ANNAI TERESA COLLEGE OF ENGINEERING – THIRUNAVALUR

VISUALIZING AND PREDICTING HEART DISEASES WITH AN

INTERACTIVE DASHBOARD

TEAM ID – PNT2022TMID38683

A PROJECT REPORT

SUBMITTED BY

E.ABINAYA	420619104001
K.ARUL SAKTHI	420619104006
S.DHANALAKSHMI	420619104012
S.GAYATHRI	420619104016
K.NIVETHA	420619104025

PROJECT REPORT

1.INTRODUCTION

1.1 PROJECT OVERVIEW

A simple web application which uses Machine Learning algorithm to predict the heart condition of a person by providing some inputs about the person health like age, gender, blood pressure, cholesterol level etc built using Flask and deployed on Heroku.

As being a Data and ML enthusiast I have tried many different projects related to the subject but what I have realized is that Deploying your machine learning model is a key aspect of every ML and Data science project. Everything thing I had studied or been taught so far in my Data science and ML journey had mostly focused on defining problem statement followed by Data collection and preparation, model building and evaluation process which is of course important for every ML/DS project but what if I want different people to interact with my models, how can I make my model available for end-users? I can't send them jupyter notebooks right!. That's why I wanted to try my hands on complete end-to-end machine learning project.

1.2 PURPOSE

Training Of neutral networks is performed using back propagation to evaluate the prediction system. In the testing place approximately 95% accuracy is achieved on testing set. Practical use of data collected from previous record is time consuming. Low accuracy rate.

So to overcome this we are implementing Random Forests Algorithm in order to achieve accurate result in time. Machine learning is given a major priority in modern life in many application and in health care sector. Prediction is one of the area where machine learning plays a vital role, our topic is to predict heart diseases by processing patient's dataset and a data of patients i.e., user of whom we need to predict the chance of occurrence of a heart diseases.

2. LITERATURE SURVEY

2.1 EXISTING PROBLEM

S.NO	AUTHOR&YEAR	TITLE	DESCRPTION	ACCURACY
01.	Dhai Eddine Salhi, abdelkamel tari, Tahar Kechadi 2021	using machine learning for heart disease prediction	found neural network are easier to configure and obtain much good results	93%
02.	Xiao-yangao, Eman M.Anwar 2020	improving the accuracy for analyzing heart diseases prediction based on the ensemble method	the bagging ensemble learning algorithm with DT and PCA feature extraction method had achieved the best performance	83%
03.	Shriniket Dixit, Pilla Vaishno Mohan, Shrishail Ravi Terni 2013	Prediction of heart disease using machine learning algorithms	comparative analysis of the results of various machine learning algorithms	89%
04.	Nabaouia Louridi, Meryem Amar, Bouabid EI Ouahidi 2019	Identification of cardio vascular diseases using machine Learning	improved the quality of cardiovascular disease prediction using a better processing phase	90%
05.	Ankita Dewan , Meghna Sharma 2015	Prediction of heart disease using a hybrid technique in data mining	important query of how to make useful information out of the data	85%

		Classification		

2.2 REFERENCE

- K. V. S. H. Gayatri Sarman
- Tenneti Madhu
- A. Mallikharjuna Prasad
- Vivek Sharma
- Sandeep Kumar
- Aarti Chugh
- Charu Jain

2.3 PROBLEM STATEMENT DEFINITION.

Heart Diseases remain the biggest cause of deaths for the last two decades. Recently computer technology and machine learning techniques are used to develop software to assist doctors in making appropriate decision of heart disease in an early stage. The diagnosis of heart disease depends on clinical and pathological data. Heart disease prediction system can assist medical professionals in predicting status of heart disease, based on the clinical data of patients.

