IBM PROJECT

Visualizing and Predicting Heart Diseases with an Interactive Dashboard

NALAIYA THIRAN PROJECT REPORT

2022

Submitted by

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Content

VISUALIZING AND PREDICTING HEART DISEASES WITH AN INTERACTIVE DASHBOARD

1. Introduction

1.1 Project Overview

The leading cause of death in the developed world is heart disease. Therefore, there needs to be work done to help prevent the risks of having a heart attack or stroke. This project aims to create an interactive Dashboard using IBM Cognos Tool and dataset to predict which patients are most likely to suffer from a heart disease in the near future using the features given.

1.2 Purpose

Heart disease (HD) is a major cause of mortality in modern society. Medical diagnosis is an extremely important but complicated task that should be performed accurately and efficiently. Cardiovascular disease is difficult to detect due to several risk factors, including high blood pressure, cholesterol, and an abnormal pulse rate. Based on the analytics we can analyze which patients are most likely to suffer from heart disease in the near future and based on the patient details we will make decisions to cure them.

2. Literature Survey

2.1 Existing Problem

In order to forecast cardiac disease, this study discusses various data mining, big data, and machine learning techniques. Building an important model for the medical system to forecast heart disease or cardiovascular illness requires the use of data mining and machine learning. Medical professionals can assist patients by identifying cardiovascular illness before it manifests. Heart disease is one of the leading causes of death in the modern world. An important clinical challenge is the ability to forecast heart disease. But occasionally, a number of methods to forecast heart disease in data mining are found. Numerous methods for predicting heart disease were described in this survey publication.

Various disorders that impact the human heart are referred to as heart disease. Thebterms "heart disease" and "cardiovascular disease" are frequently used interchangeably. Heart disease is a general term that covers a wide range of heart related medical conditions. The irregular health state related medical conditions. The irregular health state that directly affects theheart and all of its components is characterized by these medical conditions. A heart attack, stroke, or chest pain can all

be caused by illnesse that are generally made possible by restricted or obstructed blood arteries due to heart disease. Heart diseases are also characterized by other illnesses that affect the muscle, valves, or rhythm of the heart. Heart disease comes in many different forms. The most similar types are heart failure (HF) and Coronary Artery Disease (CAD). Data mining is a complicated process that uses intricate algorithms to extract implicit, previously undiscovered possibly useful information known as knowledge from medical data. Big data (BD) is a term used to describe large records of information. Data mining and big data are two distinct concepts. These two strategies accomplish the same job, which centres on gathering a sizable amount of data, managing them, and creating reports on the data by removing the knowledgeable information. Using Big Data, data mining fundamentally involves identifying meaningful patterns in data that contain specific information.

2.2 References

“Santhana Krishnan. J, Geetha S., "Prediction of Heart Disease Using Machine Learning Algorithms”

The authors of this work discuss machine learning strategies for heart disease prediction, including decision trees and the Naive Bayes algorithm. In the first algorithm, a decision tree is constructed utilizing a set of circumstances that result in True or False conclusions. Other algorithms, such as SVM and KNN, base their conclusions on dependent variables and either vertical or horizontal split conditions. However, a decision tree is a structure that resembles a tree with a root node, leaves, and branches, and it is based on the decisions made in each tree. Decision trees also aid in recognizing the significance of the dataset's properties. They have also used Cleveland data set. Dataset splits in 70% training and 30% testing. This algorithm gives a 91% accuracy. The second algorithm is Naive Bayes. It is used for classification. It can handle complicated, nonlinear, dependent data and hence is found suitable for heart disease dataset as this dataset is also complicated, dependent and nonlinear in nature. This algorithm gives an 87% accuracy.

“M.Satish, D Sridhar, “Prediction of Heart Disease in Data Mining Technique”

M.Satish, et al. (2015) used different Data Mining techniques like Rule based, Decision Tree, Naive Bayes, and Artificial Neural Network. An efficient approach called pruning classification association rule (PCAR) was used to generate association rules from cardiovascular disease warehouse for prediction of heart disease. Heart attack data warehouse was used for pre-processing for mining.

2.3 Problem Statement Definition

Who does the problem affect?

People with unhealthy lifestyles, stress, depression, age above 40 and when their ancestors got heart
disease (since heart disease is hereditary).

When does the issue occur?

The issue occurs for people with unhealthy lifestyles and age above 40. Where is the issue occurring? The issue is originating from an unhealthy lifestyle. It mostly occurs in the blood valves of the heart.

What would happen if we didn’t solve the problem?

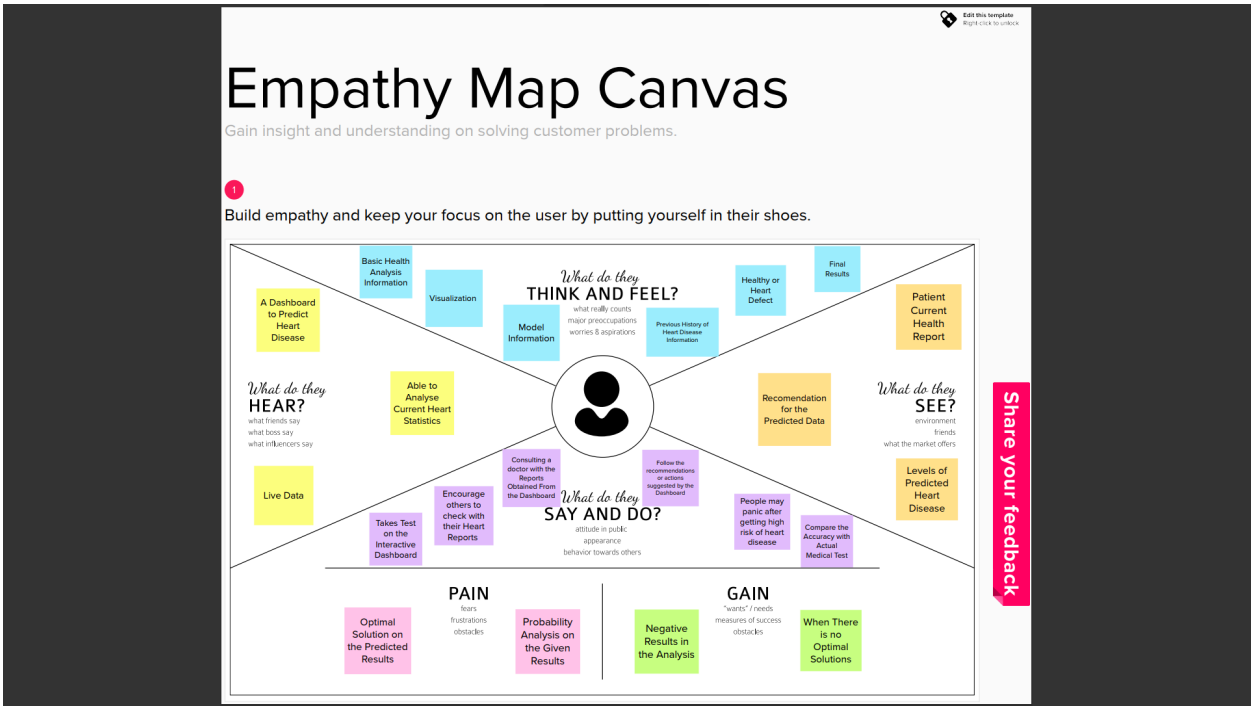
If we don’t solve the problem, many people will die at a young age. The death rate due to heart disease
will increase rapidly.

Why is it important to fix the problem?

We should predict the problem before giving treatment to the patients. As the problem is predicted early, we can solve it easily and early.

