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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Sinhgad College of Engineering , Pune-41

2020-2021

Date: / /

CERTIFICATE

This is to certify that,

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have successfully completed their project work titled "COMPREHENSIVE HEALTHCARE SYSTEM USING ML'' at Department of Computer Engineering, SCOE, Pune for the partial fulfillment of the Bachelor Degree of Computer Engineering , Savitribai Phule Pune University, in semester-I, academic Year 2020-2021.

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Last but not least we would like to thank all the Teaching, Non- Teaching staff members of our Department, our parents and colleagues those who helped us directly or indirectly for completing this Project successfully.

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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

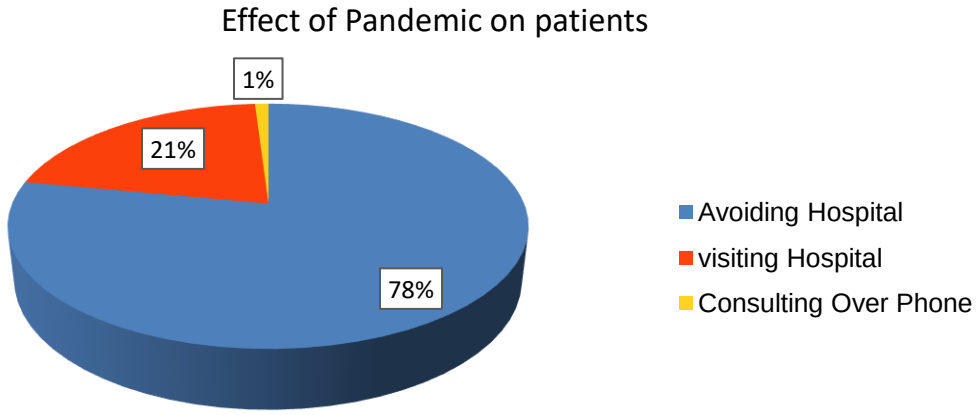
Introduction

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,

