

PROJECT REPORT FORMAT

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1.Introduction

1.1Project 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.

1.2Purpose

Know fundamental concepts and can work on IBM Cognos Analytics.
Gain a broad understanding of plotting different visualizations to provide a suitable solution.
Able to create meaningful Visualizations andDashboard(s)

2. Literature Survey

2.1References

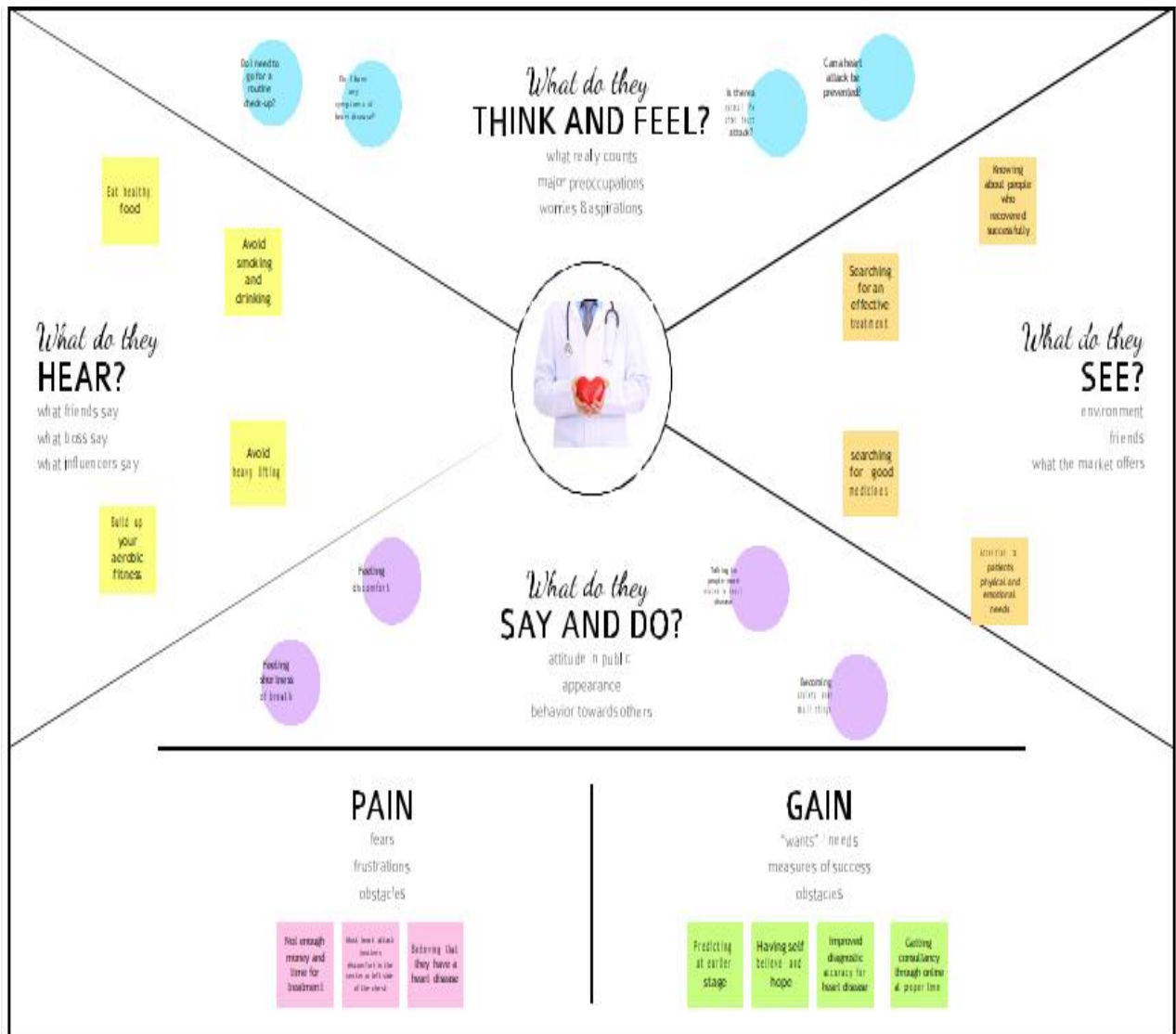
1. Bo Jin ,Chao Che, Zhen Liu, Shulong Zhang, Xiaomeng Yin, And Xiaopeng Wei, “Predicting the Risk of Heart Failure With EHR Sequential Data Modeling” ,IEEE Access 2018.
2. Aakash Chauhan , Aditya Jain , Purushottam Sharma , Vikas Deep, “Heart Disease Prediction using Evolutionary Rule Learning”, "Computational “International Intelligence Technology” (CICT 2018). and Conference on Communication
- 3.Ashir Javeed, Shijie Zhou, Liao Yongjian, Iqbal Qasim, Adeeb Noor, Redhwan Nour4, Samad Wali And Abdul Basit , “An Intelligent Learning System based on Random Search Algorithm and Optimized Random Forest Model for Improved Heart Disease Detection” , IEEE Access 2017