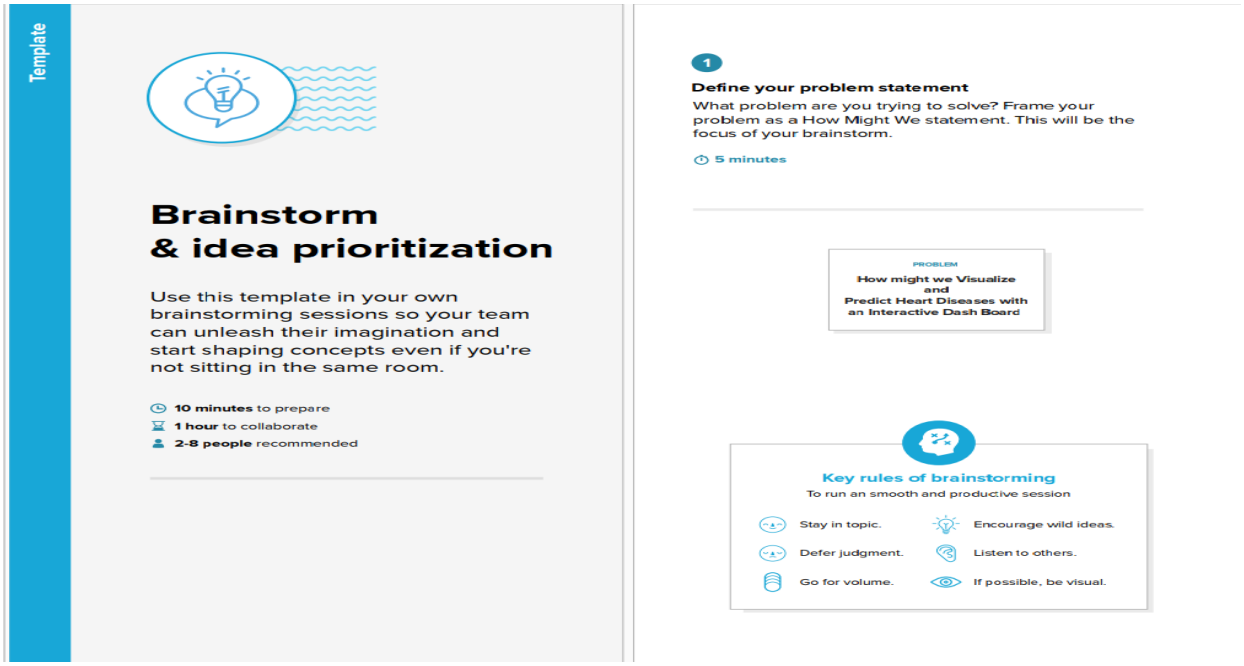
3. IDEATION & PROPOSED SOLUTION

3.1. Empathy map canvas

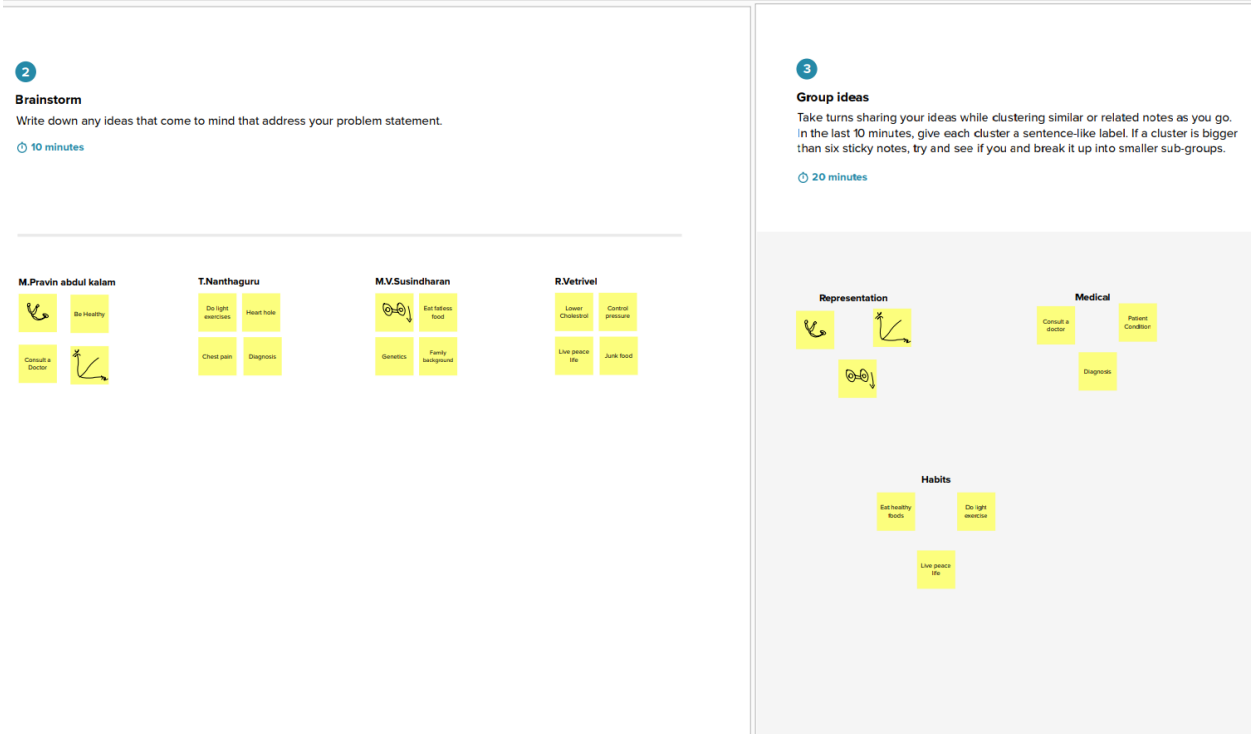


3.2 Ideation and Brainstorming

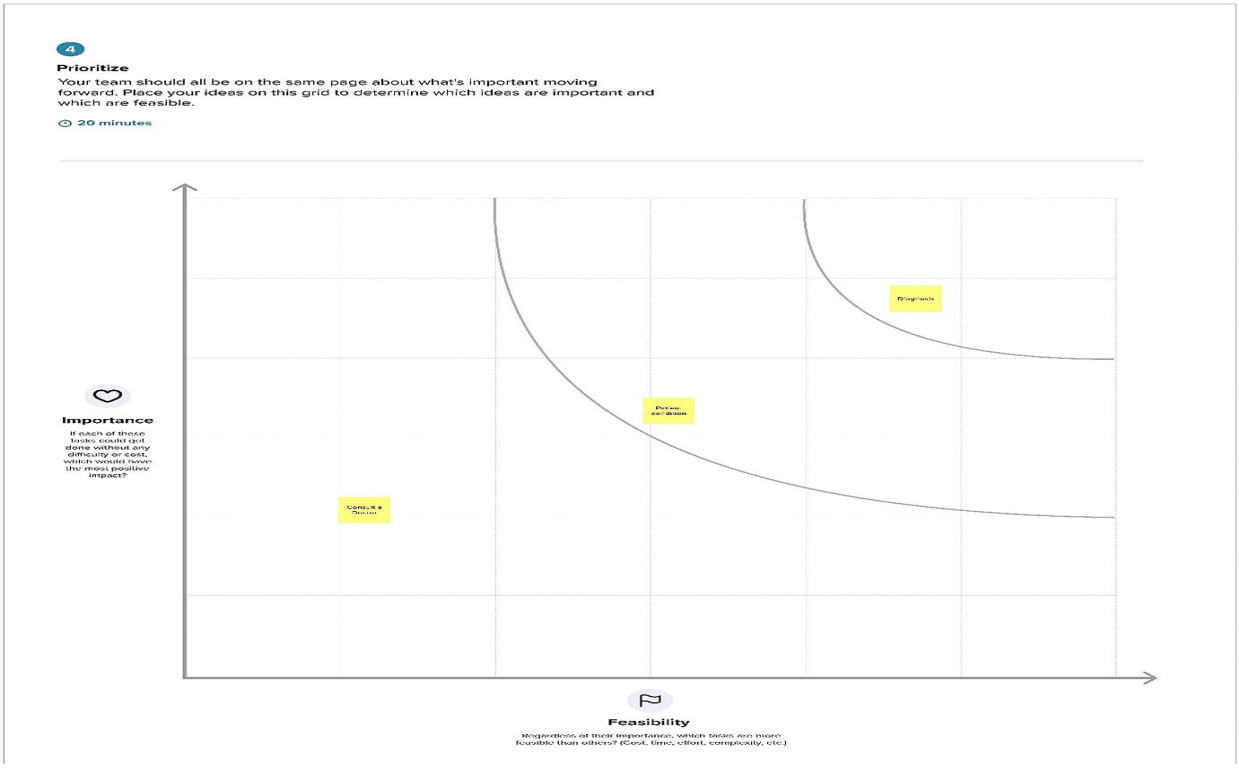
Step-1: Team Gathering, Collaboration and Select the Problem Statement



Step-2: Brainstorm, Idea Listing and Grouping



Step-3: Idea Prioritization



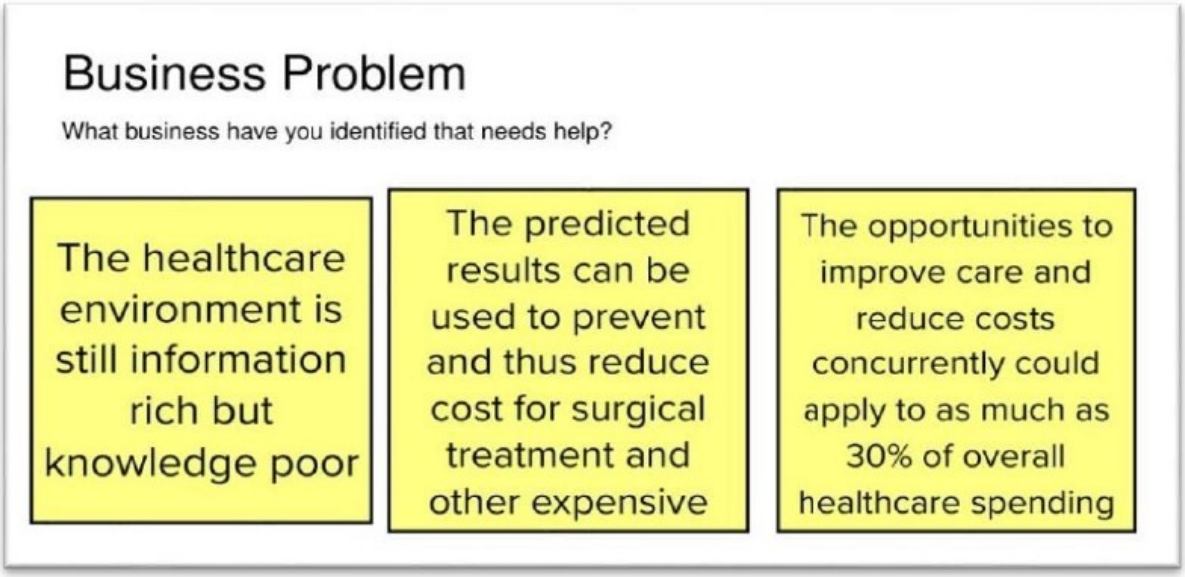
3.3 Proposed Solution

S. No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	Predicting the heart disease of a patient by analyzing Past or historical records. Where patient can get cure Or take necessary treatment before the disease is affected.
		Also, to develop am interactive dashboard to predict the disease accurately with few tests and attributes.
2.	Idea / Solution description	Analyzing data and identifying the heart disease using Cognos analytics. To predict the heart disease at the beginning stage and provide treatment for speedy recovery.
3.	Novelty / Uniqueness	Comparing other models the prediction will vary. But our model will predict accurately and give effective results
4.	Social Impact / Customer Satisfaction	By this project people can able to diagnose the heart disease at initial stage by themselves.
5.	Business Model (Revenue Model)	By subscription technique, one user will be allowed to predict the disease.
6.	Scalability of the Solution	In future, some more health associated prediction will be added with the same interactive dashboard.

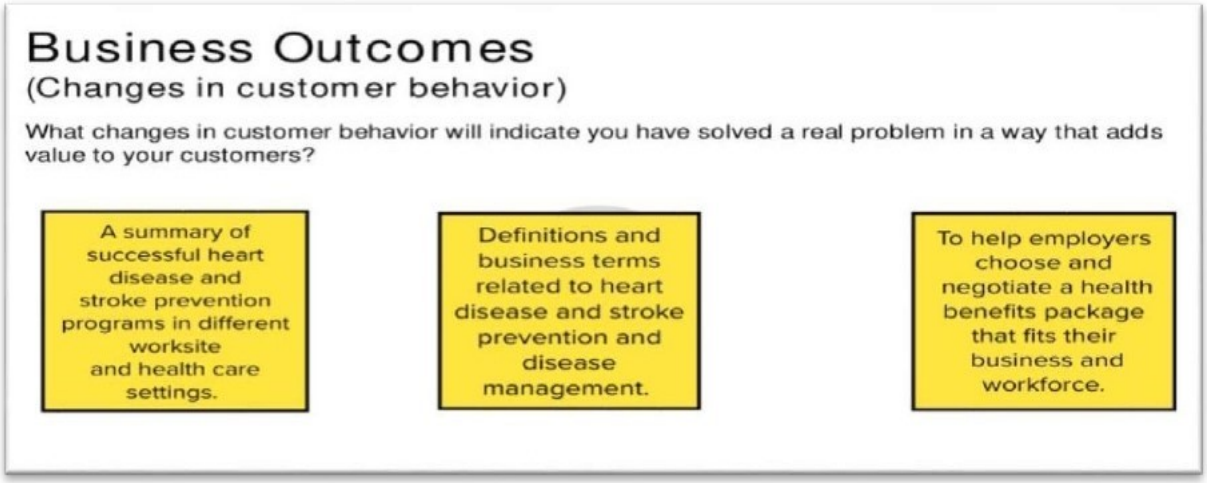
3.4 Problem Solution Fit

The problem solution fit simply means that you have found a problem with your customer and that the solution you have realized for it actually solves the customer's problem.

