# Project Report

# 1. INTRODUCTION

## 1.1 Project Overview

Recently, clinicians have been actively engaged in improving medical diagnoses. The use of artificial intelligence and machine learning in combination with clinical findings has further improved disease detection. In the modern era, with the advantage of computers and technologies, one can collect data and visualize many hidden outcomes such as dealing with missing data in medical research. Statistical machine learning algorithms based on specific problems can assist one to make decisions. Machine learning (ML), data-driven algorithms can be utilized to validate existing methods and help researchers to make potential new decisions.

## 1.2 Purpose

People who want to know whether they have liver disease or not.

# 2. LITERATURE SURVEY

## 2.1 References

| S. No | Paper | Year | Citation | Methodologies used |
|---|---|---|---|---|
| 1 | Statistical Machine Learning Approaches to Liver Disease Prediction | 2021 | Mostafa, F.; Hasan, E.; Williamson, M.; Khan, H. Statistical Machine Learning Approaches to Liver Disease Prediction. *Livers* **2021**, *1*, 294–312. https://doi.org/10.3390/livers1040023 . | The purpose of this study was to extract significant predictors for liver disease from the medical analysis of 615 humans using ML algorithms. Data visualizations were implemented to reveal significant findings such as missing values. |

| | | | | |
|---|---|---|---|---|
| 2 | Performance Analysis of Liver Disease Prediction Using Machine Learning Algorithms | 2018 | International Research Journal of Engineering and Technology (IRJET) www.irjet.net | P.Rajeswari,G.Sophia Reena et al.,[2010]has proposed the data classification is based on liver disorder. The training dataset is developed by collecting data from UCI repository consists of 345 instances with 7 different attributes. This paper deals with results in the field of data classification obtained with Naïve Bayes algorithms .FT tree algorithms, and KStar algorithms and on the whole performance made know FT Tree algorithm when tested on liver disease datasets, time taken to run the data for result is fast when compare to other algorithm with accuracy of 97.10%Based on the experimental results the classification accuracy is found to be better using FT Tree algorithm compare to other algorithms [2]. |

| | | | | |
|---|---|---|---|---|
| 3 | Liver Disease Prediction System using Machine Learning Techniques | 2021 | International Journal of Engineering Research & Technology (IJERT)<br><br>Vol. 10 Issue 06, June-2021 | Researchers are attempting to discover models for early diagnosis of illness utilizing biomedical information. Since the most recent couple of decades, they have utilized a parcel of models for early finding, each with their very own advantages and disadvantages. In this research, a CHIRP based model is proposed for the early forecast of liver disease. |
| 4 | Liver Disease Prediction Using Machine Learning Algorithm | 2021 | Authors:<br><br>Sambit Mohanty, Pradosh Kumar Gantayat, Sachikanta Dash, Bhabani P. Mishra & Shiba Ch. Barik<br><br>Conference paper<br><br>First Online: 05 May 2021<br><br>Part of the Advances in Intelligent Systems and Computing book series (AISC,volume 1407) | We can use these data to improve our healthcare services or proper identification of diseases. We have collected patient data from open source platform and applied various kinds of data analysis techniques and machine learning (ML) approaches applied to see the pattern of the |

| | | | | |
|---|---|---|---|---|
| | | | | data sets. Then, a performance comparison between these models is made to get highly accurate model for predicting liver disease. |
| 5 | Liver disease prediction using machine learning and deep learning: A comparative study | 2022 | • March 2022<br>• Intelligent Decision Technologies 16(3):1-14<br>DOI:10.3233/IDT-210065<br>Authors:<br>Bhawna Singla<br>Soham Taneja<br>Rishika Garg<br>Preeti Nagrath | This research aims to impart insight additional to the current state-of-the-art discoveries by focusing on a comparative analysis of some of the best ML/DL techniques which haven't been scrutinized altogether yet. |

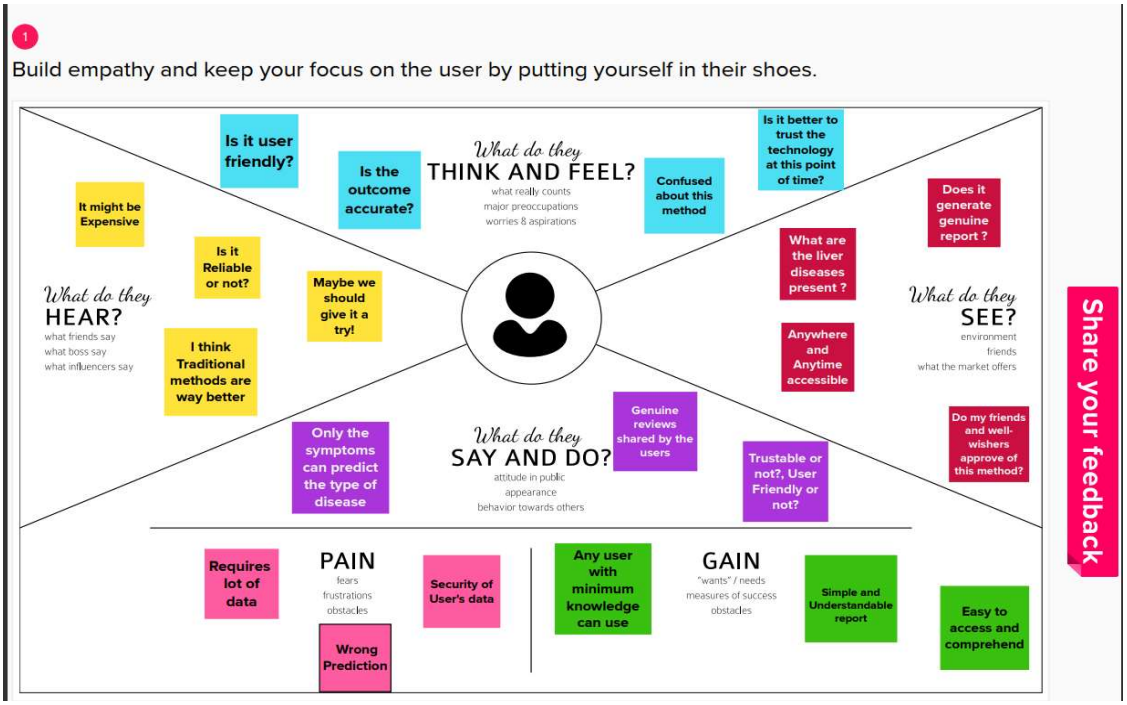
## 2.2 Problem Statement Definition

Chronic liver diseases include chronic hepatitis, fibrosis, and cirrhosis. Hepatitis can occur from viral infection (e.g., hepatitis c virus) or auto-immune origin. When liver disease is diagnosed at an earlier stage, in between infection and fibrosis but before cirrhosis, liver failure can be avoided. The use of artificial intelligence and machine learning in combination with clinical findings has further improved disease detection. Statistical machine learning algorithms based on specific problems can assist one to make decisions.

