



IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 10 Issue: VIII Month of publication: August 2022 DOI: https://doi.org/10.22214/ijraset.2022.46087

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Clinical Implication of Machine Learning Based Cardiovascular Disease Prediction Using IBM Auto AI Service

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Abstract—Cardio vascular diseases 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 this dataset contains 11 features that can be used to predict mortality by heart failure. In this project, a model is built using the Random Forest Classifier Algorithm using Auto AI and a web application is created using Node Red Application and it showcases the prediction of heart failure in a web based format. The usage of IBM cloud environment for implementing the Machine learning Model using IBM Auto AI and Node Red Flows are created for the display of Web Application Structure. The complete paper explains the coordination among the Auto AI and Node red in the Cloud Platform.

Keywords— Cardio Vascular Disease, IBM Auto AI, Machine Learning, Node Red Application, Watson Studio.

I. INTRODUCTION

Machine Learning [1] commonly deals with big data where the size of the data is massive and the data can be both in structured and unstructured format It is difficult to identify heart disease because of several contributory risk factors such as diabetes, high blood pressure, high cholesterol, abnormal pulse rate and many other factors. Various techniques in data mining and neural networks have been employed to find out the severity of heart disease among humans. The nature of heart disease is complex and hence, the disease must be handled carefully. The proposed method which we use has 10 attributes for heart disease prediction and the problem is carried out using IBM AUTO AI service.

II. LITERATURE SURVEY / RELATED WORK

Lippi et al. [2] focused on the possibility of cardiovascular disease during the COVID-19 pandemic. ,e nationwide quarantine has compelled the government to implement various forms of lockdown to reduce the transmission of COVID-19. As a result of these restrictions, all citizens remain at home, resulting in physical inactivity. Although the WHO has established clear guidelines on the amount of physical activity required to maintain adequate health, strict quarantine, on the other hand, has increased the risk of cardiovascular mortality. After quarantine, negative health effects are observed. As a result, the authors proposed the fact that it is necessary to maintain physical exercise even during quarantine to avoid unfavourable cardiovascular consequences, has influenced the current research study's Computational Intelligence and Neuroscience design

The random forest algorithm was used in the study [3] to predict the occurrence of heart disease in patients. A total of 303 samples from the Kaggle dataset were considered and the metrics used to evaluate performance were accuracy, sensitivity, and specificity. In the classification of heart disease, the algorithm achieved a prediction rate of 93.3%.

S. Krishnan J. Geetha S [4] has made a system that predicts the developing potential results of Heart Disease. Their aftereffects of this system give the chances of happening heart disease to the extent rate. They have considered datasets used are organized similar to therapeutic parameters. Their structure evaluates those parameters using the information mining plan strategy. Their datasets were set up in python programming using two standard Machine Learning Algorithm to be explicit Decision Tree Algorithm and Naive Bayes Algorithm and have exhibited the best estimation among these two to the extent the precision level of heart illness.

K.G Dinesh, K.A.raj, K.D.Santhosh, V. M.eswari [5] has talked about heart illness expectation and performed information prepreparing utilizes strategies like the removal of noisy data, removal of missing data, filling default values if applicable and classification of attributes for prediction and decision making at different levels. Their exhibition of the finding model is acquired by utilizing techniques like order, exactness, affectability and particularity examination.

This has proposed a forecast model to anticipate whether people have heart illness or not and to give mindfulness or finding on that. They have done examination by comparing the accuracies of applying rules with the individual consequences of Support Vector Machine, Gradient Boosting, Random backwoods, Naive Bayes classifier and calculated relapse on the dataset taken in a district to display an exact model of foreseeing cardiovascular ailment.

Senthil Kumar Mohan et al,[6] proposed Effective Heart Disease Prediction Using Hybrid Machine Learning Techniques in which strategy that objective is to finding critical includes by applying Machine Learning bringing about improving the exactness in the expectation of cardiovascular malady. The expectation model is created with various blends of highlights and a few known arrangement strategies. We produce an improved exhibition level with a precision level of 88.7% through the prediction model for heart disease with hybrid random forest with a linear model (HRFLM) they likewise educated about Diverse data mining approaches and expectation techniques, Such as, KNN, LR, SVM, NN, and Vote have been fairly famous of late to distinguish and predict heart disease.

