

A PROJECT REPORT
ON

“COMPREHENSIVE HEALTHCARE SYSTEM USING ML”

FOR
**PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD
OF THE DEGREE**
(B.E. Computer Engineering)
BY
Group 37

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CERTIFICATE

This is to certify that,

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ABSTRACT

Now a days challenges for medical community and public health issue have been increased and this was neglected for many years. The development and exploitation of several prominent Data mining techniques in numerous real-world application areas (e.g. Industry, Healthcare and Bio science) has led to the utilization of such techniques in machine learning environments, in order to extract useful pieces of information of the specified data in healthcare communities, biomedical fields etc. The accurate analysis of medical database benefits in early disease prediction, patient care and community services.

The techniques of machine learning have been successfully employed in assorted applications including Disease prediction. The aim of our proposed system is to immensely help to solve the health-related issues by assisting the physicians to predict and diagnose diseases at an early stage. This system demonstrates the disease prediction system developed using Machine learning algorithms such as Decision Tree classifier, KNN, and Naïve Bayes classifier. Also, it provides platform for various stakeholders to communicate with each other and thus helping healthcare field to digitalize.

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Chapter 1

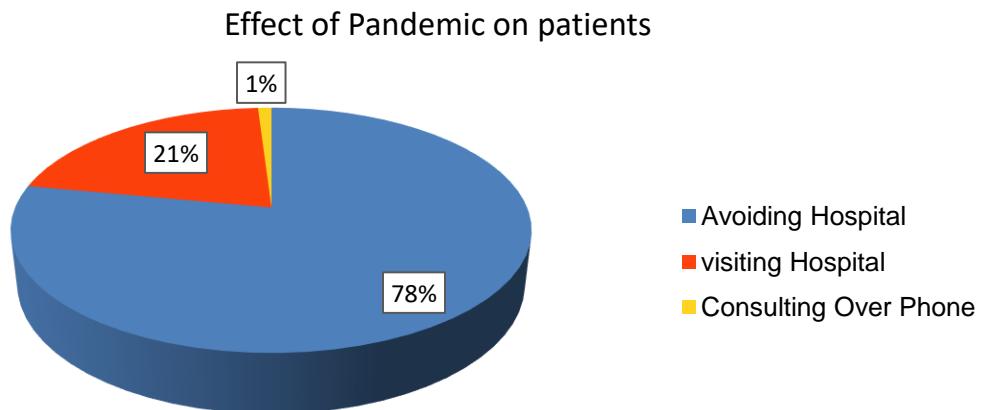
Introduction

1.1 Background and Basics:

Most of the patients today who face health problems, initially take advice from unprofessional or people with no knowledge that makes them more vulnerable. In many occasions, doctors also get confused with identifying actual disease. This might happen as they usually identify disease based on their limited experience. Moreover, general patient selects doctor according to their will and with no knowledge about the disease that may need specialist doctor. But some disease cannot be confirmed without a specialized doctor. Therefore, this system presents a Machine Learning based disease symptom analysis system for assisting the patients seeking proper treatment by selecting accurate medical department using the symptom that they can easily recognize.

1.2 Motivation:

Sometimes we need the help of doctors, but due to our helter-skelter lifestyle we choose to ignore it or sometimes we may overvalue it. But it might lead to some serious concerns. In rural areas, doctors are available but they are not specialists, so they may not give a thought to considering seriousness of disease. There isn't any existing system which connects all the medical system.



1.2.1 : Effect Of Covid-19 on Patients

As suggested by TOI article above figure shows that Covid-19 made people avoid seeking medical advice through physical interaction. This may lead to serious health issues.
This is also where the proposed system can help.

1.3 Literature Survey:

1.3.1 Literature Survey

Paper Name	Author	Year of Publication	Publication	Seed Idea
Disease Prediction using Machine Learning Algorithms	Sneha Grampurohit , Chetan Sagarnal	2020	Institute of Electrical and Electronics Engineers (IEEE)	Presents comparative study of the results obtained by algorithms such as Decision tree classifier & Random Forest classifier.
Disease Symptom Analysis Based Department Selection Using Machine Learning for Medical Treatment	Md. Latifur Rahman, Rahad Arman Nabid , Md. Farhad Hossain	2020	Institute of Electrical and Electronics Engineers (IEEE)	By using ML algorithms, K-Nearest neighbour and logistic regression provides analysis of easily recognized diseases .
An Implementation of Naïve Bayes Classifier	Feng-Jen Yang	2018	Institute of Electrical and Electronics Engineers (IEEE)	Ensure the correctness of all probabilistic computations involved in Naïve-Bayes classification.
Analysis of Symptoms Wise Disease Inference System Using Data Mining Technique	Tejal P. Burange, Dr. P. N. Chatur	2018	Institute of Electrical and Electronics Engineers (IEEE)	Implement automatic question-answer system in which user will ask any question and system will process that question using data mining algorithms to find out proper answer

1.4 Project Undertaken

1.4.1 Problem Statement

To build a system which would provide hand hold support to users in their healthcare matters by analysing their symptoms using Machine Learning techniques.

1.4.2 Scope of Statement

The system can be considered as a smart and reliable health care system for health diagnosis and disease detection. It will be able to provide a platform for all stakeholders of the healthcare system. Additionally, the application will memorise its users by keeping user records and also authenticate for enhanced security features.

However, It will be not possible for user to analyse symptoms unknown to the system, and detect newly discovered diseases.

1.4.3 Organization of The Project Report

The report is divided into four chapters. Chapter 2 discusses about project planning and management that covers system overview and functional and non-functional requirements. Chapter 3 discusses about analysis and design.

Chapter 2

Project Planning and Management

2.1 System Requirement Specification :

2.1.1 Functional Requirements :

- Add patient details - Any patient who wants to use the system needs to provide their symptoms and other details.
- Add doctor details - Doctors account has to be verified to avail the respective services of the system.
- Add pharmacist details – Pharmacists are needed to provide proper contact and licence details to the system.
- Add records of some previously diagnosed patient- Latest patient records need to be analysed for accurate results.
- Relevant diagnosis generation - System is expected to serve the user with relevant disease diagnosis after symptoms are provided.

2.1.2 Non-Functional Requirements:

- Security- User Authentication.
- Usability- Interactive User Interface.
- Serviceability- Real-time Communication among different stakeholders.
- Reliability- Two-layer Verification
- Response Time – The system provides an acknowledgement within seconds
- Capacity – The system needs to support multiple users at a time
- User interface – UI must be convenient for users.
- Availability – The system must be available all the time

2.1.3 Deployment Environment:

➤ **Software:**

- Python-Django Web Development Framework (version 2.2+).
- Web Development Kit - (HTML, CSS, JavaScript)
- Database: PostgreSQL
- Operating System: Windows / Linux

➤ **Hardware:**

- RAM - Minimum 8 GB
- Processor – at least Quad-Core
- Space Requirement – Minimum 50 GB Free

2.1.4 Project Process Modelling

Spiral Model is used in the modeling and development phase of the project. This model helps the developer to work one step at a time. First step is to create a small model with very few functionalities. Testing is done on that and then functionality is added one by one. This avoids big mistakes which are costly and difficult to solve. Regression testing and Integration testing is done at each and every step of development

2.1.4.1 Time Line Chart 1

Activities	Nov	Dec	Jan	Feb	Mar
Submission of project idea					
Project presentation					
Approval of project idea					
First presentation about progress of project work(Review 1 and Review 2)					
Second presentation about progress of project work(Review 3 and Review 4)					
Submission of partial project report					

2.1.4.2 Time Line Chart 2

Activities	Jan	Feb	Mar
Start of implementation			
Presentation about progress of project work			
Presentation about progress of project work			
Submission of report for checking			
Final submission of report and project			

Chapter 3

Analysis and Design

3.1 Idea Matrix :

Table 3.1.1 Idea Matrix

Idea	Deliverables	Parameters affected
increase	User convenience	Application design
increase	Security	User authentication
avoid	Human negligence and confusion	Negligence and confusion
advance	There is no single platform that houses all the features in one place	Usability
develop	A system housing all the features needed in the healthcare process	Usability
increase	Classification accuracy	Algorithm choice
deliver	A product that provides more efficient healthcare process	Speed

3.2 Mathematical Model:

3.2.1. Model for AI Diagnosis

$$AD = \{I, O, F, T\}$$

Where,

$$I = \{i_1, i_2, i_3, \dots, i_n\}$$

I is the user symptoms

$$O = \{o_1, o_2, o_3, \dots, o_n\}$$

O is the set of diagnosed diseases

$$F = \{f_1, f_2, f_3\}$$

f_1 = function for data cleaning

f_2 = function to retrieve user details

f_3 = function for symptoms recommendation

$$T = \{t_1, t_2, t_3, \dots, t_n\}$$

T is the collection of symptoms and disease data to train the model for Diagnosis

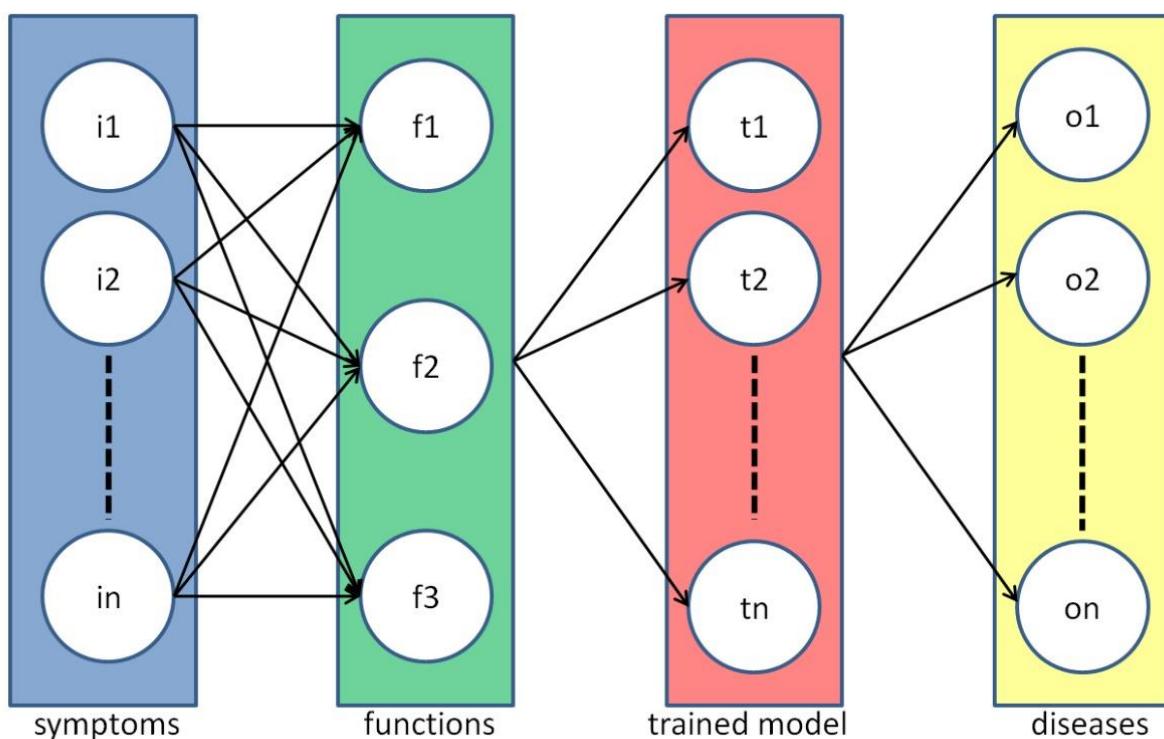


Fig : 3.2.1.1 Mathematical Model for AI Diagnosis

3.2.2. Model for Scheduling Appointment

$$SA = \{I, O, F\}$$

Where

$$I = \{i_1, i_2\}$$

i_1 = User selects a doctor for consultation.

i_2 =Doctor selects feasible date and time for an appointment.

$$O = \{o_1, o_2\}$$

o_1 = Date and Time of scheduled appointment

o_2 = Information of stakeholders involved

$$F = \{f_1, f_2\}$$

f_1 = Function to recommend doctor to user

f_2 = Function to fix appointment and convey its details to user

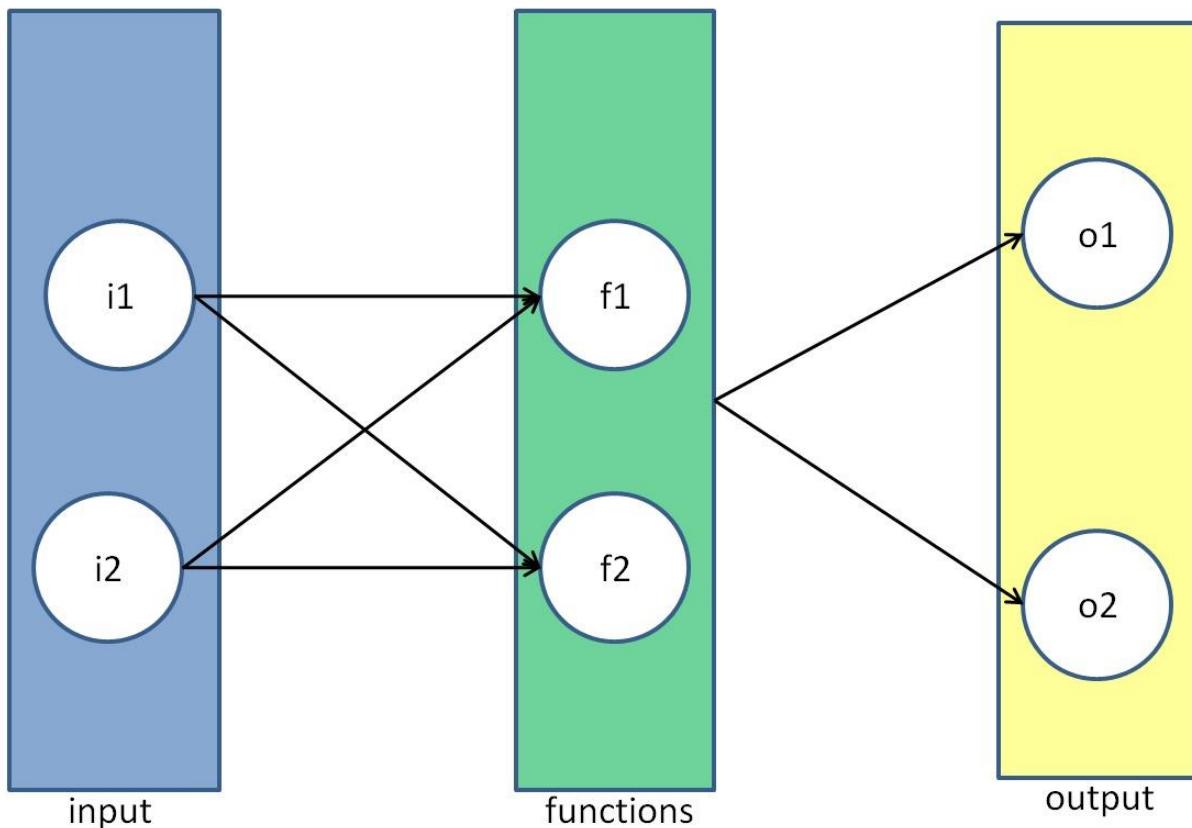


Fig : 3.2.2.1 Mathematical Model for Scheduling Appointment

3.2.3. Model for Stakeholder Communication

$$SC = \{I, O, F\}$$

Where,

$$I = \{i_1\}$$

i_1 = Information of stakeholders communicating

$$O = \{o_1, o_2\}$$

o_1 = Meeting conclusion

o_2 = User feedback

$$F = \{f_1, f_2, f_3\}$$

f_1 = function for remainder if appointment scheduled.

