Effective Heart Disease Prediction Using IBM Auto AI Service

1. INTRODUCTION

1.1 Overview

Heart related diseases or Cardiovascular Diseases (CVDs) are the main reason for a huge number of death in the world over the last few decades and has emerged as the most life-threatening disease, not only in India but in the whole world. So, there is a need of reliable, accurate and feasible system to diagnose such diseases in time for proper treatment. Machine Learning algorithms and techniques have been appliedto various medical datasets to automate the analysis of large and complex data. Many researchers, in recent times, have been using several machine learning techniques to help the health care industry and the professionals in the diagnosisof heart related diseases.

1.2 Purpose

Cardiovascular diseases (CVDs) are the number one cause of death globally, taking an estimated 17.9 million lives each year, which accounts for 31% of all deaths worldwide. Heart failure is a common event caused by CVDs and the dataset uses in this project contains 9 features that can be used to predict mortality by heart failure. In this project, a prediction model using IBM Auto AI service is built and a web server application also built to showcase the prediction of heart failure. The goal of this effective heart disease prediction project is to determine whether a patient should be diagnosed with heart disease or not, which is a binary outcome, so the positive result = 1, the patient will be diagnosed with heart disease and the negativeresult = 0, the patient will notbe diagnosed with heartdisease.

2 LITERATURE SURVEY

2.1 Existing Problem

It is very important to take into account the prediction of risk level of heart disease for healthcare industry in order to ease the medical treatment for the patients.Data science classification techniques are used in a number of applications like healthcare analytics, customer analytics, marketing analytics, water quality analytics, textile production analytics, manufacturing analytics and textile waste analytics etc.,

There are various heart disease prediction models are available based on data mining techniques such as regression, clustering, association rule and classification techniques such as decision tree,naïve Bayes, random forest, artificial neural network etc.,

Eventhough there are lot of prediction models and ensemble techniques available, there is no single infrastructure or framework existing to execute all the above techniques altogether. Therefore, for developing the effective and best heart disease prediction model, lot of efforts are neededto incorporate everything.

Ramalingam et al.,[1] providedthe survey about theHeart disease prediction using machine learningtechniques.They discussed about algorithms,techniques and performance of variousmodels such as Support Vector Machines (SVM), K-Nearest Neighbour(KNN), NaïveBayes, Decision Trees (DT), Random Forest (RF) and ensemble models.

Mohan et al., [2] also proposed effective heart disease prediction using hybrid machine learning techniques.Their method aimed at finding significant features by applying machine learningtechniques resulting in improving the accuracy in the prediction of cardiovascular disease. Their prediction model is introduced with different combinations of features and several known classification techniques. They produced an enhanced performance level with an accuracy level of 88.7% through the prediction model for heart disease with the hybrid random forest with a linear model (HRFLM).

Various research workers like Rajdhan et al.,[4],Patel et al.,[5], Singh & Kumar[6], Jagtap et al.,[7],Khourdifi& Bahaj [8],Gavhane A[9] and Jindal et al., have provided different solutions using different machinelearning techniques for developing effectiveheart diseaseprediction model.

2.2 Proposed Solution

The proposed solution is to develop a prediction model using IBM Auto AI service. Under Auto AI, there are various machine learning techniques are available. Using pipeline concept, various prediction models with different machine learning techniques are developed and also found best prediction model among them. Then finally,with the best prediction model, a web server application is also built to showcasethe prediction of heart failure using node RED service.