Doctors may sometime fail to take an accurate decision in predicting heart disease risk level, therefore heart disease prediction systems are useful in such cases to get accurate results. There are many tools available for performing this task but all of them have some flaws. Most of the tools cannot handle big data and hence predicting heart disease would be a tedious task. In this project we are making an effort to predict the risk level of the huge datasets of patients.
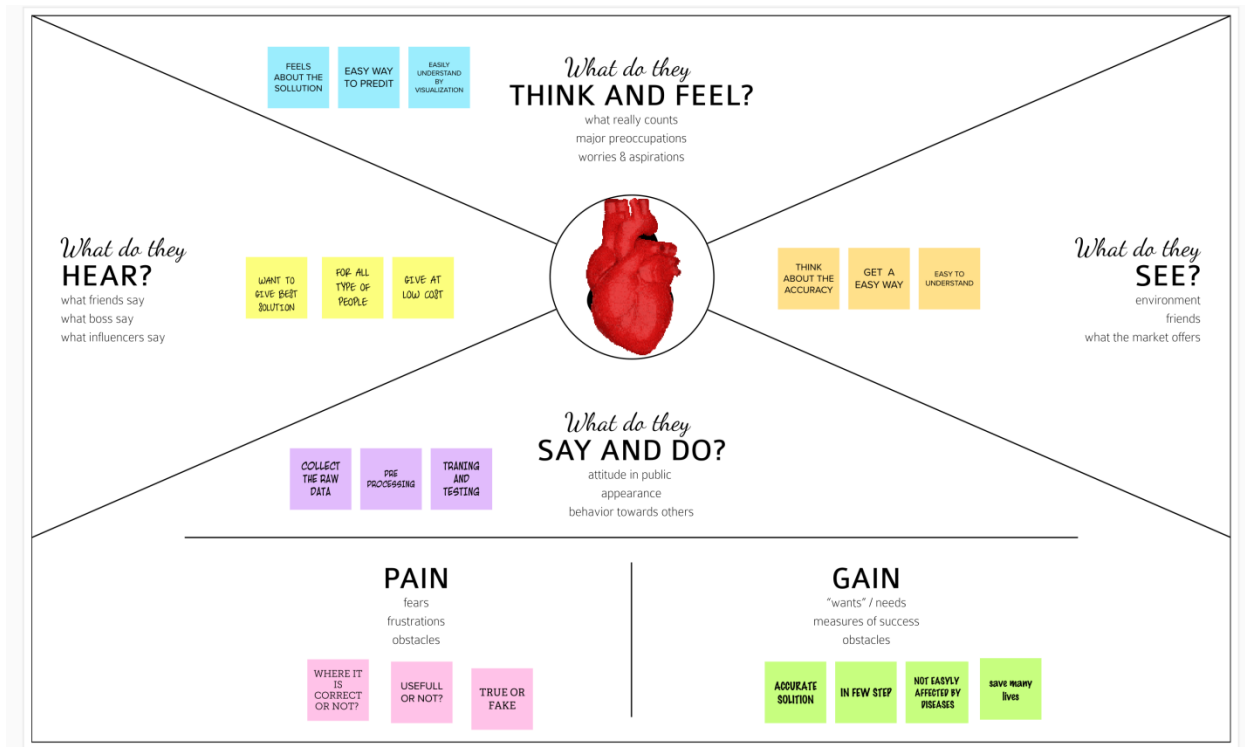
I am	I'm trying to	But	Because	Which makes me feel
Patients.	Predict The Heart Diseases.	Feels About The Accuracy And Hard To Find The Doctor (Specialist)	They Don't Have A Much Knowledge About Doctor.	Frustrated

miro

3.IDEATION & PROPOSED SOLUTION

3.1 EMPATHY MAP CANVAS

It's easy to jump straight into value proposition design. That is the core of your business and where the revenue or exchange of value will come from. However, trying to provide value to a misunderstood customer is very risky business. Do you have your blinkers on? Try using this canvas before you design your value proposition to make sure your offer nails exactly what your customer wants, needs, or may pleasantly surprise them! Keep asking yourself "why would they care?". What problem are you solving? What opportunity are you creating?