# 3.IDEATION & PROPOSED SOLUTION

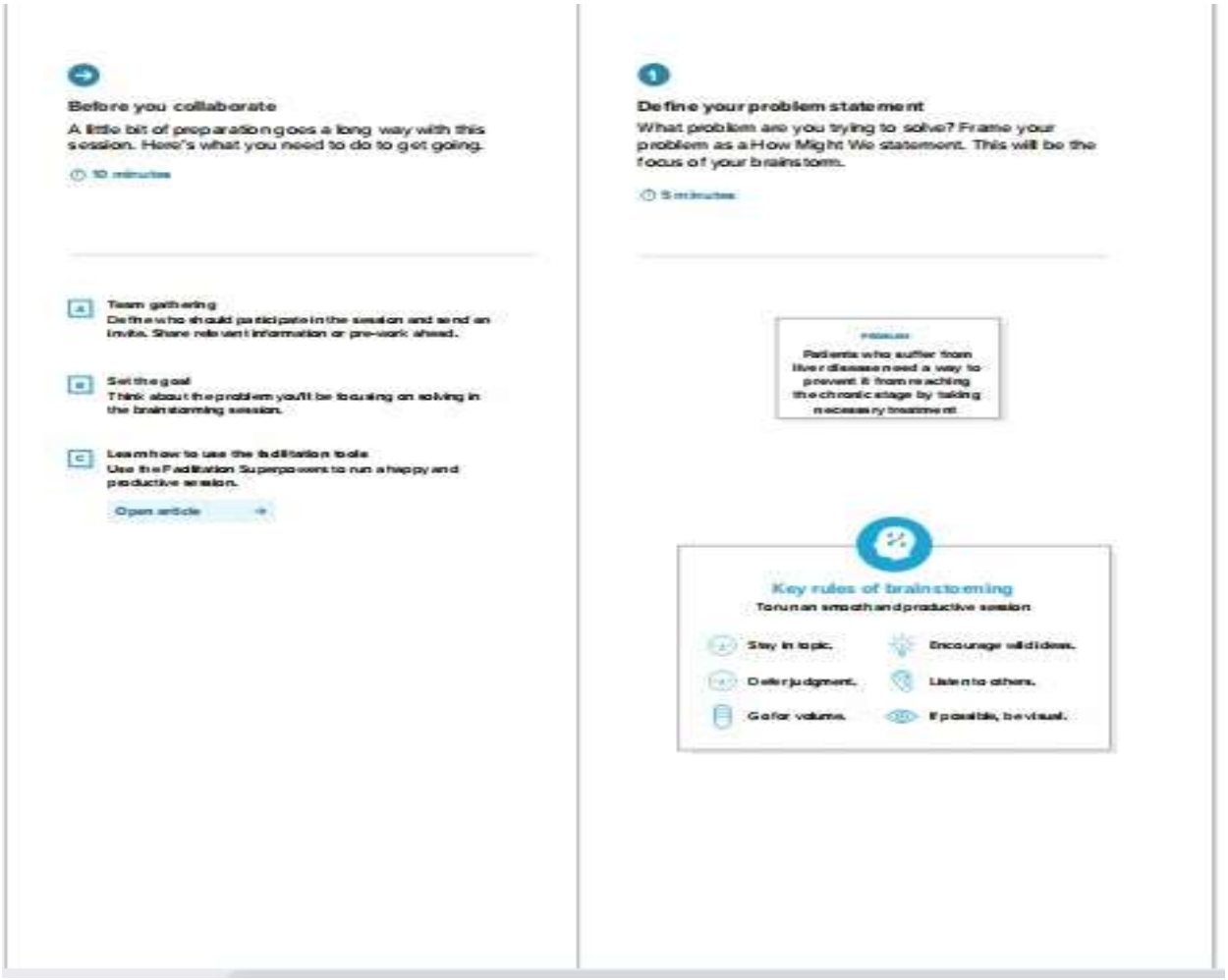
## 3.1 Empathy Map Canvas

An empathy map is a simple, easy-to-digest visual that captures knowledge about a user's behaviours and attitudes. It is a useful tool to help teams better understand their users. Creating an effective solution requires understanding the true problem and the person who is experiencing it. The exercise of creating the map helps participants consider things from the user's perspective along with his or her goals and challenges.



