VISUALIZING AND PREDICTING HEART DISEASES WITH AN INTERACTIVE DASHBOARD

TEAM ID : PNT2022TMID05795

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CHAPTER 1
INTRODUCTION

Heart disease describes a range of conditions that affect your heart. Diseases under the heart disease umbrella include blood vessel diseases, such as coronary artery disease, heart rhythm problems and heart defects you're born with (congenital heart defects), among others.The term "heart disease" is often used interchangeably with the term "cardiovascular disease". Cardiovascular disease generally refers to conditions that involve narrowed or blocked blood vessels that can lead to a heart attack, chest pain (angina) or stroke. Other heart conditions, such as those that affect your heart's muscle, valves or rhythm, also are considered forms of heart disease.

1.1 Project Overview

Heart disease is one of the leading cause of death in this world. With unhealthy attitude of people, the number of cases is increasing more and more. Using a set of attributes identify the patients who are more prone to have a heart disease will make the lives of doctors easier.

1.2 Purpose

One of the leading causes of morbidity and mortality among the global population is heart disease. One of the most crucial topics in the clinical data analysis subsection is the prediction of cardiovascular disease. The volume of information in the healthcare sector is enormous. The vast amount of unprocessed healthcare data is transformed via data mining into knowledge that may be used to make forecasts and educated judgments. The main cause of death for both men and women is heart disease. This makes heart disease a serious issue that has to be addressed. However, because of numerous contributing risk factors, including diabetes, high blood pressure, high cholesterol, an irregular pulse rate, and many other factors, it can be challenging to diagnose heart disease.Due to such constraints, scientists have turned towards modern approaches like Data Mining and Machine Learning for predicting the disease.

CHAPTER 2
LITERATURE SURVEY

2.1 Existing problem

1. Predicting the Risk of Heart Failure With EHR Sequential Data Modeling

Bo Jin, Chao Che et al. (2018) proposed a “Predicting the Risk of Heart Failure With EHR Sequential Data Modeling” model designed by applying neural network. This paper used the electronic health record (EHR) data from real-world datasets related to congestive heart disease to perform the experiment and predict the heart disease before itself. We tend to used one-hot encryption and word vectors to model the diagnosing events and foretold coronary failure events victimization the essential principles of an extended memory network model. By analyzing the results, we tend to reveal the importance of respecting the sequential nature of clinical records.

2.Heart Disease Prediction using Evolutionary Rule Learning

Aakash Chauhan et al. (2018) presented “Heart Disease Prediction using Evolutionary Rule Learning”. This study eliminates the manual task that additionally helps in extracting the information (data) directly from the electronic records. To generate

strong association rules, we have applied frequent pattern growth association mining on patient's dataset. This will facilitate (help) in decreasing the amount of services and shown that overwhelming majority of the rules helps within the best prediction of coronary sickness.

3.An Intelligent Learning System based on Random Search Algorithm and Optimized Random Forest Model for Improved Heart Disease Detection

Ashir Javeed, Shijie Zhou et al. (2017) designed "An Intelligent Learning System based on Random Search Algorithm and Optimized Random Forest Model for Improved Heart Disease Detection". This paper uses random search algorithm (RSA) for factor selection and random forest model for diagnosing the cardiovascular disease. This model is principally optimized for using grid search algorithmic program

2.2 References

1. Jin, Bo, et al. "Predicting the risk of heart failure with EHR sequential data modeling." *Ieee Access* 6 (2018): 9256-9261.
2. Chauhan, Aakash, et al. "Heart disease prediction using evolutionary rule learning." *2018 4th International conference on computational intelligence & communication technology (CICT)*. IEEE, 2018.
3. Javeed, Ashir, et al. "An intelligent learning system based on random search algorithm and optimized random forest model for improved heart disease detection." *IEEE Access* 7 (2019): 180235-180243