3.THEORETICAL ANALYSIS

3.1Block Diagram

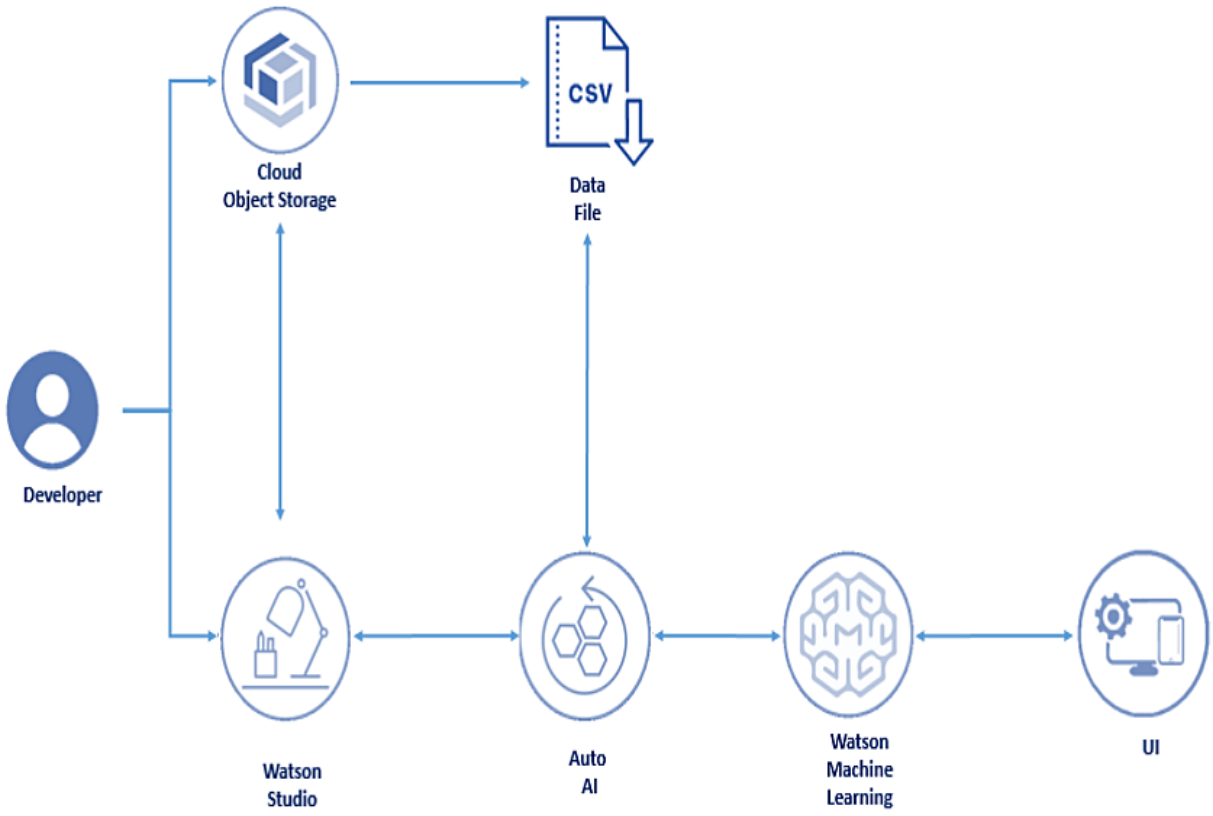


Figure.1 Technical Architecture of Effective Heart Disease Prediction Model

Figure.1 depicts the technicalarchitecture of the proposed effectiveheart disease prediction model using IBM Auto AI service. The IBM cloud provides SaaS(Software-As-A-Service).Using this service, the developer creates the IBM cloud account to acquire the services provided by the IBM cloud. Initially,the developer creates cloud object storage service and Watson studio services.After that create Node RED service for deploying web server application.Then create Watson machinelearning service and create Auto AI experiment with the patientdataset to builda machine learningmodel.Now the model is readyto deploy as web server and generate scoring end point.Then using Node RED service , create User Interface for accessingthe web server application by the user and createweb application to take user input and display prediction result on User Interface.

3.2 Hardware / Softwaredesigning

a. Hardware Designing

1. PC/Laptop
2. Operating System- Windows 7 / Windows10 Pro
3. 64-bit operating system, x64-based processor
4. 4 GB / 8 GB RAM

b. Software Designing

1. Google Chrome browser / Any other browser
2. Internet Connection with optimum bandwidth
3. SmartInternz account
4. SmartInternz MailID credentials
5. IBM Academic Initiative Account
6. IBM Cloud Account

4. EXPERIMENTAL INVESTIGATIONS

For this project, the dataset named patientdataV6.csv is used. This dataset contains 10 attributes and 10,800patient's sample records.Out of 10 attributes, 9 attributes are conditional /independent attributes and 1 is decision/dependant attribute. The conditional attributes are AVGHEARTBEATSPERMIN,FAMILYHISTORY,PALPITATIONSPERDAY,CHOLESTEROL, BMI, AGE,SEX,SMOKERLAST5YRS and EXERCISEMINPERWEEK.The decision attribute is HEART FAILURE. Out of 10,800 sample values of the dataset, one group consisted of 90% of the sample values (9720 sample records) of the dataset using for the learning (training purpose) and another group consisted of 10% of the sample values(1080 sample records) of the dataset for testing purposes.