f_2 = function to provide a platform for communication.

f_3 = function to collect feedback after meeting

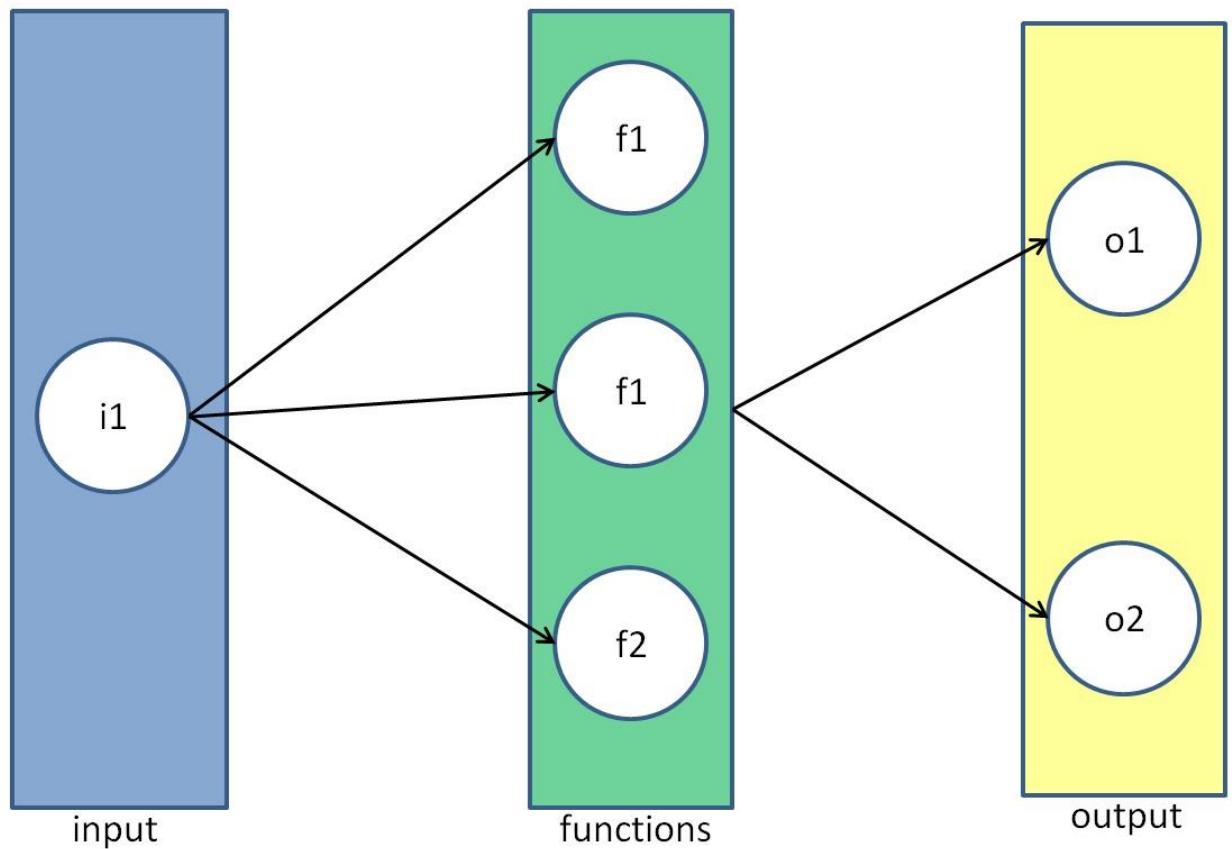


Fig : 3.2.3.1 Mathematical Model for Stakeholder Communication

3.3. UML Diagrams :

3.3.1 Use-Case Diagram:

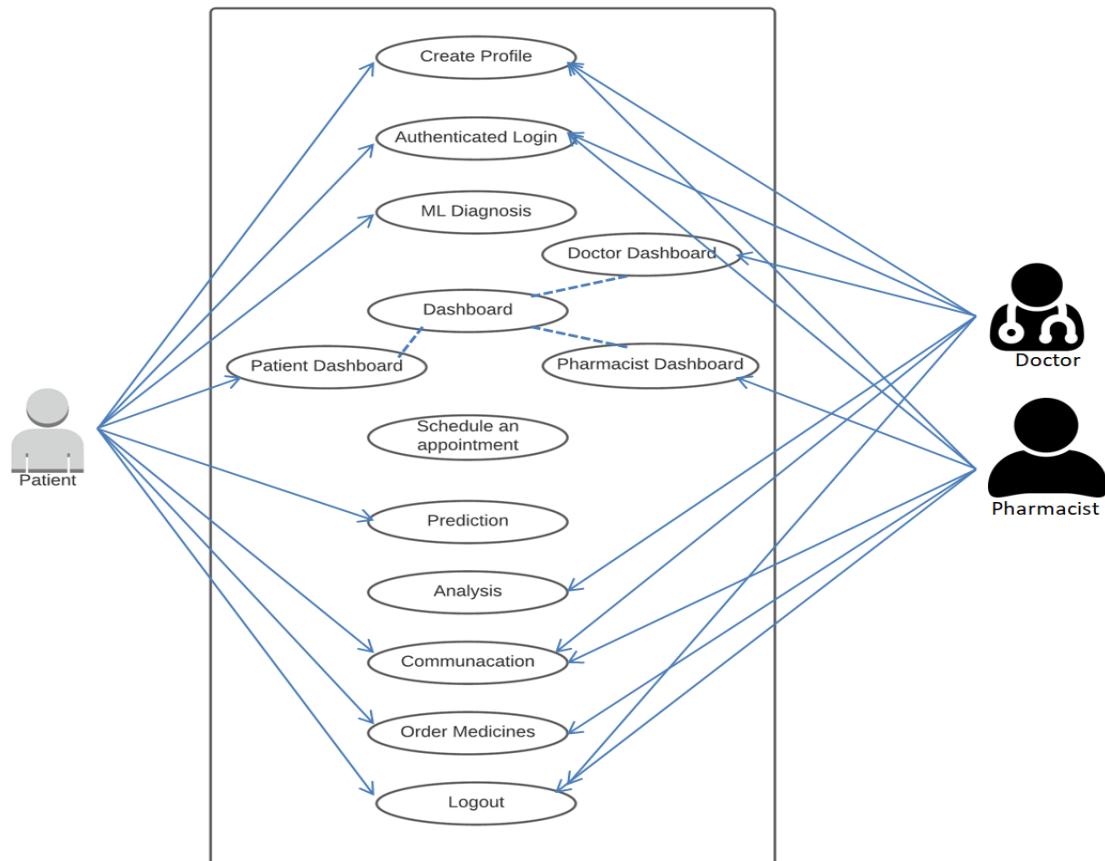


Fig : 3.3.1.1 Use-Case Diagram

3.3.2 System Flow Diagram :

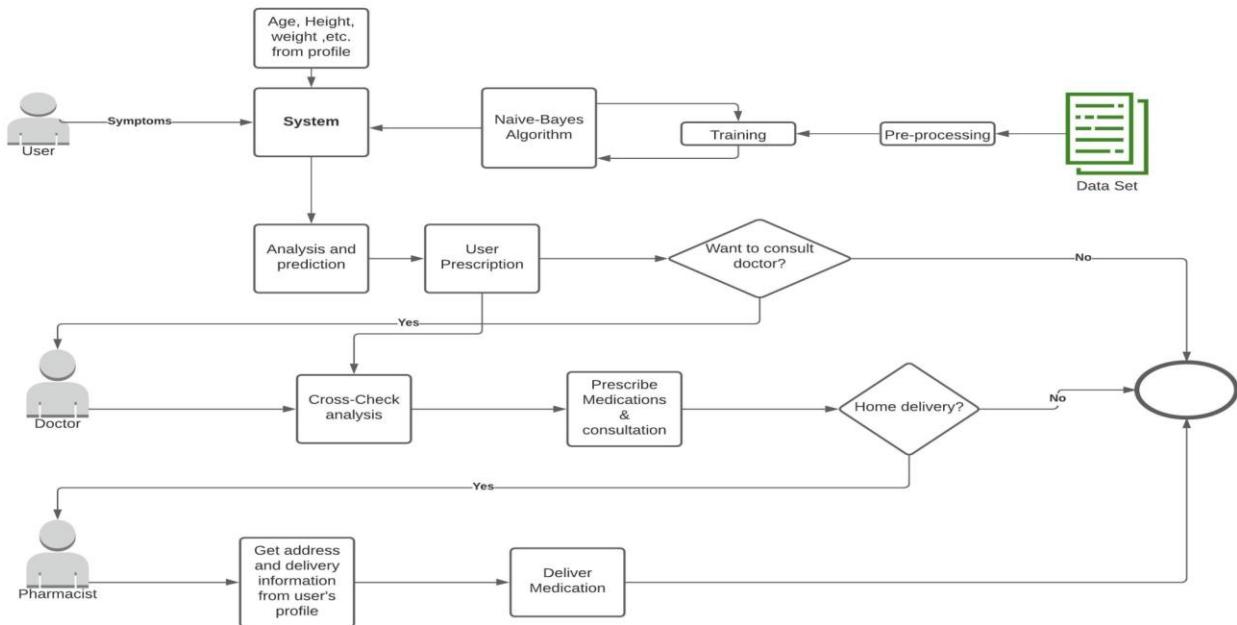


Fig: 3.3.2.1 System Flow Diagram

3.3.3 Architecture Diagram :

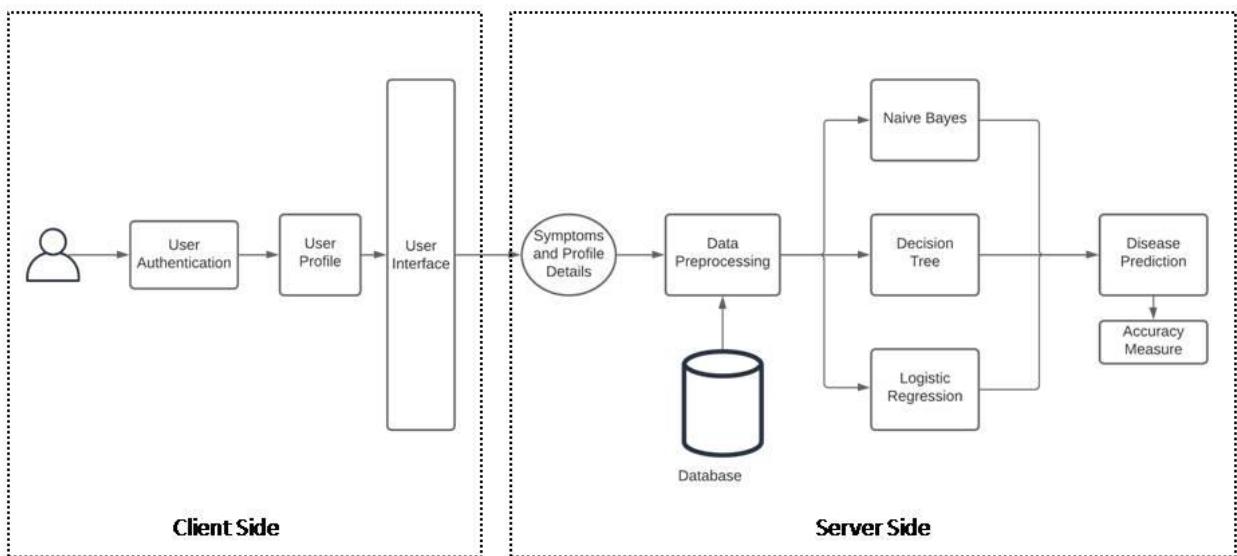


Fig: 3.3.3.1 Architecture Diagram

3.3.4 Activity Diagram :

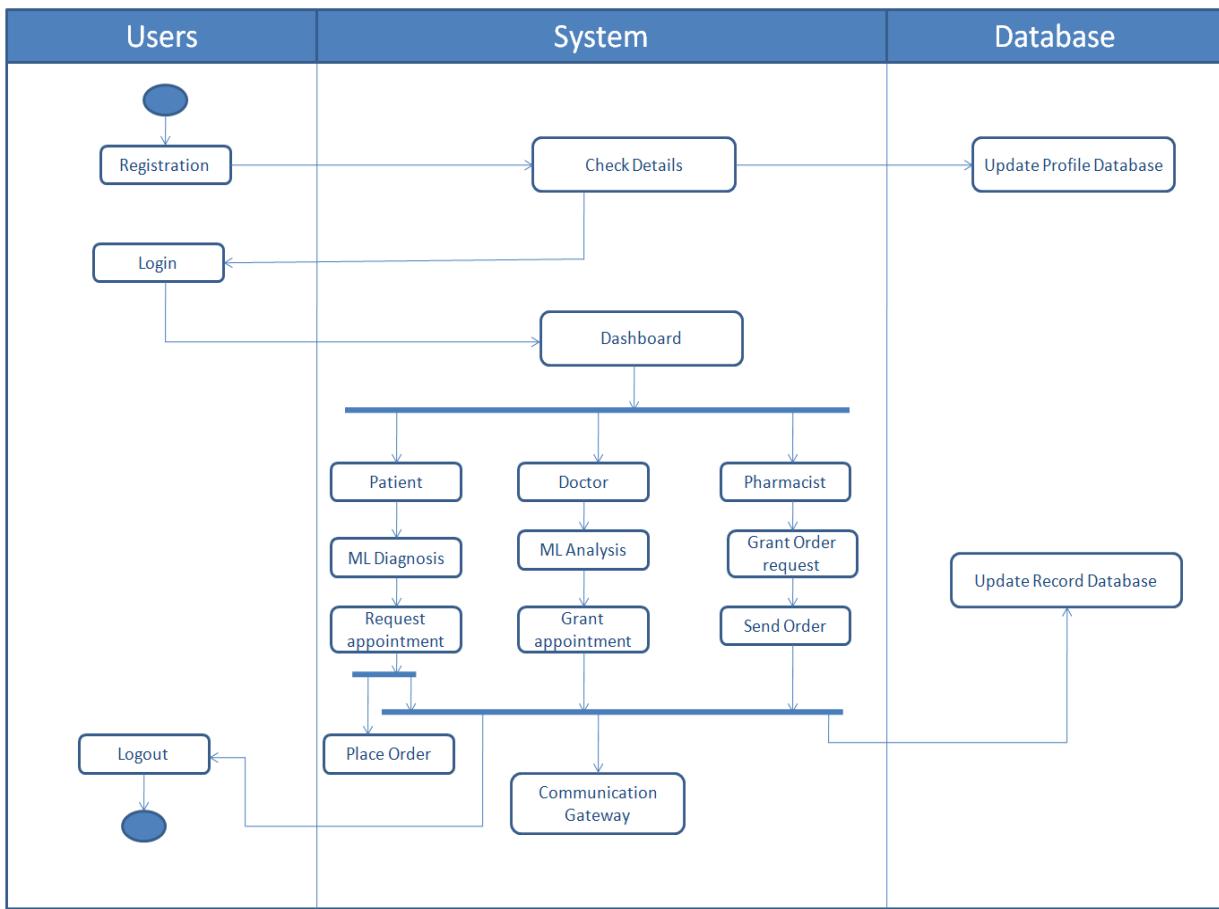


Fig : 3.3.4.1 Activity diagram

3.3.5 Sequence Diagrams :

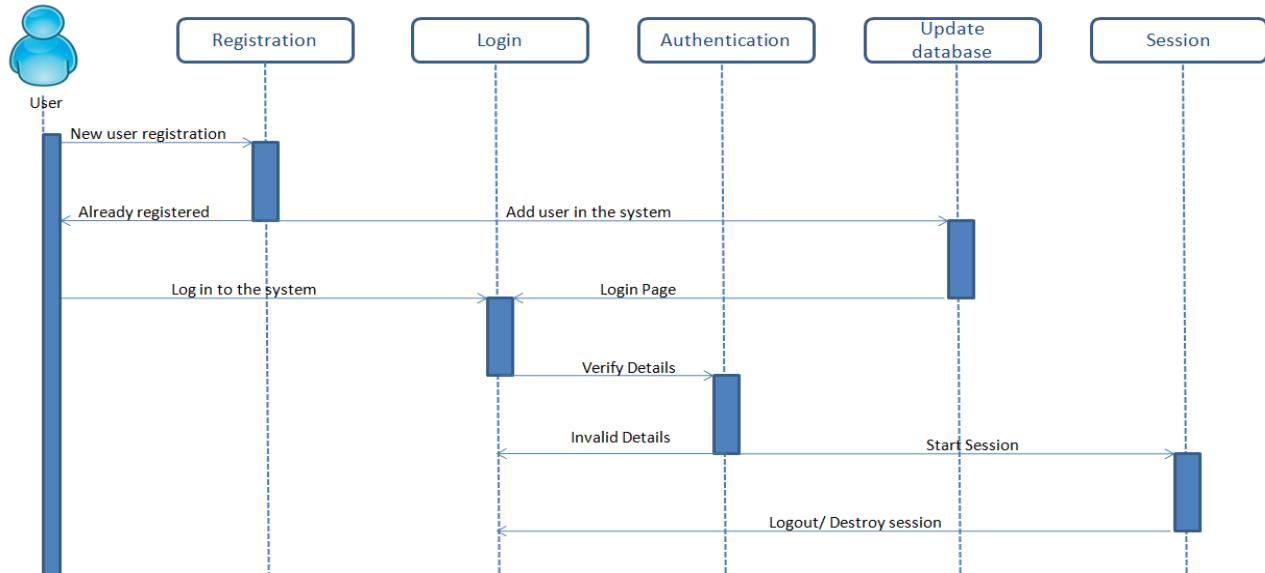


Fig : 3.3.5.1 Sequence Diagram for Login

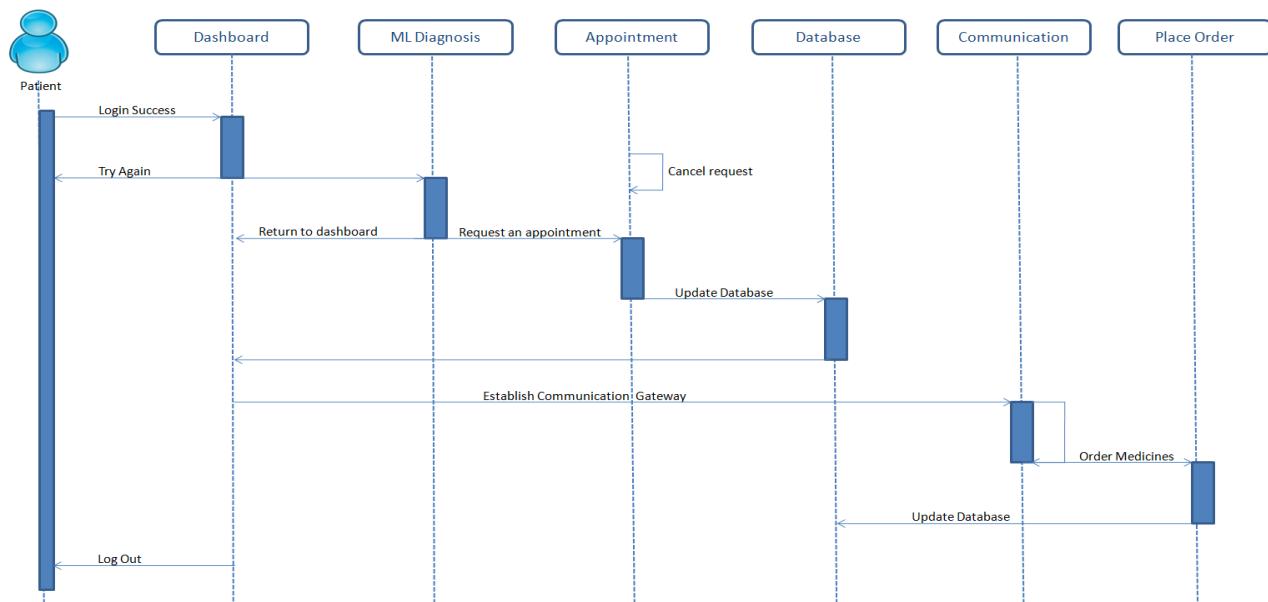
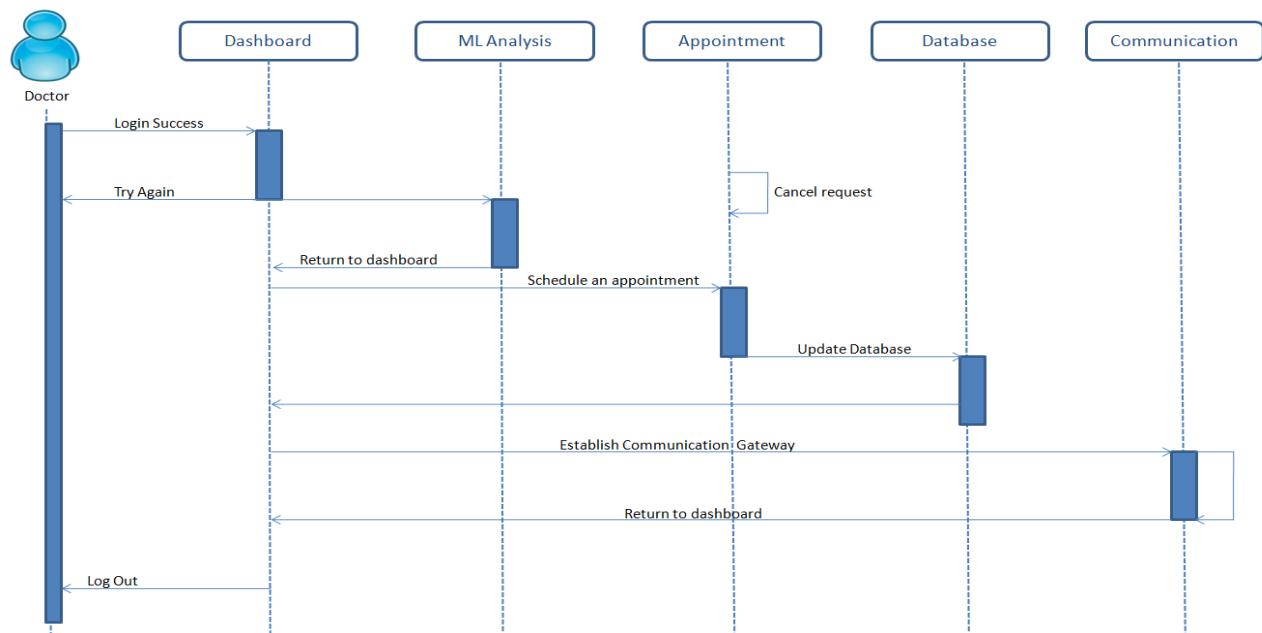


Fig : 3.3.5.2 Sequence Diagram for Patient

**Fig : 3.3.5.3 Sequence Diagram for Doctor**

3.3.6 Class Diagram:

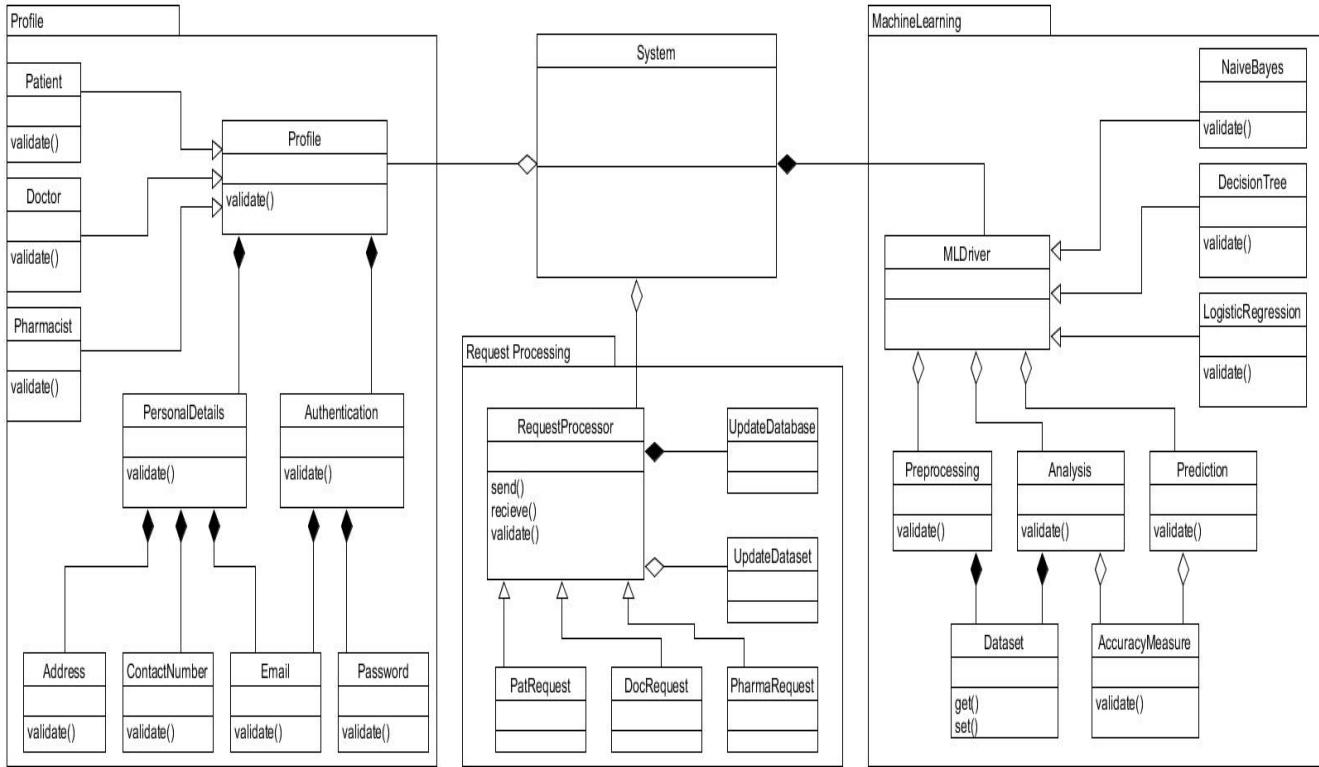


Fig : 3.3.6.1 Class Diagram

3.3.7 Deployment Diagram:

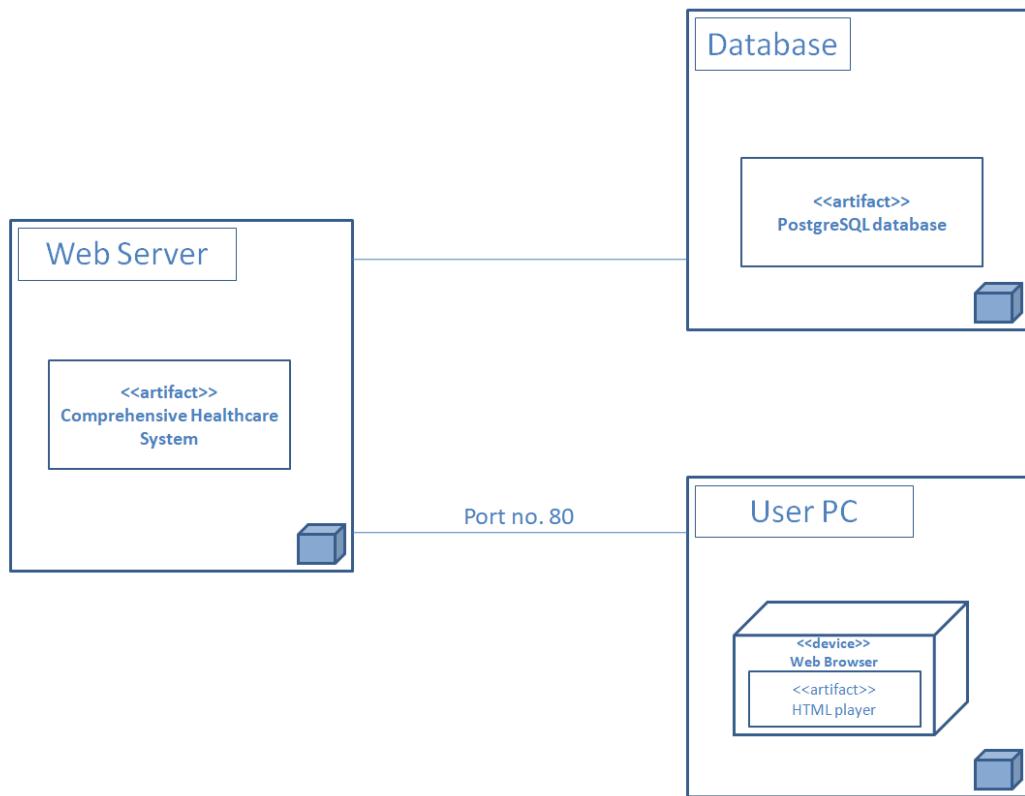


Fig : 3.3.7.1 Deployment Diagram

Chapter 4

Implementation and Coding

4.1 Introduction

The system has been developed using Python-Django Web Framework. This makes system highly scalable, versatile in nature. That encourages rapid development and clean, pragmatic design. The system has been thoroughly tested which makes it durable and powerful enough to withstand the