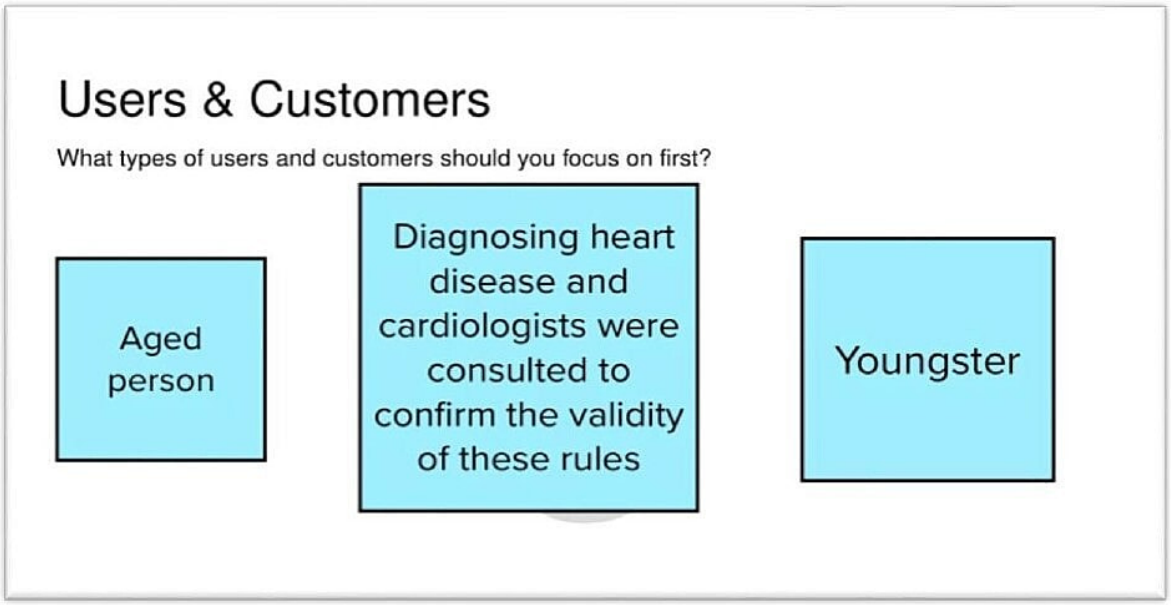
Step-1: Business Problem



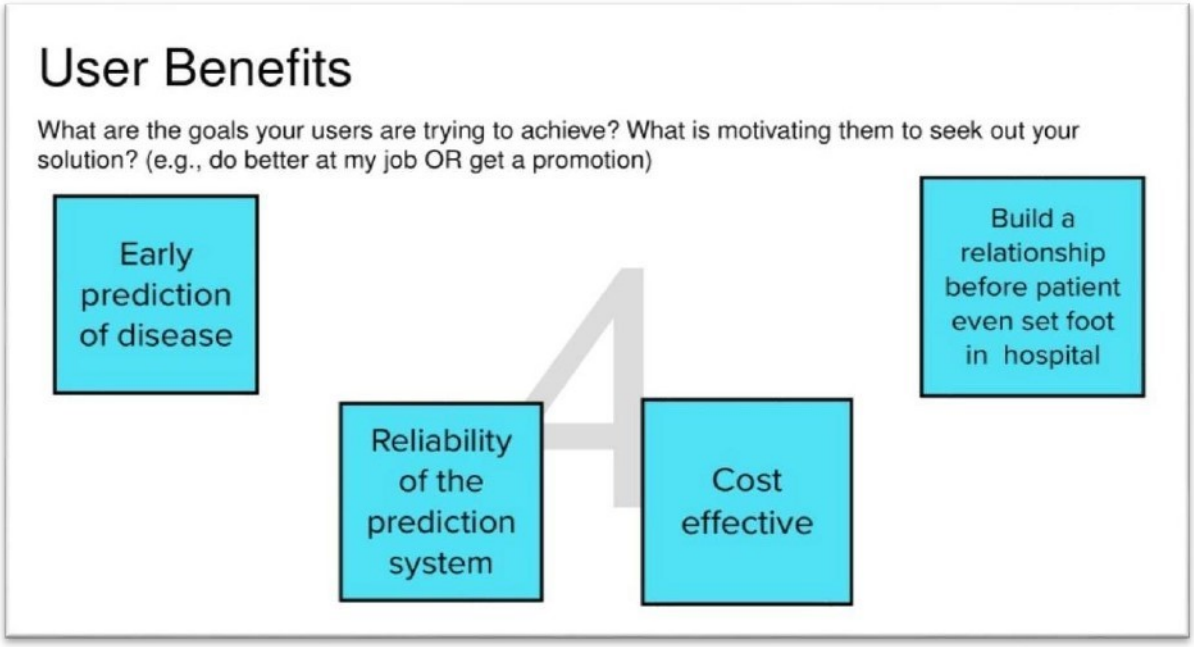
Step-2: Business Outcomes



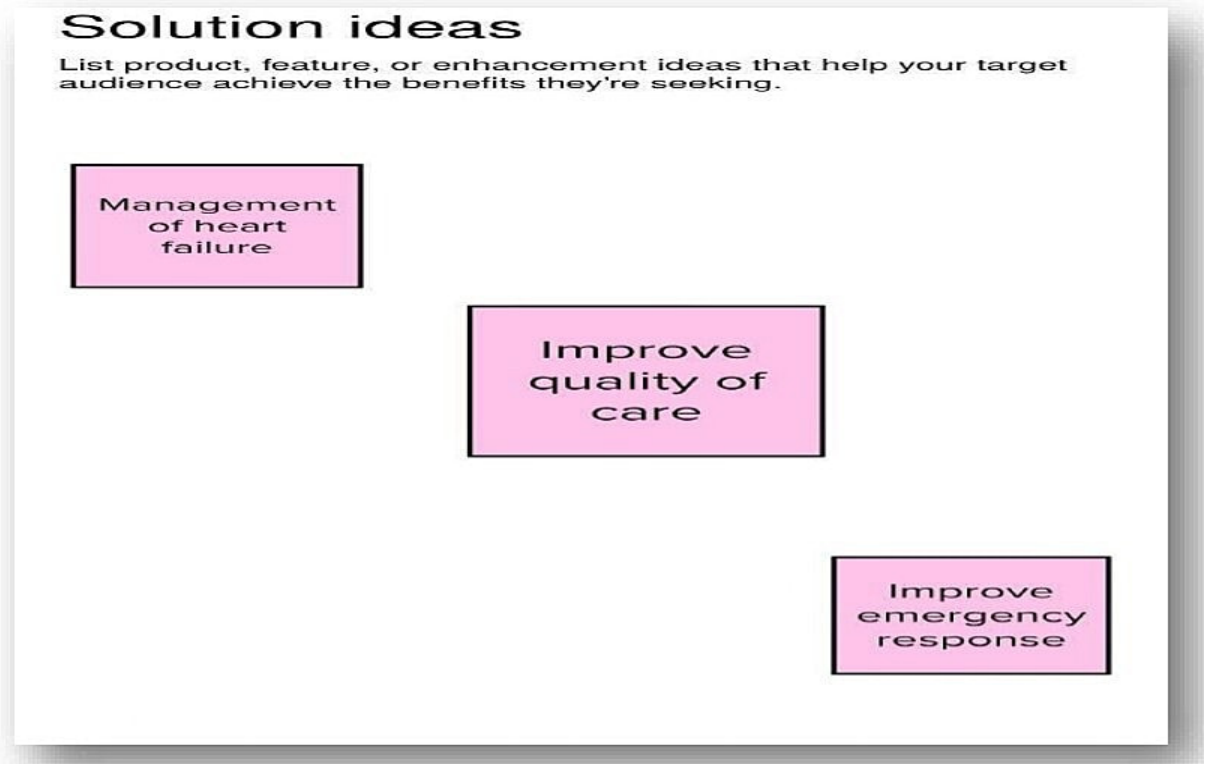
Step-3: Users & Customers



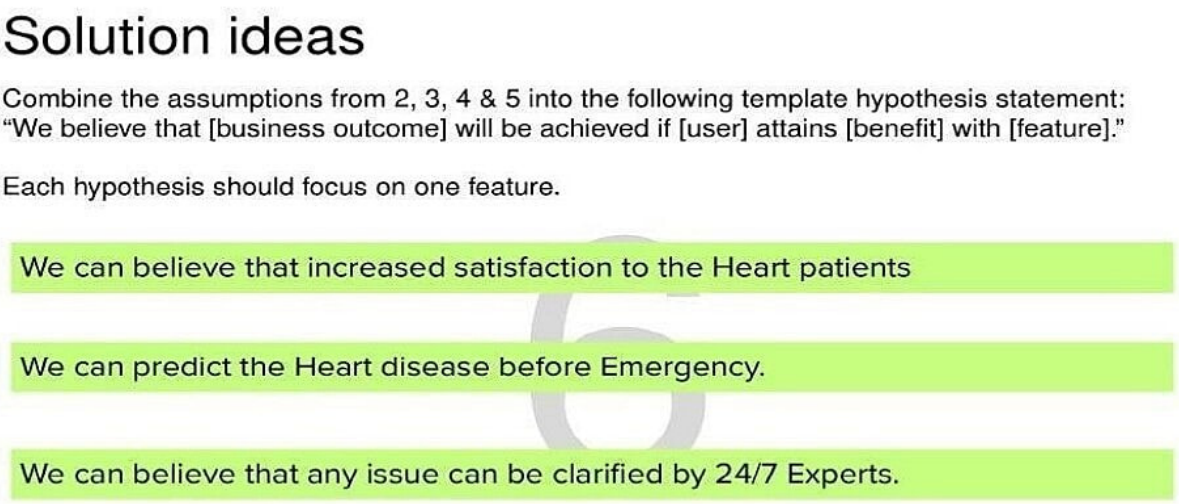
Step-4: User Benefits



Step-5: Solution Ideas-1

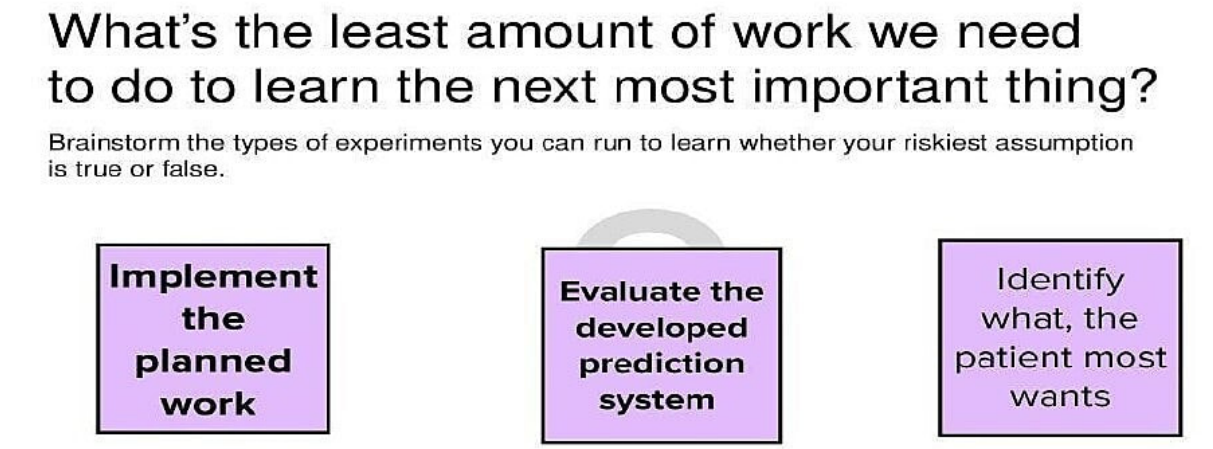


Step-6: Solution Ideas-2



Step-7: What's the most important thing we need to learn first?