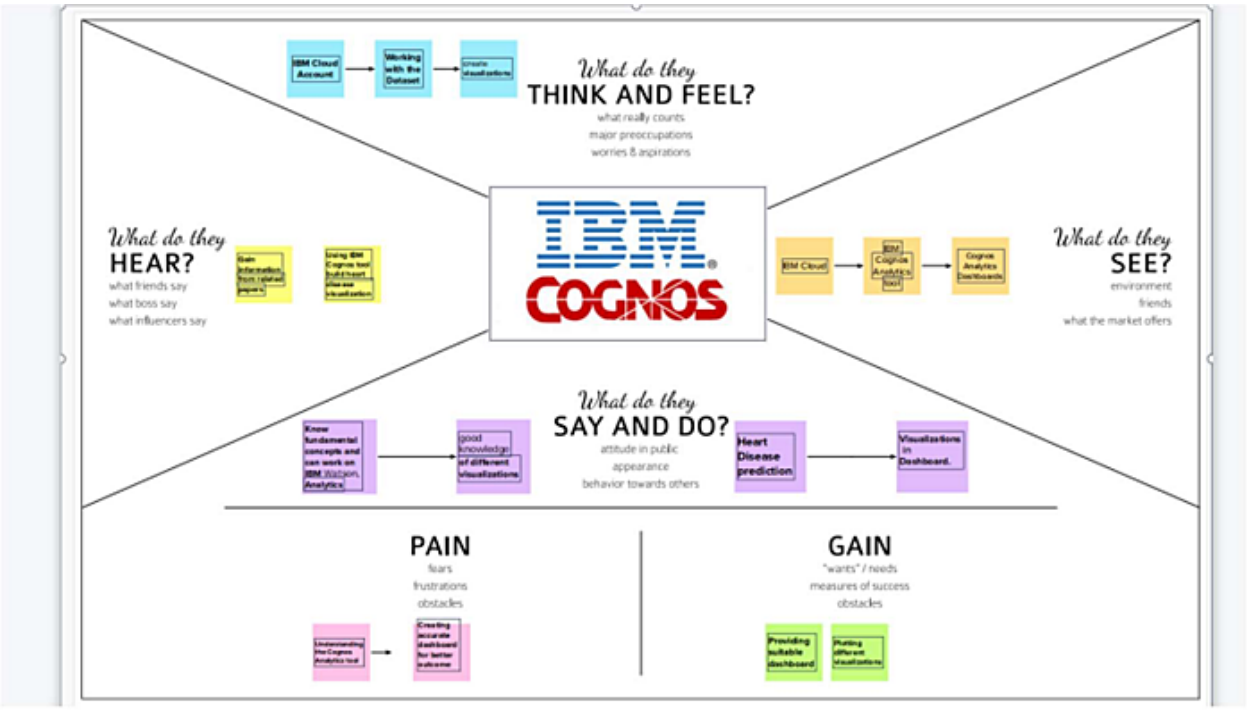
2.3 Problem Statement Definition

Who does the problem affect?	Most persons with coronary heart disease who pass away are 60 years of age or older. Although both sexes can get heart attacks inold age, women have a higher mortality rate.
What are the boundaries of the problem?	Risk for heart disease can be increased by a number of medical issues, lifestyle, age, and family history.

What's the issue?	When a person is affected by heart disease, it causes side effects. Chest pain, chest tightness, chest pressure and chest discomfort Breathing difficulties, Neck, jaw, throat, upper abdomen, or back pain.
When the issue occur?	Heart disease - and the conditions that lead to it - can happen at any age. High rates of obesity and high blood pressure among younger people (ages 35–64) are putting them at risk for heart disease earlier in life.

CHAPTER 3
IDEATION & PROPOSED SOLUTION

3.1 Empathy Map Canvas

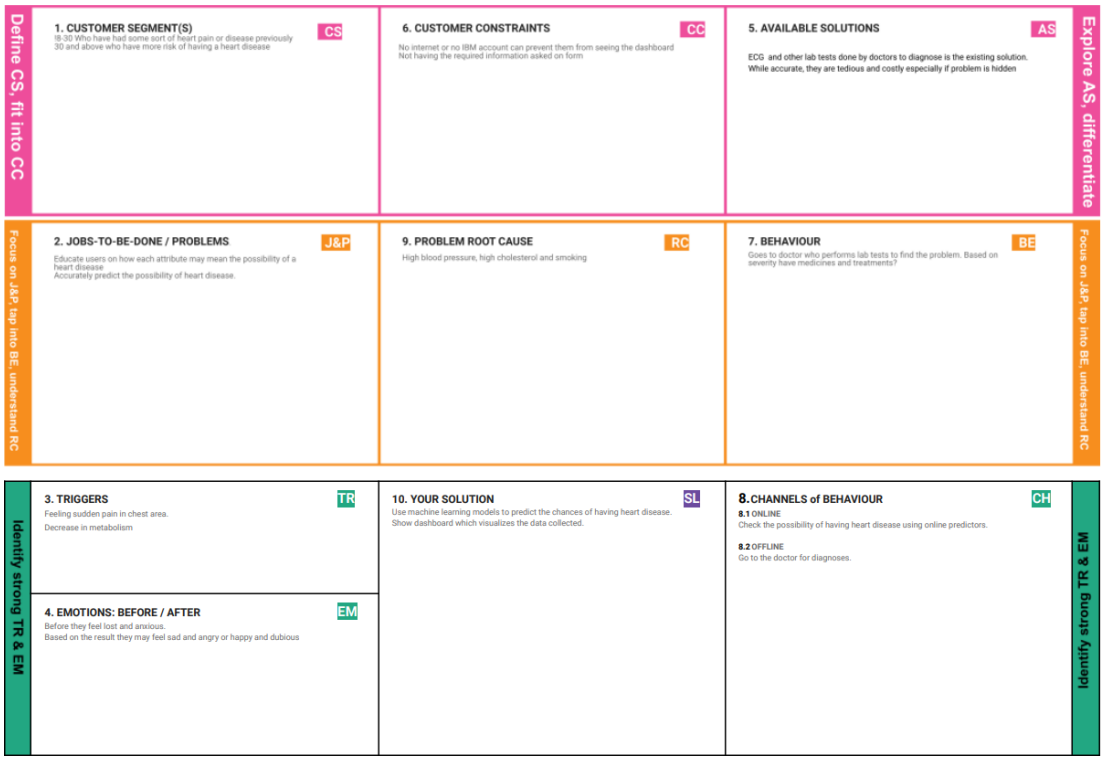


3.2 Ideation & Brainstorming

3.3 Proposed Solution

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	To develop an interactive dashboard and to predict the possibility of heart disease
2.	Idea / Solution description	Using Cognos Analytics, a dashboard is created with shows how each attribute like sex, age is related to the possibility of heart disease and a machine learning model that accurately predicts the possibility of heart disease.
3.	Novelty / Uniqueness	Use of Cognos Analytics to find relation between attributes and visualizing it in dashboard
4.	Social Impact / Customer Satisfaction	User friendly website Can check for possibility of heart disease themselves.
5.	Business Model (Revenue Model)	Confidentiality Accurate Results
6.	Scalability of the Solution	Supports increase in throughput Supports multiple platforms

3.4 Problem Solution fit



CHAPTER 4

REQUIREMENT ANALYSIS

4.1 Functional requirement

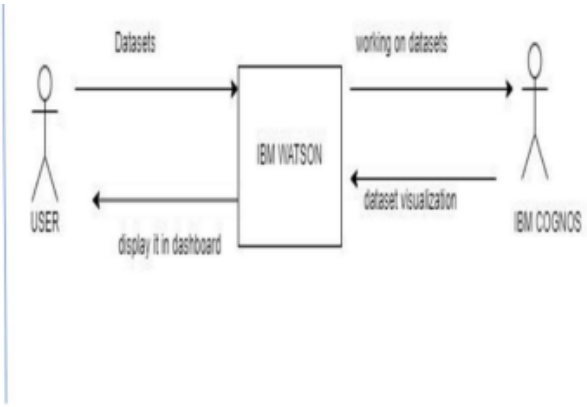
FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	The website has a home page Which lists the options	Two options- predict , dashboard
FR-2	A "predict" page	Predicts whether the person has heart disease or not
FR-3	A "dashboard" option	Shows the data entered in the form of charts