dynamic changes. The database used is PostgreSQL, which provide high end support for python. It is also secure, reliable, powerful and very good features of internationalization. The frontend is developed using HTML, JavaScript, CSS. It also includes bootstrap and jQuery third party library to make frontend responsive.

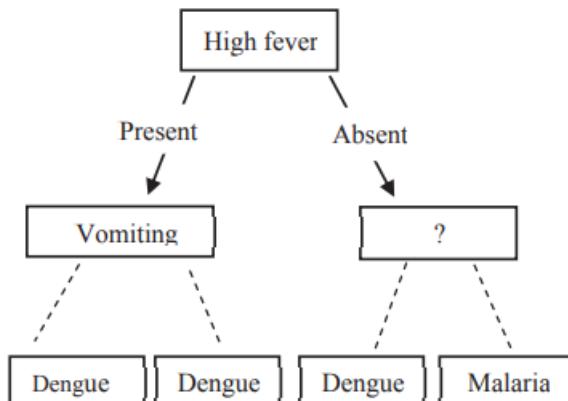
4.2 Operational Details

4.2.1 AI Diagnosis

This module can also be called as automated symptoms analysis and disease diagnosis. The main focus of this module is extracting the information from user. So, if user is not sure of the symptoms they may be experiencing; we have provided a questionnaire on the symptoms. Also, on each input from user system suggests 5 most probable symptoms using decision tree algorithm.

4.2.1.1 Decision Tree algorithm for symptoms suggestion

The classification models built by decision tree resemble the structure of tree. By learning the series of explicit if-then rules on feature values (symptoms in our case), it breaks down the dataset into smaller and smaller subsets that results in predicting a target value(disease).



4.2.1.1 Decision Tree Example

A decision tree consists of the decision nodes and leaf nodes.

- **Decision node:** Has two or more branches. In our work presented, all the symptoms are considered as decision nodes.
- **Leaf node:** Represents the classification that is, the Decision of any branch. Here the Diseases correspond to the leaf nodes.