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

I is the user symptoms

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

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

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

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

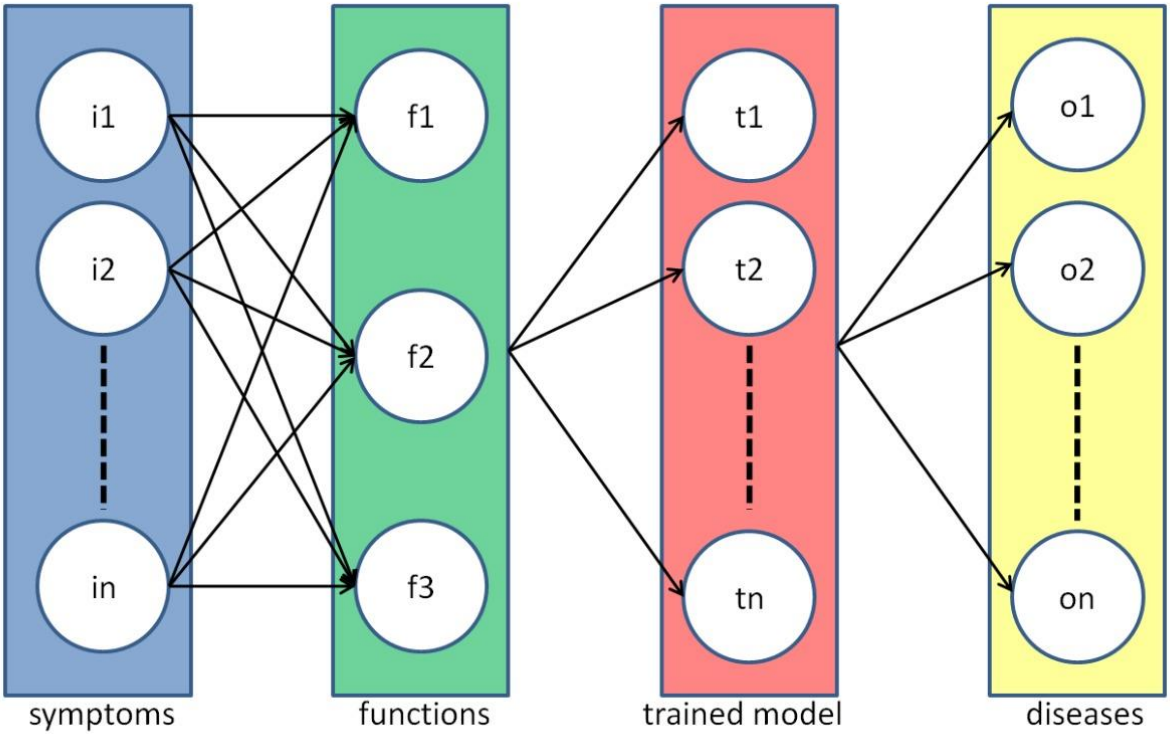


Fig : 3.2.1.1 Mathematical Model for AI Diagnosis

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

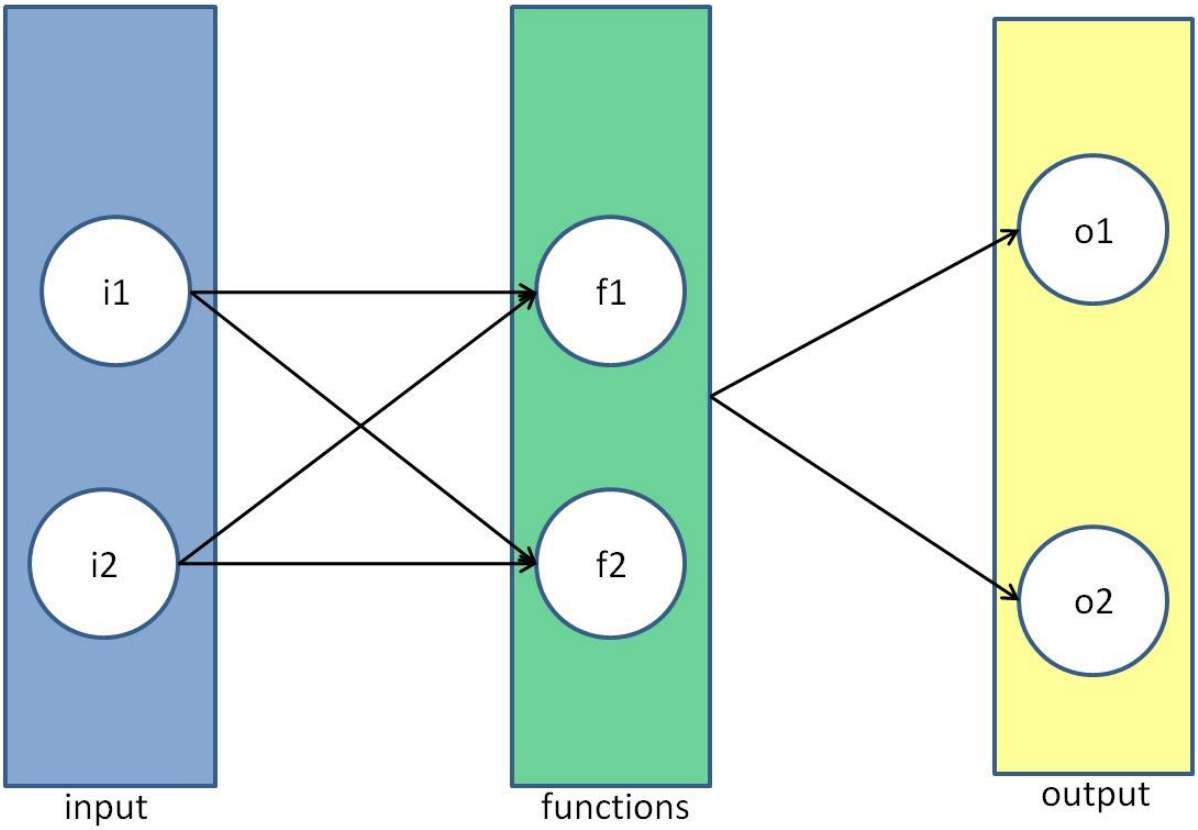


Fig : 3.2.2.1 Mathematical Model for Scheduling Appointment

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

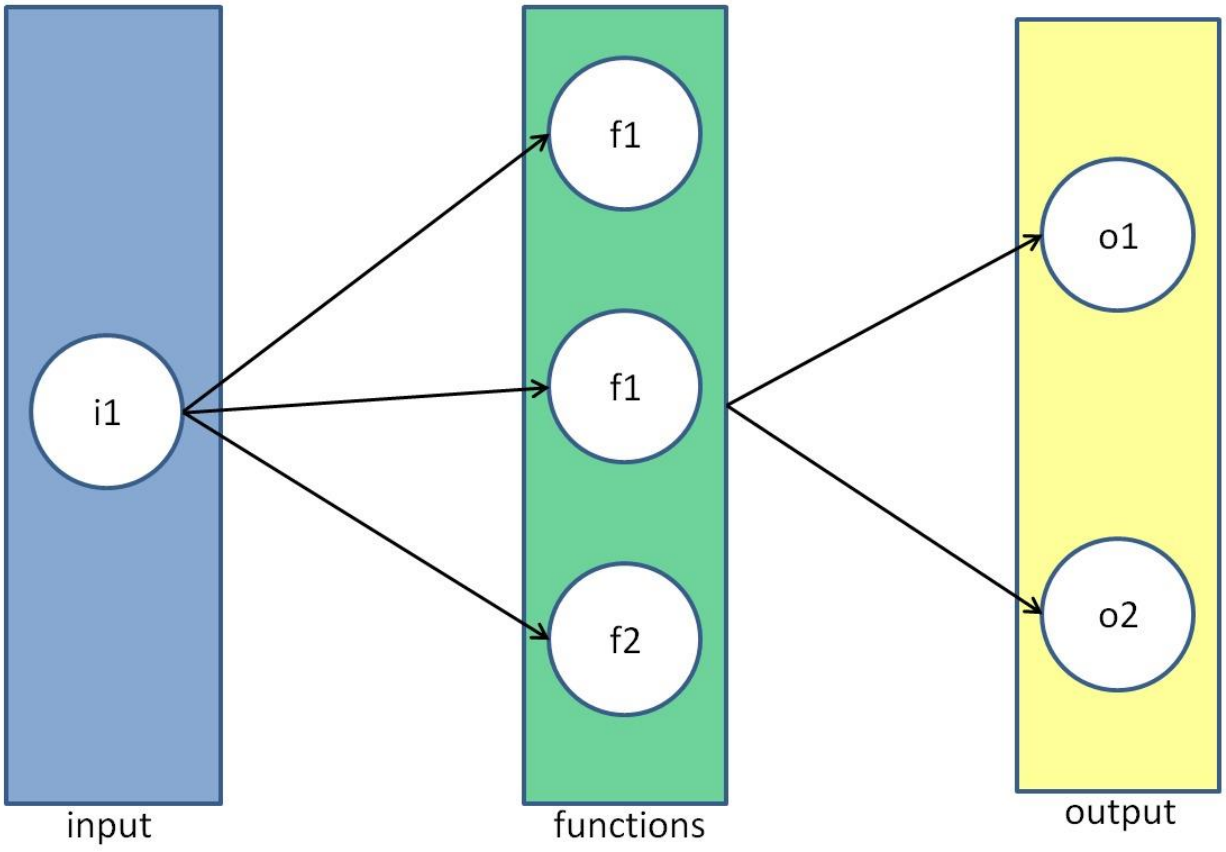