2.2Problem Statement Definition

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.

3. Ideation and Proposed Solution

3.1Empathy Map Canvas



3.2 Ideation and Brainstorming

Template



Brainstorm & idea prioritization

Use this template in your own brainstorming sessions so your team can unleash their imagination and start shaping concepts even if you're not sitting in the same room.

🕒 10 minutes to prepare

🕒 1 hour to collaborate

👥 2-8 people recommended



Before you collaborate

A little bit of preparation goes a long way with this session. Here's what you need to do to get going.

🕒 10 minutes



Team gathering

Define who should participate in the session and send an invite. Share relevant information or pre-work ahead.



Set the goal

Think about the problem you'll be focusing on solving in the brainstorming session.



Learn how to use the facilitation tools

Use the Facilitation Superpowers to run a happy and productive session.

[Open article](#) →



Define your problem statement

What problem are you trying to solve? Frame your problem as a *How Might We* statement. This will be the focus of your brainstorm.

🕒 5 minutes

PROBLEM

VISUALIZING AND
PREDICTING HEART
DISEASE WITH A
INTERACTIVE
DASHBOARD



Key rules of brainstorming

To run a smooth and productive session



Stay in topic.



Encourage wild ideas.



Defer judgment.



Listen to others.



Go for volume.



If possible, be visual.

2

Brainstorm

Write down any ideas that come to mind that address your problem statement.

🕒 10 minutes

Aarthi J

Research for papers published related to our projects

Extract and synthesize our users most essential needs

How we might creatively and effectively visualize our prediction of heart diseases

Identify the Key elements of our dashboard

AISHWARYA M

sketching a clear mind map

Focusing on the user's interface

Developing maximum solution to the problem

identify the data elements to drive opportunities

ASHNA M

relate to the users point of view

effective usage of the IBM cognos platform

identify the opportunity behind the ideation of our project

take possible solutions and / through iterative building a prototype

JASWANTHI B

try sourcing for real time data

searching for an effective algorithm

Gap Filling and Developing Processes with data

Analyze Relationships Between various attributes

3

Group ideas

Take turns sharing your ideas while clustering similar or related notes as you go. In the last 10 minutes, give each cluster a sentence-like label. If a cluster is bigger than six sticky notes, try and see if you can break it up into smaller sub-groups.

🕒 20 minutes

Early diagnosis of heart disease is significant to minimize the heart related issues.

when asked to define value in their healthcare experience, patients on average ranked having knowledge and competent practitioners

In order to protect from heart disease, don't smoke, drink alcohol.