## 3.2 Ideation , Brainstorming & Prioritize

Brainstorming



2

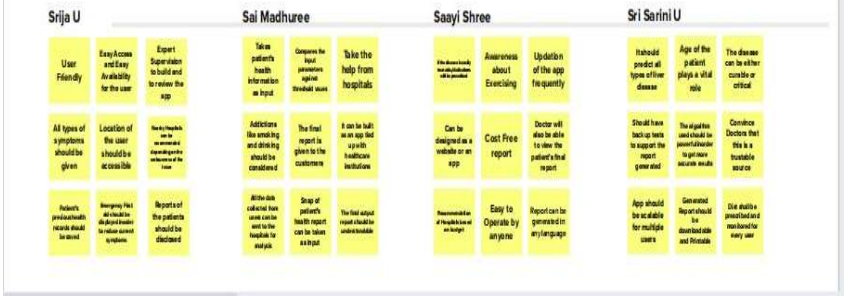
## Brainstorm

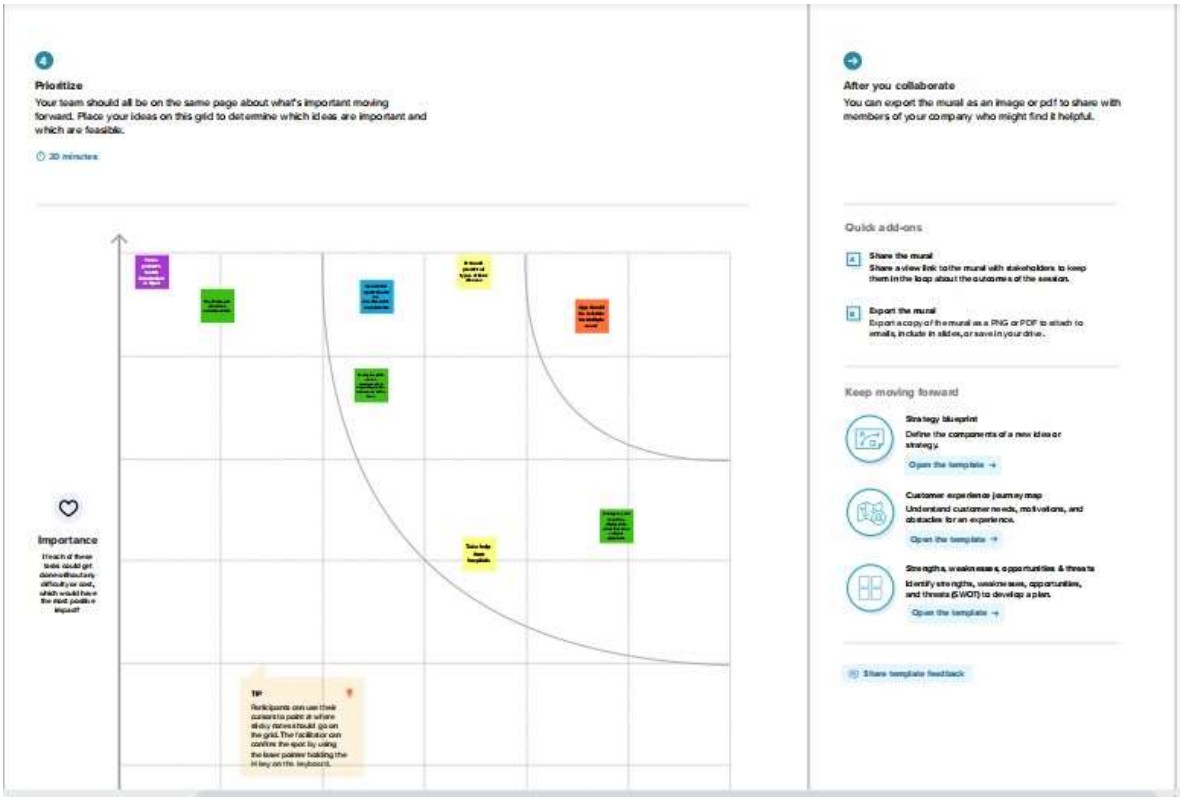
Write down any ideas that come to mind that address your problem statement.

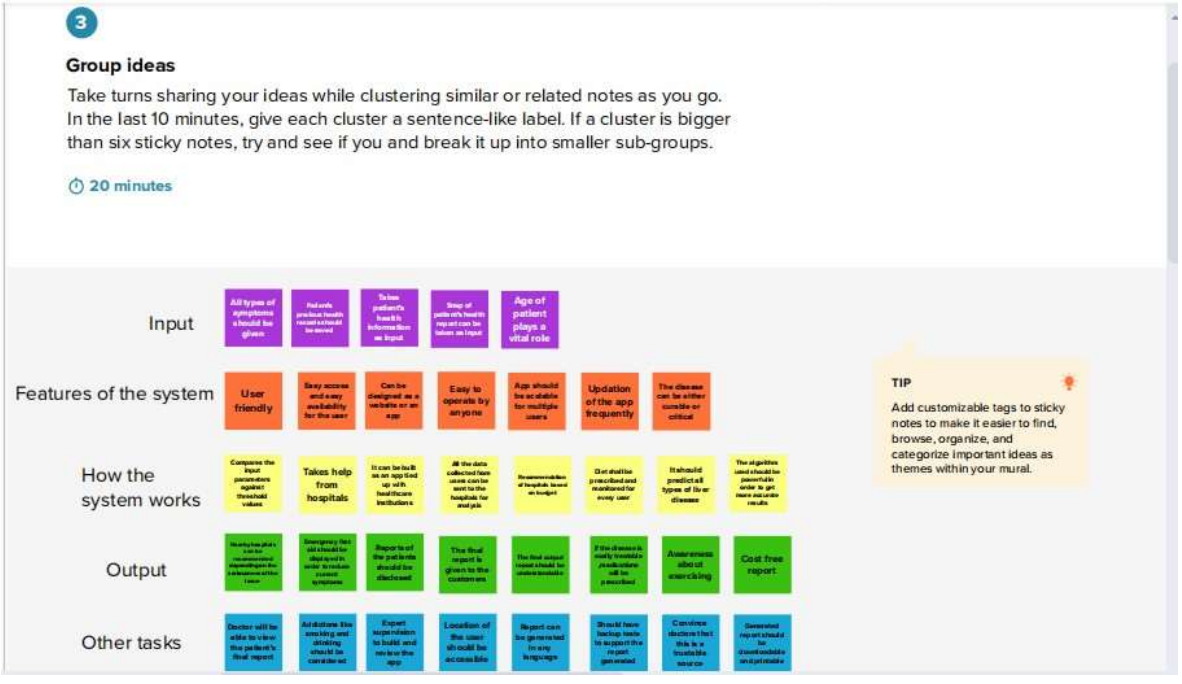
10 minutes

**TIP**

You can select a sticky note and hit the pencil [switch to sketch] icon to start drawing!




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
Importance
TIP
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
Share the mural
Share a view link to the mural with stakeholders to keep them in the loop about the outcomes of the session.
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 →
Share template feedback


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 and break it up into smaller sub-groups.
20 minutes
Input
Age of patient plays a vital role
Features of the system
User friendly
Easy to operate by anyone
Updation of the app frequently
How the system works
Takes help from hospitals
Output
Cost free report
Other tasks
TIP
Add customizable tags to sticky notes to make it easier to find, browse, organize, and categorize important ideas as themes within your mural.

## 3.3 Proposed Solution

**Project Design Phase-I**
**Proposed Solution Template**

| | |
|---|---|
| Date | 26 September 2022 |
| Team ID | PNT2022TMID53422 |
| Project Name | Statistical Machine Learning Approaches to Liver Disease Prediction |
| Maximum Marks | 2 Marks |