Step-8: What's the least amount of work we need to do learn the next most important thing?



4.Requirement Analysis

4.1 Functional Requirement

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Enables user to make registration for the application through Gmail
FR-2	User Confirmation	Once after registration, the user will get confirmation via Email
FR-3	Visualizing Data	User can visualize the trends on the heart disease through Dashboard created using IBM Cognos Analytics
FR-4	Generation Report	User can view his/her health report and can make decisions accordingly

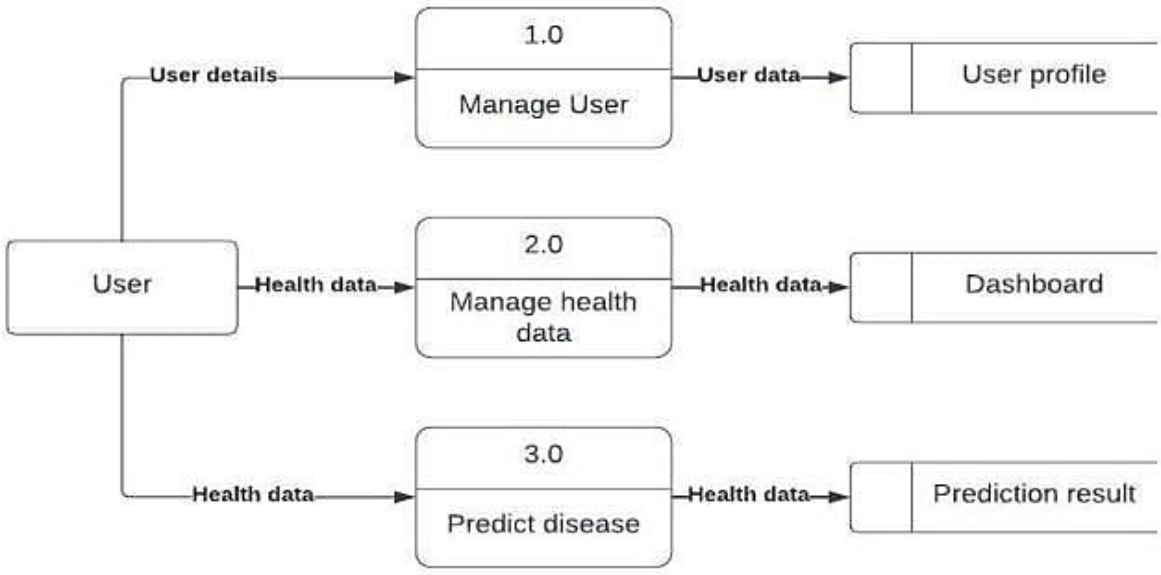
4.2 Non-Functional Requirement

Following are the non functional requirements of the proposed solution

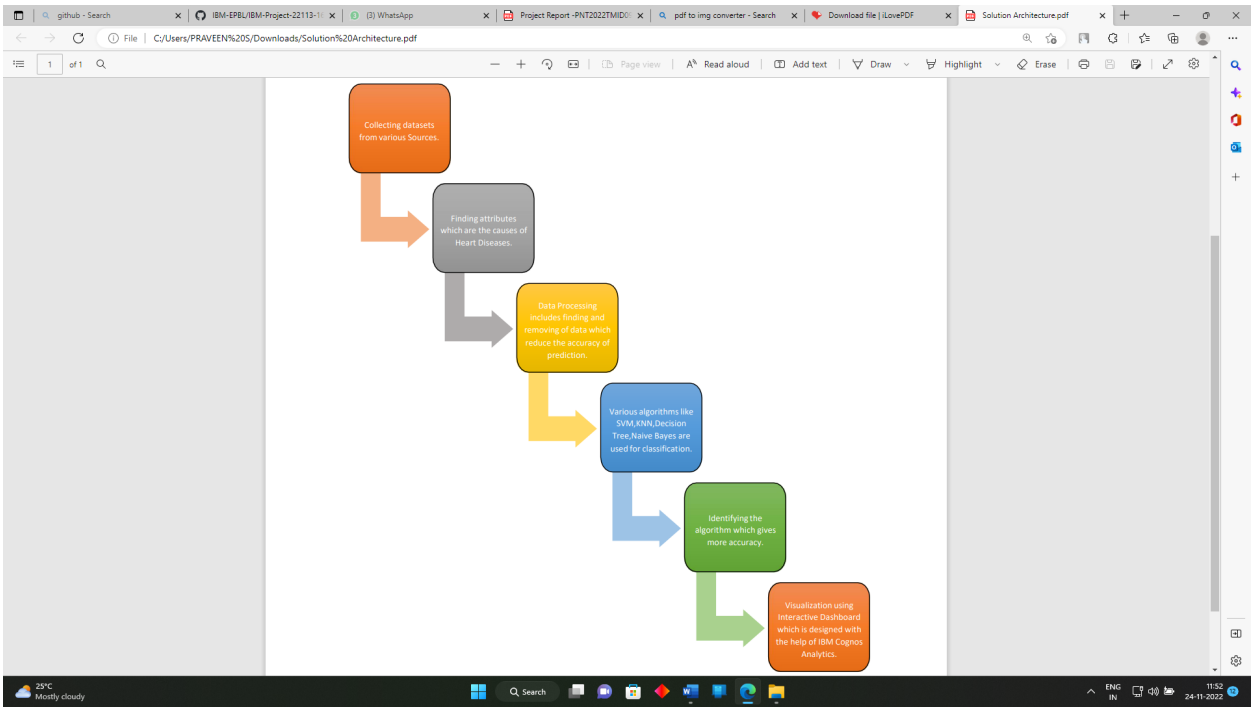
FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	The application will have a simple and user friendly graphical interface. Users will be able to understand and use all the features of the application easily. Any action has to be performed with just a few clicks
NFR-2	**Security**	For security of the application the technique known as database replication should be used so that all the important data should be kept safe. Incase of crash, the system should be able to backup and recover the data
NFR-3	**Reliability**	The application has to be consistent at every scenario and has to work without failure in any environment
NFR-4	**Performance**	Performance of the application depends on the response time and the speed of the data submission. The response time of the application is direct and faster which depends on the efficiency of implemented algorithm
NFR-5	**Availability**	The application has to be available 24 x 7 for users without any interruption
NFR-6	**Scalability**	The application can withstand the increase in the no. of users and has to be able to develop Higher versions

5.Project Design

5.1 Data Flow Diagram



5.2 Solution and Technical Architecture



6.Project Planning and Scheduling

6.1. Script Planning and Execution

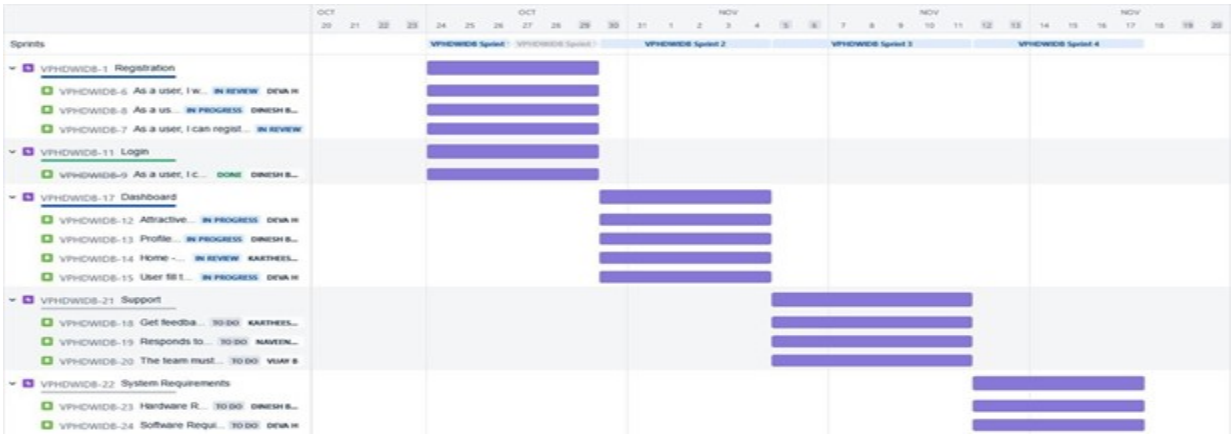
Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password	3	High	1
Sprint-1		USN-2	As a user, I will receive confirmation email once I have registered for the application	3	High	3
Sprint-1		USN-3	As a user, I can register for the application through Gmail	3	Medium	1
Sprint-1	Login	USN-4	As a user, I can log into the application by entering email & password	6	High	5
Sprint-2	Dashboard	USN-5	Attractive dashboard for the Application	3	Medium	3
Sprint-2		USN-6	Profile - view & update your profile	5	Low	2
Sprint-2		USN-7	Home - Analyse your Heart problem	2	High	4
Sprint-2		USN-8	The user will have to fill in the below 13 fields for the system to predict a disease -Age in year -Gender -Chest pain Type -Fasting Blood Sugar -Resting Electrographic Results -Exercise Induced Angina -Trust Blood Pressure	7	High	2
Sprint-3	Support	USN-9	Get feedback from users	10	Medium	3
Sprint-3		USN-10	Responds to user queries via telephone, email etc.	3	Medium	2
Sprint-3		USN-11	The team must respond immediately to the queries based on the priority	5	High	5

Sprint-4	System Requirements	USN-12	Hardware Requirement - Laptop or PC - i5 processor system or higher - 4 GB RAM or higher -128 GB ROM or higher - Mobile (12.0 and above)	5	Low	2
Sprint-4		USN-13	Software Requirement -Laptop or PC -Windows 10 or above -Android Studio	8	Medium	4

6.2. Sprint Delivery Schedule

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	20	6 Days	24 Oct 2022	29 Oct 2022	20	29 Oct 2022
Sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022	20	05 Nov 2022
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022	20	12 Nov 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	20	19 Nov 2022