In this empathy map what customer think and feels. this map shows the pain and gain of the customer and what do their hear about the problem. this is the easy way to understand the problem statement

THINK AND FEEL?
what really counts
major preoccupations
worries & aspirations

FEELS ABOUT THE SOLLUTION
EASY WAY TO PREDIT
EASILY UNDERSTAND BY VISUALIZATION

What do they
HEAR?
what friends say
what boss say
what influencers say

WANT TO GIVE BEST SOLUTION
FOR ALL TYPE OF PEOPLE
GIVE AT LOW COST

What do they
SEE?
environment
friends
what the market offers

THINK ABOUT THE ACCURACY
GET A EASY WAY
EASY TO UNDERSTAND

What do they
SAY AND DO?
attitude in public
appearance
behavior towards others

COLLECT THE RAW DATA
PRE PROCESSING
TRANING AND TESTING

PAIN
fears
frustrations
obstacles

WHERE IT IS CORRECT OR NOT?
USEFULL OR NOT?
TRUE OR FAKE

GAIN
"wants" / needs
measures of success
obstacles

ACCURATE SOLUTION
IN FEW STEP
NOT EASYLY AFFECTED BY DISEASES
save many lives

3.2 IDEATION & BRAINSTORMING

Brainstorming is **a method of generating ideas and sharing knowledge to solve a particular commercial or technical problem, in which participants are encouraged to think without interruption**. Brainstorming is a group activity where each participant shares their ideas as soon as they come to mind.

3.3 PROPOSED SOLUTION

To over come this we are implementing random forests in order to achieve accurate results in less time . Machine learning is given a major priority in modern life in many application and in healthcare sector . Prediction is one of areas where machine learning plays a vital role , Our topic is to predict heart diseases by processing patient's dataset and a data of patients i.e., user of whom we need to predict the chances of occurrence of the heart diseases.

Our aim is to build an application of heart diseases prediction system using Flask and deployed on Heroku. A csv file is given as input . After the successful completion of operation the result is predicted and displayed.

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.

After having identified the target customer segment, it's time to **investigate their needs**.

One of the cheapest, fastest and most informative things to do at this stage is to meet with customers through **customer discovery interviews** (more about customer discovery interviews here and here) until we keep hearing the same things from customers. Meeting with a customer is an invaluable source of insights, much more valuable than a survey.Besides, as entrepreneurs, our job is to meet and pitch to customers all the time, we'd be better off to start earlier rather than later.

4. REQUIREMENT ANALYSIS

A functional requirement defines a system or its component. A non-functional requirement defines the quality attribute of a software system. It specifies "What should the software system do?" It places constraints on "How should the software system fulfill the functional requirements?"

4.1 FUNCTIONAL REQUIREMENT

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through Dashboard Registration through APP Registration through LINK
FR-2	User Fill The Particular	User Fill Through the Online User Fill Through The Application
FR-3	User Confirmation	User Confirmation Through Gmail User Confirmation Through Notification

4.2 NON-FUNCTIONAL REQUIREMENT

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	Used to Improve The Accuracy Of The Heart Diseases Prediction
NFR-2	**Security**	In This Project We Secure More Lives Early
NFR-3	**Reliability**	Reliability For Accessing The Attributes Of Cardiovascular Patients About The Illness
NFR-4	**Performance**	The Performance Of This Project Is To Improve The Accuracy Of The Diseases Prediction
NFR-5	**Availability**	The Availability Solution Is More Benefit For All Type Persons To Predict The Heart Diseases
NFR-6	**Scalability**	The Scalability Is 90%-95%

5. PROJECT DESIGN

5.1 DATA FLOW DIAGRAM

A data flow diagram (DFD) is **a graphical or visual representation using a standardized set of symbols and notations to describe a business's operations through data movement**.
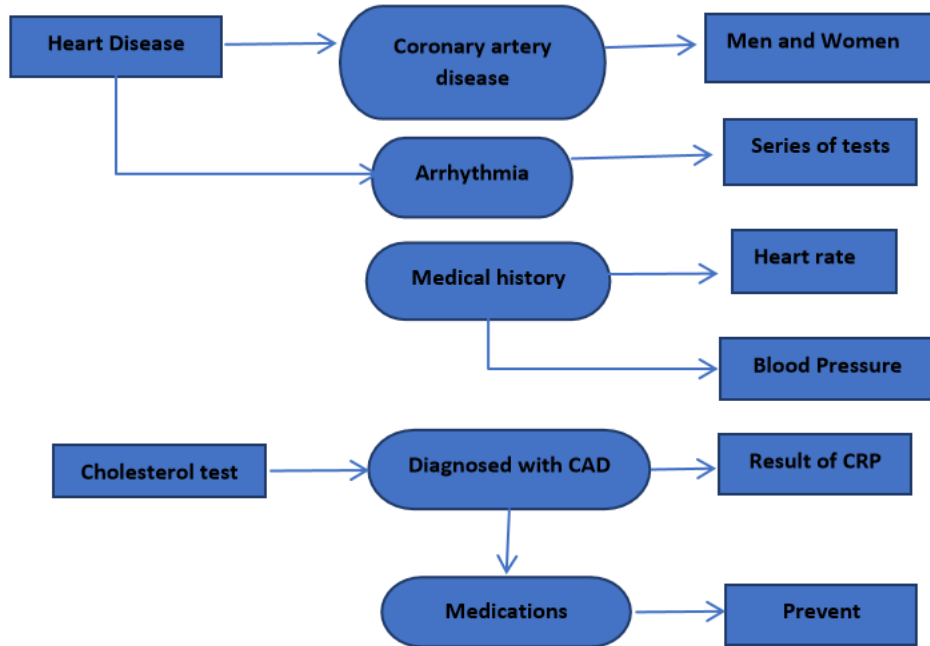
In this flow diagram we are showing that the heart diseases prediction.