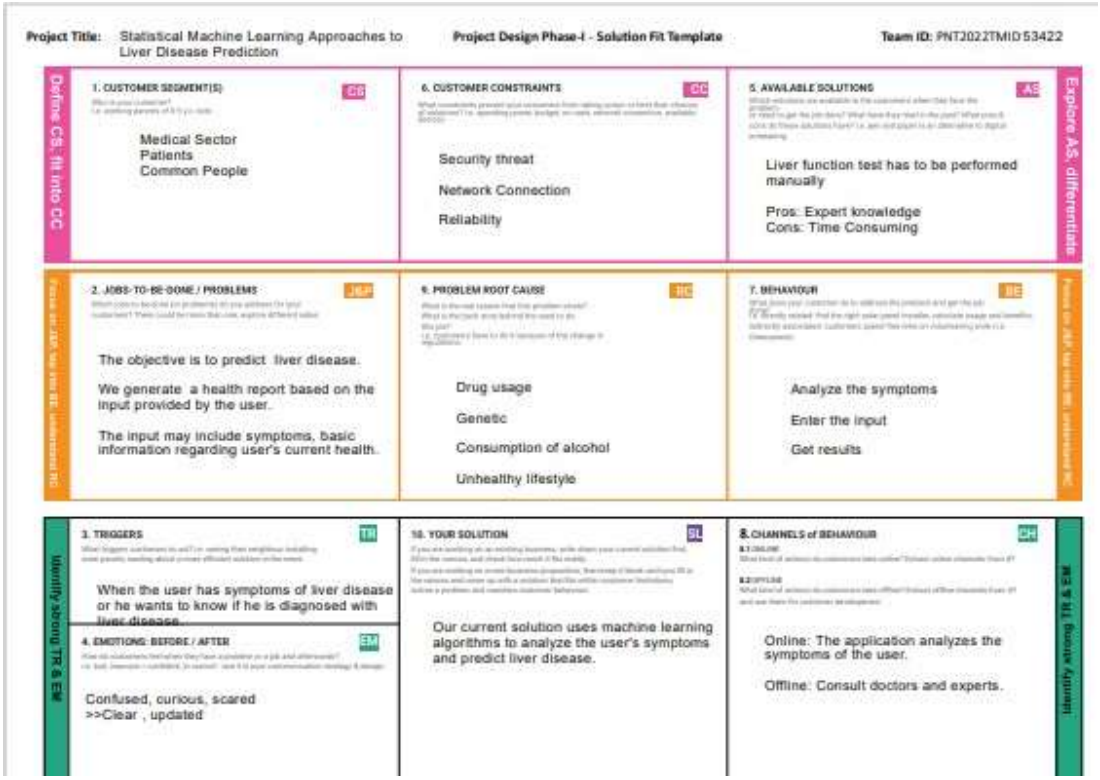
**Proposed Solution Template:**

Project team shall fill the following information in proposed solution template.

| S.No | Parameter | Description |
|---|---|---|
| 1. | Problem Statement (Problem to be solved) | To detect disease, healthcare professionals need to collect samples from patients which can cost both time and money. Often, more than one kind of test or many samples are needed from the patient to accumulate all the necessary information for a better diagnosis. There is a need to find better ways to detect and diagnose liver disease with more accuracy. |
| 2. | Idea / Solution description | Statistical machine learning algorithms based on specific problems can assist one to make decisions. Machine learning (ML), data-driven algorithms can be utilized to validate existing methods and help researchers to make potential new decisions. |
| 3. | Novelty / Uniqueness | Various kinds of data sets, such as blood panels with liver function tests, histologically stained slide images, and the presence of specific molecular markers in blood or tissue samples, have been used to train classifier algorithms to predict liver disease with good accuracy. |
| 4. | Social Impact / Customer Satisfaction | Application of the ML methods can help reduce the total burden of liver disease on public health worldwide by improving recognition of risk factors and diagnostic variables. More importantly, for chronic liver disease, detecting liver disease at earlier stages or in hidden cases by ML |

| | | |
|---|---|---|
| | | could decrease liver-related mortality, transplants, and/or hospitalizations. |
| 5. | Business Model (Revenue Model) | The global liver disease diagnostics market size was valued at USD 29.3 billion in 2019 and is estimated to grow at a compound annual growth rate (CAGR) of 6.5% from 2020 to 2027. Rising prevalence of acute and chronic liver diseases is one of the major factors expected to drive the market for liver disease diagnostics |
| 6. | Scalability of the Solution | The described ML methods can assist health sectors to achieve a better diagnosis providing effective results in identifying groups or levels within medical data to facilitate healthcare workers. The machine learning algorithms presented in this study can support medical experts but are not the alternative when making decisions from ML classifiers for diagnostic pathways. |

## 3.4 Problem Solution fit



# 4. REQUIREMENT ANALYSIS

## 4.1 Functional requirement

| FR No. | Functional Requirement (Epic) | Sub Requirement (Story / Sub-Task) |
|---|---|---|
| FR-1 | User Registration | Registration through Gmail<br>Registration through Healthcare Portals |
| FR-2 | User Confirmation | Confirmation via Email<br>Confirmation via OTP |
| FR-3 | User Application | Filling of application<br>Modification of application<br>Verification of application |
| FR-4 | User Verification | Verifying through Credentials through Database |
| FR-5 | Database Update | 1.Updating Data in Database<br>2.Altering data in Database<br>3.Deleting Data in Database |
| FR-6 | Activities Tracking | Track the activities and keep the database updated |

## 4.2 Non-Functional requirements

| FR No. | Non-Functional Requirement | Description |
|---|---|---|
| NFR-1 | **Usability** | The prediction model can be used by users, doctors and health care institutions |
| NFR-2 | **Security** | The prediction model is not vulnerable to any brute force attack or any security attacks. |
| NFR-3 | **Reliability** | The prediction model can only be accessed by the users who possess the username and password. |

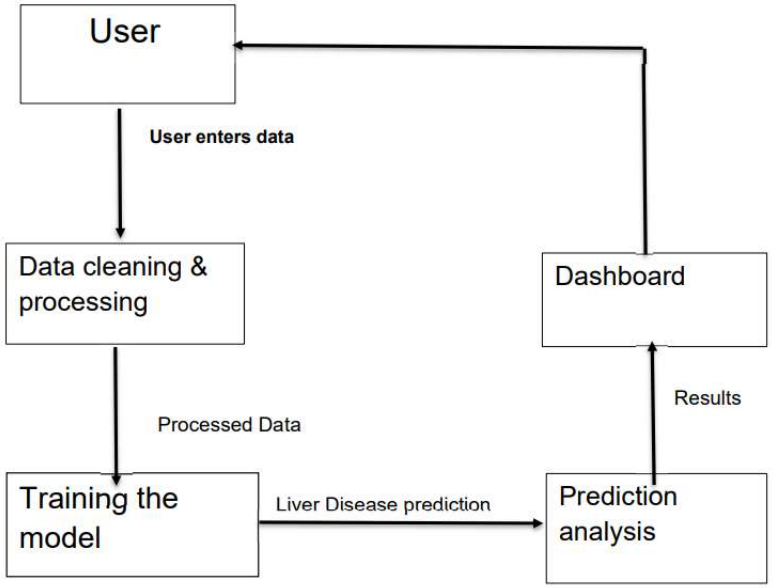
| | | |
|---|---|---|
| NFR-4 | **Performance** | The prediction model can take in huge amounts of data , scalable for large-scale users and can do prediction as well as visualization. |

| | | |
|---|---|---|
| NFR-5 | **Availability** | The prediction model can be accessed at anytime and anywhere. |
| NFR-6 | **Scalability** | The prediction model can be used by multiple users and multiple hospitals at the same time |

# 5.PROJECT DESIGN

## 5.1 Data Flow Diagrams

A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a system. A neat and clear DFD can depict the right amount of the system requirement graphically. It shows how data enters and leaves the system, what changes the information, and where data is stored.