6.3. Jira Report



7.Coding and Solutioning

7.1 Machine Learning

Learning which model is best for the given Dataset

```
data = {'Estimators':['Linear Regression',
                      'Logistic Regression',
                      'Gaussian Naive Bayes',
                      'K-Nearest Neighbor',
                      'Random Forest',
                      'Bagging Decision Tree',
                      'Hard coting classifier'],
        "Accuracy":[r2,
                    LogisticRegressionScore,
                    gauss_score,
                    KNC_accuracy,
                    rnd_clf_accuracy,
                    bag_clf_accuracy,
                    voting_clf_accuracy]
        }

data = pd.DataFrame(data)

data.sort_values('Accuracy', ascending='False')
```

	Estimators	Accuracy
0	Linear Regression	0.447140
5	Bagging Decision Tree	0.772727
6	Hard coting classifier	0.772727
3	K-Nearest Neighbor	0.795455
4	Random Forest	0.795455
1	Logistic Regression	0.818182
2	Gaussian Naive Bayes	0.818182

From the Above results we can conclude that Logistic Regression and Gaussian Naive Bayes gives Highest accuracy than others for this particular data set . In our convinient we choose the Logistic Regression

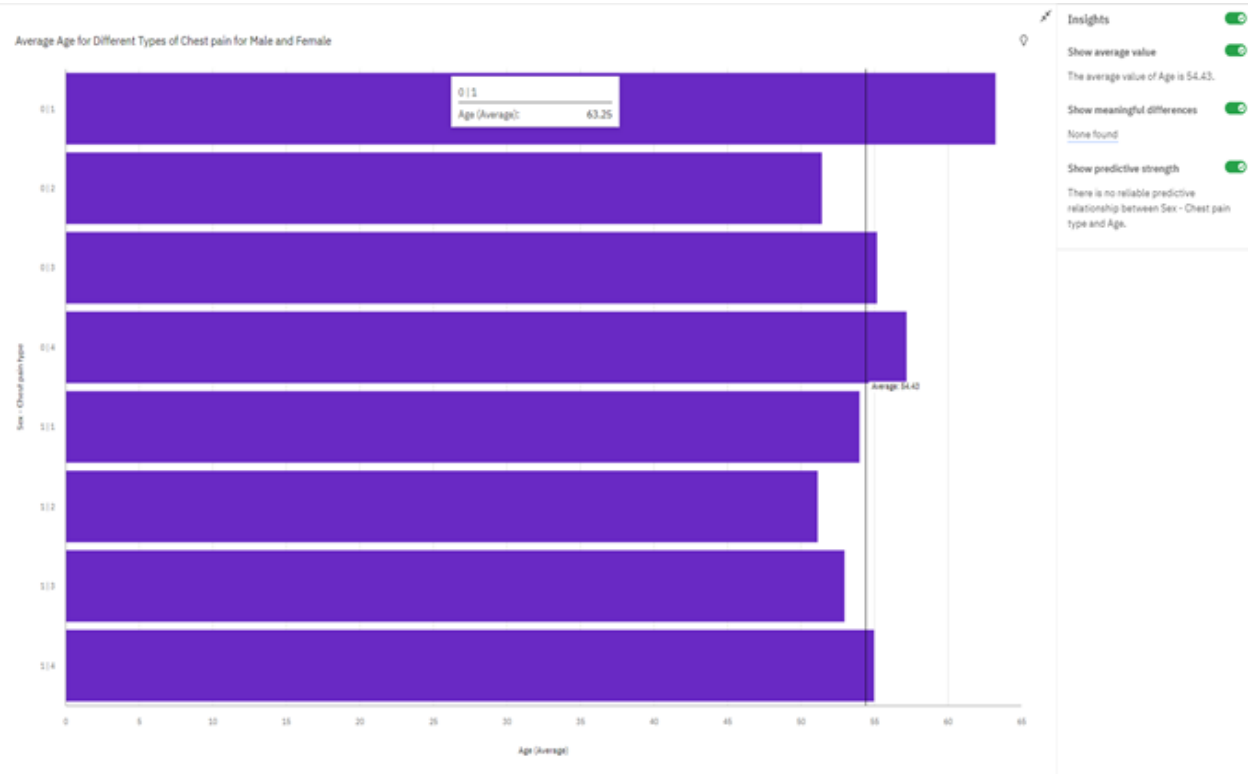
Comparing it with the accuracy gotten from Decision Tree:

```
TP=cm[0][0] #cm=Confusion Matrix
TN=cm[1][1]
FN=cm[1][0]
FP=cm[0][1]
print('Testing Accuracy for Decision Tree:',(TP+TN)/(TP+TN+FN+FP))
print('Testing Sensitivity for Decision Tree:',(TP/(TP+FN)))
print('Testing Specificity for Decision Tree:',(TN/(TN+FP)))
print('Testing Precision for Decision Tree:',(TP/(TP+FP)))
```

```
Testing Accuracy for Decision Tree: 0.9264705882352942
Testing Sensitivity for Decision Tree: 0.8888888888888888
Testing Specificity for Decision Tree: 1.0
Testing Precision for Decision Tree: 1.0
```

7.2 Dashboard

Average age for different types of chest pain for male and female

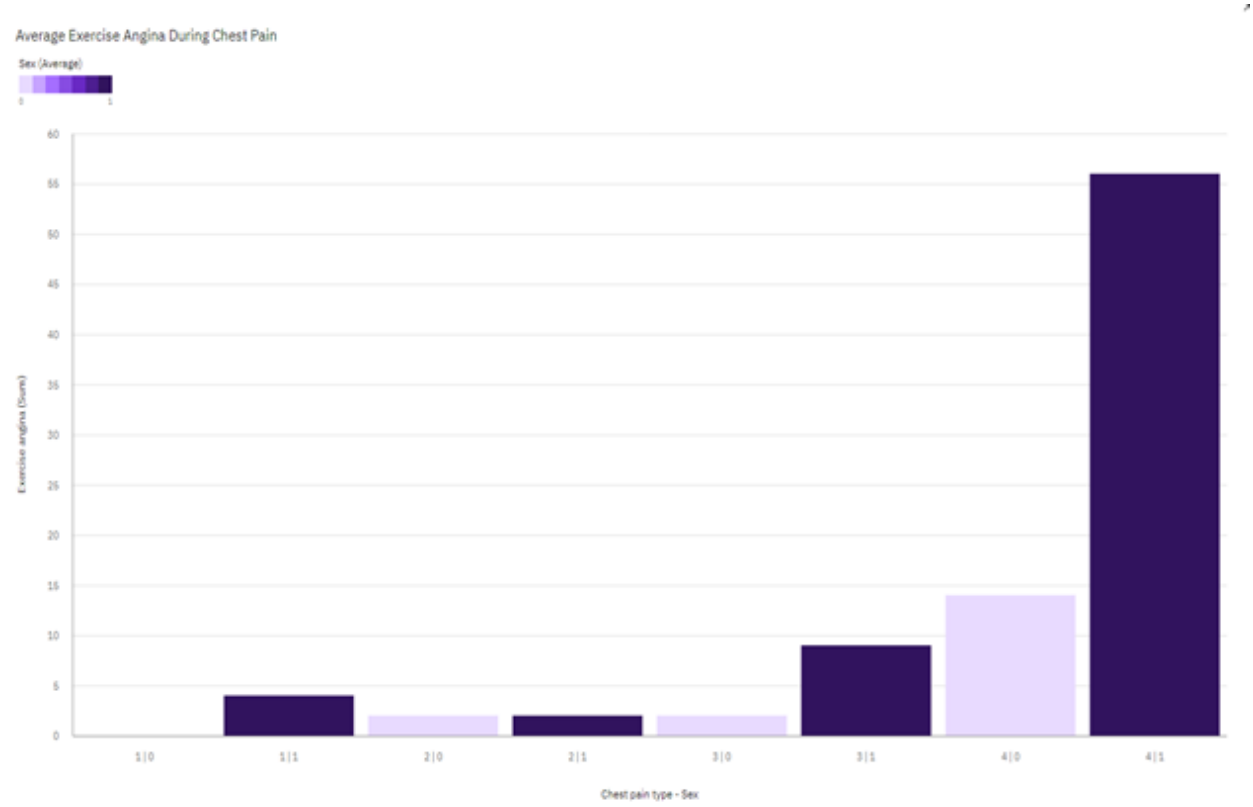


Average age for different types of chest pain in existing heart disease

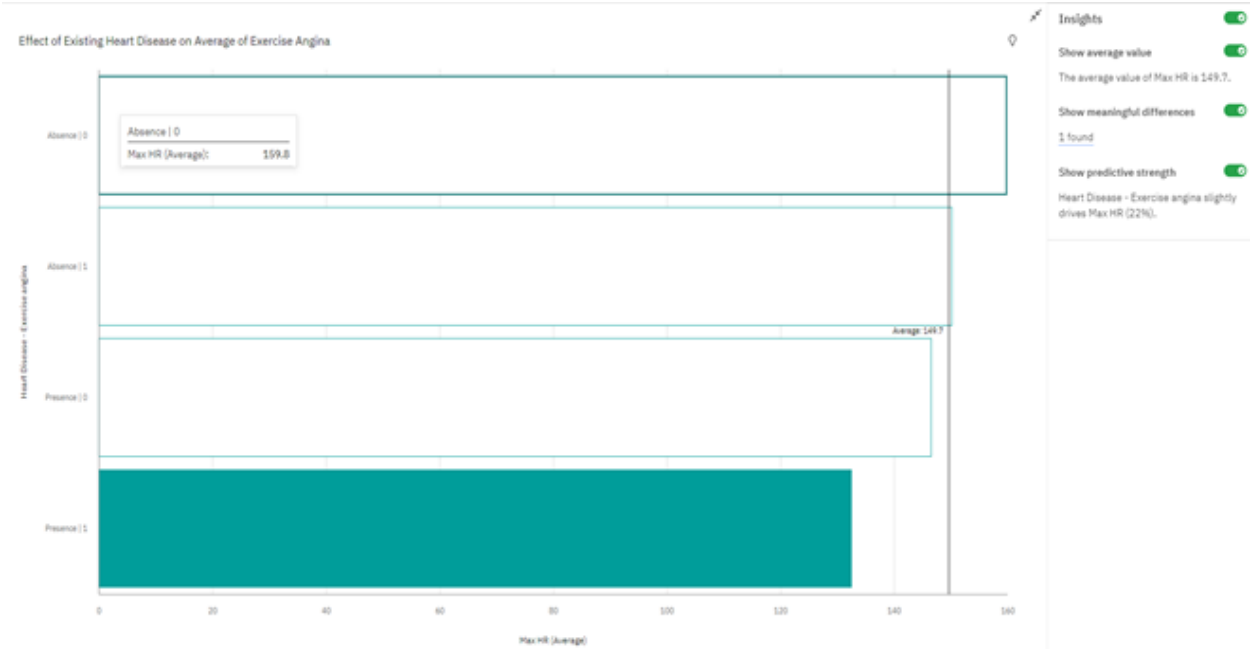
Average age for different types of chest pain in existing heart disease