Before the model development, the data preprocessing procedures such as missing valueanalysis, smoothing noisy data and data standardization were applied on the patient data set to produce reliable data.Then using cross validation technique, the datasetis split into training datasetand test dataset. The training dataset is used for model development purpose and 10% of the dataset is used for model validation purpose.Then the different prediction models are developed and best prediction model, snap random forestclassifier is selectedusing IBM Auto AI service.

The AutoAI graphical tool in Watson Studio automatically analyses patient dataset and generates candidate model pipelines customized for predictive modelling problem. These model pipelinesare created iteratively as AutoAI analysesthe patient datasetand discovers data transformations, algorithms, and parameter settings that work best for problem setting. Resultsare displayed on a leader board, showing the automatically generated model pipelines ranked according to the given problem optimization objective.Then this prediction model is

validated using test data. The accuracy of the best prediction model obtained is 87.3%. Once the pipeline creation is complete, view and compare the ranked pipelines in a leader board.The Saved model from the action menu for the pipelinewith the highestaccuracy or low error rate has chosen.This saves the pipeline as a Machine Learning asset in this project. A notification is received thatthe link to view the saved model in this project.

Then this model is deployed for ready to use. The API key and the relevantendpoint URL is generated. The user interface is created using IBM node RED service with Node RED flow editor. The Node RED flow in json format is also deployed and associated with prediction model already created. Then invoke the Input User Interface screen with dashboard.Now the patient input details are given through UI and the predicted output is displayed with score.The flow work of this project is clearly depicted in Figure.2.