5.2 SOLUTION AND TECHNICAL ARCHITECTURE

A solution architecture (SA) is **an architectural description of a specific solution**. SAs combine guidance from different enterprise architecture viewpoints (business, information and technical), as well as from the enterprise solution architecture (ESA).
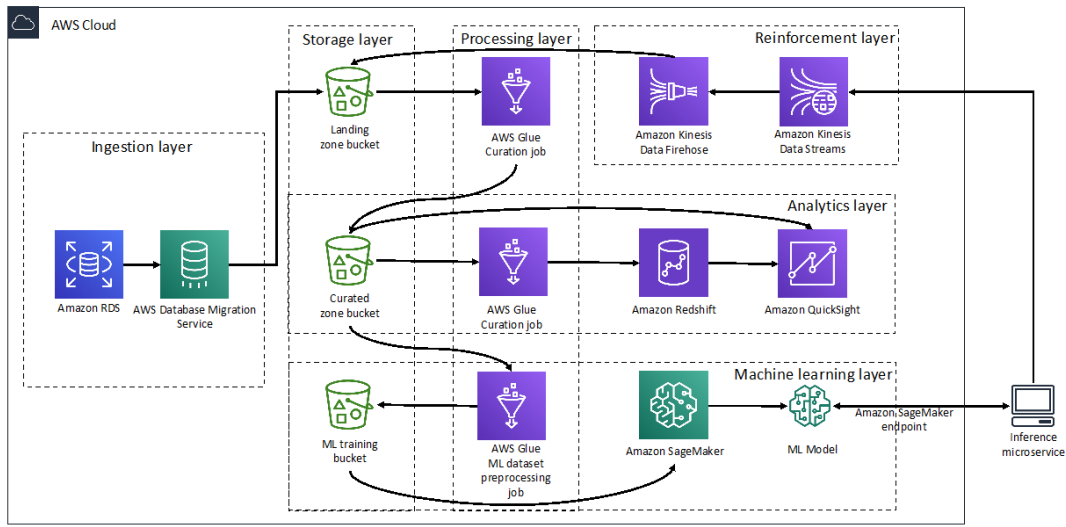
5.3 USER STORIES

User Stories

Use the below template to list all the user stories for the product.

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (Mobile user)	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	I can access my account / dashboard	High	Sprint-1
		USN-2	As a user, I will receive confirmation email once I have registered for the application	I can receive confirmation email & click confirm	High	Sprint-1
		USN-3	As a user, I can register for the application through Facebook	I can register & access the dashboard through facebook	Low	Sprint-2
		USN-4	As a user, I can register for the application through Gmail	I can register through gmail	Medium	Sprint-1
	Login	USN-5	As a user, I can log into the application by entering email & password		High	Sprint-1
	Dashboard					
Customer (Web user)		USN-6	As a user I can fill the detail asked here	I can register the asked detail	high	Sprint 1
Customer Care Executive		USN-6	As a user I executive the given detail	I can accept the terms	medium	Sprint-1
Administrator		USN-7	As a administer it predict the output	Show the result	High	Sprint-1