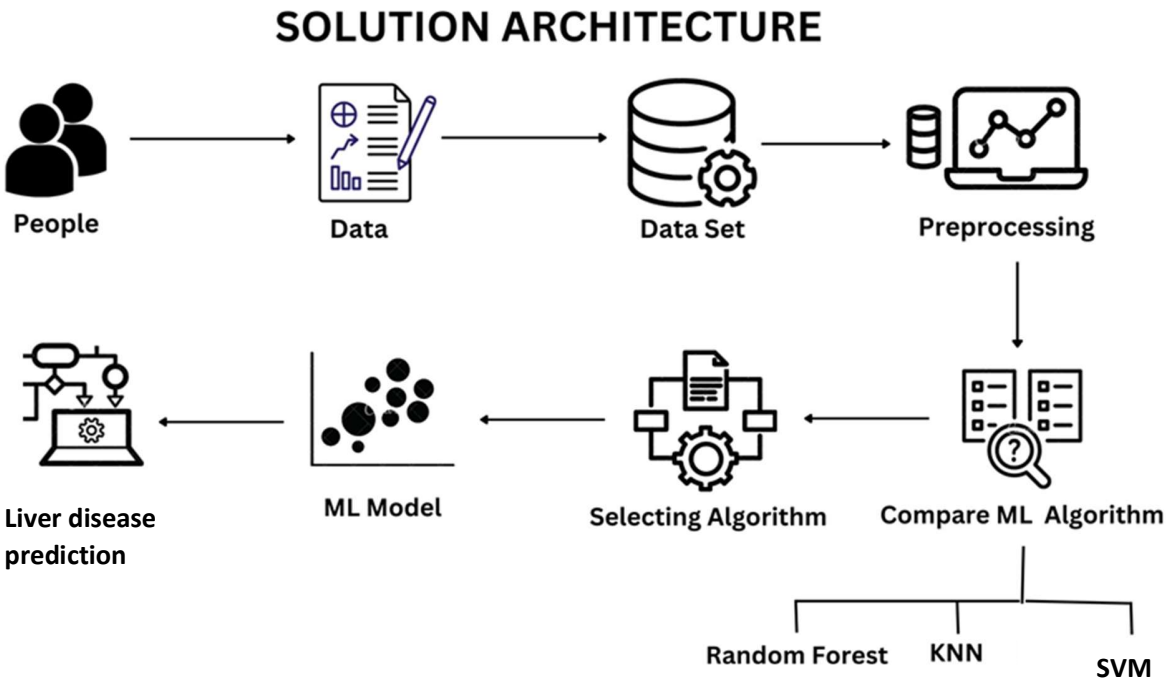


## 5.2 Solution & Technical Architecture

### Solution 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, behaviour, 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.



## 5.3 User Stories

| 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 password. | 5 | High | Srija |
| Sprint-1 | | USN-2 | As a user, I will receive confirmation email once I have registered for the application | 5 | High | Sri Sarini |
| Sprint-1 | Login | USN-3 | As a user, I can log into the application by entering email & password | 10 | Medium | Sai Madhuree |
| Sprint-2 | Input Necessary Details | USN-4 | As a user, I can give input test details to predict liver disease | 15 | High | Saayi Shree |
| Sprint-2 | Data Pre-Processing | USN-5 | Transform raw data into appropriate format for prediction | 5 | High | Srija |
| Sprint-3 | Prediction of Liver Disease | USN-6 | As a user I can get the results of liver disease prediction | 15 | High | Sri Sarini |
| Sprint-3 | | USN-7 | As a user I can get accurate results of liver disease | 5 | Medium | Sai Madhuree |
| Sprint-4 | Review | USN-8 | As an admin I reinforce the result of prediction | 20 | High | Saayi Shree |

# 6. PROJECT PLANNING & SCHEDULING

## 6.1 Sprint Planning & Estimation

Product Backlog, Sprint Schedule, 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 password. | 5 | High | Srija |
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| Sprint-4 | Review | USN-8 | As an admin I reinforce the result of prediction | 20 | High | Saayi Shree |

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

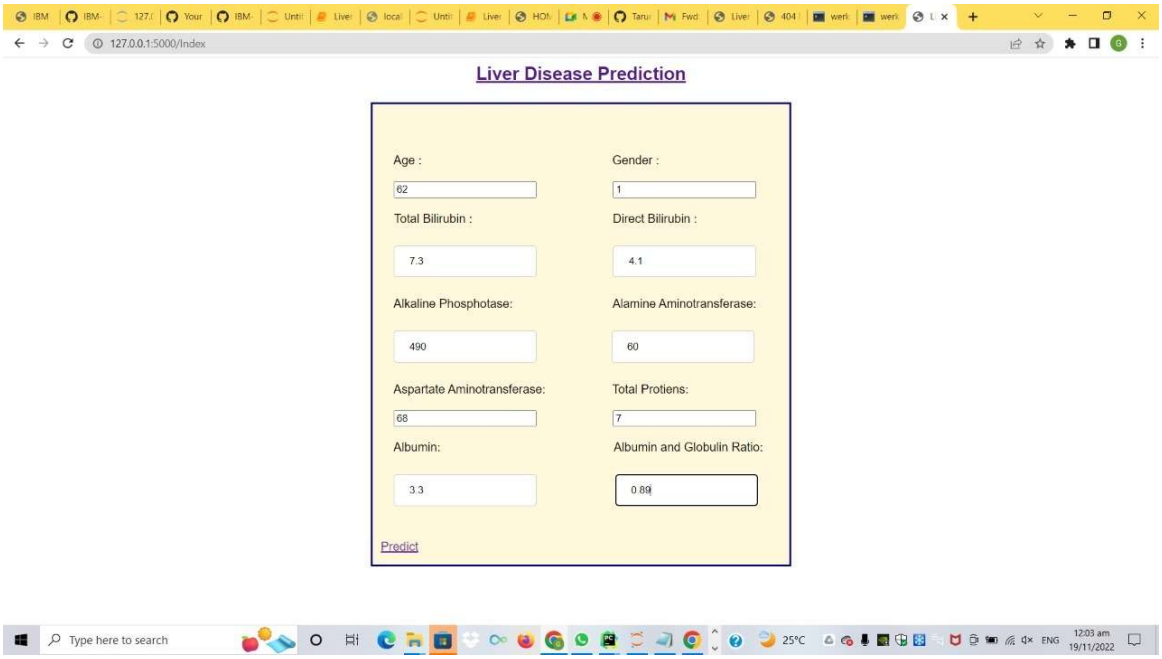
**Velocity:**

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)

