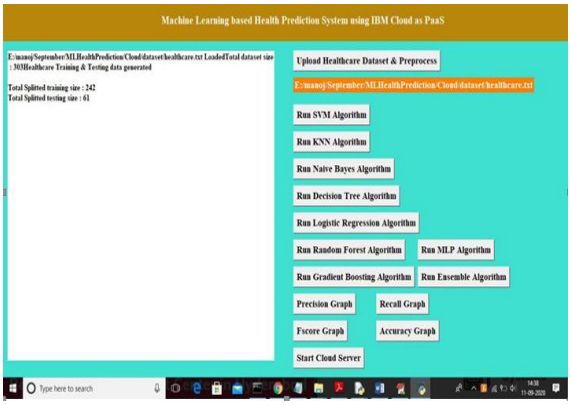

Fig. 5. precision of the algorithms

In fig.5 x-axis represents algorithm names and y-axis represents precision of those algorithms and from all algorithms ensemble is performing well. Now click on Recall Graph‟ button to get below graph of recall

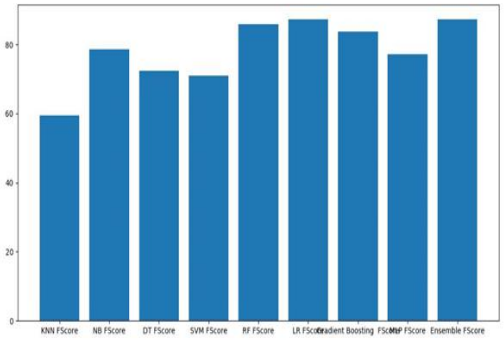

Fig.6 F Score Graph

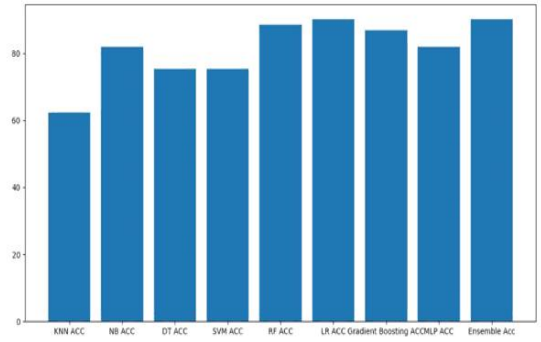

Fig.7 Accuracy Graph

In fig.7 data sent to server and server sent result back and in above client page first line contains patient vitals and second line displaying patient predicted condition based on vitals by machine learning algorithms. In above screen in first record we can see machine learning has predicted patient condition is abnormal.

X. CONCLUSION

To provide better treatment we require more advanced technologies at very low cost. It was started this project to bring out a good result in the hospitals to serve the patient.

It is used some of the existed techniques and technologies to give a new shape in the hospital and nursing sector.

Most of the ML models accuracy varied from 80% to 92%. The lowest accuracy obtained is 80%. An important finding of this project is the appropriate uses of machine learning models for medical patients and categorical data manipulations.

The IBM Cloud showed good promising actions by keeping more than 90% success rate. Al to gether the results we obtained from our project and experiments are showing promise to rise this system in large scale for urban and low economical side peoples. With the help of this project, a virtual doctor can be established to serve the people better and monitor patients with appropriate care.

This is also a decision-making assistant for the doctor as a smart health care system. As we have established this project with very few parameters of the physical segments, we can improve this project more by adding full parameters to measure the human body circulations.

In future, it is planning to install an embedded system to take a live reading from Ventilator, Medicine Pump, Heart Monitor, and other ICU machines. This will also increase the overall working accuracy of this project.

XI. REFERENCES

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