Avinash Golande et al,[7] proposed Heart Disease Prediction Using Effective Machine Learning Techniques in which Specialists utilize a few data mining strategies that are available to support the authorities or doctors distinguish the heart disease. Usually utilized methodology utilized are decision tree, k- closest and Naïve Bayes. Other unique characterization-based strategies utilized are packing calculation, Part thickness, consecutive negligible streamlining and neural systems, straight Kernel selfarranging guide and SVM (Bolster Vector Machine). The following area obviously gives subtleties of systems that were utilized in the examination.

Lakshmana Rao et al,[8] Machine Learning Techniques for Heart Disease Prediction in which the contributing elements for heart disease are more (circulatory strain, diabetes, current smoker, high cholesterol, etc..). So, it is difficult to distinguish heart disease. Different systems in data mining and neural systems have been utilized to discover the seriousness of heart disease among people. The idea of CHD ailment is bewildering, in addition, in this manner, the disease must be dealt with warily. Not doing early identification, may impact the heart or cause sudden passing. The perspective of therapeutic science furthermore, data burrowing is used for finding various sorts of metabolic machine learning a procedure that causes the framework to gain from past information tests, models without being expressly customized. Machine learning makes rationale dependent on chronicled information

Marimuthu M et al [9], proposed Heart disease is one of the prevalent disease that can lead to reduce the lifespan of human beings nowadays. Each year 17.5 million people are dying due to heart disease. Life is dependent on component functioning of heart, because heart is necessary part of our body.

Heart disease is a disease that effects on the function of heart. An estimate of a person's risk for coronary heart disease is important for many aspects of health promotion and clinical medicine. A risk prediction model may be obtained through multivariate regression analysis of a longitudinal study

Balakrishnan et al [10] proposed Machine learning is a technique converts the raw clinical data into an informational data that helps for decision making and prediction. Cardiovascular disease is one of the major causes of mortality around the world. It is considered in a large scale, so prediction of cardiovascular disease is more important in the clinical survey analysis as day by day it gets increased. The amount of data in the health club is huge. As cardiovascular is one of the major causes for death there are some data analytical techniques that predicts the occurrence of cardiovascular disease. It can be achieved through selecting a correct combination of prediction models and features.

Prediction models were developed using different classification techniques based on feature selection and there are certain algorithms which provide varied and improved accuracy.

Here prediction model is developed using Random Forest classification technique - Method for classification, regression by constructing a multitude of decision trees at training time. Developed by aggregating tree Avoids over fitting can deal with large number of features. Helps with feature selection based on importance where necessary features only classified. Pre-processing will be done first considering the clinical data. It will be spited into train and test data with which accuracy can be achieved.

III. RESEARCH METHODOLOGY

The various methods adopted during the research process have been portrayed. This is a Descriptive Research problem where the study of Medical data set is explored. It performs the prediction of Heart Disease of the patients from the medical data set by applying various methodologies with respect to Machine Learning using IBM Auto AI.

A. Research Data

The data collected from secondary data sources are tabulated in the Table 1.



| | | Tuble T. Dua Source Dound |
|-----------------|----|---|
| Dataset | | Multivariate |
| characteristics | | |
| Number | of | 10800 |
| Instances | | |
| Number | of | 10 |
| Attributes | | |
| Attribute Type | | Categorical and Numerical |
| Link | | https://github.com/IBM/predictive-model-on- |
| | | watson- |
| | | ml/blob/master/data/patientdataV6.csv |

Table 1 : Data Source Details

B. Proposed System Method Of Analysis

The project helps us to predict the heart failure of human being given various parameters like the details listed in

| Table 2 : Patient Features |
|-------------------------------------|
| DATA TYPE |
| NUMERIC |
| CATEGORICAL (F/M) |
| CATEGORICAL (Y/N) |
| CATEGORICAL (Y/N) |
| NUMERIC |
| CATEGORICAL (Y/N) (TARGET VARIABLE) |
| |

Table 2 . Detiant Fast

C. Block diagram

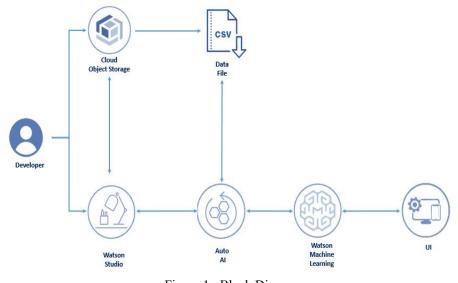
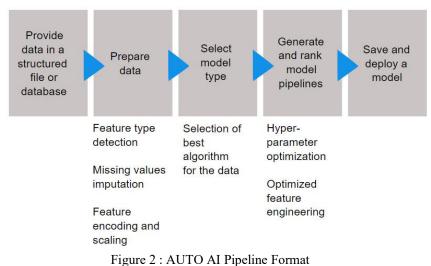


Figure 1 : Block Diagram

Cloud Object Storage: The developer creates the Cloud object storage in the ibm cloud. Cloud Object storage is a service 1) offered by IBM for storing and accessing the unstructured data. Objects are pieces of data that is uploaded in the cloud storage.