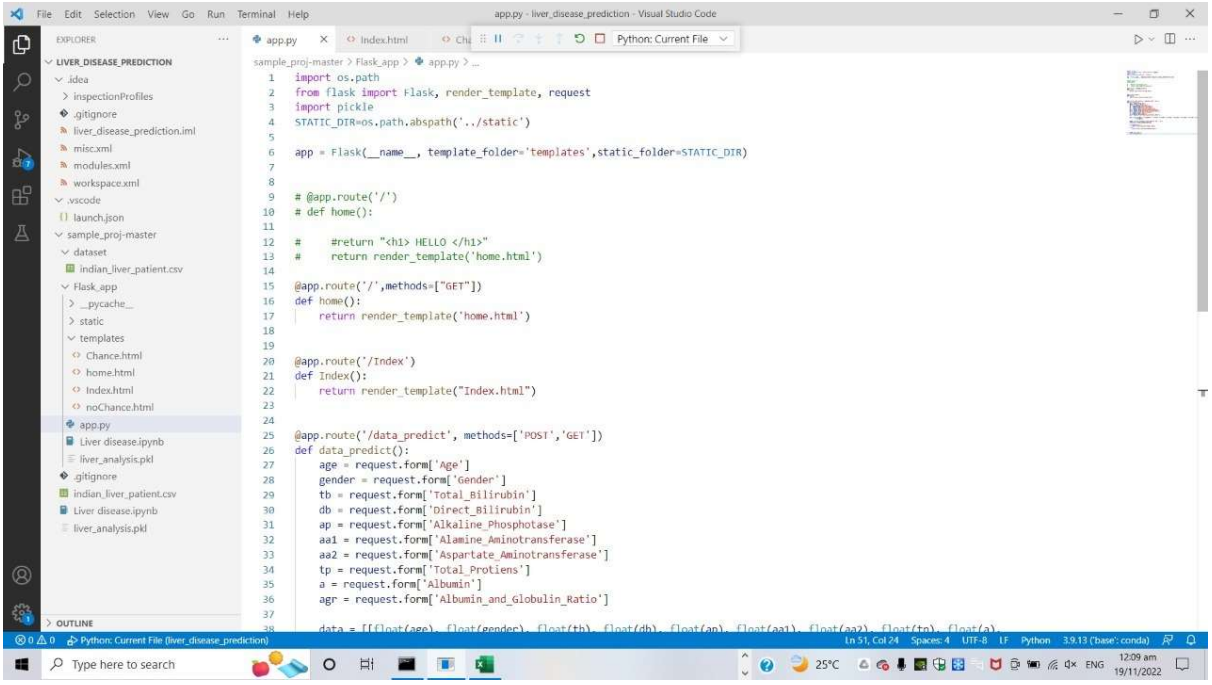
$$AV = \frac{sprint\ duration}{velocity} = \frac{20}{10} = 2$$