Fig : 3.2.3.1 Mathematical Model for Stakeholder Communication

3.3. UML Diagrams :

3.3.1 Use-Case Diagram:

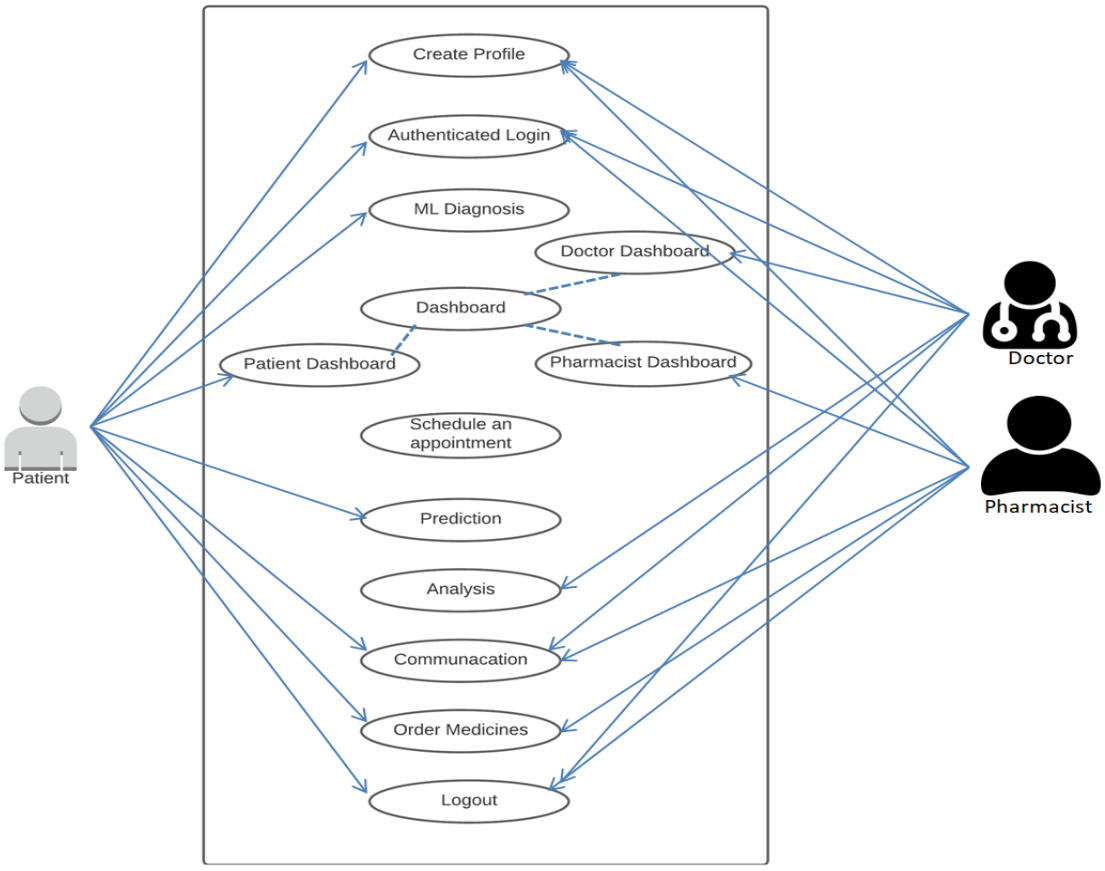


Fig : 3.3.1.1 Use-Case Diagram

3.3.2 System Flow Diagram :

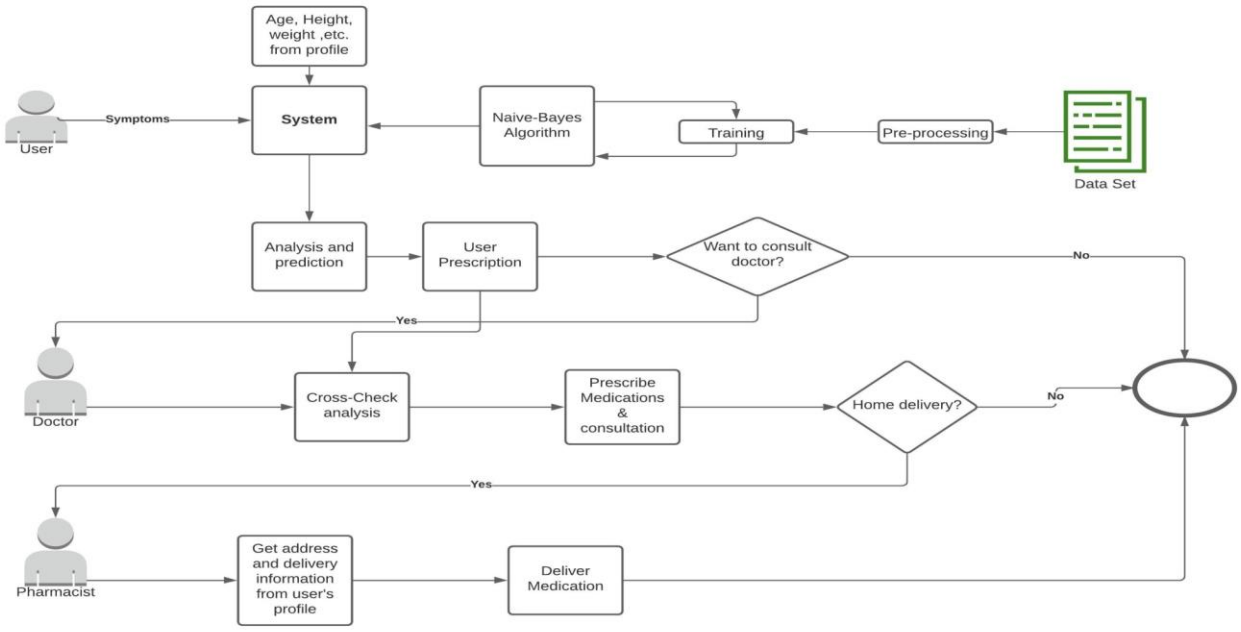


Fig: 3.3.2.1 System Flow Diagram

3.3.3 Architecture Diagram :

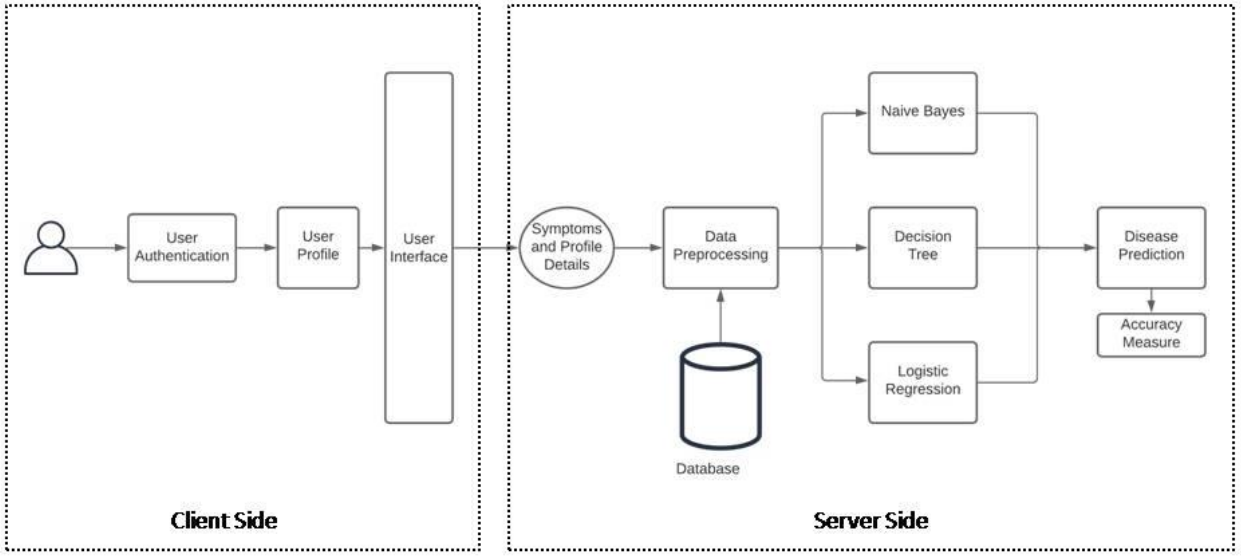