- IBM Watson Studio: IBM Watson studio is an integrated environment designed to develop, manage models and deploy AI
 powered Applications. It is Software as a Service. A project is created in IBM Watson Studio
- 3) AUTO AI: The Auto AI graphical tool in Watson Studio analyzes the data and discovers data transformations, algorithms, and parameter settings that work best for the predictive modeling problem. Auto AI displays the results as model candidate pipelines ranked on a leaderboard and the specific model can be appropriately chosen by the developer based on the result obtained.



- 4) Node Red Service: It is a programming tool for wiring together hardware devices, API's and Online services. It is a browser based editor that makes it easy to wire together flows using wide range of nodes in the palette that can be deployed in its run time in a single click. It helps in deploying the ML model as a web server
- D. Hardware and Software Specification

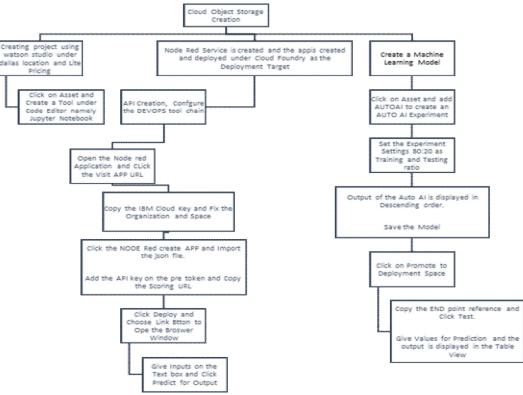
| Table 3 : Hardware Specifications | | |
|-----------------------------------|---|--|
| Processor | Intel(R) Core(TM) i3-3227U CPU @ 1.90GHz 1.90 GHz | |
| Ram | 4 GB. | |
| HDD | 100 GB. | |
| Monitor type | 15 Inch VGA. | |
| Keyboard | 110Keys Keyboard | |

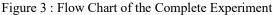
Table 3 : Hardware Specifications

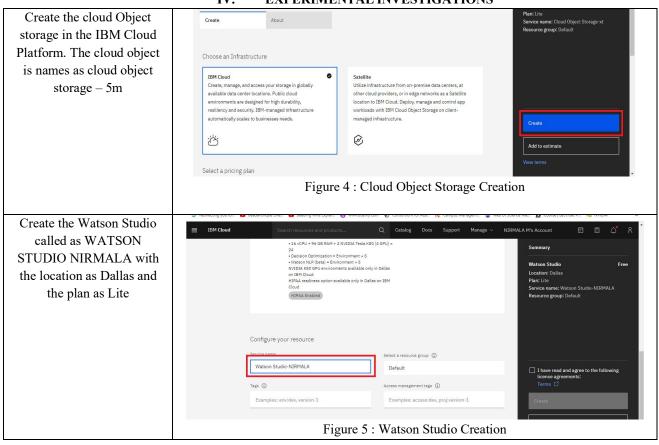
| | Te Specifications |
|--------------------------|-------------------------|
| Operating system | Windows 10 |
| Web Browser | Chrome, Mozilla firefox |
| Set up | Watson Studio |
| Storage | IBM Cloud Platform |
| Application Development | Node Red Service |
| Machine Learning Service | AUTO AI |



ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538 Volume 10 Issue VIII August 2022- Available at www.ijraset.com