After reducing to smallest dataset entropy is each symptom is calculated to get top 5 symptoms for user suggestion.

4.2.1.2 Disease Prediction:

The system predicts the disease based on user input i.e. symptoms. The system filters the previously available dataset based on given input and considers only the relevant data for training. Hence, changing dataset leads to changing accuracies of algorithms. The system uses 3 algorithms Naïve Bayes, K-Nearest Neighbors, and Decision tree classifier for training. And shows user data of most accurate result. The accuracy of these algorithms differ from 70%-100%.

4.2.1.2.1 Naïve Bayes Algorithm:

Naïve Bayes algorithm is based on Bayes theorem given by:

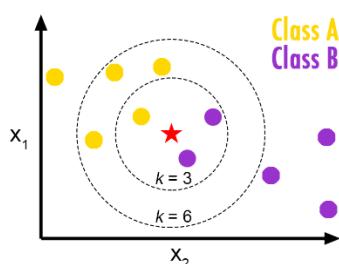
$$P(s/h) = \frac{P(h/s)P(s)}{P(h)}$$

In the formula above ‘s’ denotes class and ‘h’ denotes features. In $P(h)$, the denominator consists the only term that is a function of data(features)- it is not a function of the class we are currently dealing with. Thus, it will be same for all the classes. Traditionally in naïve Bayes Classification, we ignore this denominator as it does not affect the result of the classifier in order to make the prediction:

$$P(s/h) \propto P(h/s)P(s)$$

4.2.1.2.2 K-Nearest Neighbors

The KNN algorithm finds the K nearest records from available data. As dataset is variable the value of k is determined dynamically. And the diseases with highest number records in these k records has high probability and with lowest records has low probability.



4.2.1.2.2.1 Generalized example of KNN

4.3 Code

4.3.1 Data Preprocessing

```
def datapreprocessing(st,columns):
    df=pd.read_csv(st,header=0,
                  usecols=columns)
    indices=list(df.index[(df.T!=0).any()])
    df=pd.read_csv(st,header=0)
    df=df.iloc[indices]
    df=df.loc[:, (df!= 0).any(axis=0)]

    inp=[]
    for i in df.columns:
        if i in columns:
            inp.append(1)
        else:
            inp.append(0)
    return df,inp[:-1]
```

4.3.2 Naïve Bayes Algorithm

```
def naive_baues(df,inp):
    firstdic={}
    dfl=len(df)
    probsum=0
    for s in df.iloc[:, -1].unique():
        dis=df.loc[df['prognosis']==s]
        dis=dis.iloc[:, :-1]
        dislen=len(dis)
        pdis=[]
        flag=0
        for i in dis:
            count=0
            for j in dis[i]:
                if(j==inp[j]):
                    count+=1
            if(count==0):
                flag=1
```

```
pdis.append(count)
final_prob=1
asach=0
# print(s)
if(flag==0):
    for i in range(len(pdis)):
        x=pdis[i]/dislen
        final_prob*=x

    else:
        dislen+=1
        for i in range(len(pdis)):
            x=(pdis[i]+1)/dislen
            final_prob*=dislen/dfl
            firstdic[s]=final_prob
            probsum+=final_prob
firstdic=dict(sorted(firstdic.items(),
                     key=operator.itemgetter(1),
                     reverse=True))
print(firstdic)

return firstdic
```

4.3.3 K-Nearest Neighbors

```
def knn(countdic,ans,k):
    anslen=0

    for key,v in countdic.items():
        v=dict(sorted(v.items(),
                      key=operator.itemgetter(1),
                      reverse=True))
        total=0
        for i in v.values():
            total+=i
        unique=list(v.keys())
        if(total+anslen<=k):
```

```

for s in unique:
    ans[s]+=v[s]
    v[s]=0
    anslen+=total
else:
    while(anslen<k):
        diff=(k-anslen)//len(unique)
        if(diff==0):
            for i in range(k-anslen):
                if(v[unique[i]]>0):
                    ans[unique[i]]+=1
                    v[unique[i]]-=1
                    anslen+=1
                else:

```

```

for s in unique:
    if(v[s]>=diff):
        v[s]-=diff
        ans[s]+=diff
        anslen+=diff
    else:
        ans[s]+=v[s]
        anslen+=v[s]
        v[s]=0
        if(anslen>=k):
            break
    ans=dict(sorted(ans.items()
, key=operator.itemgetter(1), reverse=True))
return ans

```

Chapter 5

Results and Discussion

5.1 Result

The system was trained on dataset having 133 different symptoms and 42 diseases. Although the dataset does not remain constant, we update the dataset constantly by verifying the user diagnosis records. The system filters the relevant symptoms from overall dataset based on user input. Three algorithms such as Decision Tree Classifier, Naïve Bayes Algorithm, K-Nearest Neighbors are implemented.

Table 5.1.1: Algorithm Accuracy

Algorithms Used	Overall accuracy score
Naïve Bayes Algorithm	97%
K-Nearest Neighbors	95%
Decision Tree Classifier	90%

The accuracy score of algorithms were calculated by comparing the result of prediction with the testing dataset.

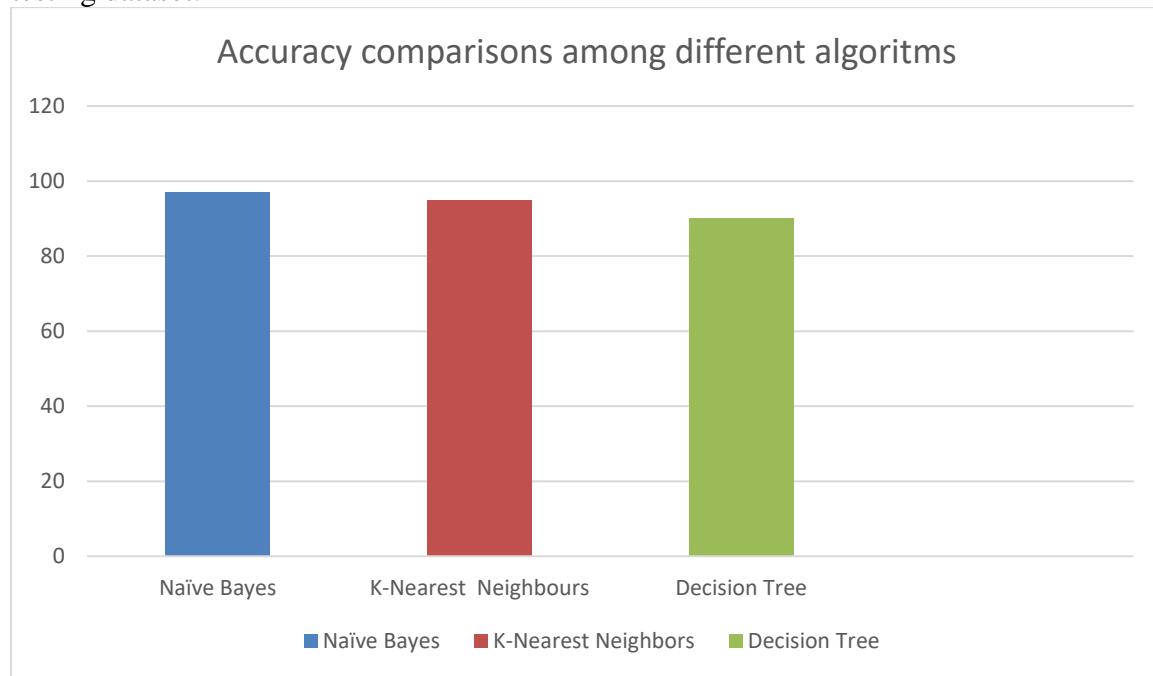


Fig 5.1.1: Accuracies of algorithms

5.2 Snapshots of User Interface

5.2.1 Home page

CHS

Health is wealth keep it healthy

Almost before we knew it, we had left the ground

Take a Service

Create A Healthy Life You Love!

Sometimes we need the help of doctors, but due to our helter-skelter lifestyle we choose to ignore it or

Take a Service

Virtual Health Advisor
Now you can avail any medical help in just one click. We are here to help you right from Consulting doctor to getting your medicines home delivery we do everything on the palm of your hand.

AI Diagnosis
Machines do everything now a days so why don't they provide a medical assistant. Well, we do that too! With modern machine learning algorithms we analyse symptoms.

Caboodle
So as you have got an idea till now we do everything! Right from keeping your medical history to provide you one click medical assistant so ya, the whole kit and caboodle.

5.2.2 About page:

What is Comprehensive Healthcare System?

Almost before we knew it, we had left the ground



[Home](#) [About](#)

[Login](#)

Diagnose Yourself With High End



Artificial Intelligence & Machine learning

This has given us more power!
Believe us, Machines comprehend much faster than humans..



Naive-Bayes

Uses the probabilistic computations involved in Naive-Bayes classification to predict & analyze the likelihood of your diseases.



K-Nearest Neighbours

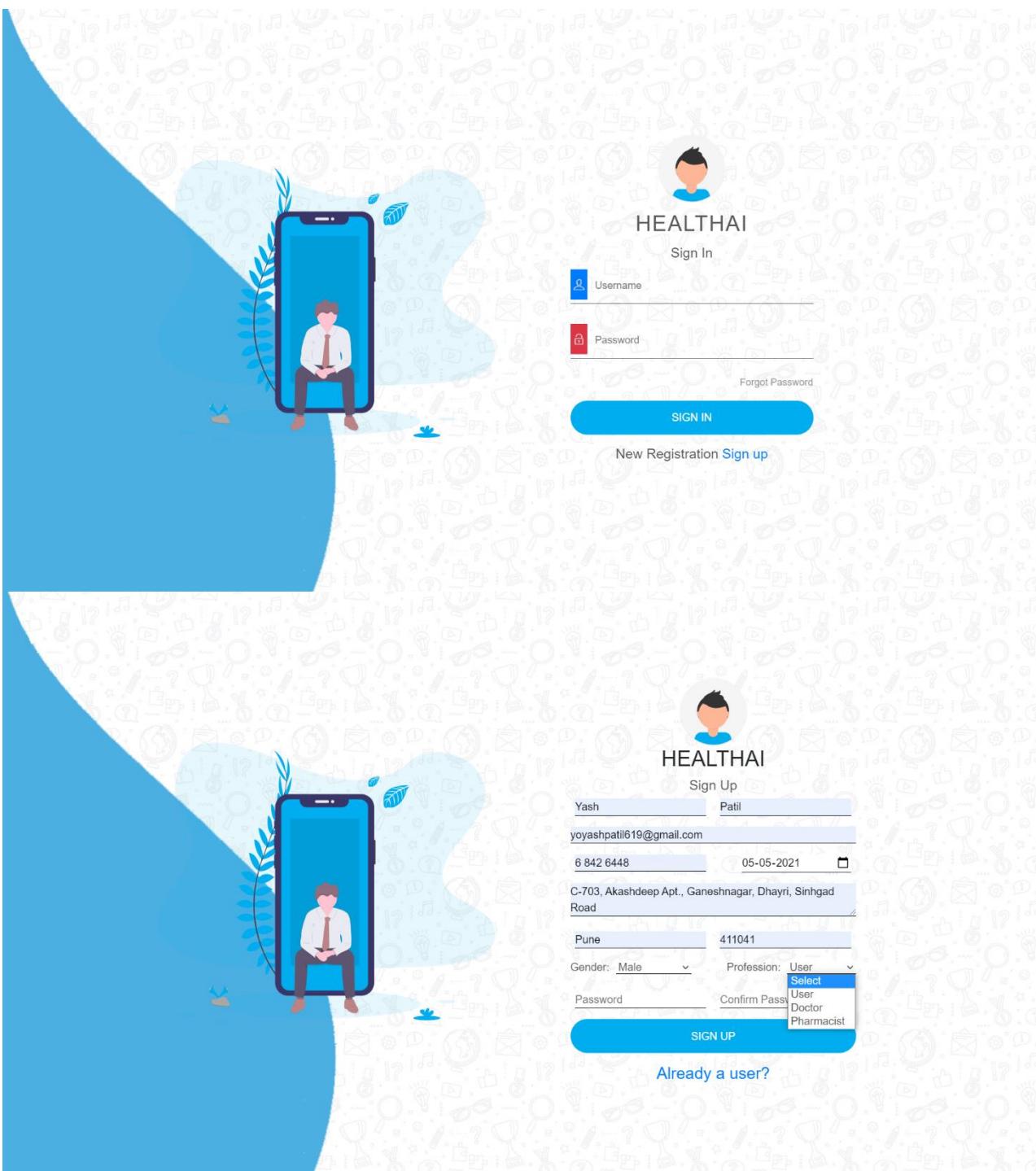
Pretty much like real life!
Compares your symptoms & tries to find its Neighbours to provide you apt analysis!



Decision Tree

Well, the system will make certain decisions for you using magic of the decision tree which certainly you won't be able to see :P!