6.PROJECT PLANNING & SCHEDULING

6.1 SPRINT PLANNING & ESTIMATION

Product Backlog, Sprint Schedule, and Estimation (4 Marks)

Use the below template to create product backlog and sprint schedule

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.	2	High	E.ABINAYA,K.ARULSAKTHI
Sprint-1		USN-2	As a user, I will receive confirmation email once I have registered for the application	1	High	S.DHANALAKSHMI,S.GAYATHRI
Sprint-2		USN-3	As a user, I can register for the application through Facebook	2	Low	E.ABINAYA,K.NIVETHA
Sprint-1		USN-4	As a user, I can register for the application through Gmail	2	Medium	E.ABINAYA
Sprint-1	Login	USN-5	As a user, I can log into the application by entering email & password	1	High	K.ARULSAKTHI
	Dashboard	USN-6	Creating a Dashboard to predict the heart diseases	3	high	S.GAYATHRI

6.2 SPRINT DELIVERY SCHEDULE

TITLE	DESCRIPTION	DATE
Literature Survey & Information Gathering	Literature survey on the selected project & gathering information by referring technical papers,research publications etc.	26 September 2022
Prepare Empathy Map	Prepare Empathy Map Canvas to capture the user Pains & Gains, Prepare list of problem statements	19 September 2022
Ideation	List the ideas by organizing the brainstorming session and prioritize the top 3 ideas based on the feasibility & importance.	19 September 2022
Proposed Solution	Prepare the proposed solution document, which includes the novelty, feasibility of idea, business model, social impact, scalability of solution, etc.	1 October 2022
Problem Solution Fit	Prepare problem - solution fit document.	1 October 2022
Solution Architecture	Prepare a solution architecture document.	22 October 2022

Customer Journey	Prepare the customer journey maps to understand the user interactions & experiences with the application (entry to exit).	15 October 2022
Functional Requirement	Prepare the functional requirement document.	05 October 2022
Data Flow Diagrams	Draw the data flow diagrams and submit for review.	7 October 2022
Technology Architecture	Prepare the technology architecture diagram.	16 October 2022
Prepare Milestone & Activity List	Prepare the milestones & activity list of the project.	15 November 2022
Project Development - Delivery of Sprint-1, 2, 3 & 4	Develop & submit the developed code by testing it.	15 November

6.3 REPORT FROM JIRA

A burndown chart **shows the amount of work that has been completed in an epic or sprint, and the total work remaining**. Burndown charts are used to predict your team's likelihood of completing their work in the time available.

Burndown Chart:

Burndown Chart
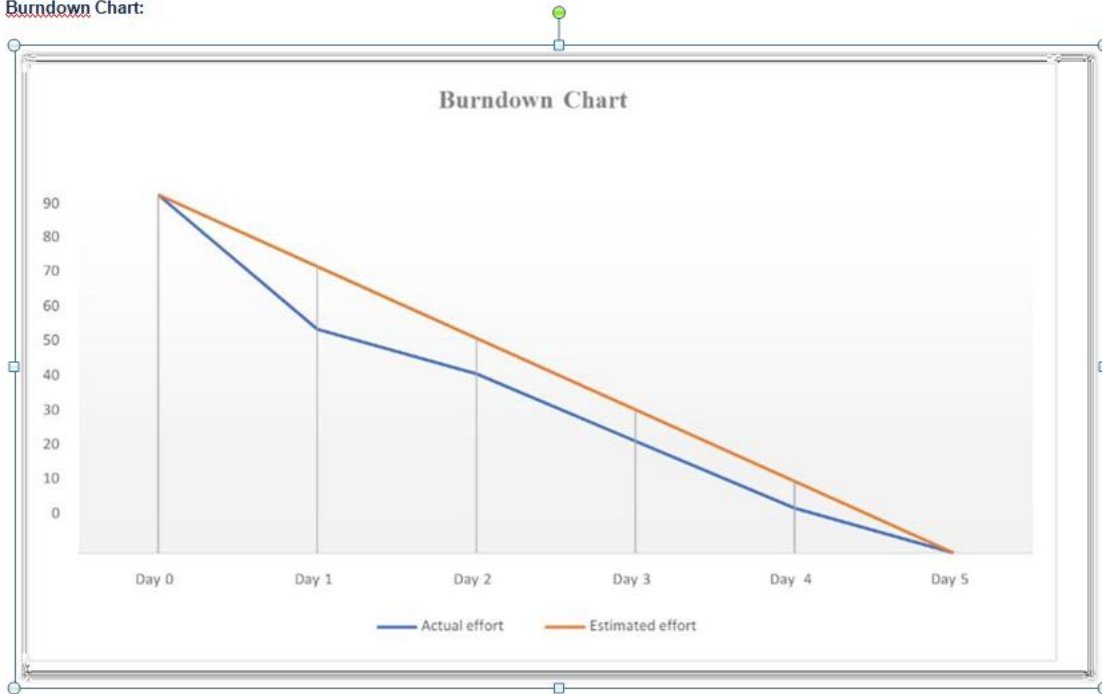
7.CODING & SOLUTIONING

7.1 FEATURE 1

```html
<!DOCTYPE
html>
<html lang="en" dir="ltr">
<head>
  <meta charset="utf-8">
  <meta name="viewport" content="width=device-width, initial-scale=1.0">
  <title>Heart Disease Predictor</title>
  <link rel="stylesheet" type="text/css" href="{{ url_for('static', filename='style.css') }}">
  <script src="https://kit.fontawesome.com/5f3f547070.js" crossorigin="anonymous"></script>
  <link href="https://fonts.googleapis.com/css2?family=Pacifico&display=swap" rel="stylesheet">
</head>
<body>
  <!-- Website Title -->
  <div class="container">
    <h2 class='container-heading'><span class="heading_font">Heart Disease Predictor</span></h2>
    <div class='description'>
      <p>A Machine Learning Web Application that predicits chances of having heart Disease or not, Built with Flask and Deployed
using Heroku.</p><br>
        <p>(Note:This model is 82.67% accurate)</p>
    </div>
  </div>
  <!-- Text Area -->
  <div class="ml-container">
    <form action="{{ url_for('predict')}}" method="POST">

        <label for="age">Age</label>
        <input type="text" id="age" name="age" placeholder="Your age..."><br>
        <label for="sex">Sex</label>
        <select id="sex" name="sex">
          <option selected>----select option----</option>
          <option value="1">Male</option>
```

```
            <option value="0">Female</option>
          </select><br>
          <label for="cp">Chest Pain Type</label>
          <select id="cp" name="cp">
            <option selected>----select option----</option>
            <option value="0">Typical Angina</option>
            <option value="1">Atypical Angina</option>
            <option value="2">Non-anginal Pain</option>
            <option value="3">Asymtomatic</option>
          </select><br>
          <label for="trestbps">Resting Blood Pressure</label>
          <input type="text" id="trestbps" name="trestbps" placeholder="A number in range [94-200] mmHg"><br>
          <label for="chol">Serum Cholesterol</label>
          <input type="text" id="chol" name="chol" placeholder="A number in range [126-564] mg/dl"><br>
          <label for="fbs">Fasting Blood Sugar</label>
          <select id="fbs" name="fbs">
            <option selected>----select option----</option>
            <option value="1">Greater than 120 mg/dl</option>
            <option value="0">Less than 120 mg/dl</option>
          </select><br>
          <label for="restecg">Resting ECG Results</label>
          <select id="restecg" name="restecg">
            <option selected>----select option----</option>
            <option value="0">Normal</option>
            <option value="1">Having ST-T wave abnormality</option>
            <option value="2">Probable or definite left ventricular
              hypertrophy</option>
          </select><br>
          <label for="thalach">Max Heart Rate </label>
          <input type="text" id="thalach" name="thalach" placeholder="A number in range [71-202] bpm"><br>
          <label for="exang">Exercise-induced Angina</label>
          <select id="exang" name="exang">
            <option selected>----select option----</option>
            <option value="1">Yes</option>
            <option value="0">No</option>
          </select><br>
          <label for="oldpeak">ST depression</label>
          <input type="text" id="oldpeak" name="oldpeak" placeholder="ST depression, typically in [0-6.2]"><br>
          <label for="slope">slope of the peak exercise ST segment</label>
          <select id="slope" name="slope">
            <option selected>----select option----</option>
            <option value="0">Upsloping</option>
            <option value="1">Flat</option>
            <option value="2">Downsloping</option>
          </select><br>

          <label for="ca">Number of Major vessels</label>
          <input type="text" id="ca" name="ca" placeholder="Typically in [0-4]"><br>

          <label for="thal">Thalassemia</label>
          <select id="thal" name="thal">
            <option selected>----select option----</option>
            <option value="0">Normal</option>
            <option value="1">Fixed Defect</option>
            <option value="2">Reversible Defect</option>
          </select><br>

      <input type="submit" class="my-cta-button" value="Predict">
    </form>
  </div>
</body>
</html>
```