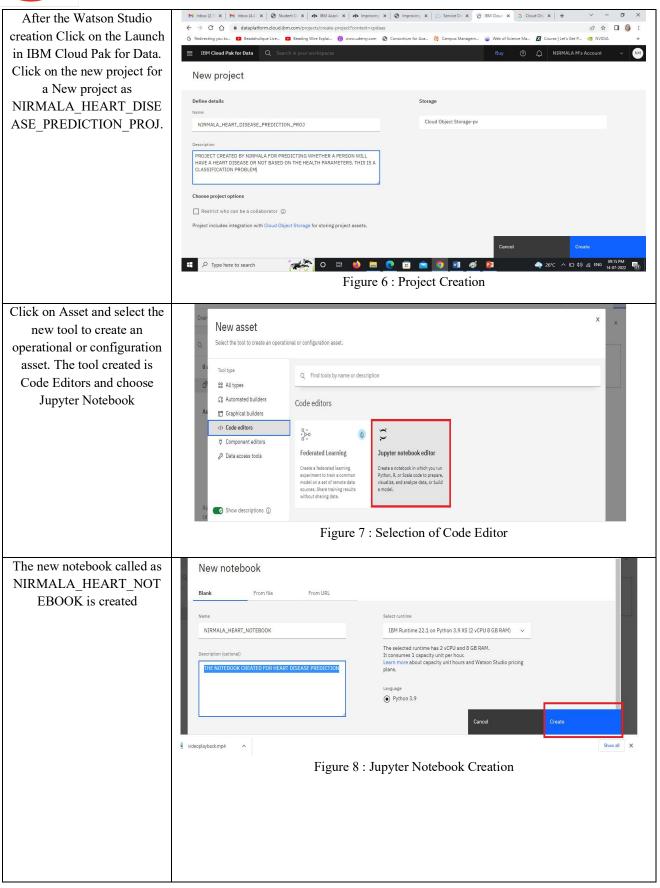






IV. EXPERIMENTAL INVESTIGATIONS







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| After the App is created | | Figure 9 : N | lode Red Ser | vice Creation | 1 | |
| Deploy the App. Choose | Details | | | Deployment Automation | | |
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| deployment target | Source | Download code | | | | |
| | | Download code | | | \cup | |
| | Resource group | Default | | Configure Continuou | s Delivery | |
| | | | | | abled for this app. Enable Continuous | |
| | Deployment target | You must deploy your app first | | | ests, and deployments through Delivery | |
| | Created | 7/17/2022 | | ripeline, dicab, and more. | | |
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| | Connect existing services + | Create service + | | | | |
| | | Figure | 10 · Ann Da | alormont | | |
| | NOUE RED NIRMALA | Figure | 10 : App Dep | Joyment | | |
| | Select the deployment target | Configure the DevOps toolchain | | | | |
| | | C) compare ne peroperiodenam | | | -`ġ́. Getting started with apps | |
| | Deployment Automation | | | | Step 1. Select the deployment target | |
| | Select your deployment target and confi deployment process is started automati | igure your DevOps toolchain. After you click C cally. | Create, the toolchain is created | I, and the | Select your deployment target, and then provide the configuration information. | |
| | Deployment target | r | | _ | IBM Cloud Foundry | |
| | 0 | 0 | <u>9</u> | 0 | Cloud Foundry is the premier industry standar Platform-as-a-Service (PaaS) that ensures fas easy, and reliable deployment of cloud-native | t, NOLL |
| | Kubernetes Service | Red Hat OpenShift | Cloud Foundry IBM | | apps. Cloud Foundry ensures that the build an deploy aspects of coding remain carefully | |
| | Deploy, scale, and manage your containerized application | Deploy your apps on highly available clusters that come | Deploy and run your applications without manag | | coordinated with any attached services — resulting in quick, consistent and reliable iterating of applications. Cloud Foundry has a | ASK A |
| | workloads to highly available clusters. | installed with Red Hat OpenShift on IBM Cloud. | servers or clusters. A Lite pl is available for quick and ea deployment. | | Lite plan that allows quick deployments for testing purposes. | |
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| | Fig | ure 11 : Deployme | nt Automatic | on using Clor | Foundry org. you must create one. | Ŧ |
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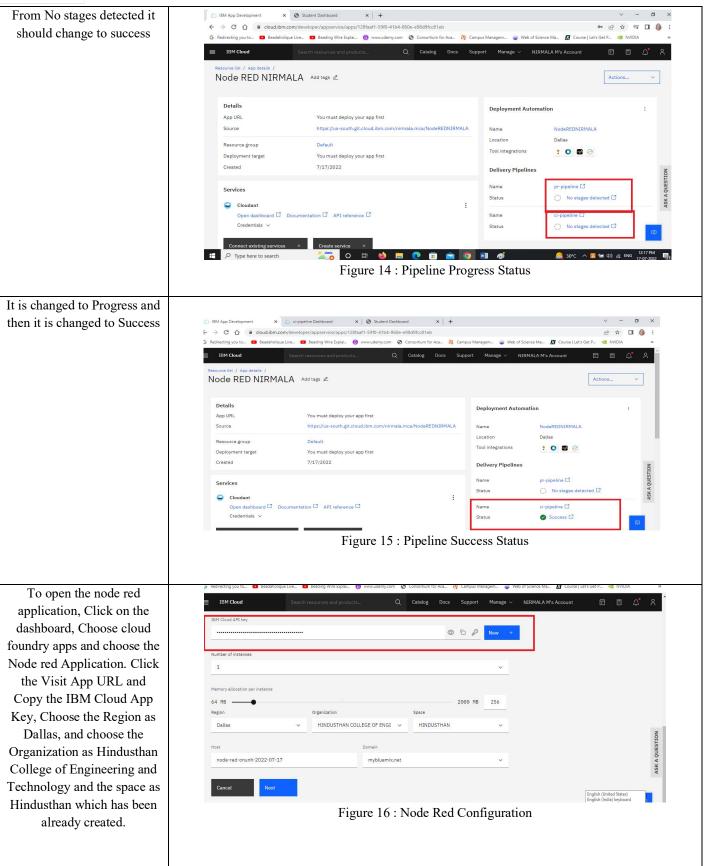


ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538 Volume 10 Issue VIII August 2022- Available at www.ijraset.com

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| name and select the region | | | | | | |
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| | Give your toolchain a name and select the region to create your toolchain in. DevOps toolchain name | | | | | |
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| | NodeREDNIRMALA | | | | | |
| | Accept the default name, or enter a value up | o to 100 characters. | | | | |
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| | Region | | | | | |
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Get into the Node Red 🕐 IBM App D 🗴 🧟 Node-RED X 🔇 Student D X 🕴 g predictive- X 🕎 telegram V X 🔇 Telegram V X 😽 Inbox (2,11 X 🕅 Inbox (4,41 X 🗗 User Court X 🕇 ٥ ← → C ☆ 🔒 node-red-nirmala.mybluemix.net/?_ga=2.96552214.860467589.1658036258-228383160.1655801507 B & 0 0 Instance on the IBM Cloud 🔓 Redirecting you to... 💶 Beadaholique Live... 💶 Beadaholique Live... 💶 Beadaholique Live... 💶 Beadaholique Live... 💶 Course | Let's Get P... 🤕 NVDIA Node-RED Flow-based programming for the Internet of Things Node-RED is a programming tool for wiring together hardware devices, APIs and online services in new and interesting ways. Go to your Node-RED flow editor This instance is running as an IBM Cloud application, giving it access to the wide range of services available on the platform Learn how to customise Node-RED Figure 17 : Node Red Editor A project is how you ← → C 🏠 🔒 dataplatform.cloud.ibm.com/projects/c934d421-327c-4691-9d73-b65f251ec2b4/ 8 \$ 0 0 organize your resources to 😚 Redirecting you to... 💶 Beadaholique Live... 💶 Beading Wire Explai... 🔞 www.udemy.com 😵 Consortium for Aca... 🔑 Campus Managem... 🥃 Web of Science Ma... 🕅 Course | Let's Get P... NVIDIA achieve a particular goal. In IBM Cloud Pak for Data Q = the Watson Studio Projects / NIRMALA_HEART_DISEASE_PRE... 8+ Launch IDE 🗸 🔹 🖇 01 .↑. NIRMALA an already Assets Jobs Overview Manage Data in this project created project called as Q Find assets Add asset 😤 NIRMALA HEART DISE Drop data files here or prowse for files to upload ASE_PREDICTION_PROJ 1 assets All assets G is already present. 🗇 All assets Nam Last modified atientdataV6.csv NIRMALA_HEART_NOTEBOOK Asset types 3 days ago NIRMALA M (You) E Assume the Jupyter () Uploading... Notebook is created using > </> Source Code 1 Figure New asset option and also 18 : Jupyter Notebook created using Asset Option the data set is loaded - 🗙 | 🚾 tel Assume there is a Machine ΰ. eb - Y 🗙 🛛 😋 Tele × o → C A a cloud.ibm.co e 🕁 🗊 🖬 🔕 0 Learning Model 8n already created **Resource list** Machine Learning-8n ✓ Name Virtual Server for Class a Q. Filter by name or IP add Dedicated Host for VPC Cloud Foundry servicer
 Machine Learning Service Θ Services and software O Virtual Server for VPC @ Continuous Deliver Simple Machin 3 Machine Learning Dallas Machine Learr G Ne Watson Studio-NIF Search "mAC" in Supp s E7 Dallas atson Stu node-red-nirmala-Search "mAC" in Docs 17 Dalla 33 Storage (1 🕎 predictive-model-o....zip 🥎 📾 Bead jev ー ア Type here to search 🤹 💀 🧔 😑 💼 📀 💼 🗢 🧑 Figure 19 : Machine Learning Model Created

