ANNAI TERESA COLLEGE OF ENGINEERING – THIRUNAVALUR

# VISUALIZING AND PREDICTING HEART DISEASES WITH AN INTERACTIVE DASHBOARD

TEAM ID – PNT2022TMID38683

A PROJECT REPORT

SUBMITTED BY


| | |
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# 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, TaharKechadi 2021 | using machine learning for heart disease prediction | found neural network are easierto configure and obtain much good results | 93% |
| 02. | Xiao-yangao, Eman M.Anwar 2020 | improving the accuracy for analyzing heart diseases predictionbased on the ensemble method | the bagging ensemble learningalgorithm 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 heartdisease using machine learning algorithms | comparative analysis of theresults of various machine learning algorithms | 89% |
| 04. | Nabaouia Louridi, Meryem Amar, Bouabid EI Ouahidi2019 | Identification of cardio vascular diseases using machine Learning | improved the quality of cardiovascular disease predictionusing a better processing phase | 90% |
| 05. | Ankita Dewan , Meghna Sharma 2015 | Prediction of heartdisease using a hybrid technique indata 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.

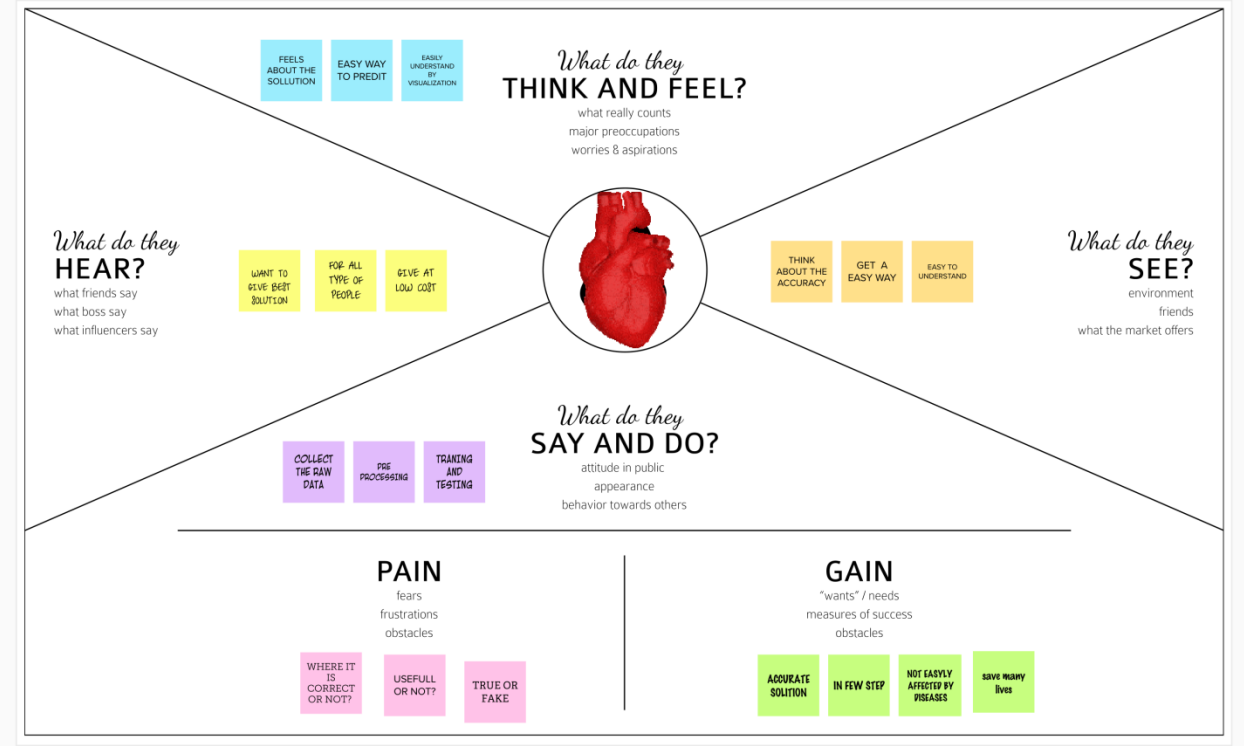
Doctors may sometime fail to take an accurate decision in predicting heart disease risk level, therefore heart disease prediction systems are useful in such cases to get accurate results. There are many tools available for performing this task but all of them have some flaws. Most of the tools cannot 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.