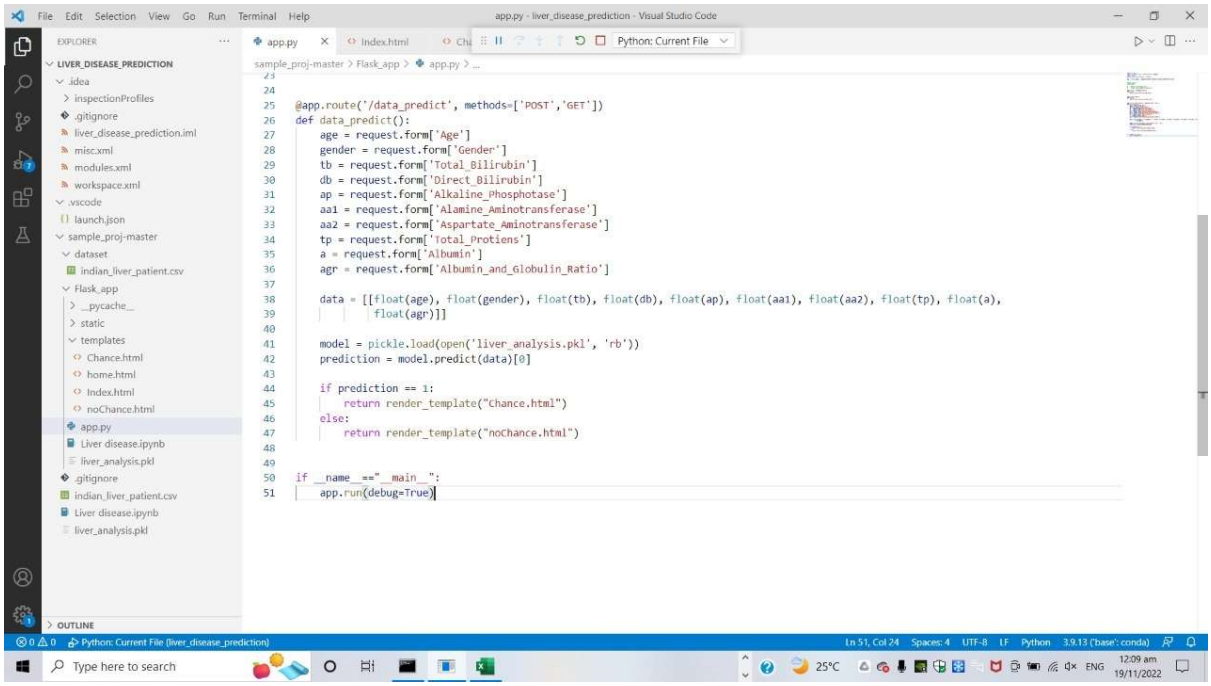
# 7. CODING & SOLUTIONING

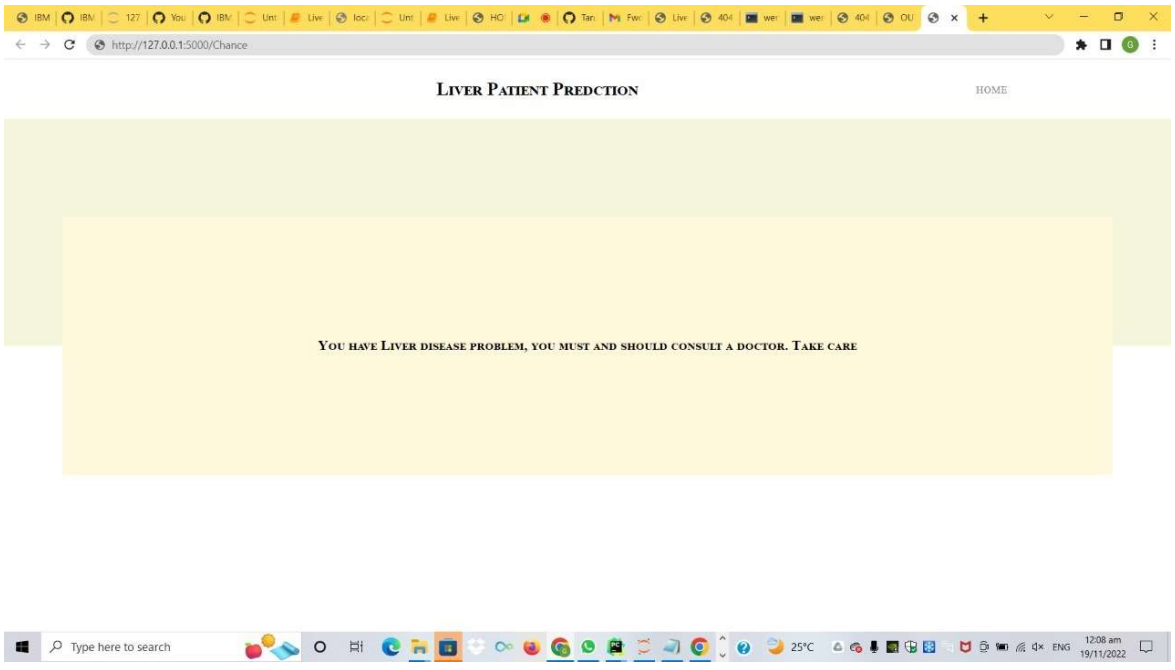
## 7.1 Feature 1




## 7.2 Feature 2




File Edit Selection View Go Run Terminal Help
app.py - liver_disease_prediction - Visual Studio Code
EXPLORER
LIVER_DISEASE_PREDICTION
app.py
Index.html
Python: Current File
sample_proj-master > Flask_app > app.py > ...
@app.route('/data_predict', methods=['POST','GET'])
def data_predict():
age = request.form['Age']
gender = request.form['Gender']
tb = request.form['Total_Bilirubin']
db = request.form['Direct_Bilirubin']
ap = request.form['Alkaline_Phosphotase']
aa1 = request.form['Alamine_Aminotransferase']
aa2 = request.form['Aspartate_Aminotransferase']
tp = request.form['Total_Protiens']
a = request.form['Albumin']
agr = request.form['Albumin_and_Globulin_Ratio']
data = [[float(age), float(gender), float(tb), float(db), float(ap), float(aa1), float(aa2), float(tp), float(a),
float(agr)]]
model = pickle.load(open('liver_analysis.pkl', 'rb'))
prediction = model.predict(data)[0]
if prediction == 1:
return render_template("Chance.html")
else:
return render_template("noChance.html")
if __name__=="__main__":
app.run(debug=True)
.idea
inspectionProfiles
.gitignore
liver_disease_prediction.iml
misc.xml
modules.xml
workspace.xml
.vscode
launch.json
sample_proj-master
dataset
indian_liver_patient.csv
Flask_app
__pycache__
static
templates
Chance.html
home.html
Index.html
noChance.html
app.py
Liver disease.ipynb
liver_analysis.pkl
.gitignore
indian_liver_patient.csv
Liver disease.ipynb
liver_analysis.pkl
OUTLINE
Python: Current File (liver_disease_prediction)
Ln 51, Col 24 Spaces: 4 UTF-8 LF Python 3.9.13 ('base': conda)
Type here to search
25°C
ENG
12:09 am
19/11/2022


http://127.0.0.1:5000/Chance
LIVER PATIENT PREDCTION
HOME
YOU HAVE LIVER DISEASE PROBLEM, YOU MUST AND SHOULD CONSULT A DOCTOR. TAKE CARE
Type here to search
25°C
ENG
12:08 am
19/11/2022

## 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| tc01 | Functional | Page | Verify user is able to click on Predict button | | 1.Enter URL and fill the form 2.Click on Predict button | | Loan form should display | Working as expected | Pass | | | | |
| tc02 | Functional | Home Page | The web page is getting refreshed | | 1.Automatic page reload | | Loan form must appear automatically after page reload | Working as expected | Fail | No steps needed | Y | BUG-1234 | |
| tc03 | Functional | Home page | Field address validation | | 1. Double-click on the E-mail address field | | User should navigate to E-mail address field | Working as expected | Pass | | | | |
| tc04 | Functional | Output page | Loan Credibility predicted output | | 1. Click on predict button 2. View the predicted results | | User should access the Loan credibility predicted result | Working as expected | Pass | | | | |

### 8.2 User Acceptance Testing

## 1. Purpose of Document

The purpose of this document is to briefly explain the test coverage and open issues of the [ProductName] project at the time of the release to User Acceptance Testing (UAT).