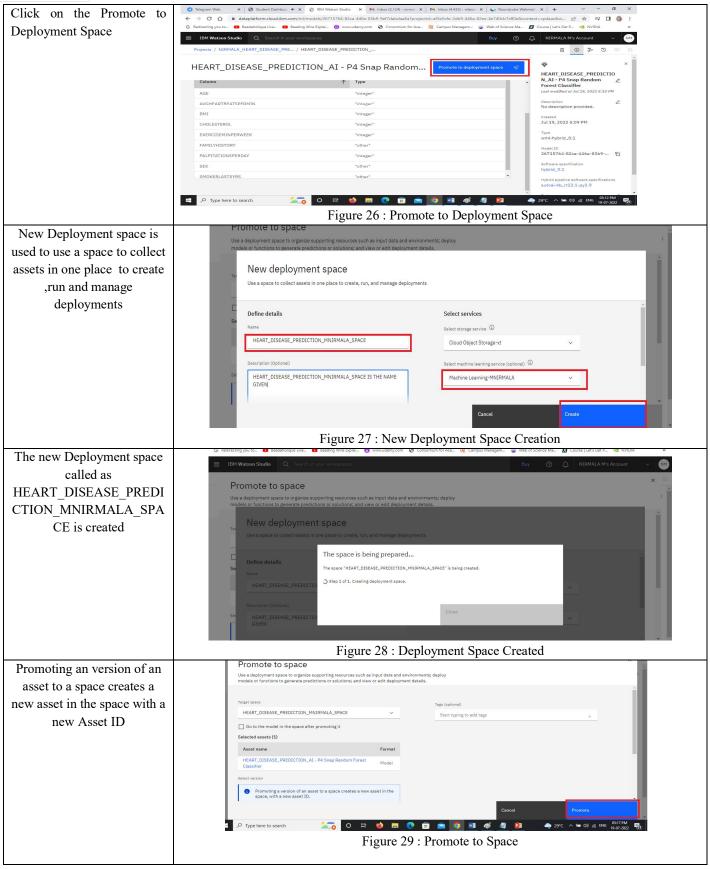


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| | | TO PREDICT THE HEART DISEASE | button below to refresh the instances available for association. | | | |
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| | Figure | 21 : AUTO AI Associate | ed with Machine Learning | | | |
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| Testing data set ratio. | Learn more. | What do you want | to mustice? | | | |
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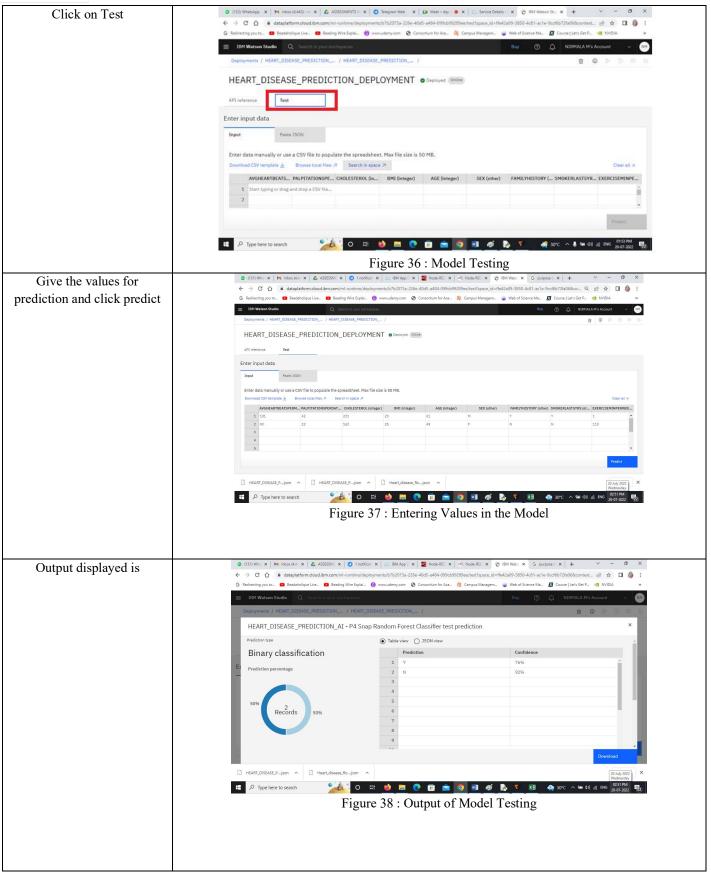