7.2 FEATURE 2

```html
<!DOCTYPE
<html>
         lang="en" dir="ltr">
             <head>
                      <meta charset="utf-8">
                      <meta name="viewport" content="width=device-width, initial-scale=1.0">
                      <title>Heart Disease Predictor</title>
                      <link rel="shortcut icon" href="{{ url_for('static', filename='diabetes-favicon.ico') }}">
                      <link rel="stylesheet" type="text/css" href="{{ url_for('static', filename='style.css') }}">
                      <script src="https://kit.fontawesome.com/5f3f547070.js" crossorigin="anonymous"></script>
                      <link href="https://fonts.googleapis.com/css2?family=Pacifico&display=swap" rel="stylesheet">
             </head>
         <body>
           <!-- Website Title -->
                      <div class="container">
               <h2 class='container-heading'><span class="heading_font">Heart Disease Predictor</span></h2>
                <div class='description'>
                               <p>A Machine Learning Web App, Built with Flask, Deployed using Heroku.</p>
                      </div>
                </div>
                      <!-- Result -->
                      <div class="results">
                               {% if prediction==1 %}
                                        <h1>Prediction: <span class='danger'>Oops! You have Chances of Heart
Disease.</span></h1>

                               {% elif prediction==0 %}
                                        <h1>Prediction: <span class='safe'>Great! You DON'T chances have Heart
Disease.</span></h1>

                               {% endif %}
                      </div>
                </div>
                   </body>
         </html>
```

8.TESTING

8.1 TEST CASES

Test case ID	Feature Type	Compo nent	Test Scenario	Pre-Requisite	Steps To Execute	Test Data	Expected Result	Actual Result	Stat us	Comments	TC for Automation(Y/N)	BUG ID	Executed By									
LoginPage_TC_001	Functional	Home Page	Verify user is able to see the Login/Signup popup when user clicked on My account button		1.Enter URL and click go 2.Click on My Account dropdown button 3.Verify login/Signup popup displayed or not		Login/Signup popup should display	Working as expected	Pass			BUG-1235										
LoginPage_TC_002	UI	Home Page	Verify the UI elements in Login/Signup popup		1.Enter URL and click go 2.Click on sign 3.Verify login/Signup popup with below UI elements: a.email text box b.password text box c.Login button d.New-customer? Create account link e.Last password? Recovery		Application should show below UI elements: a.email text box b.password text box c.Login button with orange colour d.New-customer? Create account link e.Last password? Recovery password link	Working as expected	Fail	Steps are not clear to follow		BUG-1234										
LoginPage_TC_003	Functional	Home page	Verify user is able to log into application with Valid credentials		1.Enter URL 2.Click on sign 3.Enter Valid username/email in Email text box 4.Enter valid password in password text box 5.Click on login button	Username: ashu23@gmail.com password:124	User should navigate to user account homepage	working as expected	fail	incorrect mail id password		BUG 1236B UG 1237										
LoginPage_TC_004	Functional	Login page	Verify user is able to log into application with InValid credentials		1.Enter URL(https://shopenzer.com/) and click go 2.Click on sign in 3.Enter InValid username/email in Email text box 4.Enter valid password in password text box 5.Click on login button	Username: chalam@gmail password: Testing123	Application should show 'Incorrect email or password ' validation message.	working as expected	pass													
LoginPage_TC_004	Functional	Login page	Verify user is able to log in		1.Enter URL(https://shopenzer.com/) and click go 2.Click on sign 3.Enter Valid username/email in Email text box 4.Enter Invalid password in password text box 5.Click on login button	Username: chalam@gmail.com password: Testing123678686786876 876	Application should show login successfully	working as expected	pass													
LoginPage_TC_005	Functional	Login page	Verify user is able to log into application with InValid credentials		user can directly login once sign in		application should be login in	Working as expected	pass													

A test case is nothing but **a series of step executed on a product, using a predefined set of input data, expected to produce a pre-defined set of outputs,**

in a given environment. It describes "how" to implement those test cases. Test case specifications are useful as it enlists the specification details of the items.