5. FLOW CHART

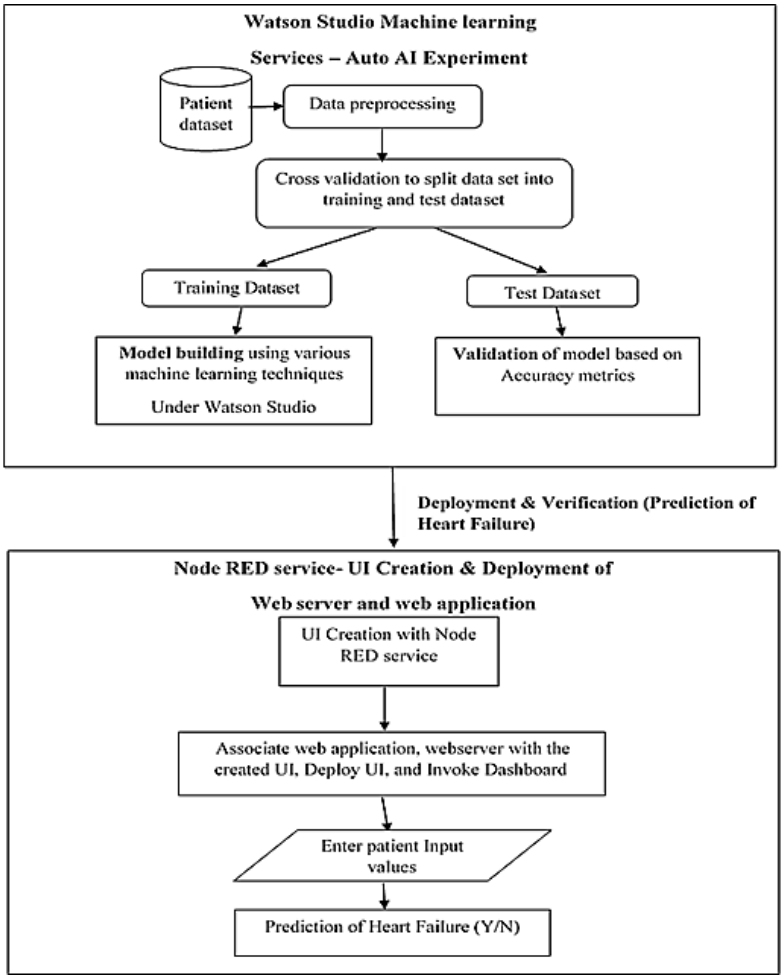
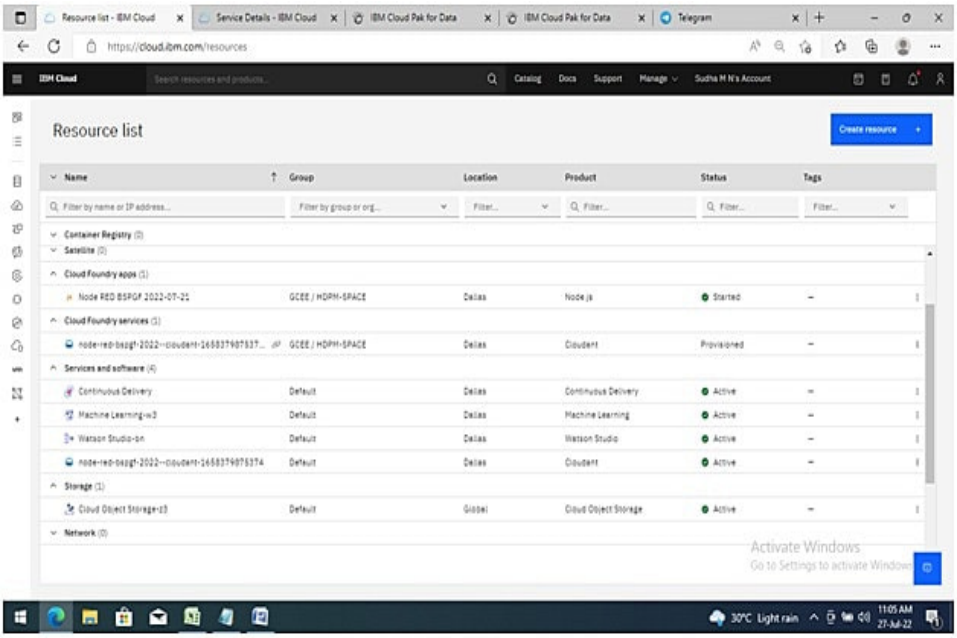
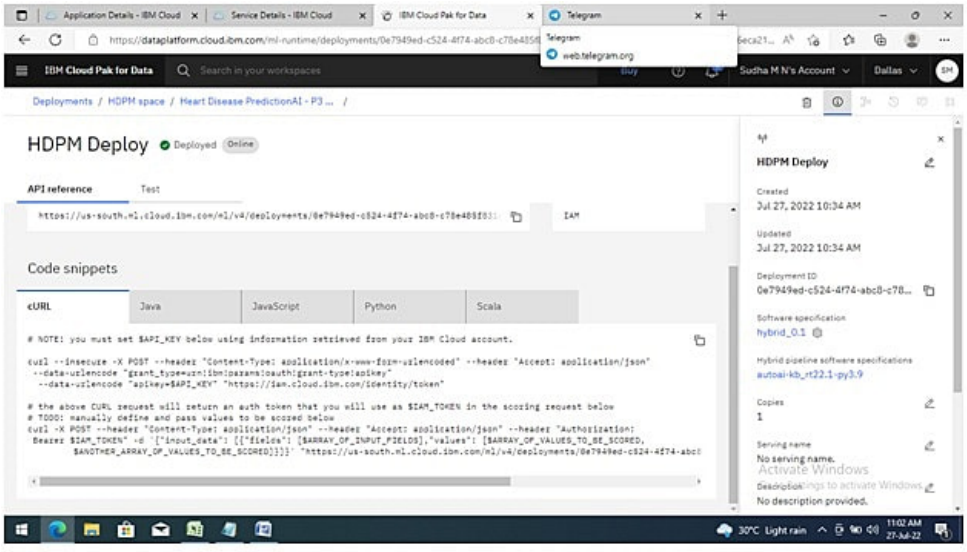
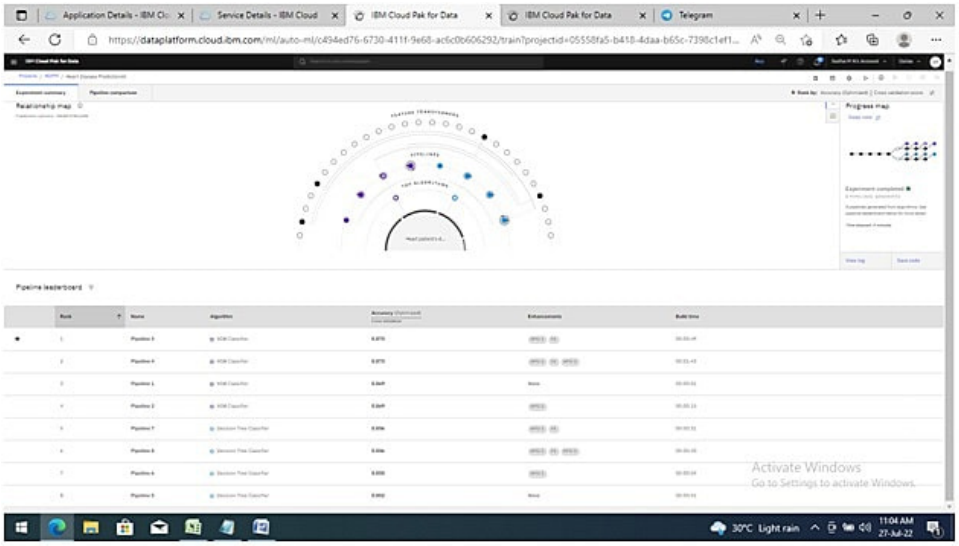