Heart Disease	1	2	3	4	Summary
0	1	2	2	2	2
1	2	2	2	2	2
Summary	2	2	2	2	2

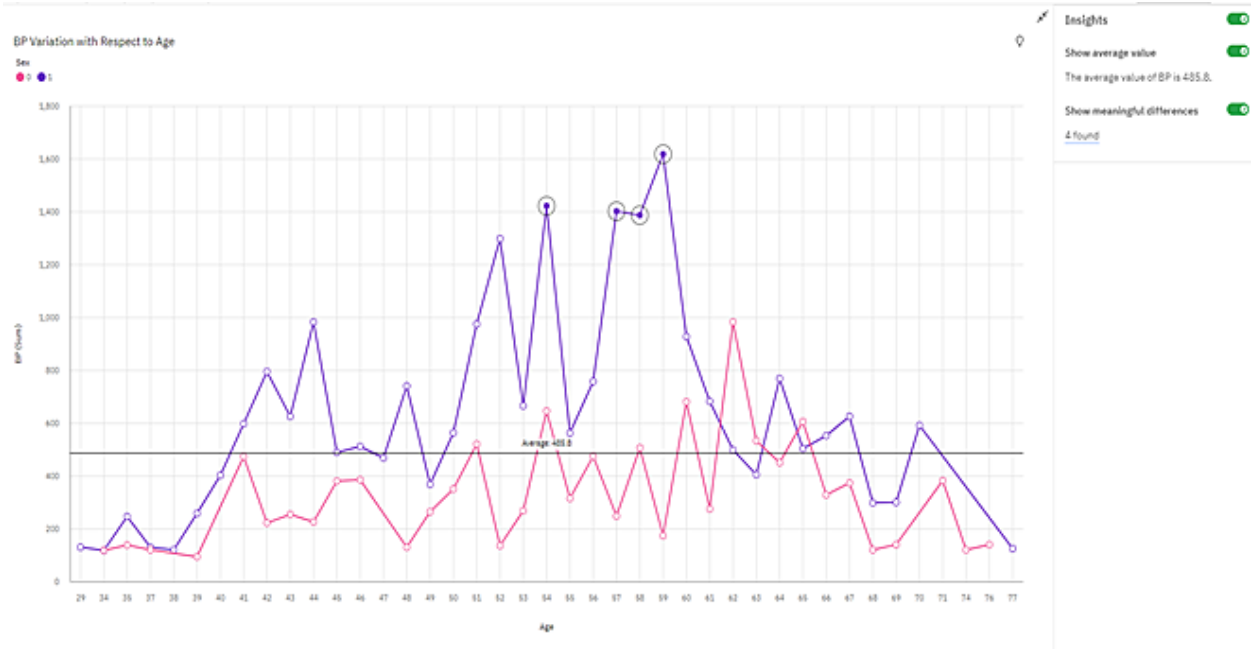
Average Exercise Angina During Chest Pain



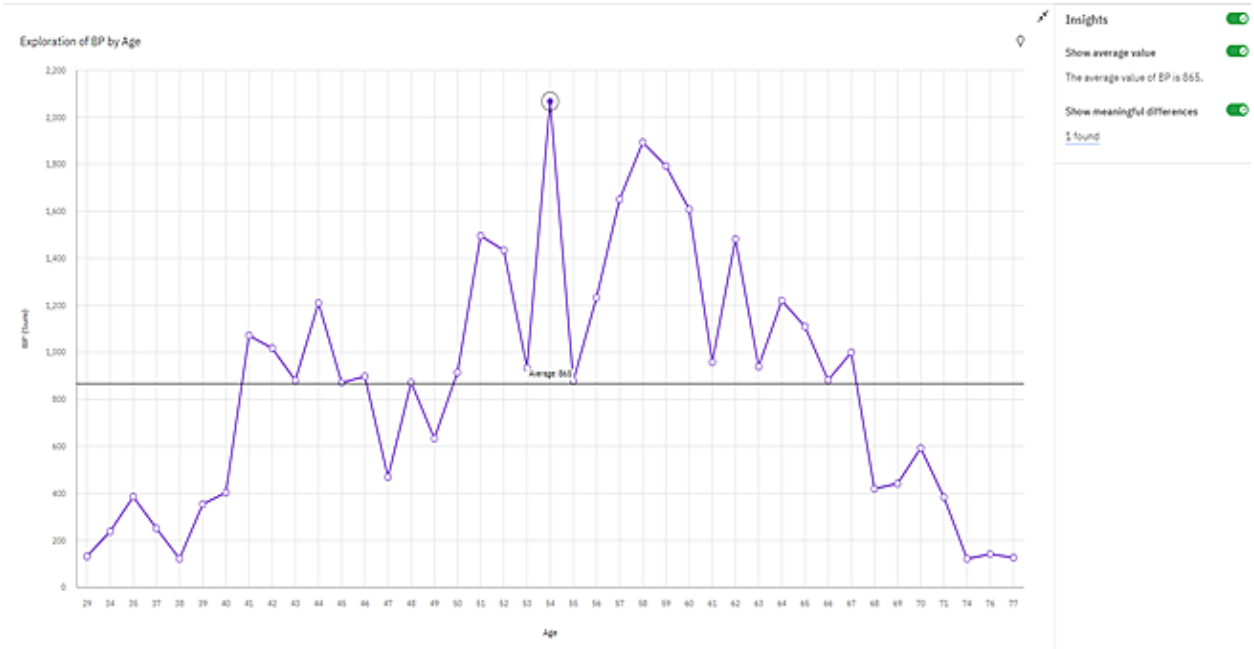
Effect of existing heart disease on average of exercise angina