4.2 Non-Functional requirements

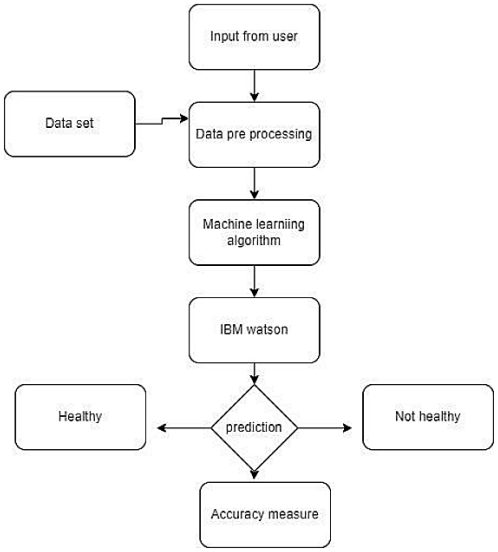
FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	The website will utilise the user interface for navigation purposes
NFR-2	**Security**	The website will be protected against SQL injection, DDoS attacks.
NFR-3	**Reliability**	The model will give exact results most of the time
NFR-4	**Performance**	An optimized website which includes smooth experience for the user.
NFR-5	**Availability**	The tool will be available to use for the users.
NFR-6	**Scalability**	The system will be able to support n no of users at the same time with good speed.

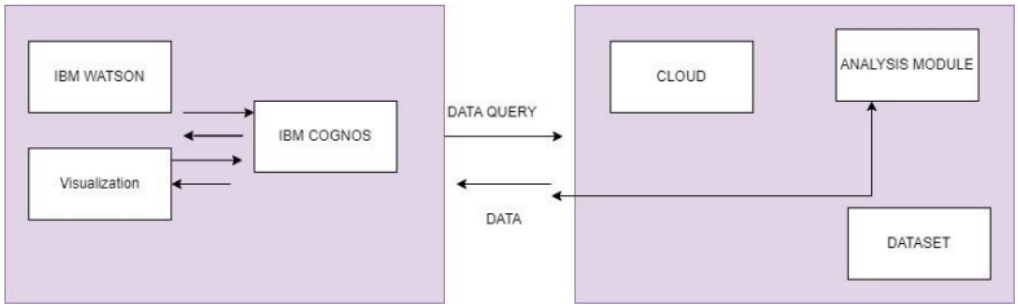
CHAPTER 5
PROJECT DESIGN

5.1 Data Flow Diagrams



5.2 Solution & Technical Architecture



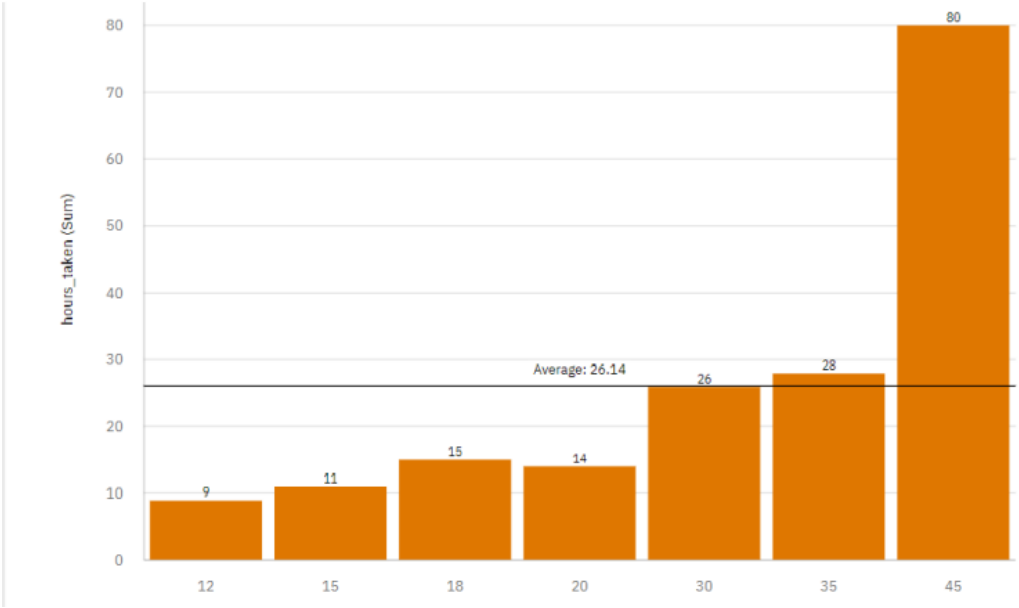


5.3 User Stories

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer	Homepage	USN-1	As a user, I can go to homepage	I can access predictor or dashboard	Low	Sprint-1
		USN-2	As a user, I can click on dashboard	I will see dashboard	Medium	Sprint-1
		USN-3	As a user, I can click on predict	I will see form for prediction	Medium	Sprint-1
	Dashboard	USN-4	As a user, I can interact with dashboard	I can change parameters of the charts	High	Sprint-2
	Predict	USN-5	As a user, I can access prediction form	I can change parameters of the charts	High	Sprint-3
		USN-6	As a user I can submit the form	I can see if I have heart disease or not	High	Sprint 4