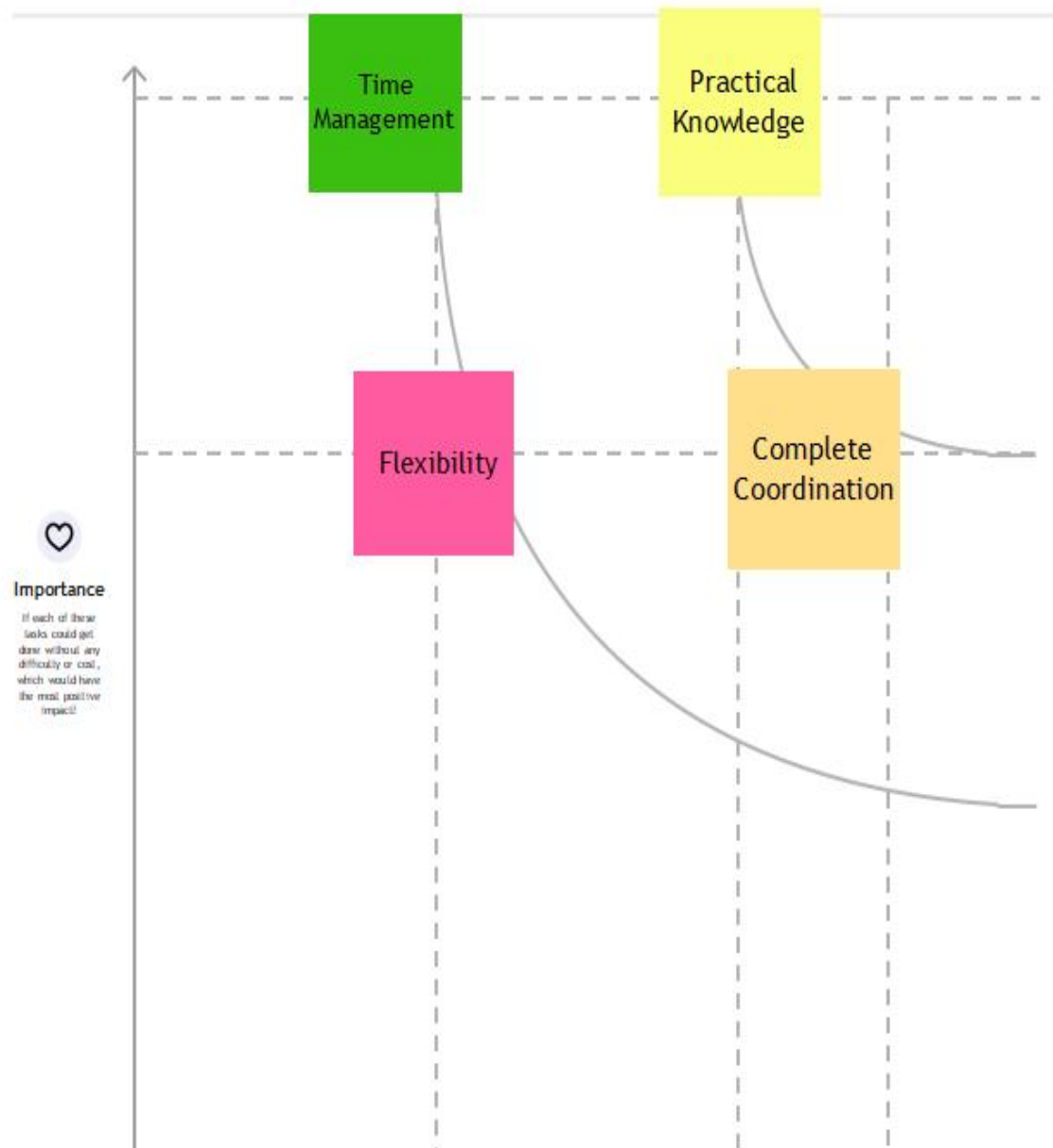
focusing on patient experience could broadly improve value

4

Prioritize

Your team should all be on the same page about what's important moving forward. Place your ideas on this grid to determine which ideas are important and which are feasible.

🕒 20 minutes



After you collaborate

You can export the mural as an image or pdf to share with members of your company who might find it helpful.

Quick add-ons

- A** **Share the mural**
Share a **view link** to the mural with stakeholders to keep them in the loop about the outcomes of the session.
- B** **Export the mural**
Export a copy of the mural as a PNG or PDF to attach to emails, include in slides, or save in your drive.

Keep moving forward



Strategy blueprint

Define the components of a new idea or strategy.

[Open the template →](#)



Customer experience journey map

Understand customer needs, motivations, and obstacles for an experience.

[Open the template →](#)



Strengths, weaknesses, opportunities & threats

Identify strengths, weaknesses, opportunities, and threats (SWOT) to develop a plan.

[Open the template →](#)

3.3 Proposed Solution

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	Predicts the chances of Heart Disease and classifies patient's risk level .
2.	Idea / Solution description	->Find Number of people suffering from heart disease and classifying with genders ->using data analytics to improve diagnosis ->Visualize frequency distribution of lach variable and find what the heart rate and heart disease relation. ->Chest pain is the key to recognize the heart disease. In this work, the heart diseases are predicted by considering major factors with four types of chest pain.The role of exploratory data using tableau provided a visual appealing and accurate clustering experience.
3.	Novelty / Uniqueness	Using various statistical test for feature selection and to find out the most efficient classification algorithm that can help us to detect heart diseases at early stage.This algorithm can be used on heart records of the patient or by using it on classification reports.
4.	Social Impact / Customer Satisfaction	people thinks heart disease is incurable and people can understand with what heart disease he/she may have affected and understand that 80% preventable cases of heart disease and stroke and detecting the disease at earliest.
5.	Business Model (Revenue Model)	Cost efficiency,potential consumer space is huge.
6.	Scalability of the Solution	As these are being analyzed using data analytics method,the scaling is flexible hence it is scalable.