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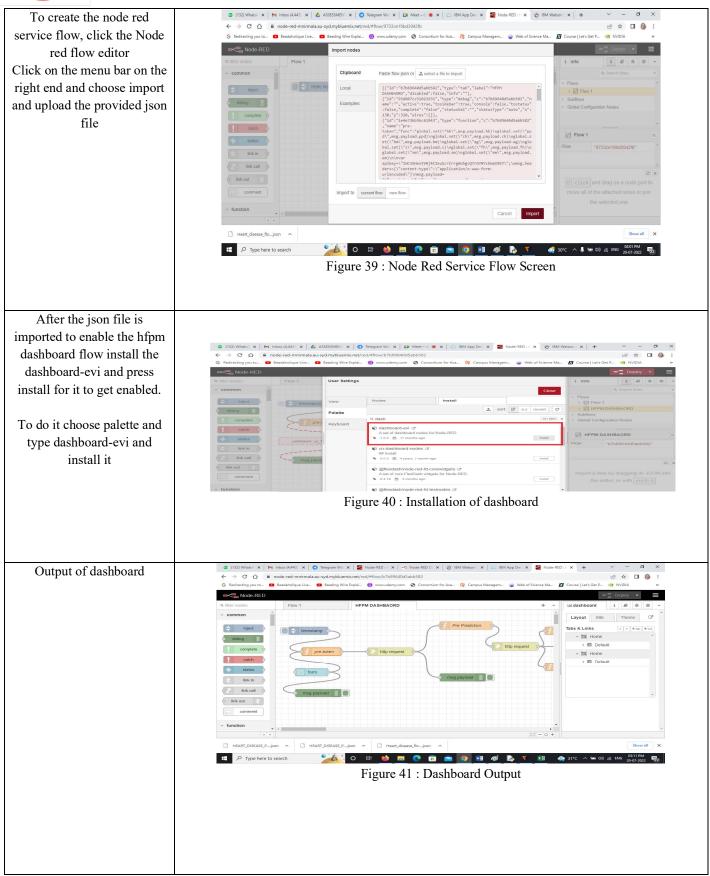
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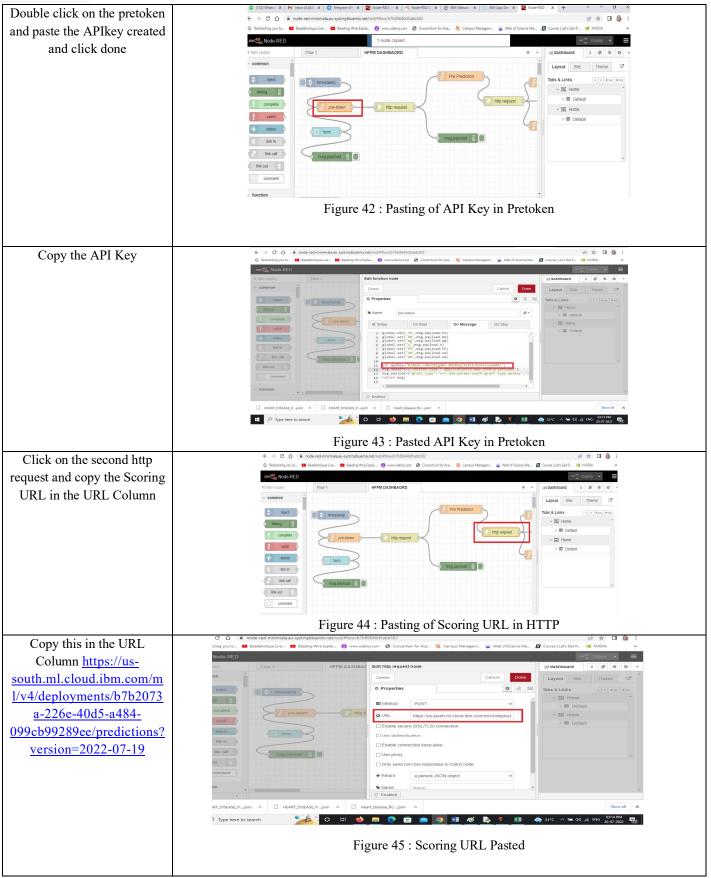
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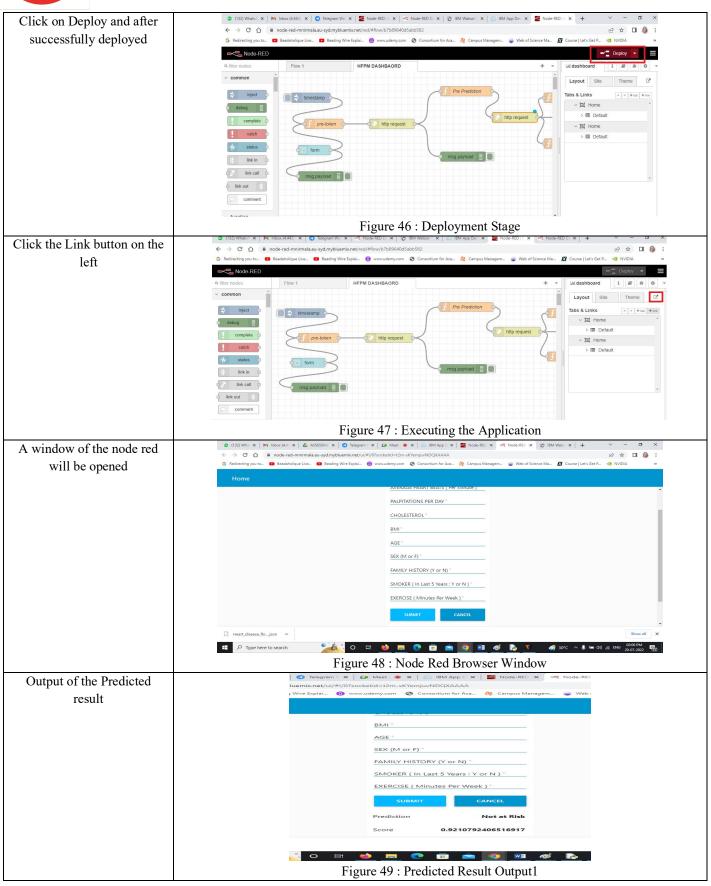