CHAPTER 6
PROJECT PLANNING & SCHEDULING

6.1 Sprint Planning & Estimation



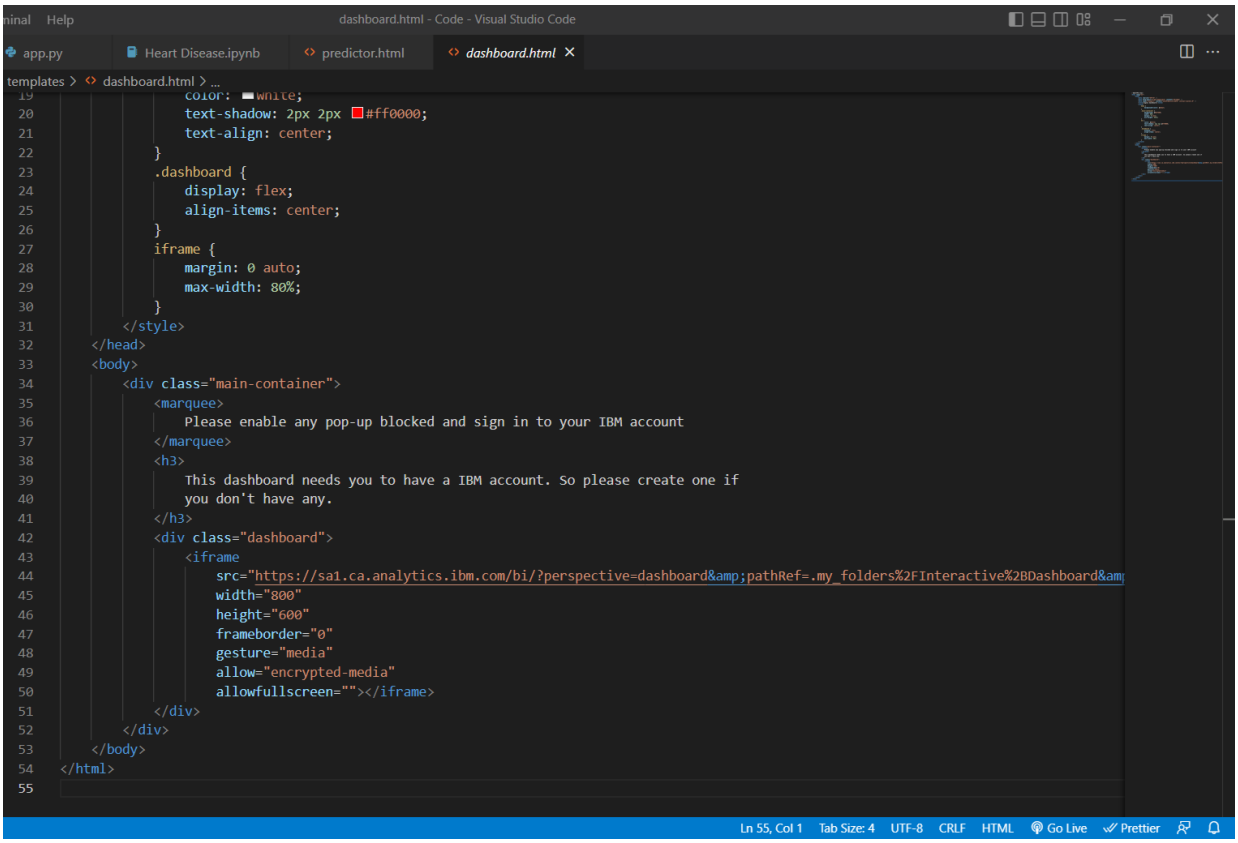
Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Story points	Priority	Team Members
Sprint-1	Homepage	USN-1	As a user, I can go to homepage	I can access predictor or dashboard	5	High	Gokul C, Senthilkailaash
		USN-2	As a user, I can click on dashboard	I will see dashboard	5	Medium	Gokul C, Senthilkailaash
		USN-3	As a user, I can click on predict	I will see form for prediction	5	Medium	Gokul C, Senthilkailaash
Sprint-2	Cognos Dashboard	USN-4	As a user, I can interact with dashboard	I can change parameters of the charts	25	High	Gokulprasanth
Sprint-3	Predictor	USN-5	As a user, I can access prediction form	I can change parameters of the charts	15	High	Manisha
Sprint-4		USN-6	As a user I can submit the form	I can see if I have heart disease or not	25	High	Manisha

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	15	6 Days	24 Oct 2022	29 Oct 2022	15	28 Oct 2022
Sprint-2	25	6 Days	31 Oct 2022	05 Nov 2022	25	02 Nov 2022
Sprint-3	15	6 Days	07 Nov 2022	12 Nov 2022	15	09 Nov 2022
Sprint-4	25	6 Days	14 Nov 2022	19 Nov 2022	25	14 Nov 2022