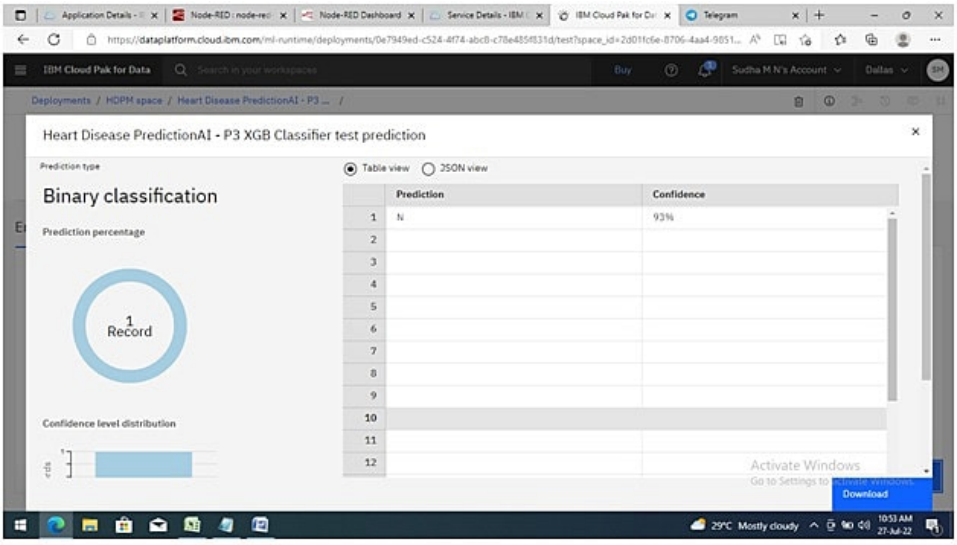
Figure.2 Flow work of Effective Heart Disease Prediction Model using IBM Auto AI

6. RESULT (Sample screen shots)






Pipeline leaderboard
Activate Windows
Go to Settings to activate Windows.
30°C Light rain
11:04 AM
27-Jul-22