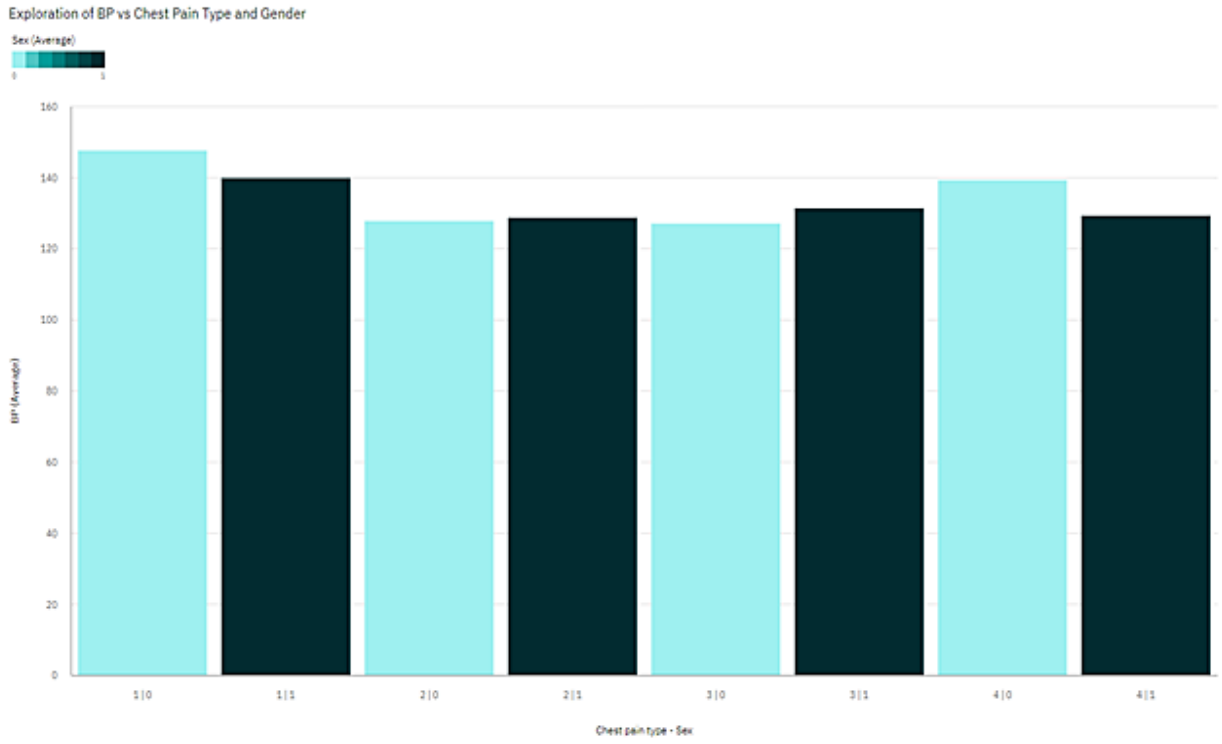
BP variation with respect to age



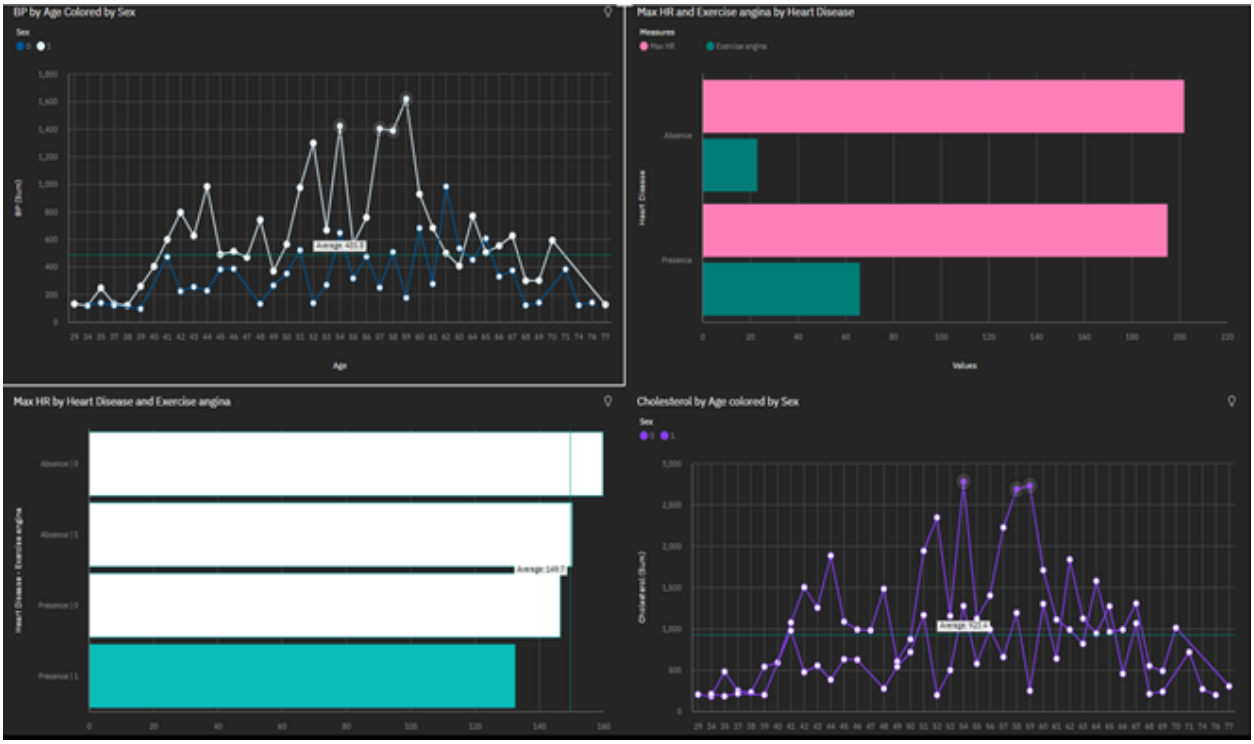
Exploration of BP by age



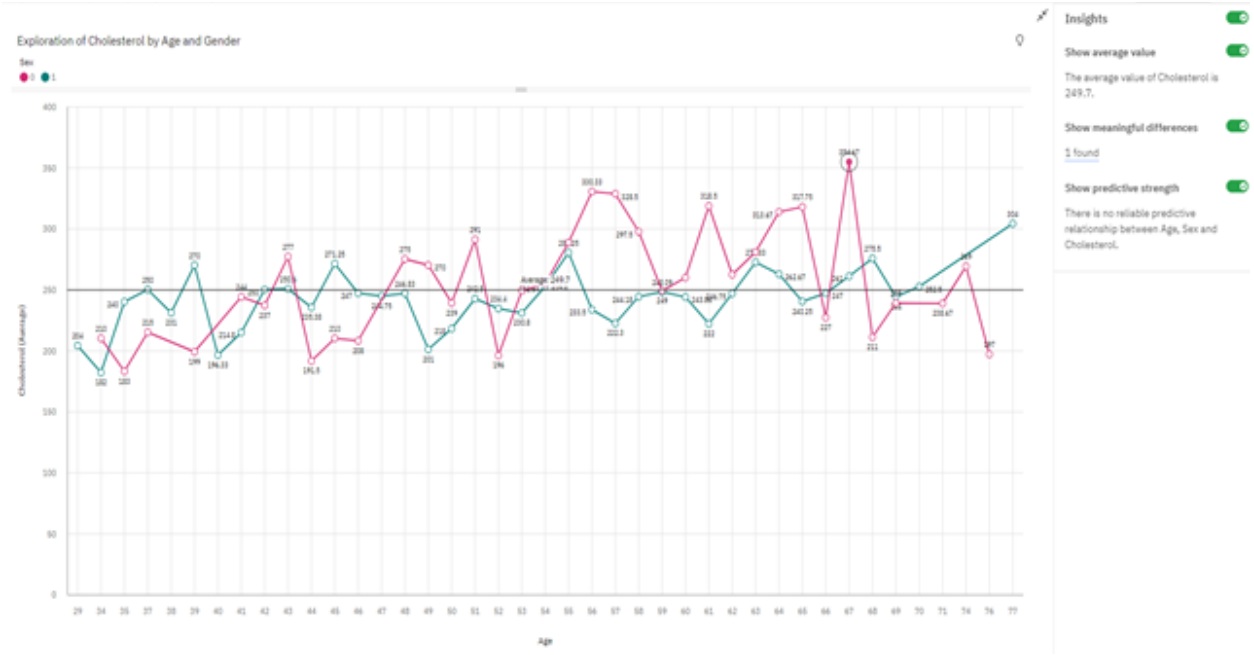
Exploration of BP vs Chest pain type and gender



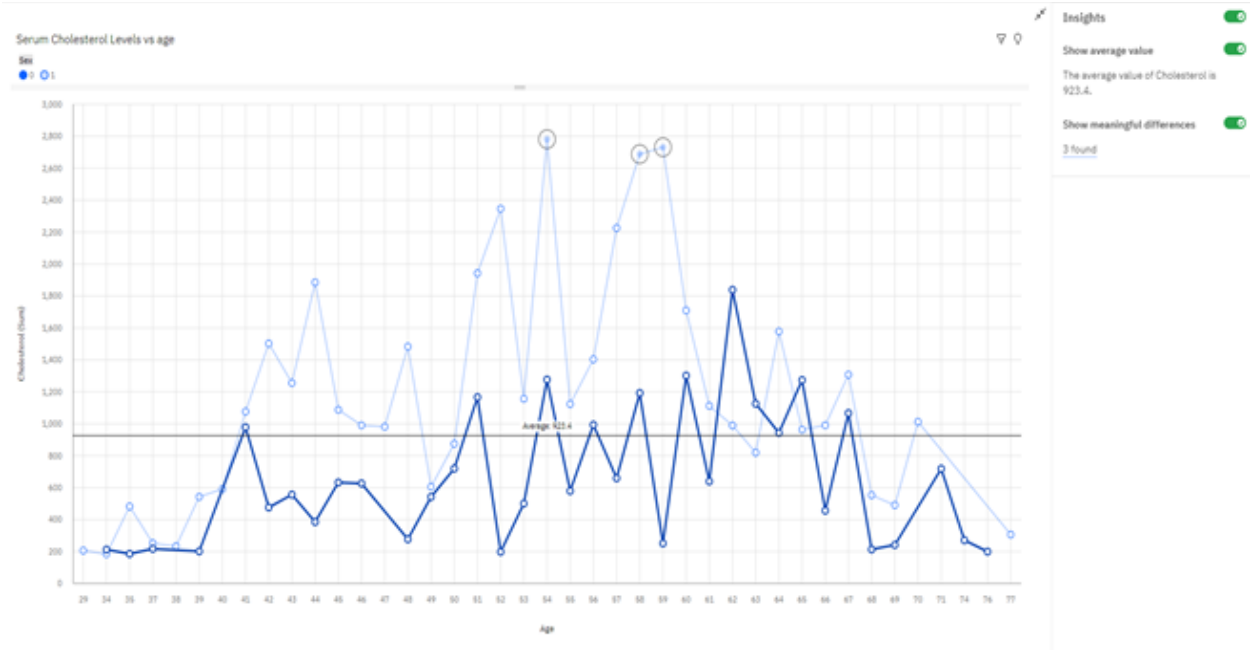
Different types of dashboarsd



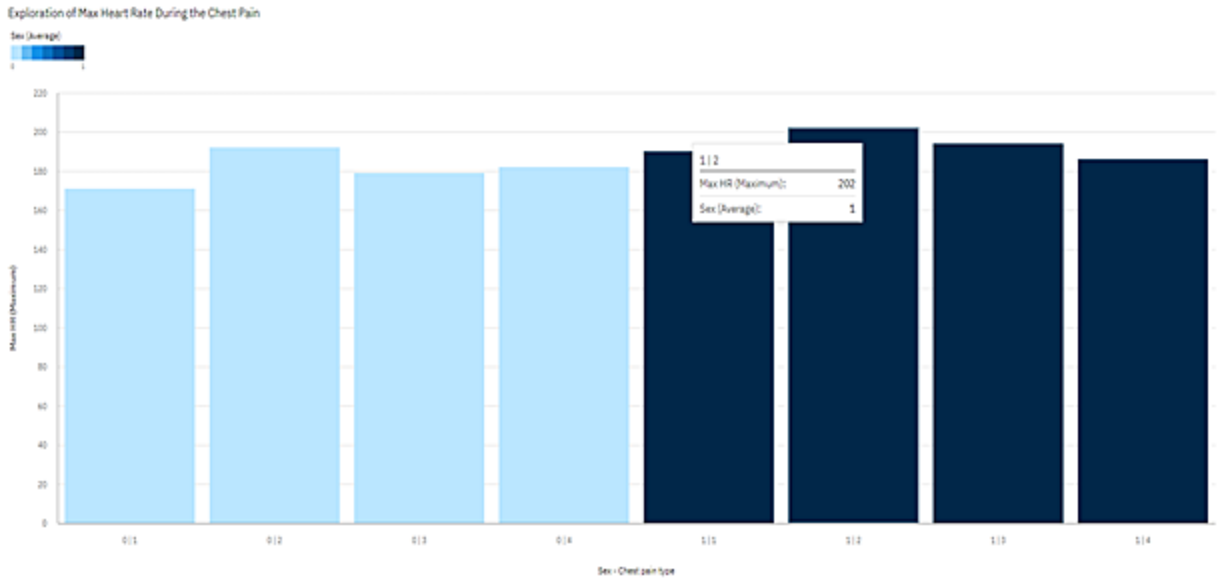
Exploration of cholesterol by age and gender



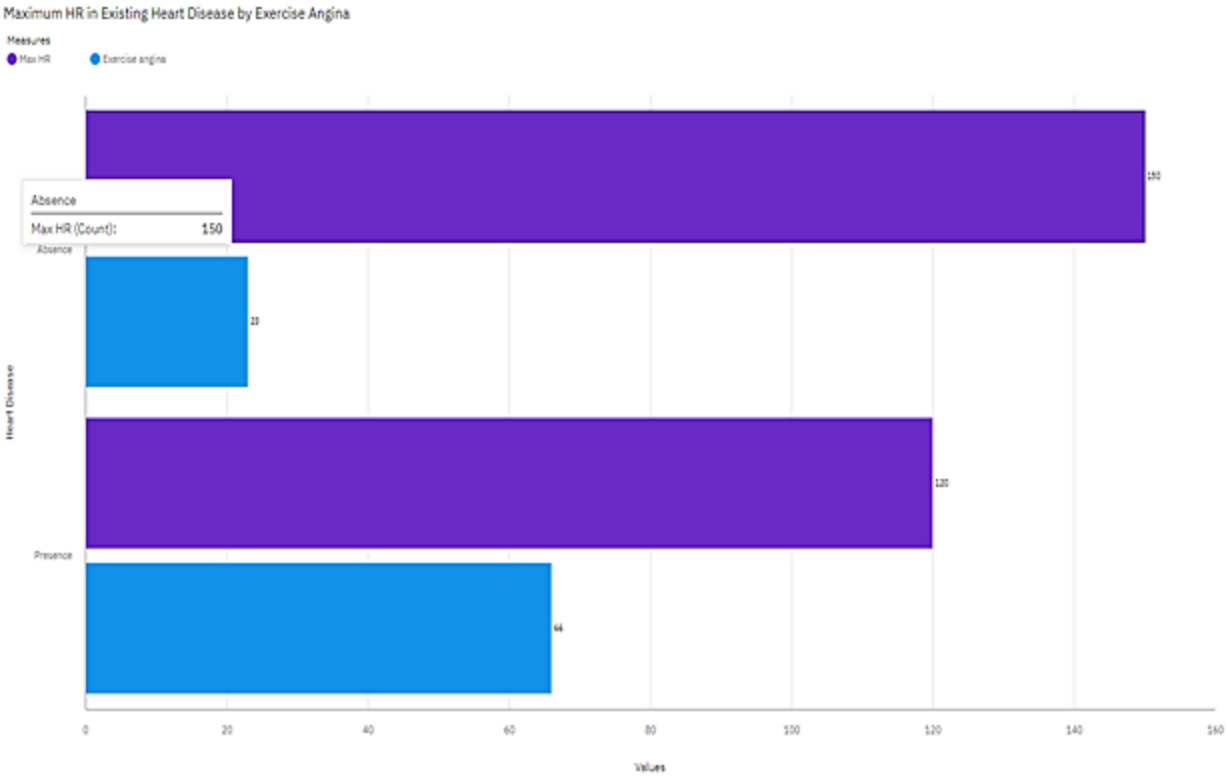
Serum Cholesterol Levels vs age



Exploration of Max Heart Rate During the Chest Pain



Maximum Heart Rate in Existing Heart Disease by Exercise Angina



8. Testing

8.1 Test Cases

Testing the data model for various input values.

```
from sklearn.metrics import accuracy_score
input=(63,1,3,145,200,150,98,0,0,0,0,0,0)
input_as_numpy=np.asarray(input)
input_reshaped=input_as_numpy.reshape(1,-1)
pre1=tree_model.predict(input_reshaped)
print(pre1)
a1 = accuracy_score(pre1,model1.predict(input_reshaped)) * 100
print(a1)
```