# 3.IDEATION & PROPOSED SOLUTION

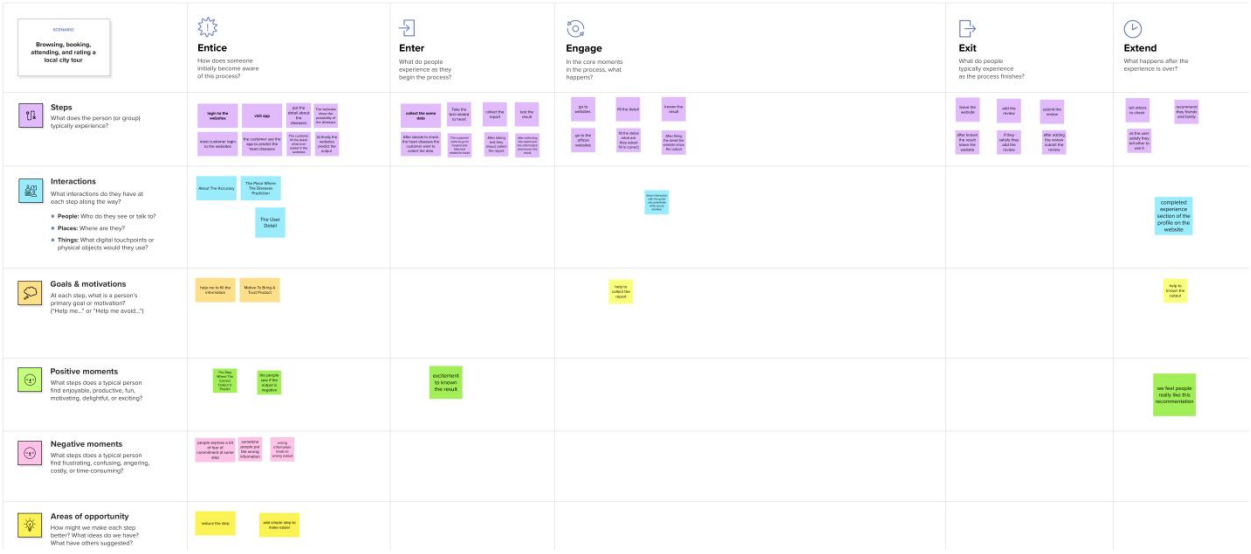
## 3.1 EMPATHY MAP CANVAS

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




## 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<br>Registration through APP<br>Registration through LINK |
| FR-2 | User Fill The Particular | User Fill Through the Online<br>User Fill Through The Application |
| FR-3 | User Confirmation | User Confirmation Through Gmail<br>User Confirmation Through Notification |

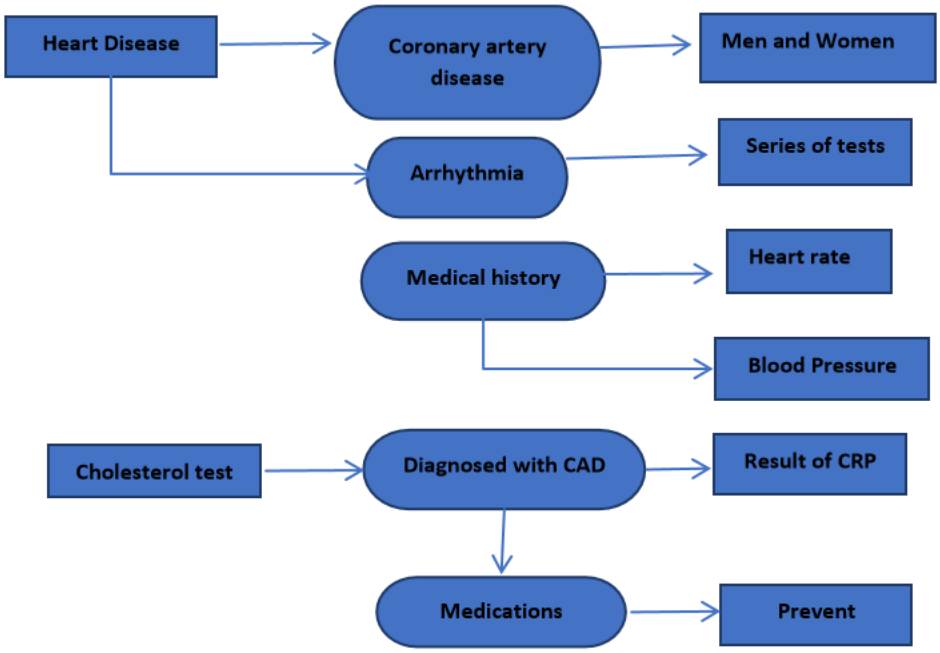
## 4.2 NON-FUNCTIONAL REQUIREMENT

| 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**.