3.4 Problem Solution Fit

Problem-Solution Fit

Visualising and prediction of heart disease

1. CUSTOMER SEGMENT(S) CS Define CS, fit into CL People with the age group of above 20>	6. CUSTOMER LIMITATIONS CL EG. BUDGET, DEVICES Health expenses especially people who are from low profile	5. AVAILABLE SOLUTIONS AS PROS & CONS Explore AS, differentiate Using various statistical test for feature selection Using various algorithm
2. PROBLEMS / PAINS PR + ITS FREQUENCY Focus on PR, tap into BE, understand RC Preprocessing of data sets, Calculating the scores	9. PROBLEM ROOT / CAUSE RC Smoking/alcohol High BP Stress	7. BEHAVIOR BE + ITS INTENSITY Focus on PR, tap into BE, understand RC Use interactive dashboard for visualising and predicting
3. TRIGGERS TO ACT TR Identify strong TR & EM People who believe these modern technology and data analytics 4. EMOTIONS EM BEFORE / AFTER Lack of confidence or Fear about everything Especially about their health	10. YOUR SOLUTION SL Find Number of people suffering from heart disease and classifying with genders ->using data analytics to improve diagnosis ->Visualize frequency distribution of each variable and find what the heart rate and heart disease relation	8. CHANNELS of BEHAVIOR CH Extract online & offline CH of BE ONLINE Patient get a detail score and report of the disease OFFLINE Spreading awareness about this to others

4. Requirement Analysis

4.1 Functional Requirement

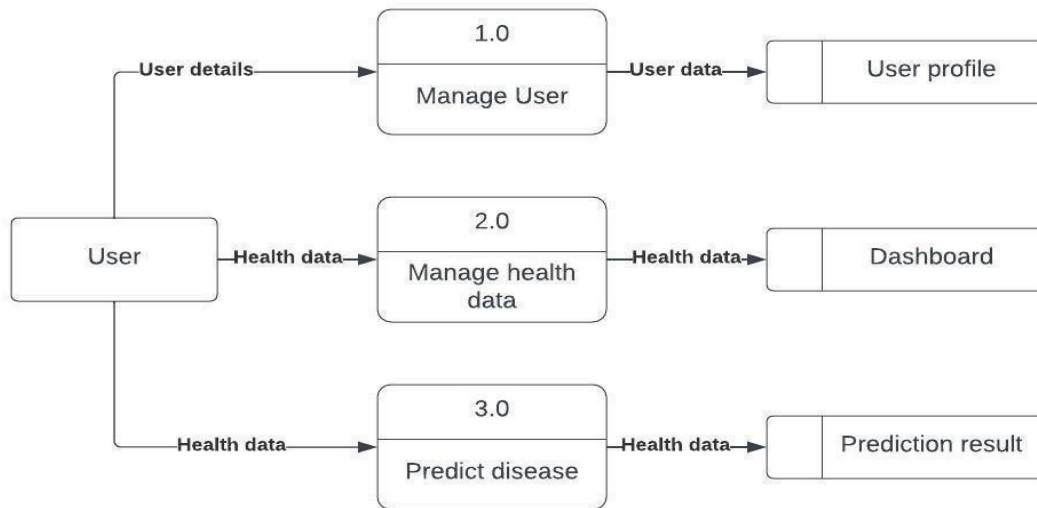
FR No.	Functional Requirement(Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Enables user to make registration for the application through Gmail.
FR-2	User Confirmation	Once after registration, the user will get confirmation via E-mail.
FR-3	Visualizing Data	User can visualize the trends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

4.2 Non- Functional Requirement

NFR 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. In case 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 number of users and has to be able to develop higher versions.