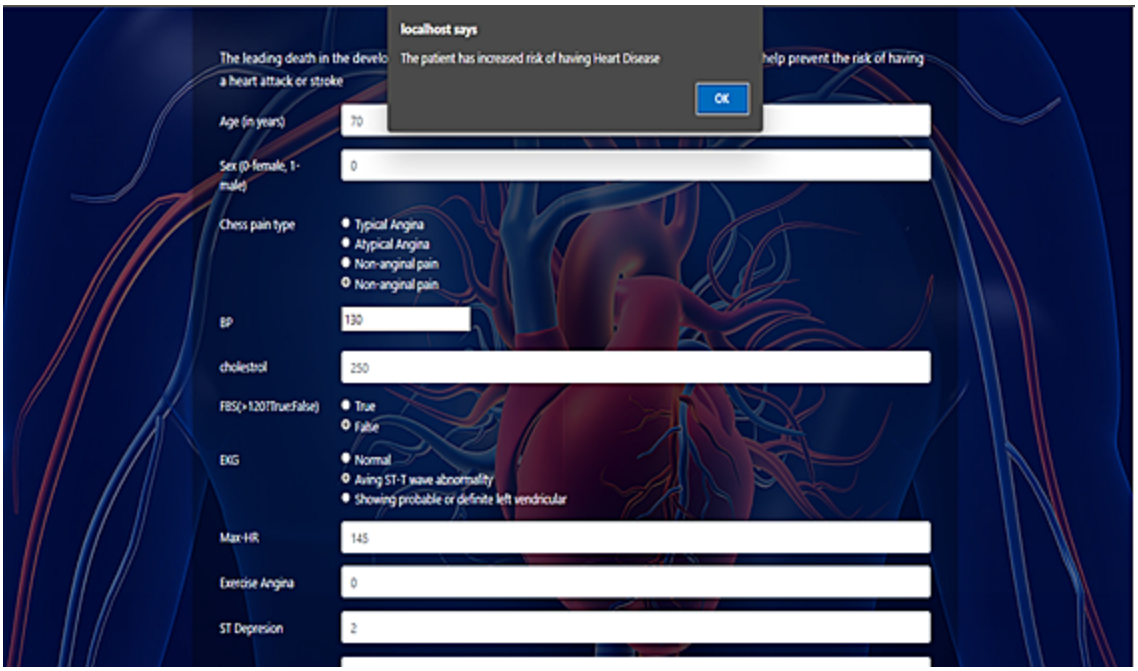
```
['Absence']
100.0
```

```
from sklearn.metrics import accuracy_score
input=(70,1,4,130,322,0,2,109,0,2.4,2,3,3)
input_as_numpy=np.asarray(input)
input_reshaped=input_as_numpy.reshape(1,-1)
pre1=tree_model.predict(input_reshaped)
print(pre1)
a1 = accuracy_score(pre1,model1.predict(input_reshaped)) * 100
print(a1)
```

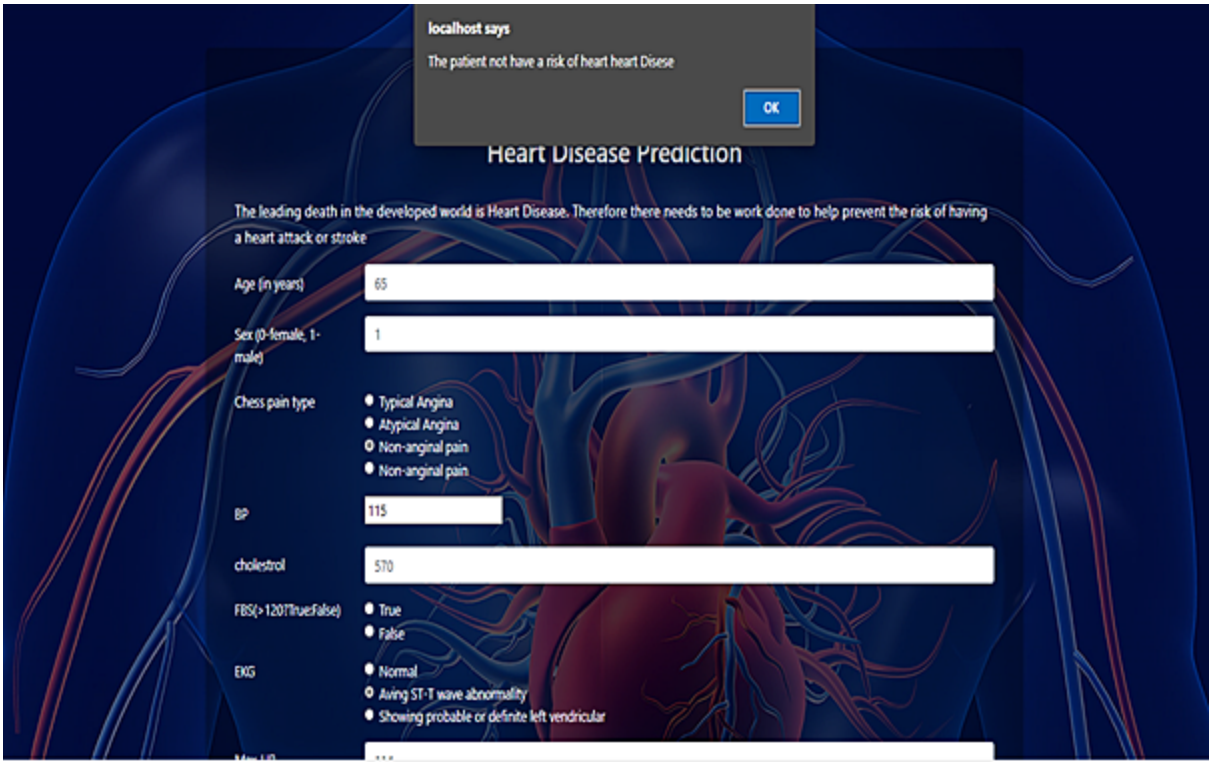
```
['Presence']
100.0
```

8.2 User acceptance Testing

Testing a case where user has heart disease



Testing a case where user does not have heart disease



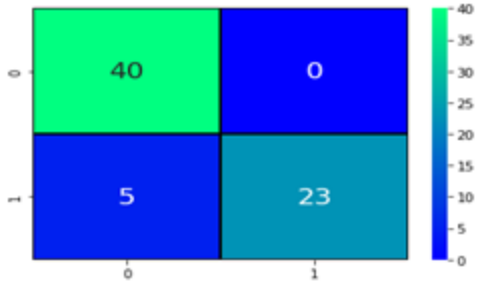
9. Result

9.1 Performance Metrics

The confusion matrix below shows the performance metrics of the machine learning model.

```
from sklearn.model_selection import RandomizedSearchCV
from sklearn.tree import DecisionTreeClassifier

tree_model = DecisionTreeClassifier(max_depth=5,criterion='entropy')
cv_scores = cross_val_score(tree_model, x, y, cv=10, scoring='accuracy')
m=tree_model.fit(x, y)
prediction=m.predict(X_test)
cm= confusion_matrix(y_test,prediction)
sns.heatmap(cm, annot=True,cmap='winter',linewidths=0.3, linecolor='black',annot_kws={"size": 20})
print(classification_report(y_test, prediction))

TP=cm[0][0]
TN=cm[1][1]
FN=cm[1][0]
FP=cm[0][1]
print('Testing Accuracy for Decision Tree:',(TP+TN)/(TP+TN+FN+FP))
print('Testing Sensitivity for Decision Tree:',(TP/(TP+FN)))
print('Testing Specificity for Decision Tree:',(TN/(TN+FP)))
print('Testing Precision for Decision Tree:',(TP/(TP+FP)))
```

```
              precision    recall  f1-score   support

     Absence       0.89      1.00      0.94        40
    Presence       1.00      0.82      0.90        28

    accuracy                           0.93        68
   macro avg       0.94      0.91      0.92        68
weighted avg       0.93      0.93      0.93        68

Testing Accuracy for Decision Tree: 0.9264705882352942
Testing Sensitivity for Decision Tree: 0.8888888888888888
Testing Specificity for Decision Tree: 1.0
Testing Precision for Decision Tree: 1.0
```



10. Advantages Disadvantages

Advantages:

1. This is one of the fastest ways to determine if a person is likely to suffer from a heart disease or not.
2. Useful for medical practitioners to easily classify their patients.
3. User Friendly.
4. Easy to understand.
5. Secure.
6. Dashboard provides insightful information.

Disadvantages:

1. Needs work.
2. Users need to know all the fields.
3. Does Not take null value as input.
4. Does not provide suggestions to user.

11. Conclusion

Complications of heart disease include heart attack and stroke. You can reduce the risk of complications with early diagnosis and treatment. So, the suggestion that we get from the website might help save patients. It is always to get treated in the early stages of heart disease.

12.Future Scope

Like the saying goes “Prevention is better than cure”. We have to look into methods to prevent heart diseases altogether other than just predicting it in early stages.

To use this website, we need to take a lot of tests beforehand. So, it would be better if we require less attributes and still give an effective result.

13.Appendix

Source Code:

IBM-EPBL/IBM-Project-22113-1659805257: Visualizing and Predicting Heart Diseases with an Interactive Dash Board (github.com)

Demo video link:

https://www.youtube.com/watch?v=Fkp6JUNMhJA