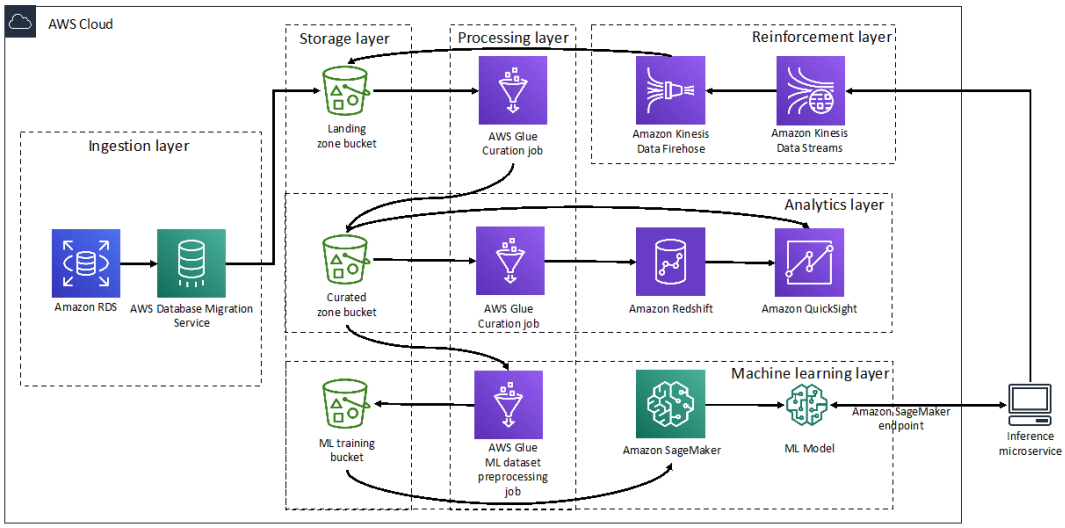





In this flow diagram we are showing that the heart diseases prediction.

## 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

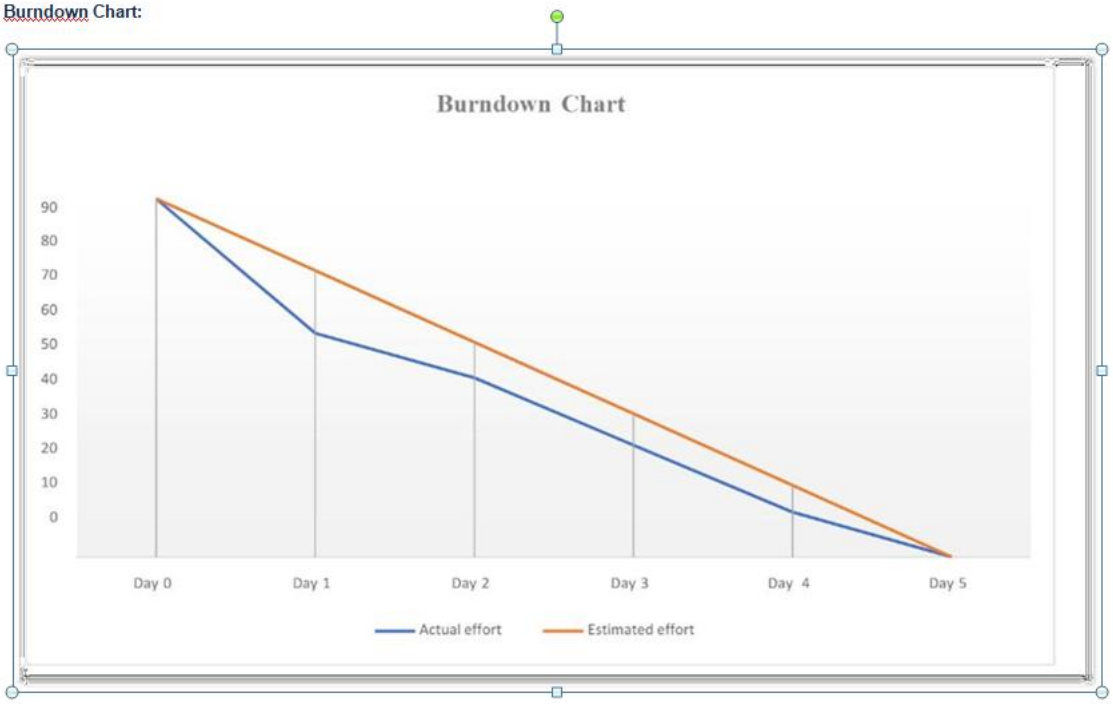
| TITLE | DESCRIPTION | DATE |
|---|---|---|
| Literature Survey & Information Gathering | Literature survey on the selected project & gathering information by referring technical papers,research publications etc. | 26 September 2022 |
| Prepare Empathy Map | Prepare Empathy Map Canvas to capture the 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:




# 7.CODING & SOLUTIONING

## 7.1 FEATURE 1

```
<!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

```
<!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 | Component | Test Scenario | Pre-Requisite | Steps To Execute | Test Data | Expected Result | Actual Result | Status | Comments | TC for Automation(Y/N) | BUG ID | Executed By |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5 | 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<br>2.Click on My Account dropdown button<br>3.Verify login/Signup popup displayed or not | | Login/Signup popup should display | Working as expected | Pass | | | BUG-1236 | |
| 6 | LoginPage_TC_002 | UI | Home Page | Verify the UI elements in Login/Signup popup | | 1.Enter URL and click go<br>2.Click on sign<br>3.Verify login/Signup popup with below UI elements:<br>a.email text box<br>b.password text box<br>c.Login button<br>d.New customer? Create account link<br>e.Last password? Recovery password link | | Application should show below UI elements:<br>a.email text box<br>b.password text box<br>c.Login button with orange colour<br>d.New customer? Create account link<br>e.Last password? Recovery password link | Working as expected | Fail | Steps are not clear to follow | | BUG-1234 | |
| 7 | LoginPage_TC_003 | Functional | Home page | Verify user is able to log into application with Valid credentials | | 1.Enter URL<br>2.Click on sign<br>3.Enter Valid username/email in Email text box<br>4.Enter valid password in password text box<br>5.Click on login button | Username: ssha23@gmail.com<br>password: 124 | User should navigate to user account homepage | working as expected | fail | Incorrect mail id password | | BUG 1236B UG 1237 | |
| 8 | LoginPage_TC_004 | Functional | Login page | Verify user is able to log into application with InValid credentials | | 1.Enter URL(https://rohopenzer.com/) and click go<br>2.Click on sign in<br>3.Enter InValid username/email in Email text box<br>4.Enter valid password in password text box<br>5.Click on login button | Username: chalam@gmail<br>password: Testing123 | Application should show 'Incorrect email or password ' validation message. | working as expected | pass | | | | |
| 9 | LoginPage_TC_004 | Functional | Login page | Verify user is able to log in | | 1.Enter URL(https://rohopenzer.com/) and click go<br>2.Click on sign<br>3.Enter Valid username/email in Email text box<br>4.Enter Invalid password in password text box<br>5.Click on login button | Username: chalam@gmail.com<br>password: Testing@2367868676876 | Application should show login successfully | working as expected | pass | | | | |
| 10 | 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 | | | | |
| 11 | | | | | | | | | | | | | | |
| 12 | | | | | | | | | | | | | | |

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
```

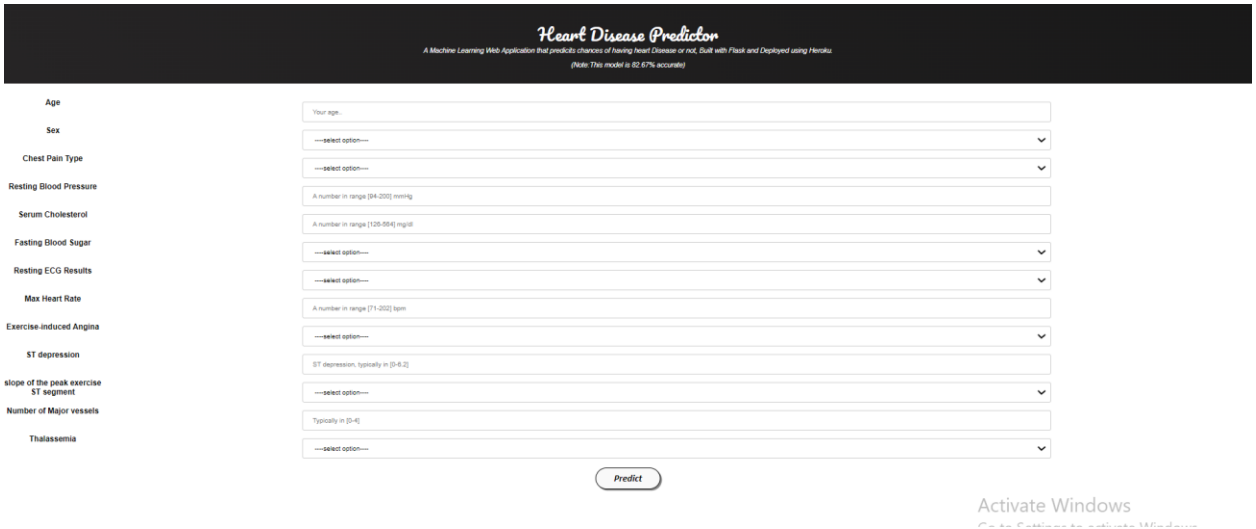
```
import pickle
import numpy as np
# Load the Random Forest CLassifier model
filename = 'heart-disease-prediction-knn-model.pkl'
model = pickle.load(open(filename, 'rb'))
app = Flask(__name__)
@app.route('/')
def home():
          return render_template('main.html')
@app.route('/predict', methods=['GET','POST'])
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

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