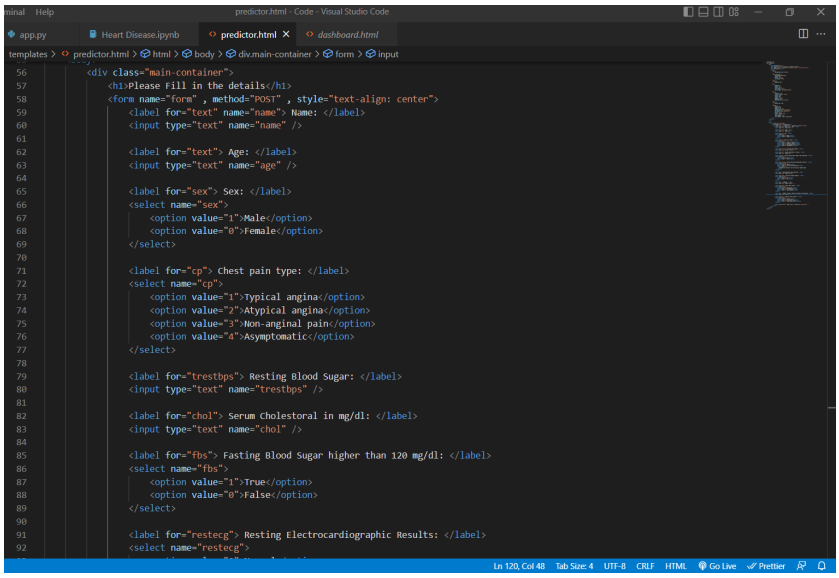
CHAPTER 7
CODING & SOLUTIONING

7.1 Feature 1 - Dashboard

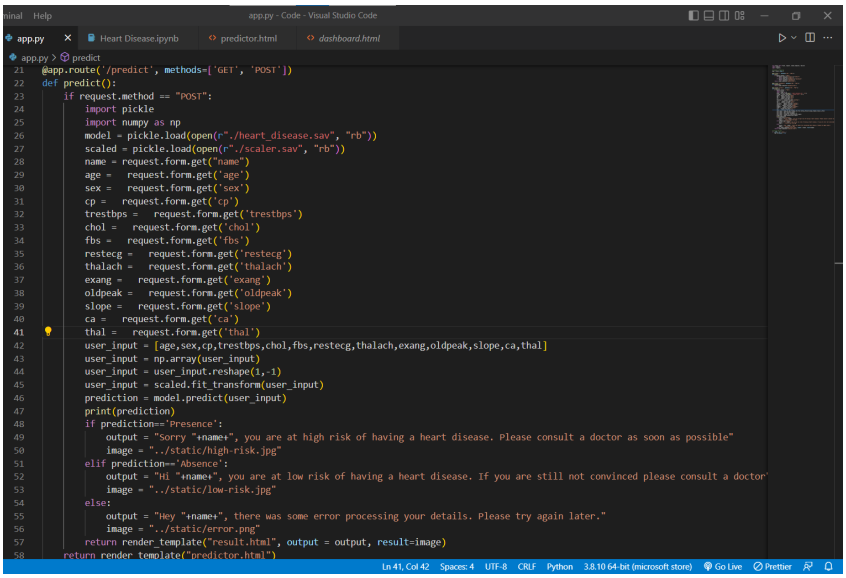


Using Cognos Analytics, dashboard is created which shows the relation between attributes and how they are responsible for chances of heart disease. The dashboard is incorporated in website using iframe. It is mandatory to have an IBM account to view the dashboard. As soon as the page is loaded, it asks to sign in to the IBM account. Once signed in, user can view the dashboard. Dashboard has multiple tabs, each containing a chart of relation between attributes. The above code shows how dashboard is included in the website.

7.2 Feature 2 - Predictor



```
<div class="main-container">
    <h1>Please Fill in the details</h1>
    <form name="form" , method="POST" , style="text-align: center">
        <label for="text" name="name"> Name: </label>
        <input type="text" name="name" />

        <label for="text"> Age: </label>
        <input type="text" name="age" />

        <label for="sex"> Sex: </label>
        <select name="sex">
            <option value="1">Male</option>
            <option value="0">Female</option>
        </select>

        <label for="cp"> Chest pain type: </label>
        <select name="cp">
            <option value="1">Typical angina</option>
            <option value="2">Atypical angina</option>
            <option value="3">Non-anginal pain</option>
            <option value="4">Asymptomatic</option>
        </select>

        <label for="trestbps"> Resting Blood Sugar: </label>
        <input type="text" name="trestbps" />

        <label for="chol"> Serum Cholestoral in mg/dl: </label>
        <input type="text" name="chol" />

        <label for="fbs"> Fasting Blood Sugar higher than 120 mg/dl: </label>
        <select name="fbs">
            <option value="1">True</option>
            <option value="0">False</option>
        </select>

        <label for="restecg"> Resting Electrocardiographic Results: </label>
        <select name="restecg">
```



```
@app.route('/predict', methods=['GET', 'POST'])
def predict():
    if request.method == "POST":
        import pickle
        import numpy as np
        model = pickle.load(open(r"./heart_disease.sav", "rb"))
        scaled = pickle.load(open(r"./scaler.sav", "rb"))
        name = request.form.get("name")
        age =   request.form.get('age')
        sex =   request.form.get('sex')
        cp =   request.form.get('cp')
        trestbps =   request.form.get('trestbps')
        chol =   request.form.get('chol')
        fbs =   request.form.get('fbs')
        restecg =   request.form.get('restecg')
        thalach =   request.form.get('thalach')
        exang =   request.form.get('exang')
        oldpeak =   request.form.get('oldpeak')
        slope =   request.form.get('slope')
        ca =   request.form.get('ca')
        thal =   request.form.get('thal')
        user_input = [age,sex,cp,trestbps,chol,fbs,restecg,thalach,exang,oldpeak,slope,ca,thal]
        user_input = np.array(user_input)
        user_input = user_input.reshape(1,-1)
        user_input = scaled.fit_transform(user_input)
        prediction = model.predict(user_input)
        print(prediction)
        if prediction=='Presence':
            output = "Sorry "+name+", you are at high risk of having a heart disease. Please consult a doctor as soon as possible"
            image = "../static/high-risk.jpg"
        elif prediction=='Absence':
            output = "Hi "+name+", you are at low risk of having a heart disease. If you are still not convinced please consult a doctor"
            image = "../static/low-risk.jpg"
        else:
            output = "Hey "+name+", there was some error processing your details. Please try again later."
            image = "../static/error.png"
        return render_template("result.html", output = output, result=image)
    return render_template("predictor.html")
```

The above code shows how user input is got as form and how it is processed and given as input to machine learning model. Which in turn gives if heart disease is present or absent.