5. Project Design

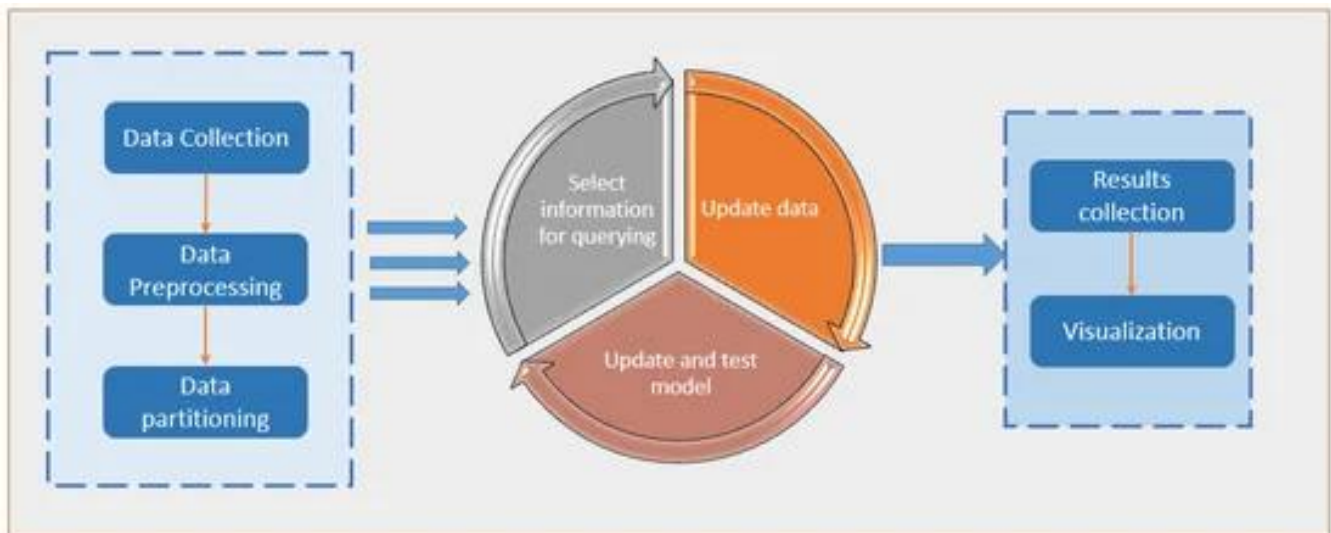
5.1 Data Flow Diagrams

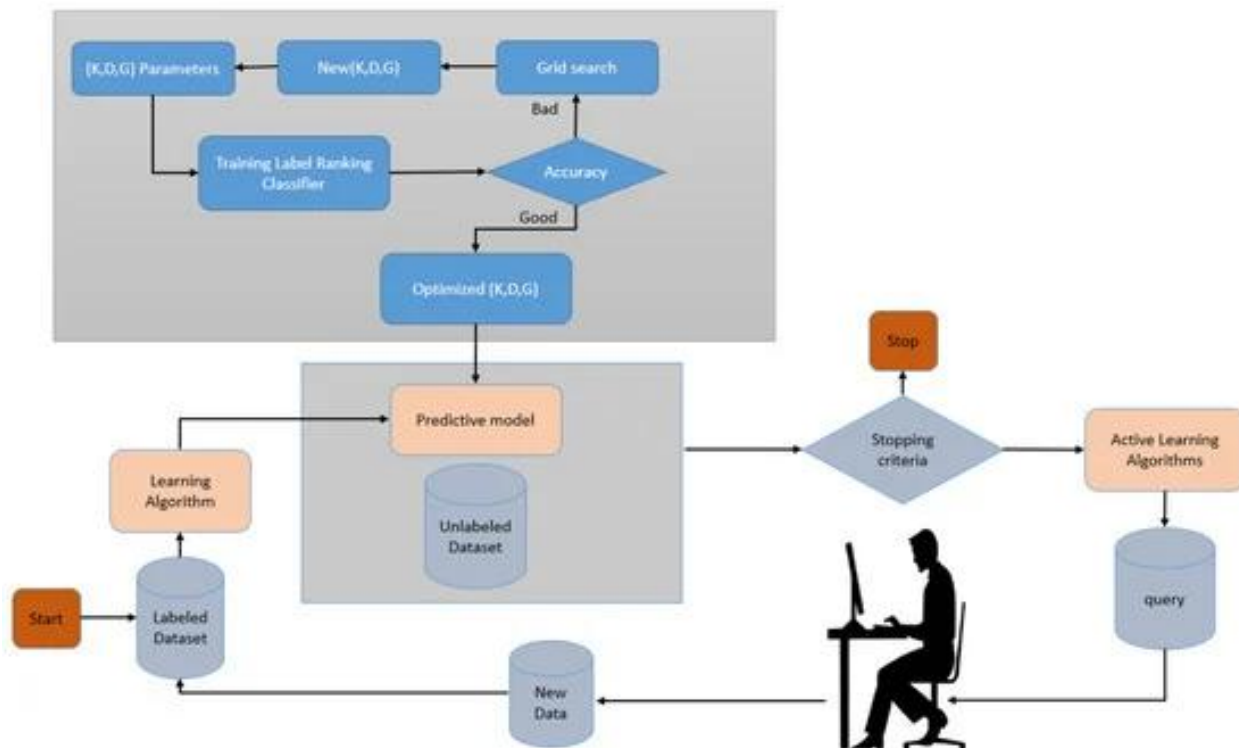


5.2 Solution and Technical Architecture

Solution architecture is a complex process – with many sub-processes – that bridges the gap between business problems and technology solutions. Its goals are to:

- Find the best tech solution to solve existing business problems.