## 2. Defect Analysis

This report shows the number of resolved or closed bugs at each severity level, and how they were resolved

| Resolution | Severity 1 | Severity 2 | Severity 3 | Severity 4 | Subtotal |
|---|---|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| By Design | 9 | 3 | 1 | 2 | 15 |
| Duplicate | 0 | 0 | 4 | 0 | 4 |
| External | 1 | 2 | 0 | 0 | 3 |
| Fixed | 10 | 5 | 4 | 21 | 40 |
| Not Reproduced | 0 | 0 | 0 | 0 | 0 |
| Skipped | 0 | 0 | 0 | 0 | 0 |
| Won't Fix | 0 | 0 | 0 | 0 | 0 |
| Totals | 20 | 9 | 9 | 23 | 64 |

# 1. Test Case Analysis

This report shows the number of test cases that have passed, failed, and untested

| Section | Total Cases | Not Tested | Fail | Pass |
|---|---|---|---|---|
| Print Engine | 5 | 0 | 0 | 5 |
| Client Application | 46 | 0 | 0 | 46 |
| Security | 4 | 0 | 0 | 4 |
| Outsource Shipping | 3 | 0 | 0 | 3 |
| Exception Reporting | 7 | 0 | 0 | 7 |
| Final Report Output | 4 | 0 | 0 | 4 |
| Version Control | 2 | 0 | 0 | 2 |

# 9. RESULTS

## 9.1 Performance Metrics

## Model Performance Testing:

Project team shall fill the following information in the model performance testing template.

| S.No. | Parameter | Screenshot / Values |
|---|---|---|
| 1. | Data Responsiveness | The ML model takes about 0.3 seconds to process the dataset. The credibility result is predicted in approximately 0.9 seconds. |
| 2. | Utilisation of Data Filters | Sufficient data filters have been used for ideal model building |
| 3. | Effective User Story | No of Scene Added - 15 |
| 4. | Descriptive Reports | No of Visualisations / Graphs - 13 |

# 10. ADVANTAGES & DISADVANTAGES

**Advantage:**

Anyone can use the application.

Our application can be used by anyone with minimum knowledge. The Usability of the App is one of the advantage.

User Friendly UI

User Friendly User Interface enables the users to easily understand how the application works. Therefore, Encouraging users to use the application whenever they want.

Remote Access

At home diagnosis in case of emergencies as the results are much easier and faster to get. Simple diagnosis can be done at home without the need to go to the hospital.

**Disadvantage:**

Does not replace hospitals

The user cannot completely rely on the application and this application cannot replace hospitals or prevent the users to go to the hospitals .It is just an emergency or a support application for the users.

Prediction may not be accurate

The user cannot completely trust the diagnosis done through the application. The user may need to double check by visiting a doctor. But this may not happen everytime. This is advised just to be on a safer side.

## 11. CONCLUSION

The analysis starts from data cleaning and processing missing value, exploratory analysis and finally model building and evaluation of the model. The best accuracy on public test set is when we get higher accuracy score and other performance metrics which will be found out. This project can help to predict the liver disease of the user.

## 12. FUTURE SCOPE

The health or life of the user is relied on this application therefore the accuracy can be improved in order to completely trust the application. This application can also help healthcare workers and can serve as a support system.

## 13. APPENDIX

### Source Code

**app.py**

```
import os.path

from flask import Flask, render_template, request
import pickle
STATIC_DIR=os.path.abspath('../static')
```

```
app = Flask(_name_, template_folder='templates',static_folder=STATIC_DIR)

# @app.route('/')
# def home():

#     #return "<h1> HELLO </h1>"
#     return render_template('home.html')

@app.route('/',methods=["GET"])
def home():
    return render_template('home.html')


@app.route('/Index')
def Index():
    return render_template("Index.html")


@app.route('/data_predict', methods=['POST','GET'])
def data_predict():
    age = request.form['Age']
    gender = request.form['Gender']
    tb = request.form['Total_Bilirubin']
    db = request.form['Direct_Bilirubin']
    ap = request.form['Alkaline_Phosphotase']
   aa1 = request.form['Alamine_Aminotransferase']
    aa2 = request.form['Aspartate_Aminotransferase']
    tp = request.form['Total_Protiens']
    a = request.form['Albumin']
    agr = request.form['Albumin_and_Globulin_Ratio']

    data = [[float(age), float(gender), float(tb), float(db), float(ap), float(aa1),
     float(aa2), float(tp), float(a),
           float(agr)]]

    model = pickle.load(open('liver_analysis.pkl', 'rb'))
    prediction = model.predict(data)[0]

    if prediction == 1:
        return render_template("Chance.html")
    else:
        return render_template("noChance.html")
```

```
  if _name=="main_"
app.run(debug=True)
```

**index.html**

```
<form action="/predict" method="post">
        <br>
        <br>
        <br>
          Age :  
       
           
;          &nbs
p; 
           
; 
                 Gender :
        <br>
        <br>
        <input type="number" id="Age" placeholder="Age " name="Age"
style="width: 190px ; margin-left:17px;">  <input type="number" id="Gender"
           placeholder="Gender (Male:1 , female:0)" name="Gender"
style="width: 190px ; margin-left: 97px;">
        <br>
        <br>

            Total Bilirubin :  
         
         

           
;        Direct Bilirubin :
        <br>
        <br> <input type="text" id= "Total_Bilirubin"
placeholder="Total_Bilirubin"
           name="Total Bilirubin" style="width: 190px ; margin-left:17px;">
         <input type="text" id="Direct_Bilirubin" placeholder="Direct
Bilirubin"
           name="Direct_Bilirubin" style="width: 190px ; margin-left: 97px;">

        <br>
        <br>
            Alkaline Phosphotase:  
       
```

```
           
;        Alamine Aminotransferase:
        <br>
        <br>
        <input type="text" id="Alkaline_Phosphotase" placeholder="Alkaline
Phosphotase"
            name="Alkaline_Phosphotase" style="width: 190px ; margin-left:
17px;">
         <input type="text" id="Alamine_Aminotransferase"
            placeholder="Alamine Aminotransferase"
name="Alamine_Aminotransferase" style="width: 190px ; margin-left: 95px;">
        <br>
        <br>

            Aspartate Aminotransferase:  
         
       Total Protiens:
        <br>
        <br>
         <input type=" text" id="Aspartate_Aminotransferase"
            placeholder="Aspartate_Aminotransferase"
name="Aspartate_Aminotransferase" style="width: 190px ; margin-left:
17px;">
        <input type=" text" id="Total Protiens" placeholder="Total Protiens"
name="Total Protiens" style="width: 190px ; margin-left: 97px;">

        <br>
        <br>

            Albumin:  
       

           
;          

           
;        Albumin and Globulin
Ratio:
        <br>
        <br>
        <input type="text" id="Albumin" placeholder=" Albumin " name="
Albumin" style="width: 190px ; margin-left:17px;">
         <input type="text" id="Albumin_and_Globulin_Ratio"
```

```
            placeholder="Albumin and Globulin Ratio"
name="Albumin_and_Globulin_Ratio" style="width: 190px ; margin-left:
100px;">
        <br>
        <br>
        <br>
        <!-- <button type="submit" style="width: 100px ; margin-left:
200px;">Predict</button> -->
        <a href="/data_predict">Predict</a>

    </form>
```

## 13.2 GitHub& Project:

https://github.com/IBM-EPBL/IBM-Project-18196-1659680664/upload/main/Project%20Development%20Phase