CHAPTER 8
TESTING

8.1 Test Cases

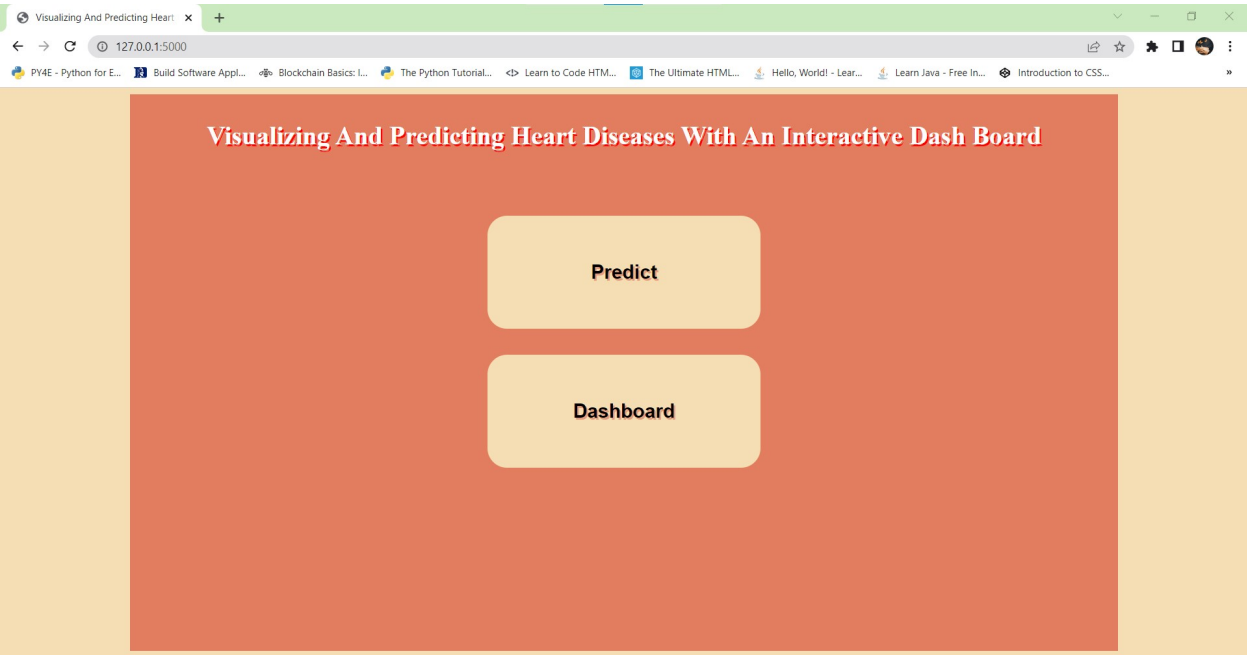
Test case ID	Test case description	Expected results	Actual results	Pass/Fail
TC01	Check for valid IBM account	User should see the IBM cognos dashboard	As Expected	Pass
TC02	Check for invalid IBM account	User should not see the IBM Cognos dashboard	As Expected	Pass
TC03	Check for values in all the Input boxes	User should see whether he/she has high risk or low risk of getting affected by heart disease	As Expected	Pass
TC04	Check for empty values in any one of the input boxes	User should not see whether he/she has high risk or low risk of getting affected by heart disease	As Expected	Pass

8.2 User Acceptance Testing

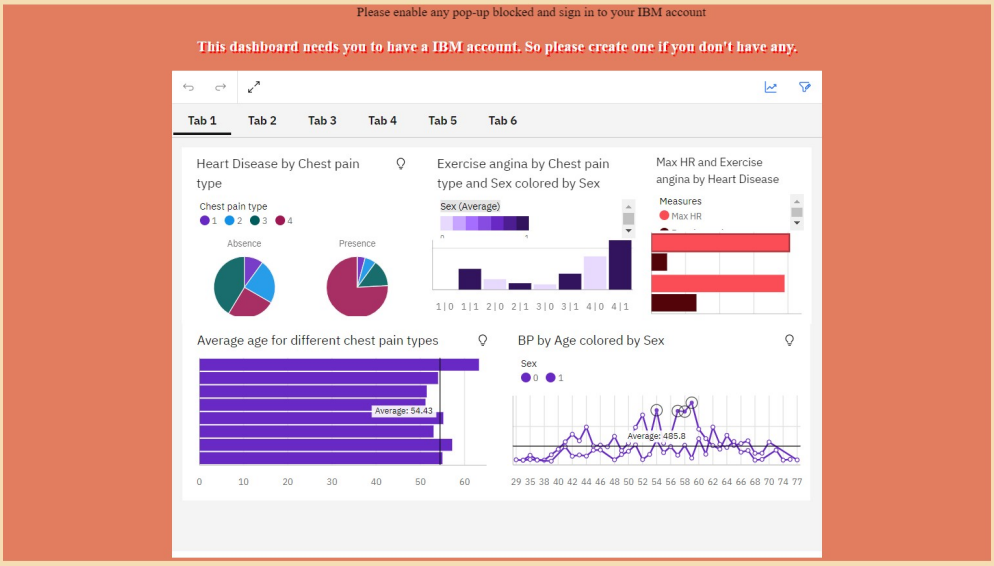
Test case ID	Test case description	Acceptence criteria	Actual results	Pass/Fail
TC01	As a user, I can go to homepage	I can access predictor or dashboard	As Expected	Pass
TC02	As a user, I can click on dashboard	I will see dashboard	As Expected	Pass
TC03	As a user, I can click on predict	I will see form for prediction	As Expected	Pass
TC04	As a user, I can interact with dashboard	I can change parameters of the charts	As Expected	Pass
TC05	As a user, I can access prediction form	I can fill form	As Expected	Pass
TC06	As a user I can submit the form	I can see if I have heart disease or not	As Expected	Pass