- Describe the structure, characteristics, behavior, and other aspects of the software to project stakeholders.
- Define features, development phases, and solution requirements.
- Provide specifications according to which the solution is defined, managed, and delivered.





TECHNICAL ARHITECTURE

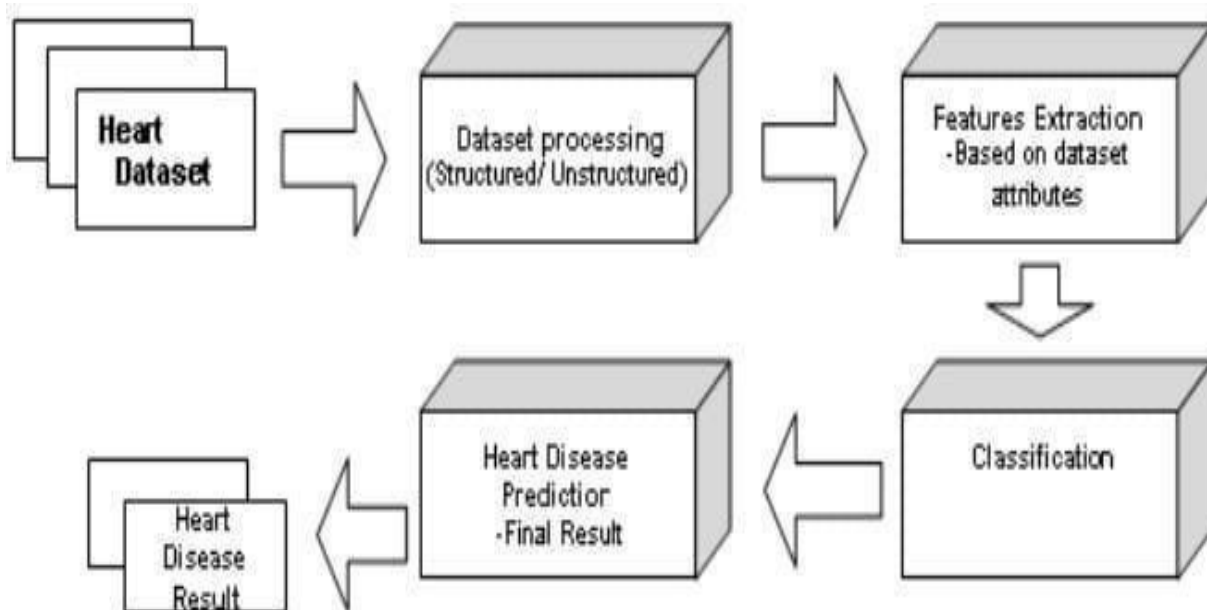


Table-1 : Components & Technologies:

S.No	Component	Description	Technology
1.	User Interface	How user interacts with application e.g. WebUI, Mobile App, Chatbot etc.	HTML, CSS, JavaScript / Angular Js / React Js etc.
2.	Application Logic-1	Logic for a process in the application	Java / Python
3.	Application Logic-2	Logic for a process in the application	IBM Watson STT service
4.	Application Logic-3	Logic for a process in the application	IBM Watson Assistant
5.	Database	Data Type, Configurations etc.	MySQL, NoSQL, etc.
6.	Cloud Database	Database Service on Cloud	IBM DB2, IBM Cloudant etc.
7.	File Storage	File storage requirements	IBM Block Storage or Other StorageService or Local Filesystem
8.	External API-1	Purpose of External API used in the application	IBM Weather API, etc.
9.	External API-2	Purpose of External API used in the application	Aadhar API, etc.
10.	Machine Learning Model	Purpose of Machine Learning Model	Object Recognition Model, etc.
11.	Infrastructure (Server / Cloud)	Application Deployment on Local System / CloudLocal Server Configuration: Cloud Server Configuration:	Local, Cloud Foundry, Kubernetes, etc.

Table-2: Application Characteristics:

S.No	Characteristics	Description	Technology
1.	Open-Source Frameworks	List the open-source frameworks used	Technology of Opensource framework
2.	Security Implementations	List all the security / access controls implemented, use of firewalls etc.	e.g.SHA-256, Encryptions, IAM Controls, OWASP etc.
3.	Scalable Architecture	Justify the scalability of architecture (3 – tier, Micro-services)	Technology used
4.	Availability	Justify the availability of application (e.g. Use of load balancers, distributed servers etc.)	Technology used
5.	Performance	Design consideration for the performance of the application (number of requests per sec, use of Cache, use of CDN's) etc.	Technology used

5.3 User Stories

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (Web 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
	Login	USN-3	As a user, I can log into the application by entering email & password.	I can access my account / Dashboard when logged in.	High	Sprint-1
Customer (Web user)	Dashboard	USN-4	User can view his/her complete medical analysis and accuracy of disease prediction.	I can view my medical analysis in the dashboard.	High	Sprint-2

		USN-5	User can view the accuracy of occurrence of heart disease.	I can view the accuracy of heart disease in the dashboard.	High	Sprint-2
Customer Care Executive	Helpdesk	USN-6	As a customer care executive, he/she can view the customer queries.	I can post my queries in the dashboard.	Medium	Sprint-3
		USN-7	As a customer care executive, he/she can answer the customer queries.	I can get support from helpdesk.	High	Sprint-3
Administrator	User Profile	USN-8	As an admin, he/she can update the health details of users.	I can view my updated health details.	High	Sprint-4
		USN-9	As an admin, he/she can add or delete users.	I can access my account / Dashboard when logged in.	High	Sprint-4
		USN-10	As an admin, he/she can manage the user details.	I can view the organized data of myself.	High	Sprint-4

6. Project Planning and Scheduling

6.1 Sprint Planning and Estimation

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	1
Sprint-1		USN-2	As a user, I will receive confirmation email once I have registered for the application	1	High	2
Sprint-2		USN-3	As a user, I can register for the application through Facebook	2	Low	4
Sprint-1		USN-4	As a user, I can register for the application through Gmail	2	Medium	3
Sprint-1	Login	USN-5	As a user, I can log into the application by entering email & password	1	High	2
Sprint-2	Dashboard	USN-6	Profile - view & update your profile	2	High	4

Sprint-1		USN-7	Change Password - user can change the password	1	High	2
Sprint-1		USN-8	Home - Analyze your Heart	2	High	4
Sprint-3		USN-9	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(Restecg) -Exercise Induced Angina(Exang) -The slope of the peak exercise STsegment -CA – Number of major vessels colored by fluoroscopy -Thal -Trest Blood Pressure -Serum Cholesterol - Maximum heart rate achieved(Thalach) -ST depression induced by exercise(Oldpeak)	2	High	3
		USN-10	View Doctors - view doctor detail by searching by names or filter by specialty	1	Medium	4
Sprint-3	System Requirement	USN-11	I. Hardware Requirement i. Laptop or PC • I5 processor system or higher	2	High	2
			• 4 GB RAM or higher • 128 GB ROM or higher ii. Android Phone (12.0 and above)			
Sprint-3		USN-12	II. Software Requirement iii. Laptop or PC • Windows 10 or higher • Android Studio	2	Medium	2
Sprint-4	Dashboard	USN-13	Query	1	High	1

		USN-14	Toll Free	1	High	1
		USN-15	Ratings	2	Medium	2
		USN-16	Verification	2	High	2
		USN-17	Validation	1	High	2
		USN-18	Feedback – send feedback to theAdmin	2	Medium	3