5.2.3 Login and Signup

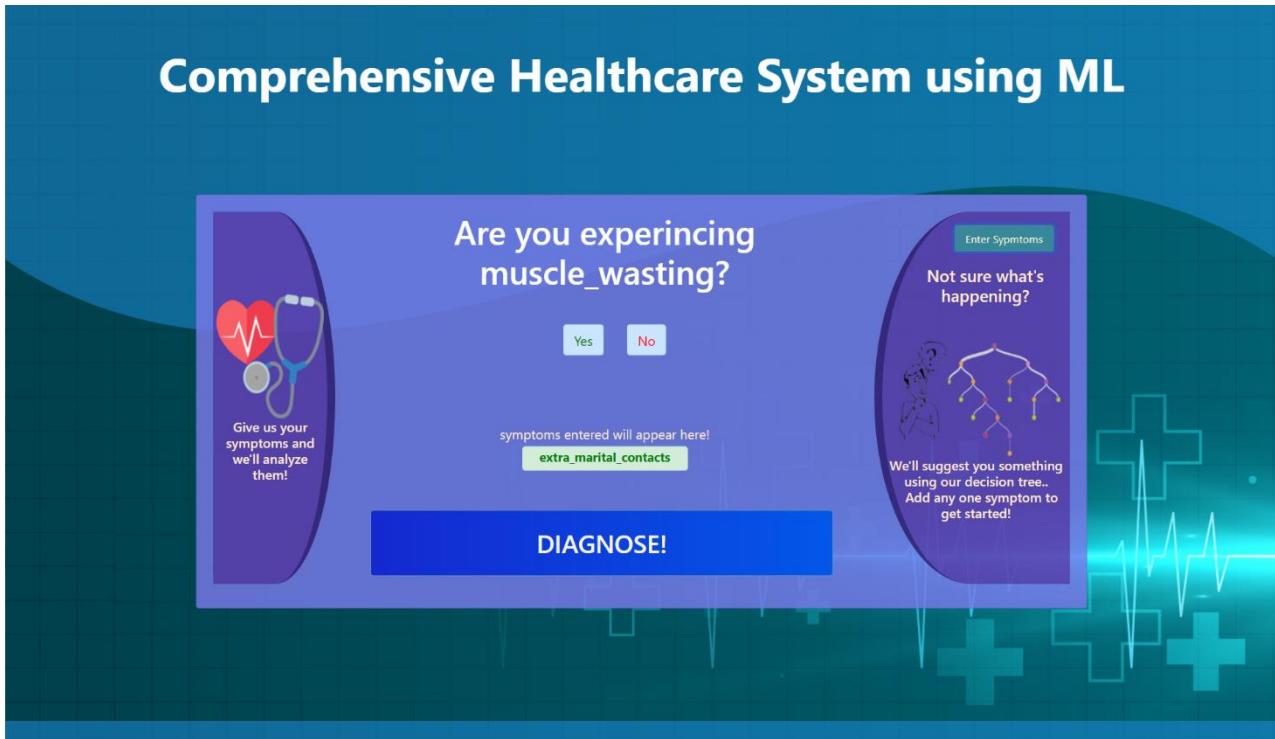


5.2.4 User Dashboard:

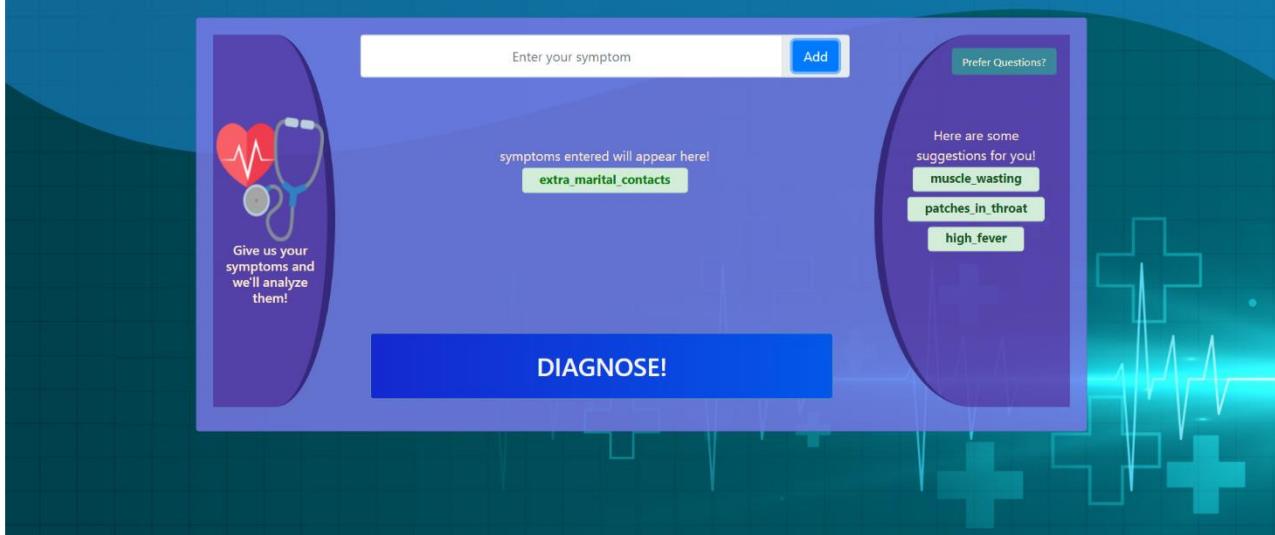
The dashboard features a top navigation bar with the CHS logo, a user icon, and a three-dot menu. On the left is a sidebar with links: Dashboard (selected), Appointments, My Orders, Analysis, Profile, Chat, and Calendar. The main area starts with a greeting "Hello, Yash" and a message "What Do we say to God Of Death ? Not Today!!!". Below this is a "What's New !!!" section with a blue header and a central graphic showing a document with charts and icons (handshake, person, brain, etc.) connected by dashed lines. The text "8 Mental Health Infographics to Raise Awareness" is displayed below. To the right are four cards: "Total Bookings" (New Appointment), "Total Appointments" (My Appointments), "Dignose Here" (AI Diagnosis), and "Chat Here" (Contact with Doctor). At the bottom left is a copyright notice: "Copyright © Project Group 37 Sinhgad College Of Engineering (Computer Department). All rights reserved." and a gear icon at the bottom right.

5.2.5 AI Diagnosis:

The interface has a dark blue header with the text "Comprehensive Healthcare System using ML". The main area has a purple rounded rectangle containing a stethoscope and a heart icon. Text inside says "Give us your symptoms and we'll analyze them!". Above it is a search bar with "Enter your symptom" placeholder and an "Add" button. Below the search bar is a text box with the placeholder "symptoms entered will appear here!". At the bottom is a large blue button labeled "DIAGNOSE!". To the right is a circular callout with a person icon and the text "Not sure what's happening?". Inside the callout is a decision tree diagram with nodes and branches. Text inside says "We'll suggest you something using our decision tree.. Add any one symptom to get started!". The background features a grid pattern and several green plus signs.



Comprehensive Healthcare System using ML

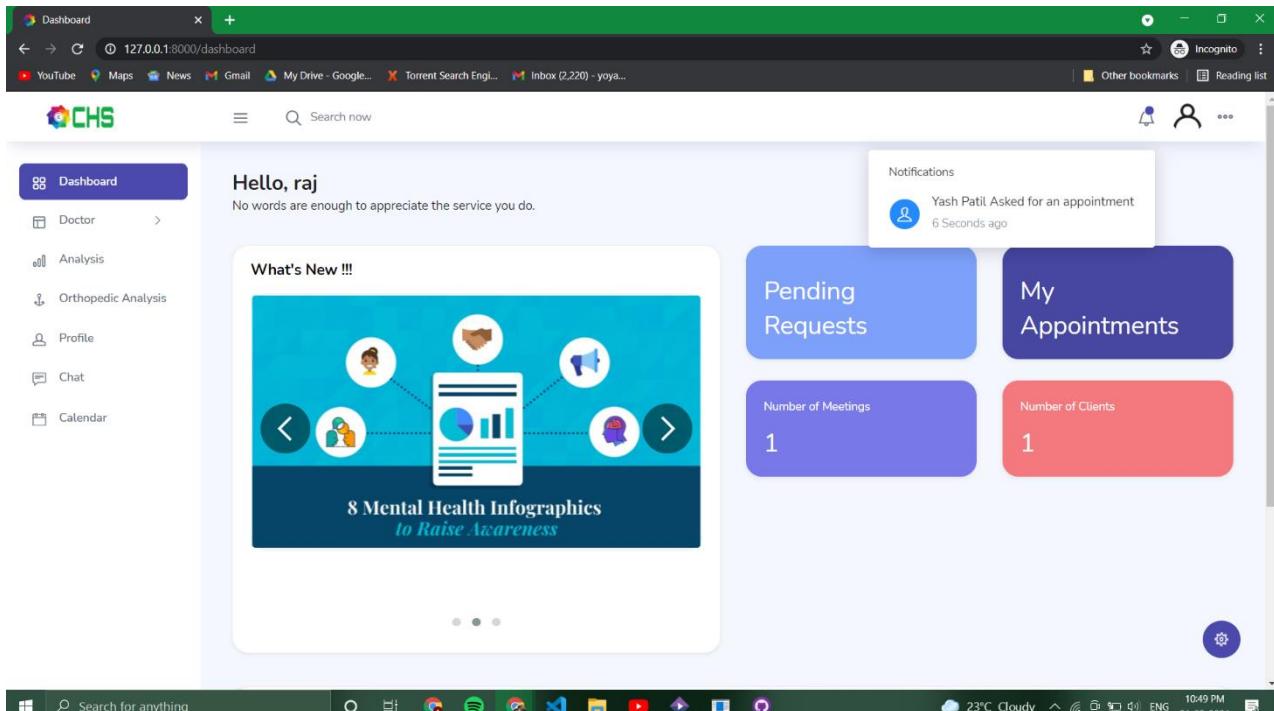
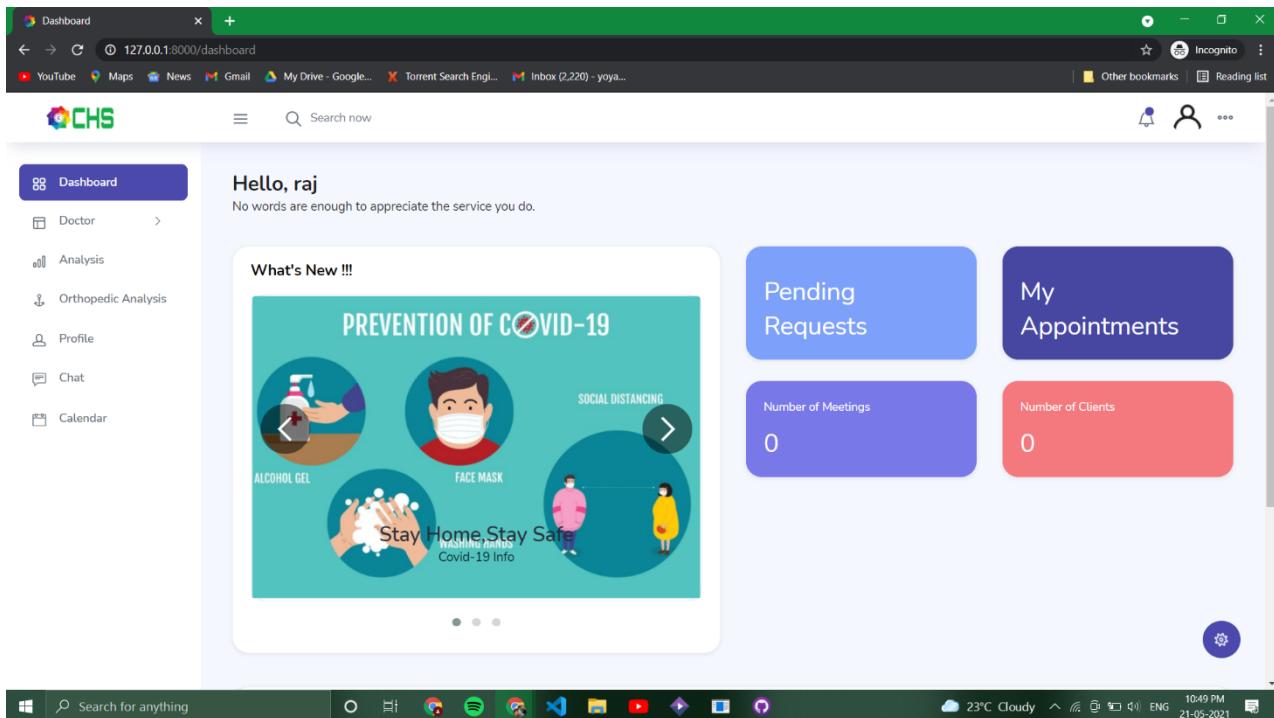


5.2.6 Diagnosis Result:

The screenshot shows a medical dashboard interface. On the left, a sidebar menu includes 'Dashboard' (selected), 'Appointments', 'My Orders', 'Analysis', 'Profile', 'Chat', and 'Calendar'. The main content area displays a diagnosis result: 'You have been diagnosed with AIDS'. It states that the system has chosen a Naive Bayes Classifier with 100% accuracy. The symptoms listed are 'extra_marital_contacts'. Below this, there are three buttons: 'Diagnose again', 'Consult Doctor', and 'Dashboard Home'. A pie chart indicates 100% probability for 'AIDS'. To the right, a section titled 'You might also have' lists 'AIDS' with a probability of 100.0%. At the bottom, three classifier cards are shown: 'Naive Bayes Classifier' (Accuracy: 100%), 'K Nearest Neighbors' (Accuracy: 100%), and 'Decision Tree Classifier' (Accuracy: 100%). A progress bar at the bottom left shows 'Waiting for 127.0.0.1...'.

This screenshot shows a medical dashboard with a different layout. At the top, there's a header with the 'CHS' logo, a search bar, and user icons. Below the header, three classifier cards are displayed in a green-bordered box: 'Naive Bayes Classifier' (Accuracy: 100%, 'AIDS' diagnosis), 'K Nearest Neighbors' (Accuracy: 100%, 'AIDS' diagnosis), and 'Decision Tree Classifier' (Accuracy: 100%, 'AIDS' diagnosis). Below these cards is a large pink box containing links to 'WebMD' and other health resources, as well as a list of 'Common Conditions' including ADD/ADHD, Allergies, Arthritis, and Cancer.

5.2.7 Doctor Dashboard

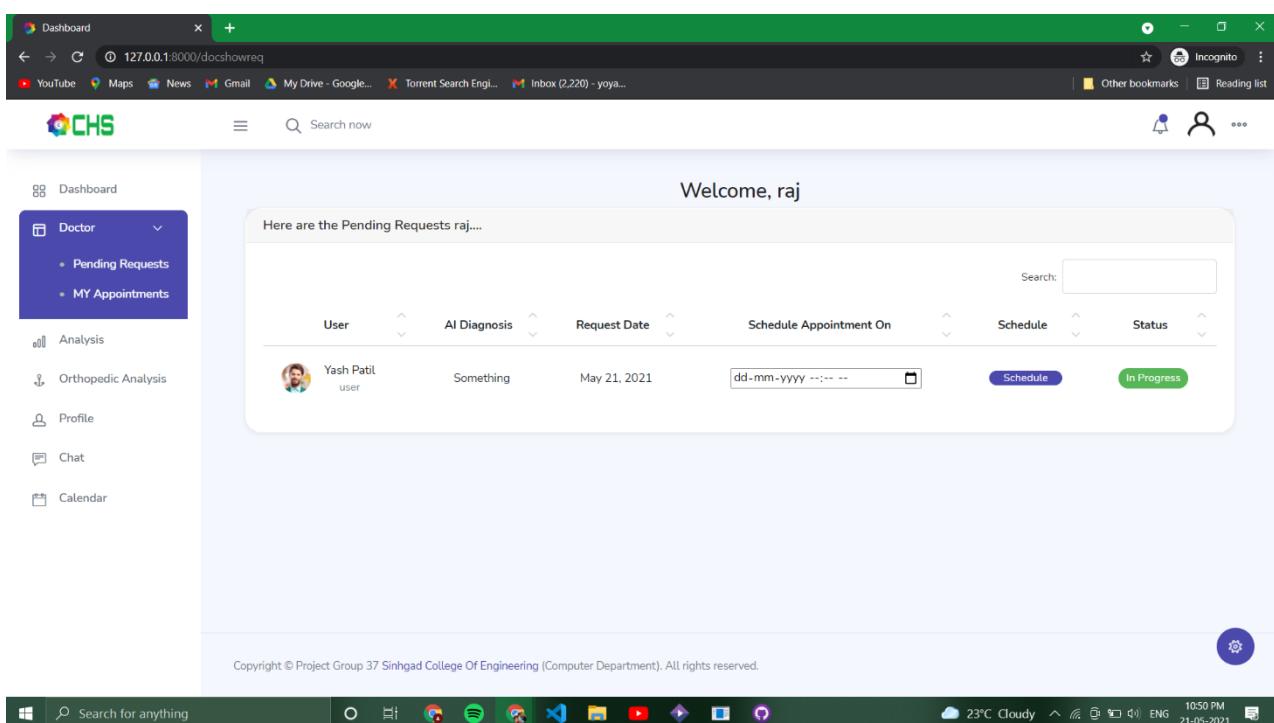
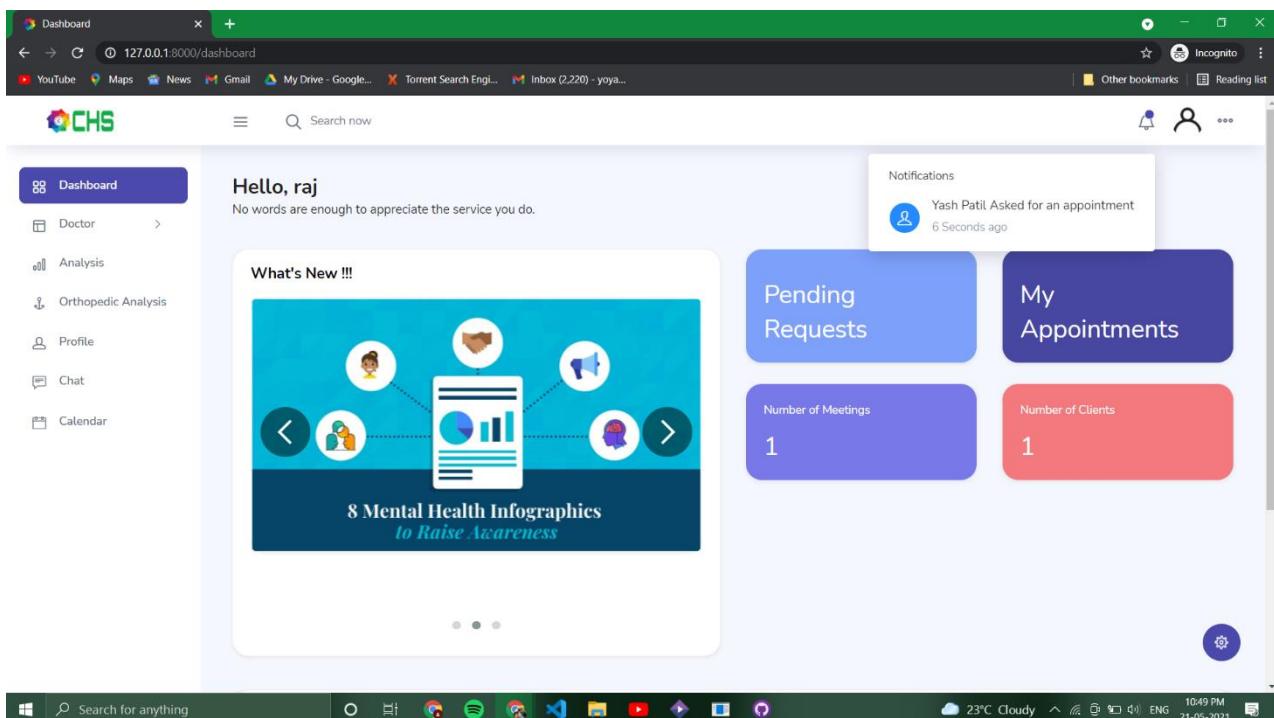