IBM Cloud Pak for Data
Deployments / HDPM space / Heart Disease PredictionAI - P3 ...
Heart Disease PredictionAI - P3 XGB Classifier test prediction
Prediction type
Binary classification
Prediction percentage
1
Record
Confidence level distribution
Table view
JSON view
Prediction
Confidence
1 N 93%
Download
Activate Windows
29°C Mostly cloudy
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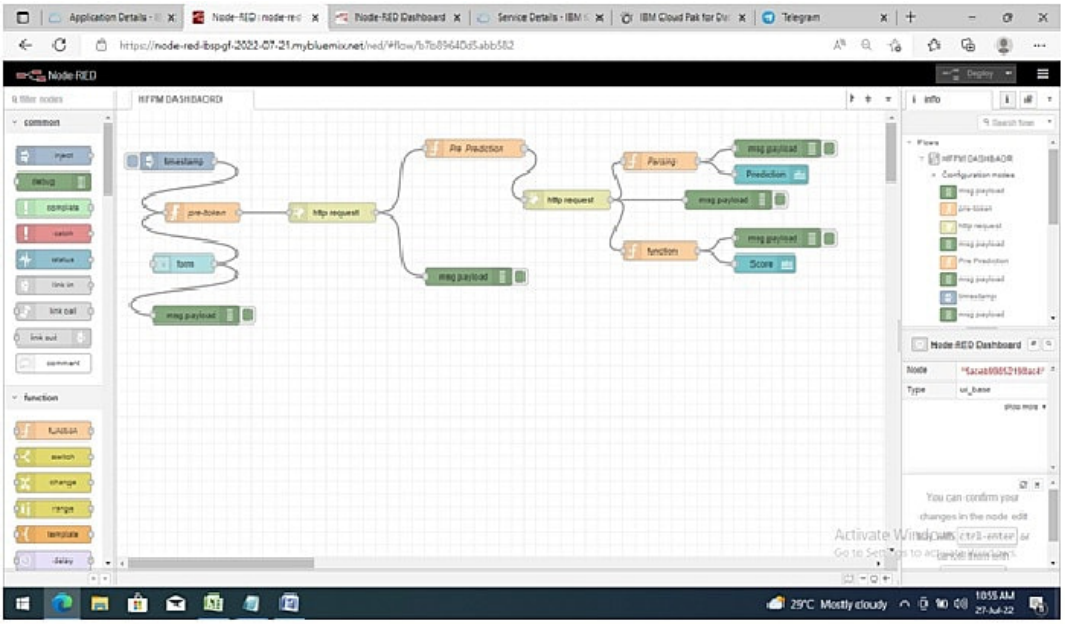
Node-RED
HFPM DASHBACRD
timestamp
pre-token
http request
form
msg.payload
Pre Prediction
http request
msg.payload
Parsing
msg.payload
Prediction
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function
msg.payload
Score
Node-RED Dashboard
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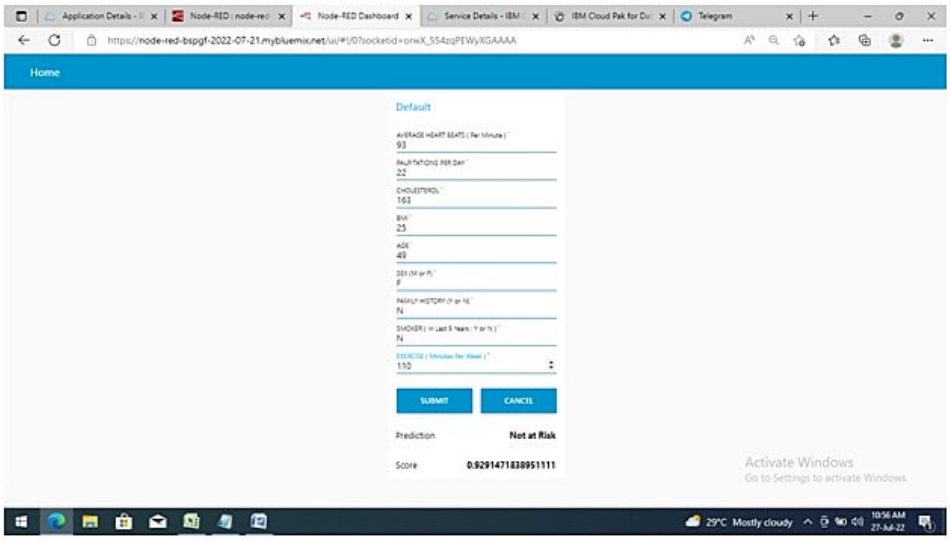
Home
Default
AVERAGE HEART BEATS (Per Minute)
93
PALPITATIONS PER DAY
22
CHOLESTEROL
163
BMI
25
AGE
49
SEX (M or F)
F
FAMILY HISTORY (Y or N)
N
SMOKER (in Last 5 Years : Y or N)
N
EXERCISE (Minutes Per Week)
110
SUBMIT
CANCEL
Prediction
Not at Risk
Score
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Activate Windows
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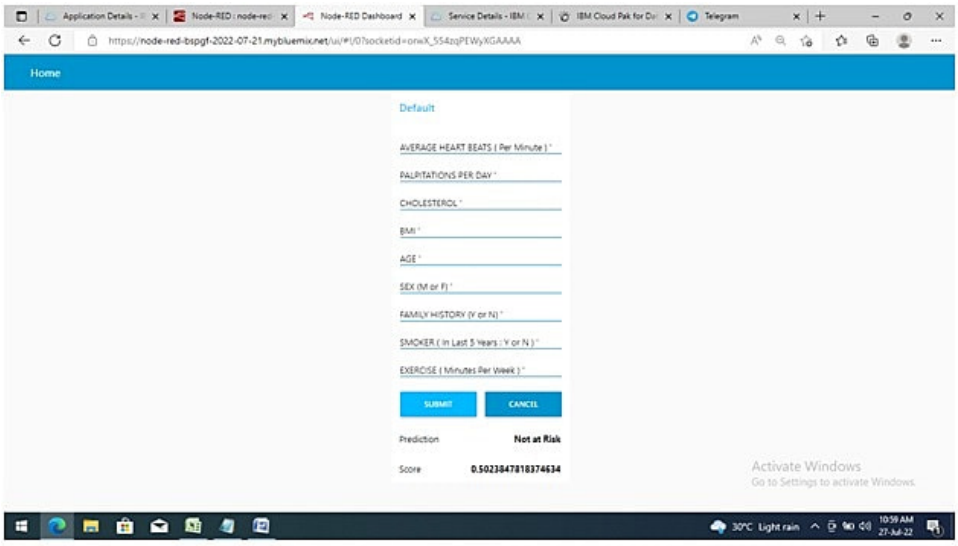