6.2 Sprint Delivery Schedule

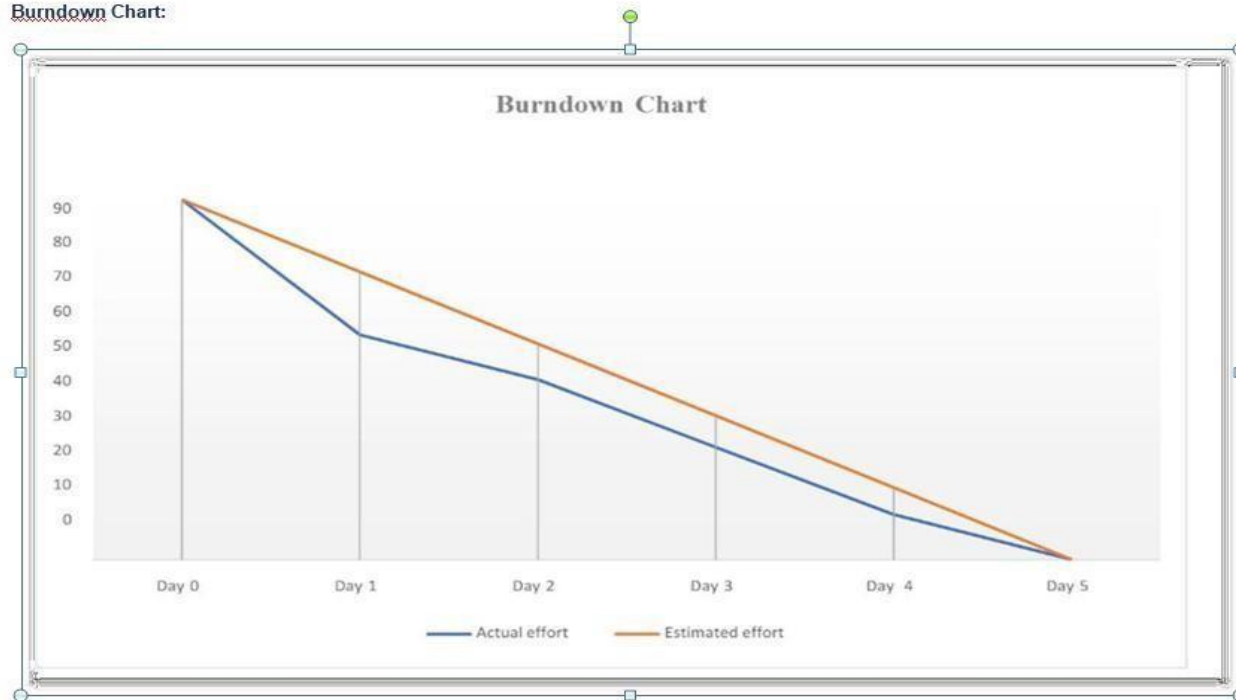
Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as onPlanned End Date)	Sprint Release Date (Actual)
Sprint-1	20	6 Days	24 Oct 2022	29 Oct 2022	20	29 Oct 2022
Sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022	18	06 Nov 2022
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022	20	11 Nov 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	19	19 Nov 2022

Velocity:

Imagine we have a 10-day sprint duration, and the velocity of the team is 20 (points per sprint). Let's calculate the team's average velocity (AV) per iteration unit (story points per day)

$$AV = \frac{\text{sprint duration}}{\text{velocity}} = \frac{20}{10} = 2$$

Burndown Chart:



7. Coding and 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 predicts 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>
      </select>
    </form>
  </div>
</body>
</html>
```

```
<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 have Heart
Disease.</span></h1>
        {% endif %}
      </div>
    </div>
  </body>
</html>
```

8. Testing

8.1 Test Cases

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

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. Advantages and Disadvantages

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. Conclusion

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 themigration count for better performance. Also, the algorithm will be comprehensively compared to other existing algorithm in the literature.

13. Appendix

13.1 Source Code

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.

#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)
```

14. Github and Project Demo Link

PROJECT DEMO LINK:

<https://github.com/IBM-EPBL/IBM-Project-10956-1659247896/blob/main/Final%20Deliverables/project%20video.mp4>

Github:

<https://github.com/IBM-EPBL/IBM-Project-10956-1659247896>