CHAPTER 9
RESULTS

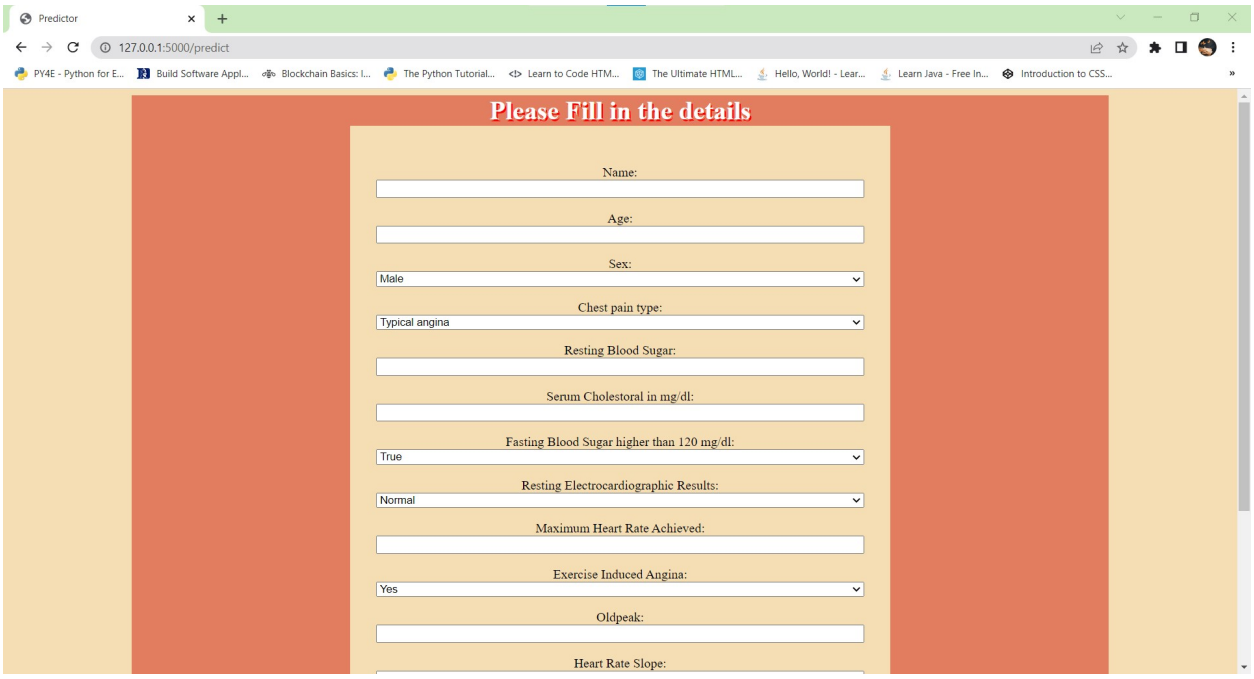
Homepage

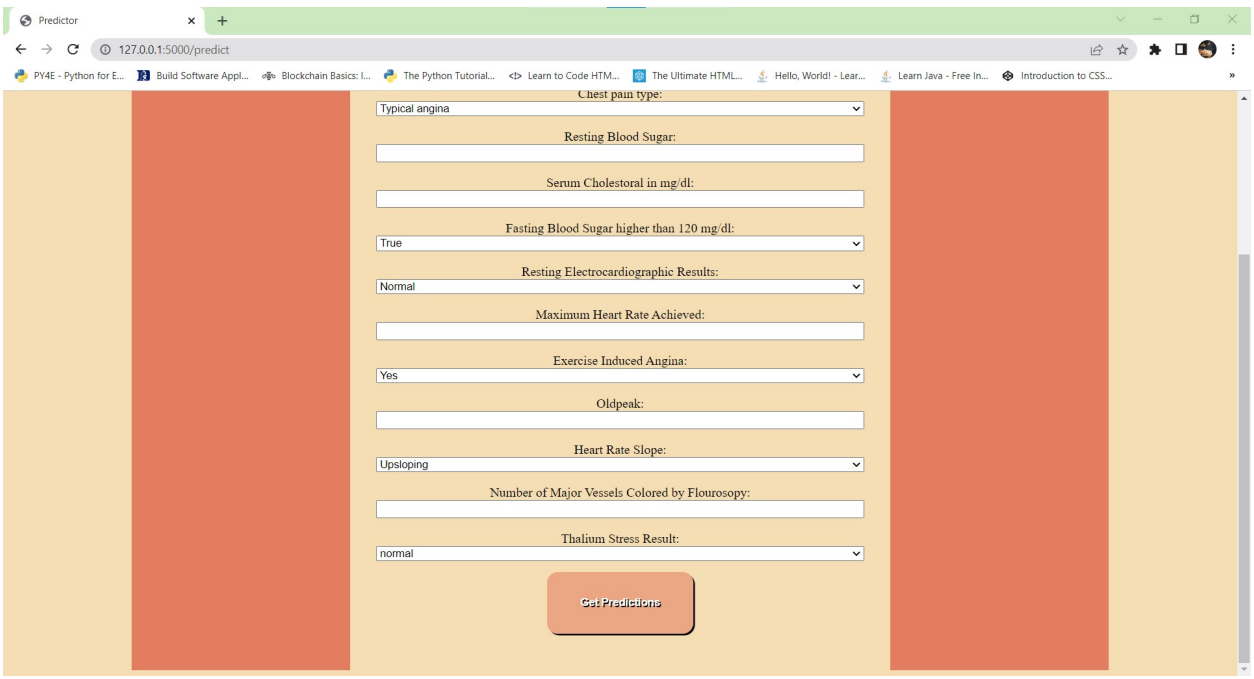


Dashboard

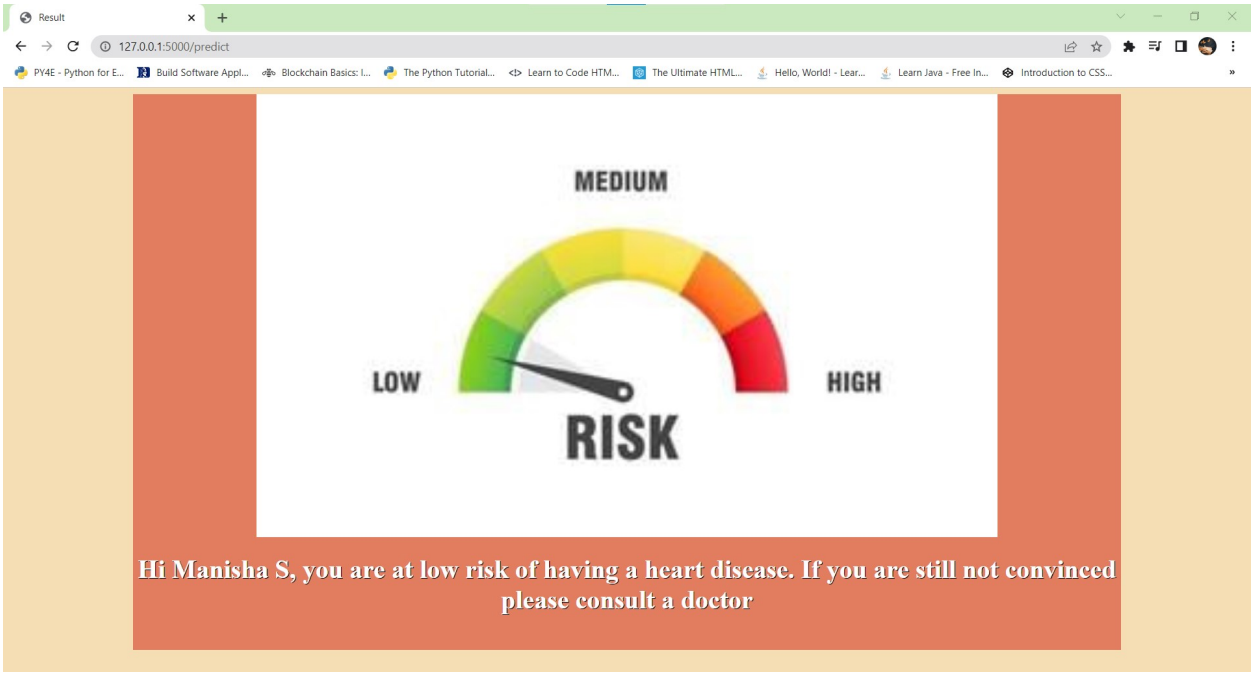


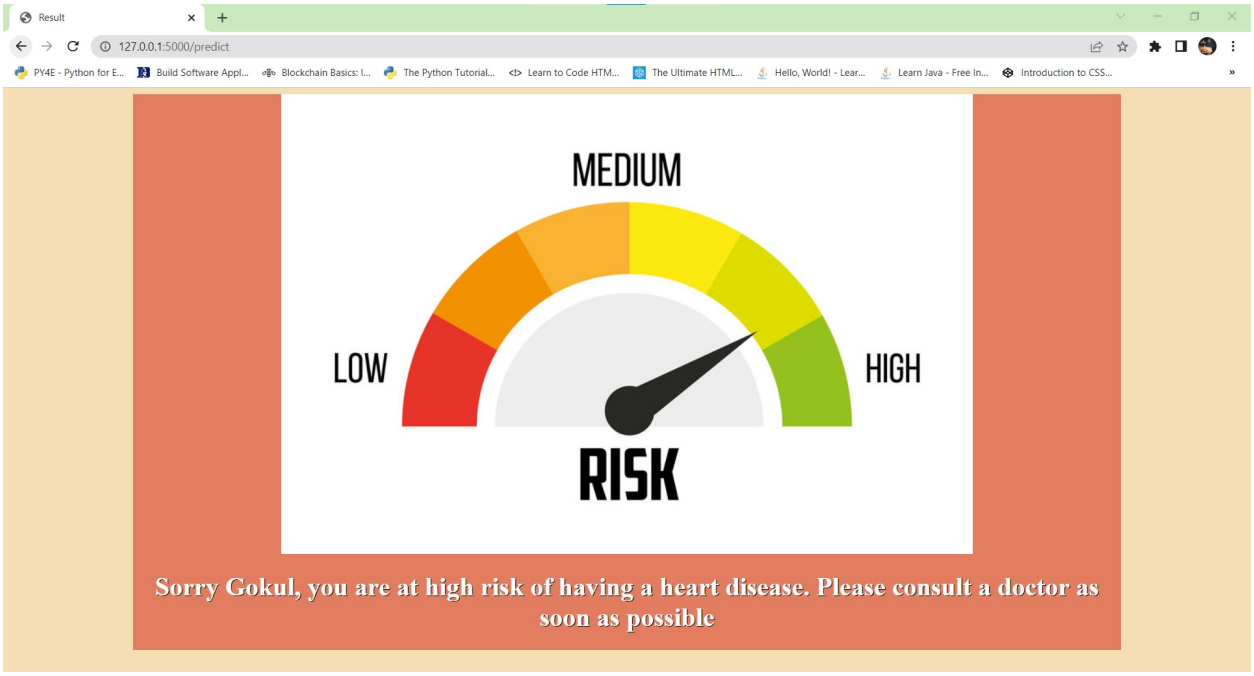
Prediction Form


Predictor
127.0.0.1:5000/predict
Please Fill in the details
Name:
Age:
Sex:
Male
Chest pain type:
Typical angina
Resting Blood Sugar:
Serum Cholestoral in mg/dl:
Fasting Blood Sugar higher than 120 mg/dl:
True
Resting Electrocardiographic Results:
Normal
Maximum Heart Rate Achieved:
Exercise Induced Angina:
Yes
Oldpeak:
Heart Rate Slope:


Predictor
127.0.0.1:5000/predict
Chest pain type:
Typical angina
Resting Blood Sugar:
Serum Cholestoral in mg/dl:
Fasting Blood Sugar higher than 120 mg/dl:
True
Resting Electrocardiographic Results:
Normal
Maximum Heart Rate Achieved:
Exercise Induced Angina:
Yes
Oldpeak:
Heart Rate Slope:
Upsloping
Number of Major Vessels Colored by Flourosopy:
Thalium Stress Result:
normal
Get Predictions

Prediction Result





CHAPTER 10
ADVANTAGES & DISADVANTAGES

10.1 Advantages

1. Reduce the work of doctors
2. Users can know the result instantly
3. Can change parameters of charts in dashboard

10.2 Disadvantages

1. Can have unwanted biases and errors
2. Diagnosis from doctor is more trusted than an online predictor

CHAPTER 11

CONCLUSION

This project predicts if people have cardiovascular disease using their medical history.Using a dataset that includes parameters such as chest pain, sugar level, blood pressure, etc, a dashboard is constructed which showcases the relation between attributes. A machine learning model is also created with the same dataset to predicted the chances of a user having heart disease.

CHAPTER 12
FUTURE SCOPE

Using more robust dataset with more necessary parameters, the accuracy of prediction can be increased. In collaboration with hospitals, doctors can be suggested with contact information. People can also book appointments through the website. The dashboard can be expanded to have more charts and relations.

APPENDIX

Git link -
https://github.com/IBM-EPBL/IBM-Project-25300-1659957984

Demo link -
https://drive.google.com/file/d/1Z1K2AJwZlX5B17BLVJaBlesI7tt7yFIW/view?usp=sharing