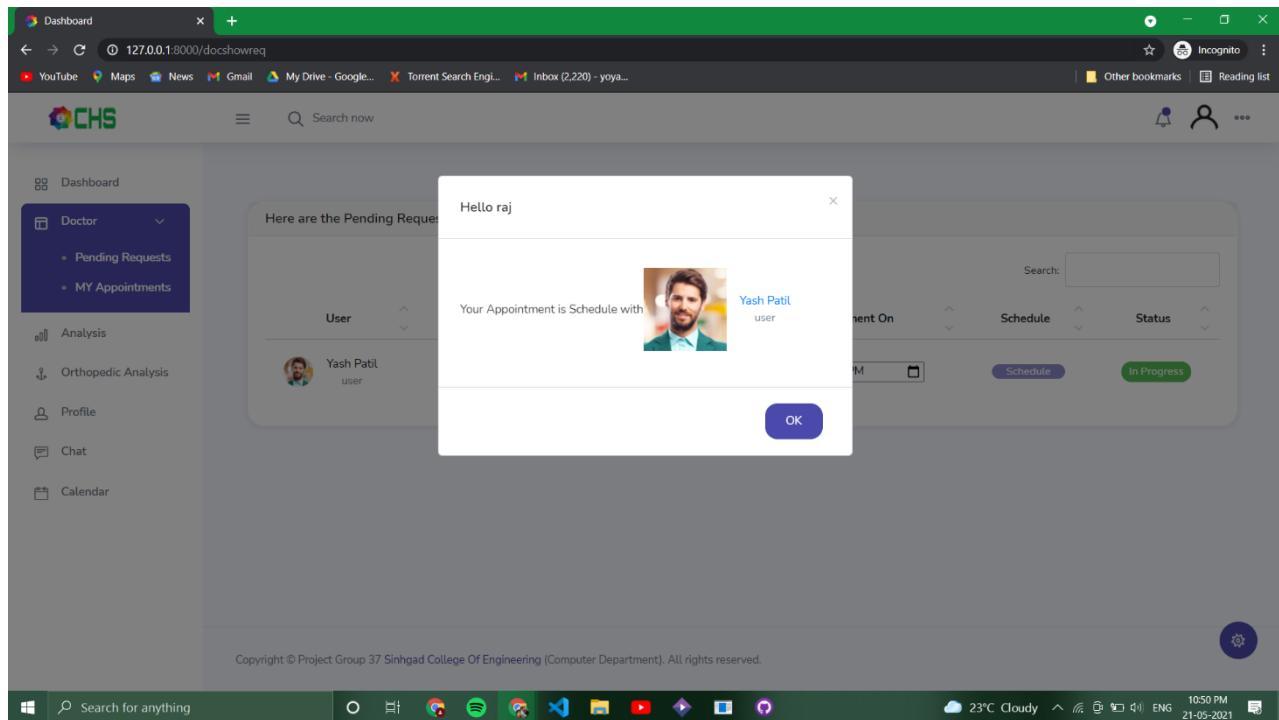
5.2.8 User request Doctor appointment

The screenshot shows the CHS application's user interface. On the left, there is a sidebar with various options: Dashboard, Appointments (New, In process, Completed), My Orders, Analysis, Profile, Chat, and Calendar. The main content area displays a message 'Hello, Yash' and a search bar with placeholder 'Enter City'. Below this, a doctor profile card is shown for 'raj Patil' (raj@gmail.com, Pune). The profile includes an average rating of 0/5 stars. Two buttons are present: 'Request' and 'Profile'. At the bottom of the page, a copyright notice reads 'Copyright © Project Group 37 Sinhgad College Of Engineering (Computer Department). All rights reserved.'

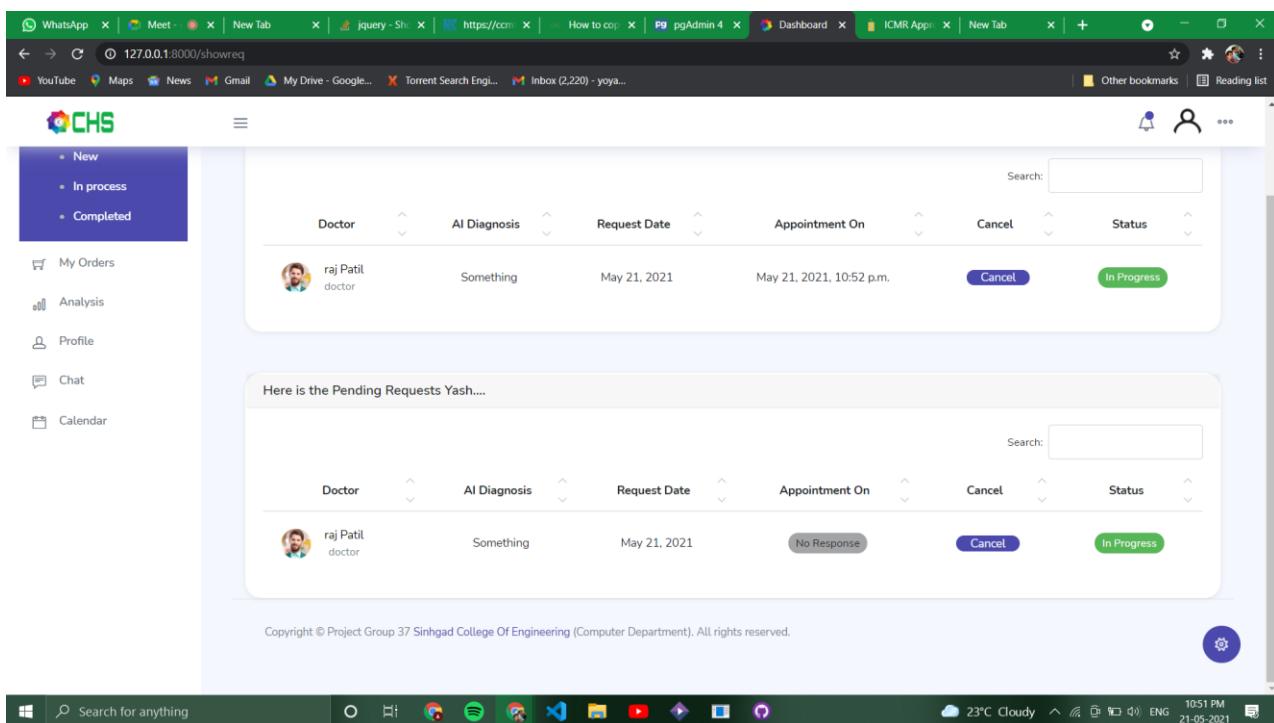
This screenshot shows the same application interface as the previous one, but with a modal dialog box in the center. The dialog is titled 'Confirmation' and contains the question 'Do You want to ConFirm Your Request?'. It has two buttons at the bottom: 'OK' and 'Cancel'. The background of the application is dimmed, indicating it is waiting for a user response.

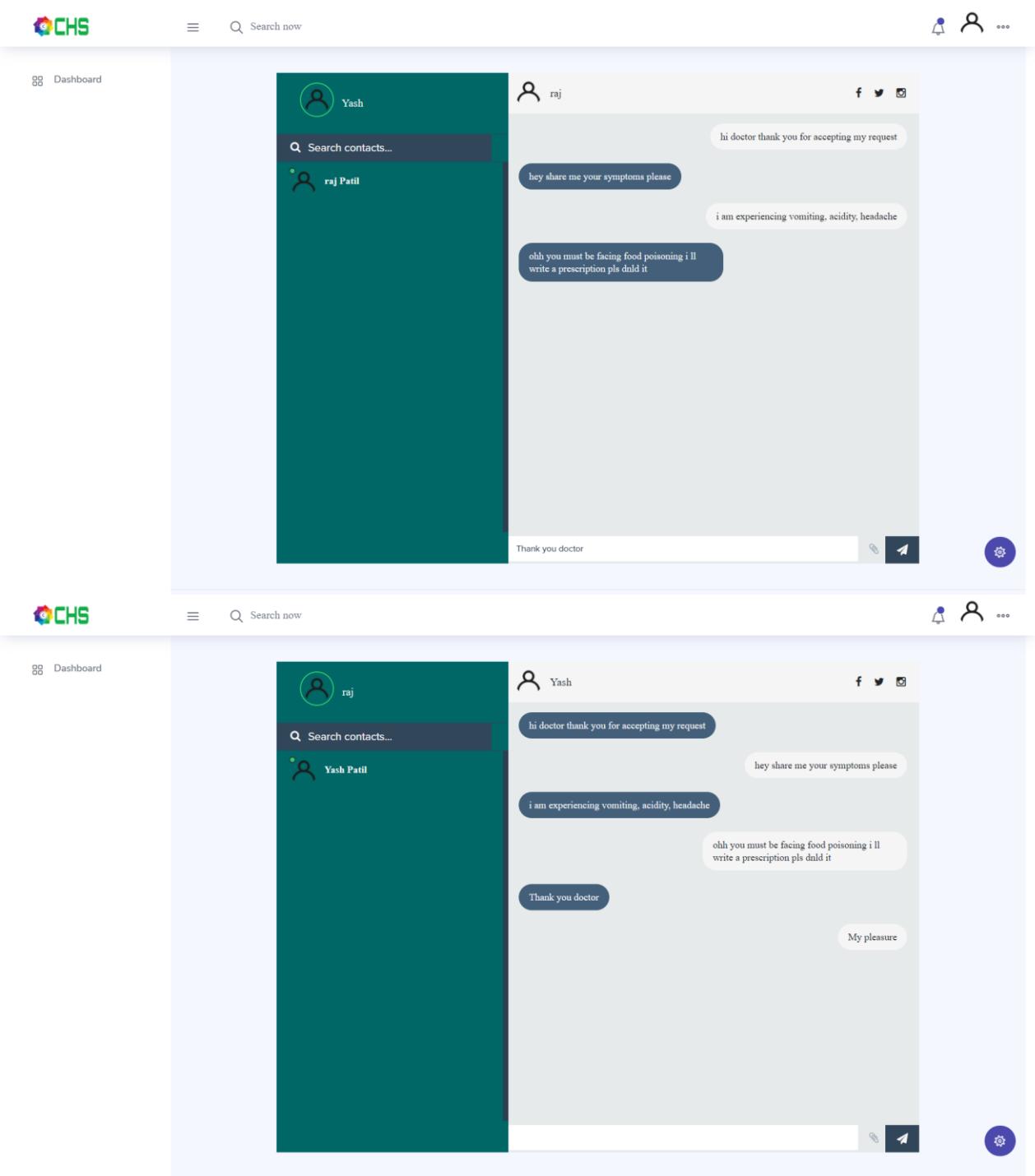
5.2.9 Doctor schedules appointment





5.2.10 User attends the appointment





5.2.11 Doctor Writes prescription after appointment

The screenshot displays a medical application interface with two main sections: a chat window on the right and a prescription form on the left.

Chat Window (Top Right):

- Sender: Yash (Profile picture: green circle)
- Text: "hi doctor thank you for accepting my request"
- Sender: raj (Profile picture: blue circle)
- Text: "hey share me your symptoms please"
- Text: "i am experiencing vomiting, acidity, headache"
- Text: "ohh you must be facing food poisoning i ll write a prescription pls dnd it"
- Text: "Thank you doctor"
- Text: "My pleasure"

Prescription Form (Bottom Left):

Prescription HERE

Prescription Details:

- Name: Yash Patil
- Email address: yoyashpatil619@gmail.com

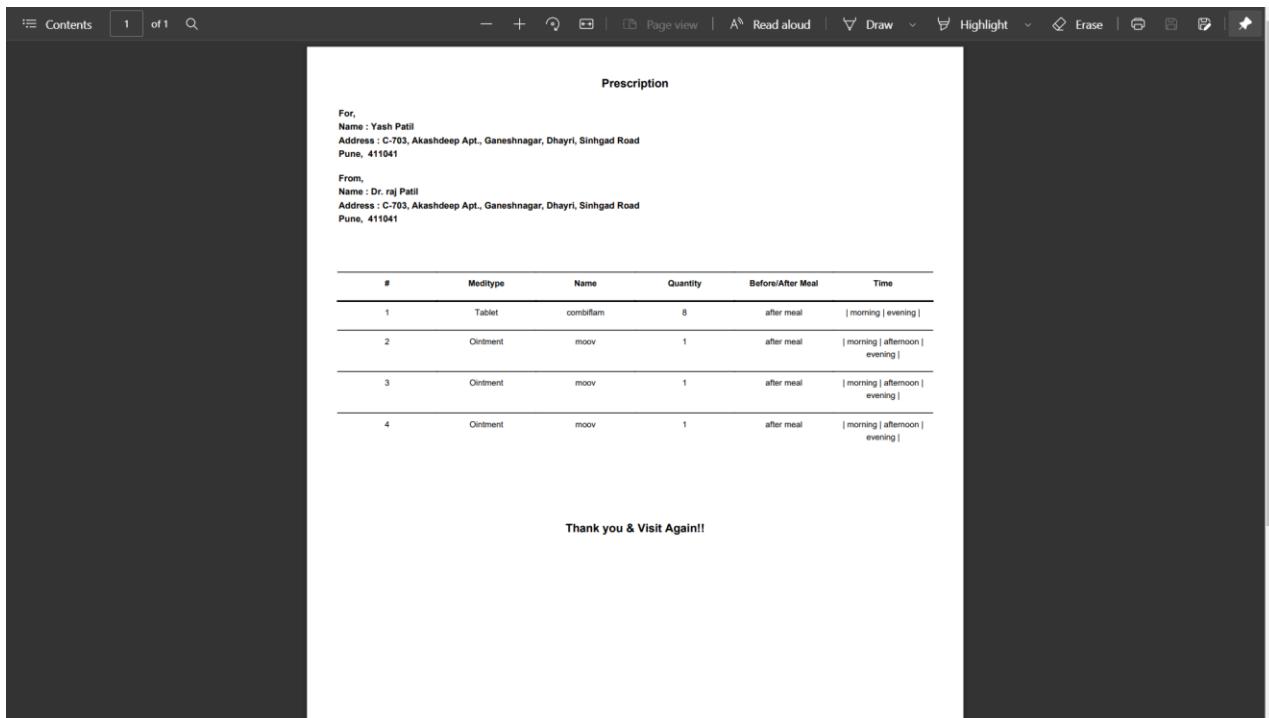
Prescription Table:

Sr NO.	Type	Name	Quantity	Before/After Meal	Time
1	Tablet	combiflam	8	<input type="radio"/> Before <input checked="" type="radio"/> After	M A E
2	Ointment	moov	1	<input type="radio"/> Before <input checked="" type="radio"/> After	M A E

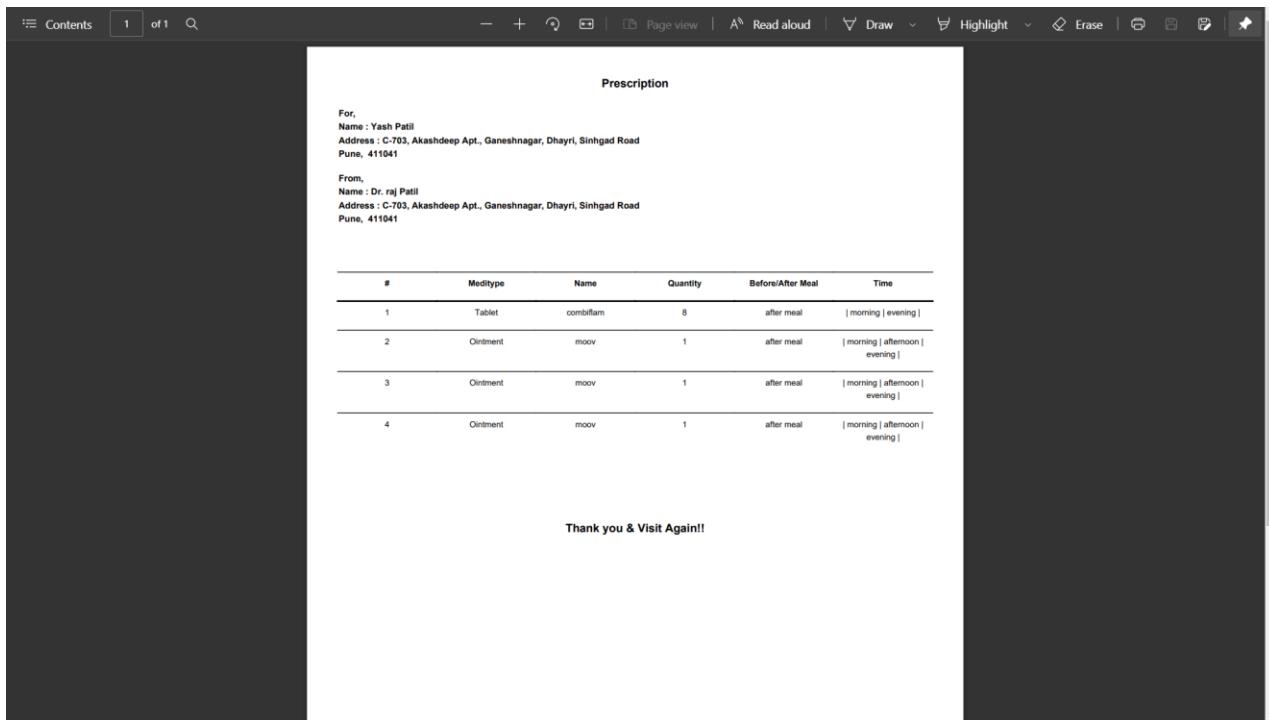
Buttons:

- Submit
- Cancel
- ADD

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5.2.12 User can write doctor feedback and down lad prescription



Feedback Form

A feedback form to improve our services.

Dear Yash,

Thank you for using our system we would like to know your experience. You can rate your experience on the scale of 1 to 5 on the form below you can read doctors as well as pharmacist after getting their service or

How Would like to rate Dr. raj Patil?

Comments About Doctor :

[Submit your review](#)
|
[Cancel](#)

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Feedback Form

A feedback form to improve our services.

Dear Yash,

Thank you for using our system we would like to know your experience. You can rate your experience on the scale of 1 to 5 on the form below you can read doctors as well as pharmacist after getting their service or

How Would like to rate Dr. raj Patil?

Comments About Doctor :

Excellent doctor

Submit your review Cancel

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5.2.13 Order the prescribed medicine

WhatsApp | Meet - | New Tab | jquery - Sh | https://com | How to co | pg pgAdmin 4 | Dashboard | ICMR App | New Tab | + | - | ○ | ○ 127.0.0.1:8000/completedreq | YouTube | Maps | News | Gmail | My Drive - Google... | Torrent Search Engli... | Inbox (2,220) - yoya...

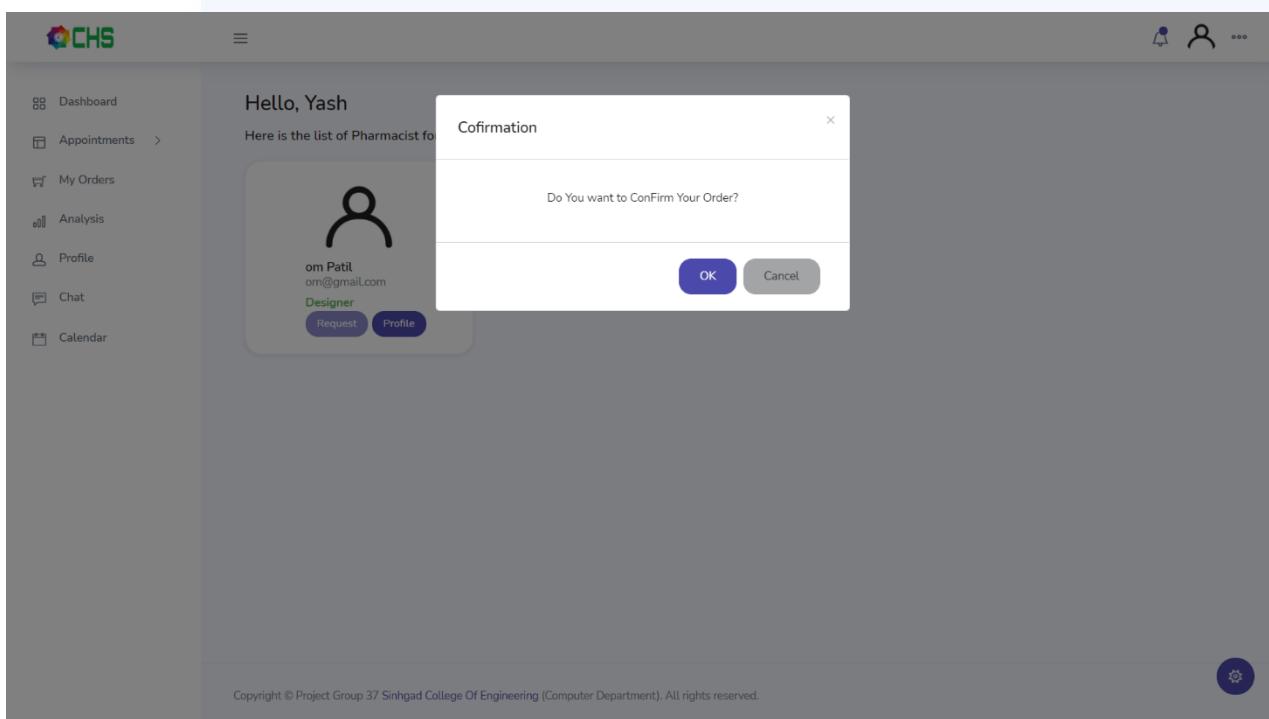
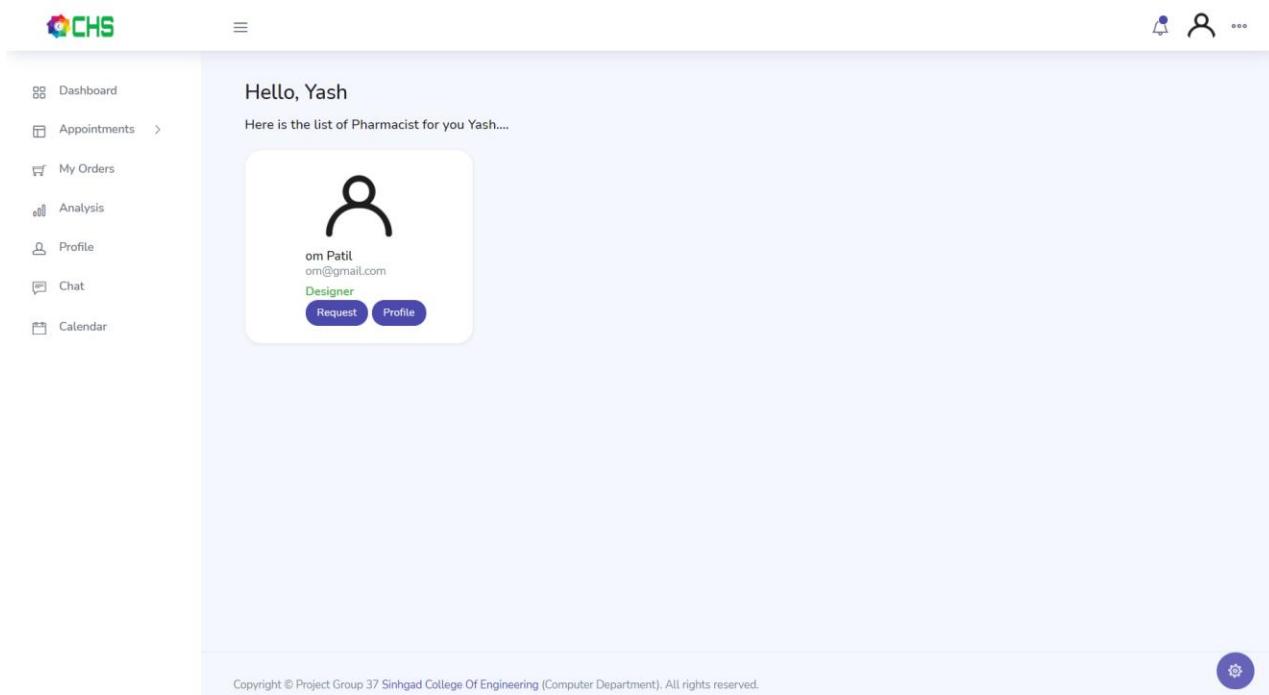
Hello, Yash

Here are the Completed Appointments Yash....

Doctor	Appointment was On	Status	Prescription	Order	Feedback
raj Patil doctor	May 21, 2021, 10:52 p.m.	Completed	Show	order	Feedback

Search:

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5.2.14 Pharmacist Schedules the delivery

The screenshot shows a web-based pharmaceutical application interface. At the top left is the logo 'CHS'. The top right features a search bar and user profile icons. A sidebar on the left includes links for Dashboard, ORDERS (with sub-options for Pending Orders and Past ORDERS), Analysis, Profile, Chat, and Calendar.

The main content area starts with a greeting 'Hello, om' and a message: 'It is easy to get a thousand prescriptions, but hard to get one single remedy.' Below this is a 'What's New !!!' section featuring a teal-colored graphic titled 'PREVENTION OF COVID-19' with illustrations of handwashing, wearing a face mask, and social distancing, along with the text 'Stay Home Stay Safe Covid-19 Info'.

On the right side, there are four cards: 'Pending Orders' (blue background, 1 order), 'Past Orders' (dark blue background, 1 client), 'Total Orders' (purple background, 1), and 'Number of Clients' (red background, 1).

Below these sections is a table titled 'Your Current Appointments....' with columns for User, Address, Request Date, Expected Delivery, Prescription, Bill, and Status. A green header bar at the top of the table area displays the URL '127.0.0.1:8000/pharmashoworders'.

At the bottom of the page, there is a copyright notice: 'Copyright © Project Group 37 Sinhgad College Of Engineering (Computer Department). All rights reserved.' The bottom right corner shows a Windows taskbar with various icons and system status information.

5/21/2021

Press F11 to exit full screen

To,
Yash Patil
Pune.

Description

#	Meditype	Mediname	Quantity	Cost
1	Tablet	crosin	10	130
2	Tablet	aspirin	2	40
3	Ointment	moov	1	56

Sub - Total amount: 226
Other: 0
Total : 226

[Generate Bill](#)

CHS

Search now

Press F11 to exit full screen

Hello, om

Here are the In process Orders om....

User	Address	Request Date	Expected Delivery	Prescription	Bill	Cancel	Status
 Yash Patil user	Pune	May 21, 2021	May 22, 2021, 11:09 p.m.	Show	Bill	Cancel	In Process

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5.2.15 User can see bill after order confirmation

Dashboard > My Orders

Hello, Yash

Here is the In Process Orders Yash...

#	Pharmacist	Request Date	Expected Delivery Date	Prescription	Bill	Cancel
1	om Patil pharma	May 21, 2021	May 22, 2021, 11:09 p.m.	Show	Bill	Cancel

Search:

Here is the Pending Orders Yash....

#	Pharmacist	Request Date	Expected Delivery Date	Prescription	Cancel
1	om Patil pharma	May 21, 2021	No Response	Show	Cancel

Search:

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Dashboard > My Orders

Hello, Yash

Here is the In Process Orders Yash...

#	Pharmacist	Request Date	Expected Delivery Date	Prescription	Bill	Cancel
1	om Patil pharma	May 21, 2021	May 22, 2021, 11:09 p.m.	Show	Bill	Cancel
2	om Patil pharma	May 21, 2021	May 7, 2021, 11:13 p.m.	Show	Bill	Cancel

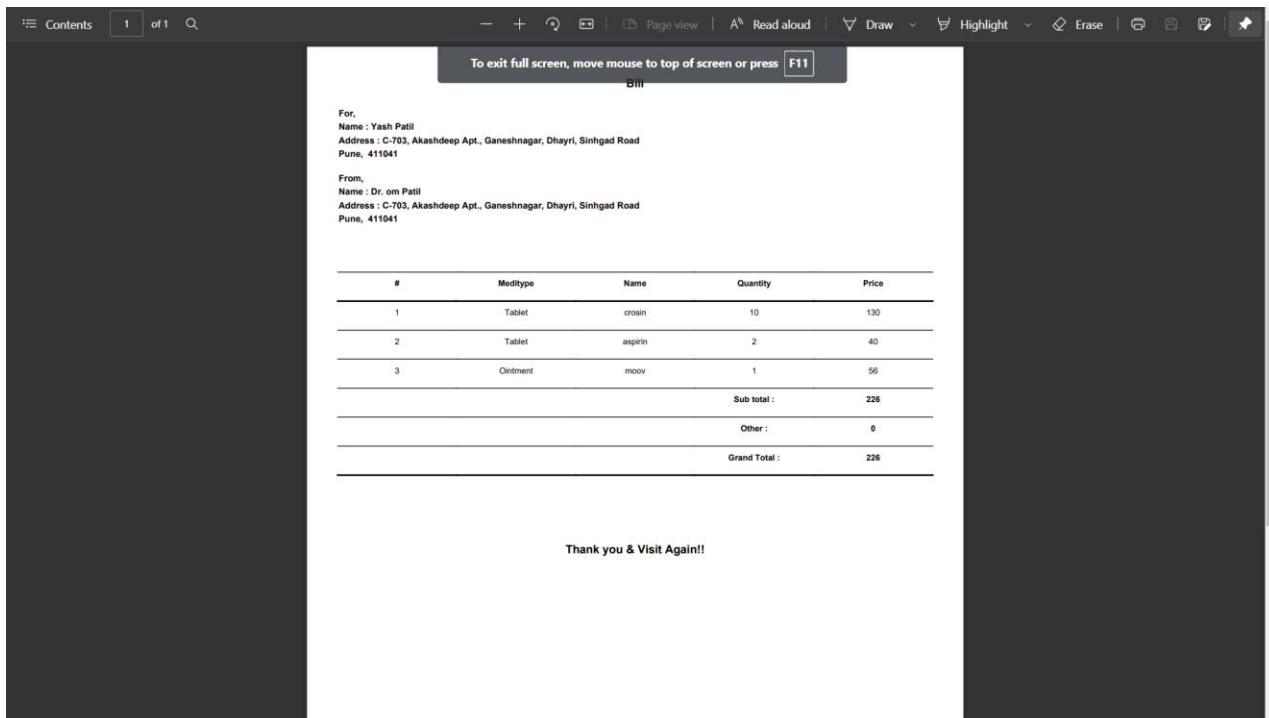
Search:

Here is the Pending Orders Yash....