7 ADVANTAGES AND DISADVANTAGES ADVANTAGES

- No need to worry about infrastructure,platform and software.
- Initial setup and maintenance cost is reduced
- All under single umbrella, i.e., everything comes under single framework
- Improves health care services
- Reduces medical supervision procedures
- Ease of maintaining EHR (Electronic Health Care) records
- Proactively preparing for upcoming population health trends
- Acquiring new patients through personalized campaigns
- Reducing costs on appointment no show and readmission penalties
- Speeding up administrative tasks such as discharge procedures and insurance claims submission
- Preventing ransom and other cyberattacks by analysing ongoing transactions and assigning risk scores DISADVANTAGES
- Internet Connectivity is mandatory
- More steps to remember during creation of different services
- User interface creation is little bit tougher

8 APPLICATIONS

- Chronic disease prediction model
- Autism disorder prediction model
- Prediction modelling in healthcare system

- Preventing readmissions
- Managing population health
- Enhancing cybersecurity
- Increasing patient engagement and outreach
- Speeding up insurance claims submission
- Predicting suicide attempts
- Forecasting appointment no-shows
- Preventing readmissions
- Managing population health

9. CONCLUSION

The proposed effective heart disease prediction model is used to predict the HEART FAILURE target attribute of the patientusing the followingconditional attributes such as AVGHEARTBEATSPERMIN,FAMILYHISTORY,PALPITATIONSPERDAY,CHOLESTEROL, BMI, AGE,SEX,SMOKERLAST5YRS,EXERCISEMINPERWEEK of the Patient.The proposed model is built with IBM Watson Studio,Node-RED service,Auto AI service, Cloud Object Storage service(COS) and Machine Learning Service. The prediction model is developed with Snap Random Forest Classifierwhich has accuracy of 87.3%.

10. FUTURE SCOPE

The model creation,validation and deployment have taken lots of procedures and steps. The aim of the future work is to predict the target attribute by reducing the number of procedures and steps. The accuracyof the model is also somewhat less compared to already existingprediction models discussed under literature review. In order to improve the accuracy, pipeline structure and algorithm selection procedure will need to be optimized.

11. BIBILIOGRAPHY

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APPENDIX