The purpose of testing is to discover errors . Testing is the process of trying to discover every conceivable fault or weakness in a work product . It provide a way to check the functionality of component , sub assemblies , assemblies and/or a finished product. It is the process of exercising software with the intent of ensuring that the software system meets its requirement and user expectation and does not fail in an unacceptable manner. There are various types of testing. Each test type addressing a specific testing requirement.

The testing report are submitted in github account.

8.2 USER ACCEPTANCE TESTING

User acceptance testing is a critical phase of any project and requires significant participant by the end user. It also ensure that the system meets the functional requirement.

9. RESULTS

9.1 PERFORMANCE METRICS

```
Classification Report
              precision    recall  f1-score   support

           0       0.98      1.00      0.99       132
           1       1.00      0.98      0.99       125

    accuracy                           0.99       257
   macro avg       0.99      0.99      0.99       257
weighted avg       0.99      0.99      0.99       257

Accuracy: 98.83%
```

10.ADVANTAGE & DISADVANTAGE

ADVANTAGE

- The advantage of this model are high performance and accuracy rate.
- It is very flexible and high rates of success are achieved

- The application when implemented using random forests has more accuracy rate when compare to other algorithm. In this system, we achieve around 98%.

11. CONCLUTION

The primary objective of the proposed algorithm is to minimize Makespan and improve fitness function. Improving the load balance process through task Scheduling can result in efficient utilization of cloud resources. The objective of this proposed work was to provide an enhanced load balancing algorithm. Result proved that our algorithm reduce makespan and provide efficient resources utilization of compared to existing dynamic LBA (load balancing algorithm). It also shows that the proposed algorithm can function in a dynamic cloud environment where user requests arrive in random order and where there are many changes in the length of the user requests. The algorithm is also to handle large size requests compared to the existing approach.

12. FUTURE SCOPE

In the future, various other metrics like throughput, average time, resources utilizing, waiting time, etc. can be considered. In the future, author will work to optimize the cloud resources further and enhance cloud-based application performance, such as considering more SLA (service level agreement) parameters. For example, the algorithm will be tested based on the number of violation and the migration count for better performance. Also, the algorithm will be comprehensively compared to other existing algorithm in the literature.

13. APPENDIX

PYTHON

Python is a computer programming language often used to **build websites and software, automate tasks, and conduct data analysis**. Python is a general-purpose language, meaning it can be used to create a variety of different programs and isn't specialized for any specific problems.

SOURCE CODE

```
#Importingessentiallibraries
                    from flask import Flask, render_template, request
```

```
import pickle
import numpy as np
# Load the Random Forest CLassifier model
filename = 'heart-disease-prediction-knn-model.pkl'
model = pickle.load(open(filename, 'rb'))
app = Flask(__name__)
@app.route('/')
def home():
        return render_template('main.html')
@app.route('/predict', methods=['GET','POST'])
def predict():
    if request.method == 'POST':
        age = int(request.form['age'])
        sex = request.form.get('sex')
        cp = request.form.get('cp')
        trestbps = int(request.form['trestbps'])
        chol = int(request.form['chol'])
        fbs = request.form.get('fbs')
        restecg = int(request.form['restecg'])
        thalach = int(request.form['thalach'])
        exang = request.form.get('exang')
        oldpeak = float(request.form['oldpeak'])
        slope = request.form.get('slope')
        ca = int(request.form['ca'])
        thal = request.form.get('thal')

        data = np.array([[age,sex,cp,trestbps,chol,fbs,restecg,thalach,exang,oldpeak,slope,ca,thal]])
        my_prediction = model.predict(data)

        return render_template('result.html', prediction=my_prediction)


    if __name__ == '__main__':
        app.run(debug=True)
```

PROJECT DEMO LINK

IBM-EPBL/IBM-Project-41501-1660642520