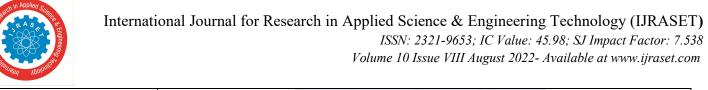












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| using using Node-RED | CHOLESTEROL" | | | |
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| user and showcases the | FAMILY HISTORY (Y or N) * | | | |
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| | Figure 50 : Predicted Result Output2 | | | |

V. EXPERIMENTAL RESULTS

The transformed data set is partitioned into training data set and the test data set where the training data is 80% of the whole data set and the remaining unused 20% is used as Test data set. The random state is set as 0. The parameters applied for various algorithms are depicted in

| Table 5 : Experimented Results | | |
|--------------------------------|----------|--|
| Model Type | Accuracy | |
| Random Forest | 87% | |
| Logistic Regression | 79% | |

VI. CONCLUSION

The Machine learning methodology is rapidly increasing and the impact of the machine able to predict the result of a system by itself and also it is able to train a data over a period of time and also test the trained model with a different set of data to prove that the model is working efficiently and effectively. The problem is able to predict whether a person is at risk of heart failure. The data is clean and does not require any exploratory data analysis. The problem can be applied in a hospital environment to identify with the given parameters whether the person will have a heart disease or not. In this research study it has been apparently proved that Random Forest got the accuracy of 87% and Logistic Regression has got a accuracy of 79% and the model is working efficiently when connected with the node red application to display the output in the browser window.

VII. **FUTURE SCOPE**

The present study predicted whether patient is at risk of heart failure. The problem has to support with more parameters to be suitable for a generalized application. The web page creation can be further enhanced to make it a user friendly format.

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