#	Pharmacist	Request Date	Expected Delivery Date	Prescription	Cancel
			No data available in table		

Search:

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5.2.16 Doctor can analyze biomechanical values in this module:

Classification of Orthopedic Patients Using ML

A person can be categorized based on his orthopedic condition and to do that we have used a number of machine learning techniques. Since there has not been enough application of machine learning in orthopedic field, we tried to implement a 2 algorithms to analyze the comparative performance. Six biomechanical features have been used as parameters for the algorithms

pelvic_incidence Range(26 to 129)

pelvic_tilt Range(-6 to 49)

lumbar_lordosis_i Range(14-126)

sacral_slope Range(13-122)

pelvic_radius Range(70-163)

degree_spondylolisthesis Range(-11 to 418)

KNN

NAIVE BAYES

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The screenshot shows a web-based application for orthopedic patient classification. On the left, a sidebar menu includes Dashboard, Doctor, Analysis, Orthopedic Analysis, Profile, Chat, and Calendar. The main content area displays the title "Classification of Orthopedic Patients Using ML". Below the title is a descriptive text about using machine learning for orthopedic condition categorization. Six input fields show numerical values: 30, 30, 30, 30, 100, and 30. The ranges for these inputs are: Range(26 to 129), Range(-6 to 49), Range(14-126), Range(13-122), Range(70-163), and Range(-11 to 418). The results for the two models are displayed as "Result : Abnormal" and "Spondylolisthesis". A "KNN" button is visible above the first result, and a "NAIVE BAYES" button is visible above the second result.

5.2.17 User Profile

The screenshot shows a user profile page. The sidebar menu includes Dashboard, Doctor, Analysis, Orthopedic Analysis, Profile, Chat, and Calendar. The main content area shows a user profile for "raj Patil" with the email "raj@gmail.com". The bio states: "Bureau Oberhaeuser is a design bureau focused on Information- and Interface Design." Below the profile picture are "Edit Image" and "Upload" buttons. To the right, there is a "Message" button and an "Info" section with fields for Status, Phone, Mail, City, and Gender. The status is listed as "Active" with the value "6 842 6448", "Phone" as "raj@gmail.com", "Mail" as "Pune", and "Gender" as "male". A copyright notice at the bottom reads: "Copyright © Project Group 37 Sinhgad College Of Engineering (Computer Department). All rights reserved."

Classification Of Orthopedic patients using ML

The screenshot shows a Windows operating system interface. At the top, there is a file explorer window titled "Open" with the path "This PC > Pictures >". The contents of the folder include various files and folders such as "586886943-naruto-pictures-and-wallpapers.jpg", "activity diagram.pg", "asach.jpg", "autorun.inf", "Documents - Shortcut", "Naruto_wallpaper_download.jpg", "server (2).jpg", "server.jpg", "setup.exe", and "setup-1.bin". Below the file explorer is a user profile card for "raj Patil" (raj@gmail.com). The card displays the following information:

Status	Active
Phone	6 842 6448
Mail	raj@gmail.com
City	Pune
Gender	male

The user profile card also includes a "Message" button and "Edit Image" and "Upload" buttons. The bottom of the screen shows the Windows taskbar with various icons and the system tray indicating the date and time.

5.2.18 User can see doctor feedback before consulting

The screenshot shows a user profile page for 'raj Patil'. The profile picture is a circular logo with orange and yellow patterns. The name 'raj Patil' and email 'raj@gmail.com' are displayed. Below the name is a brief description: 'Bureau Oberhaeuser is a design bureau focused on Information- and Interface Design.' On the right side of the profile, there is a 'Message' button and an 'Info' section. The 'Info' section includes fields for Status (Active), Phone (6 842 6448), Mail (raj@gmail.com), City (Pune), and Gender (male). Below the profile, there is a section for 'Yash Patil' with a doctor icon, showing a rating of 4 stars from 11 reviews. The bottom of the page has a copyright notice: 'Copyright © Project Group 37 Sinhgad College Of Engineering (Computer Department). All rights reserved.'

5.3 Discussion

This metrics is used to measure the behavior, reliability and performance of any system. It has been used by researchers to evaluate the performance of any model or system. Here we have provided a brief definition and discussion on each method with some basic mathematical equations

- Accuracy: Accuracy shows the percentage of the accurate results of department selection.
- Confusion matrix: shows the number when the results true and false when they were predicted either positive and negative.

		Actual values	
		Positive	Negative
Predicted values	Positive	True positive	False positive
	Negative	False negative	True negative

Fig 5.3.1 Generalized example of confusion matrix

- Precision: Shows how relevant the result is:

$$\text{Precision} = \frac{TP}{TP + FP}$$

- Recall or Sensitivity: Measures the returned relevant results.

$$\text{Recall} = \frac{TP}{TP + FN}$$

- F1-Measure: Combines precision and recall in calculation.

$$\begin{aligned} F1 &= \frac{2}{\frac{1}{\text{Precision}} + \frac{1}{\text{Recall}}} \\ &= 2 \times \frac{\text{Precision} * \text{Recall}}{\text{Precision} + \text{Recall}} \end{aligned}$$

The algorithms were tested using confusion matrix to verify the accuracy of result the dimension of matrix was 41 X 41. It is shown in following figure.

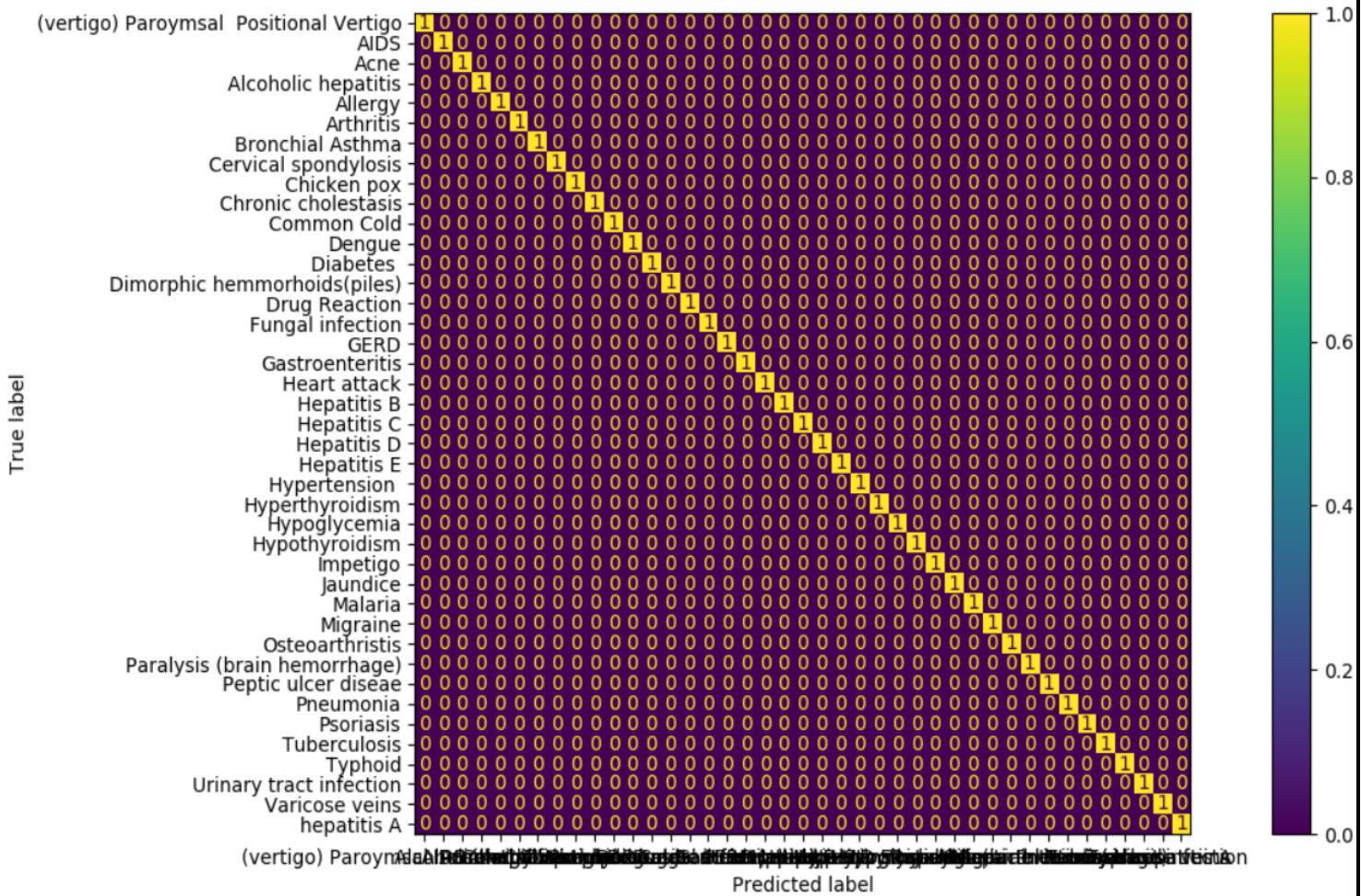


Fig 5.3.2 Confusion Matrix

As Figure shows all records are predicted accurately to give 100% result. And the model can be made more accurate as the amount of data is very limited in comparison to the number of symptoms. So more data will increase the accuracy of all the algorithms, and precision of all the data. And more accuracy will be found by changing different parameters and other variables for respective algorithm.

Chapter 6

Testing

6.1 Unit Testing

Each functional module has been tested with everything possible and the modules were able to live with that. Every unit of the proposed system has been tested, so that it ensures its safety at very tiny level. As each and every unit of the system has been tested, the failure of any particular unit's failure does not affect the execution of other units of the system.

6.1.1 Client:

Table 6.1.1.1: Client-side test cases

Test Case	Input	Expected Output
Display/UI module	Server response	Correct fields shown in the UI.
User Authentication	User Login Credentials	Login in the system on correct credentials or reject the request.
User Module	Patient Details or symptoms	Appropriate analysis and prediction of diseases.
Appointment Module	User convenient date and time	User should be able to schedule an appointment on their convenient time.
Doctor Module	Server Request	All patient requests and analyzed symptoms
Doctor Prescription	Doctor's medicinal input	Generate expected prescription and send that to the patient.
Place Order	Doctors Prescription	Place order to nearest pharmacist as per user request.
Pharmacist Module	Server Request	All incoming medication requests and preferable time of delivery.
Orthopedic Analysis	Biomechanical Values	Doctor should be able to see the apt analysis.
Communication	Intended User and message	Establish a communication path between those users and should be able to send and receive messages.
Analysis	Server Request	Show respected graphs and charts with apt analysis.

6.1.2 Server:

Table 6.1.2.1: Server-side test cases

Test Case	Input	Expected Output
HTTP Server	Requests	Responses
Page request	HTTP GET/POST request	Properly rendered dynamic html page response
User Authentication	User login credentials	Credentials validity fetched from database records.
Appointment Module	User convenient date and time	Slot should be booked for those particular users and database should be updated.
Doctor Module	Client Request	All patient requests and analyzed symptoms fetched from database and render in a dynamic HTML page.
Doctor Prescription	Doctor's medicinal input	Generate expected prescription and update the database accordingly.
Place Order	Patient Request	Search and show nearest pharmacists available and updated the database when order is confirmed.
Pharmacist Module	Client Request	All incoming medication requests along preferable time of delivery and render a proper page with updated database.
Orthopedic Analysis	Biomechanical Values	Analysis of provided values using already trained ML algorithms and properly rendered age with apt result as response.
Communication	Intended User and message	Establish a communication path between those users and should be able to send and receive messages while updating the database for future use.
Analysis	Client Request	Serve respected graphs and charts with apt analysis by using pre-fed data and using ML algorithms.

6.3 Integration Testing

Integration Testing is defined as a type of testing where software modules are integrated logically and tested as a group. All the pre-tested modules which are already tested as mentioned in unit testing above. These all individual units are then combined one by one and integrated together to make the complete system. The system has been thus ensured to be error free and can sustain even if any single unit fails to cope with the live environment. Integration test cases differed from other test cases in the sense they focused mainly on the interfaces & flow of data/information between the modules. Here priority was given for the integrating links rather than the unit functions which are already tested.

6.4 Acceptance Testing

Table 6.4.1 Acceptance Testing

Test Case	Expected Output
Accuracy Of the System	High
Ease of use	High
Ease of installation	High
Difficulty in interpreting results	Low
Overall performance/responsiveness	High

Conclusion

From the historical development of machine learning and its applications in the medical sector, it can be shown that systems and methodologies have emerged that have enabled sophisticated data analysis by simple and straightforward use of machine learning algorithms. This paper presents a comprehensive comparative study of three algorithms performance on a medical record each yielding an accuracy >90 percent. The performance is analyzed through confusion matrix, accuracy score and visualization aids such as graphs. Artificial Intelligence will play an even more important role in data analysis in the future due to the availability of huge data produced and stored by modern technology. The proposed system is also able to connect all the stakeholders and provide crucial medical assistance sitting at any place.

References

1. 2020 IEEE International Students' Conference on Electrical, Electronics and Computer Science "Disease Symptom Analysis Based Department Selection Using Machine Learning for Medical" by Md. Latifur Rahman, Rahad Arman Nabid, and Md. Farhad Hossain.
2. 2020 International Conference for Emerging Technology (INCET) Belgaum, India. Jun 5-7, 2020 "Disease Prediction using Machine Learning Algorithms" by Sneha Grampurohit and Chetan Sagarnal.
3. 2018 International Conference on Computational Science and Computational Intelligence (CSCI) "An Implementation of Naive Bayes Classifier " by Feng-Jen Yang.
4. Proceedings of the Second International Conference on Intelligent Computing and Control Systems (ICICCS 2018) "Analysis of Symptoms Wise Disease Inference System Using Data Mining Technique" by Tejal P. Burange and Dr. P. N. Chatur
5. Proceedings of the International Conference on Inventive Computing and Informatics (ICICI 2017) "An Intelligent Framework for Health Estimation with Naïve Bayes Approach" by Rahul Katarya
6. International Journal of Intelligent Systems and Applications in Engineering ISSN:2147-67992 "Performance Analysis of ANN and Naive Bayes Classification Algorithm for Data Classification" by Mücahid Mustafa Saritas and Ali Yasar.