Fig: 3.3.3.1 Architecture Diagram

3.3.4 Activity Diagram :

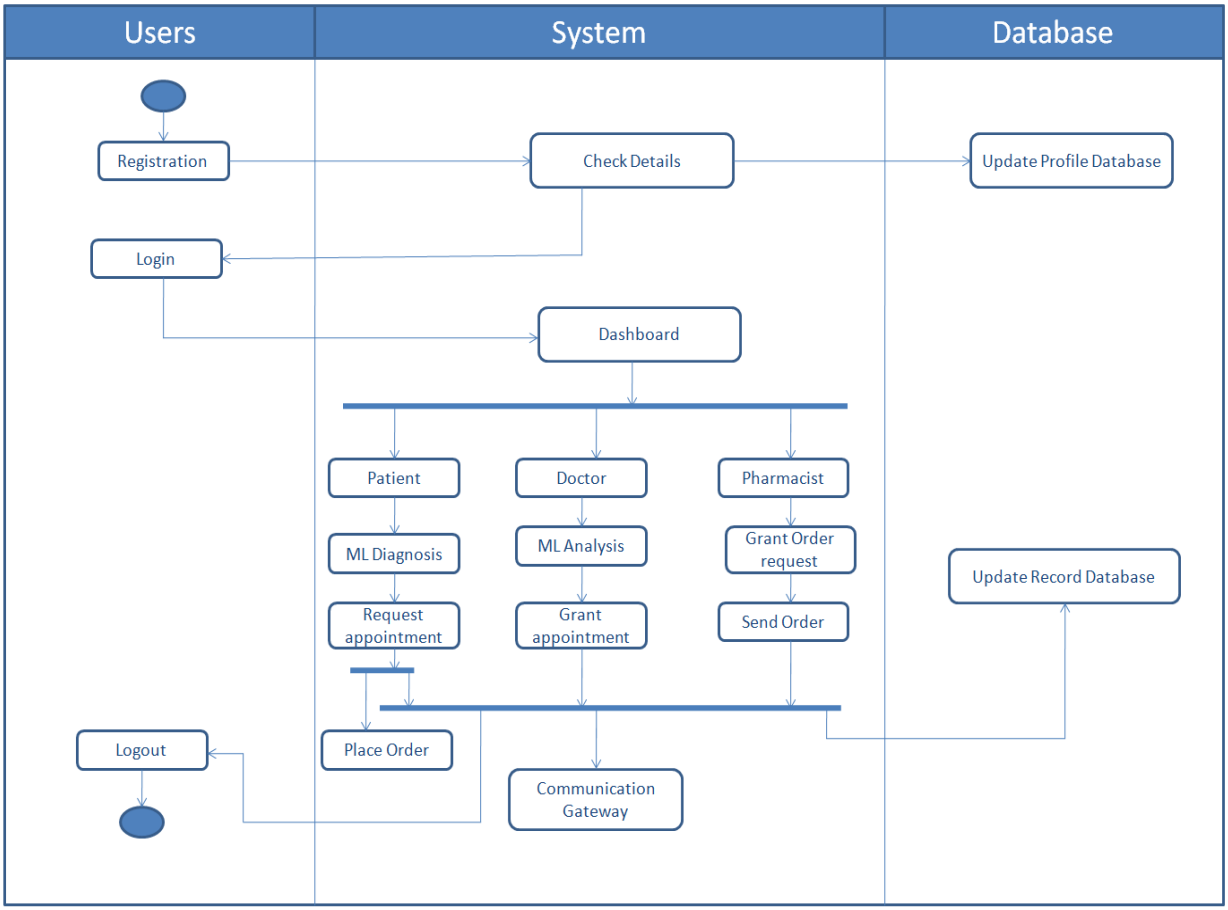


Fig : 3.3.4.1 Activity diagram

3.3.5 Sequence Diagrams :

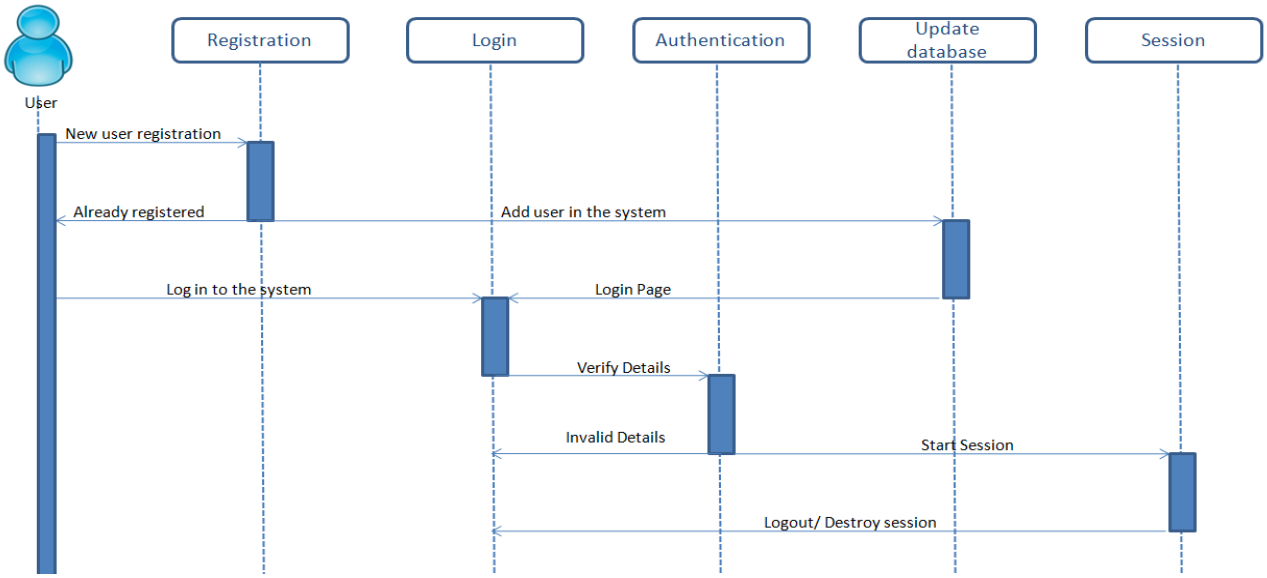


Fig : 3.3.5.1 Sequence Diagram for Login

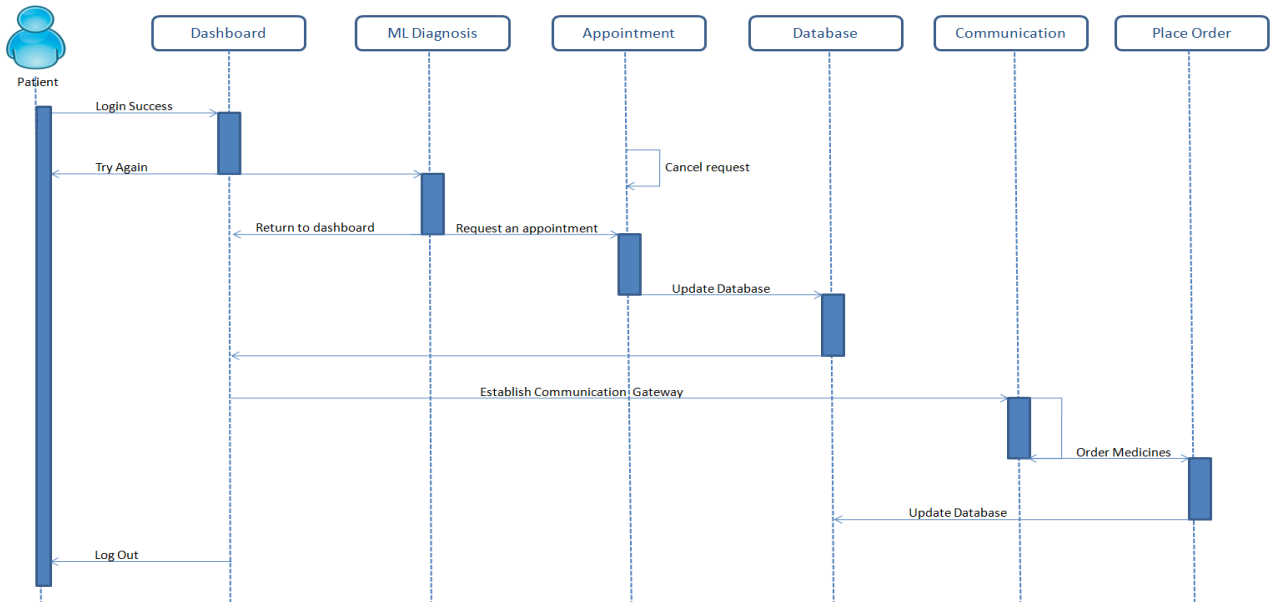


Fig : 3.3.5.2 Sequence Diagram for Patient

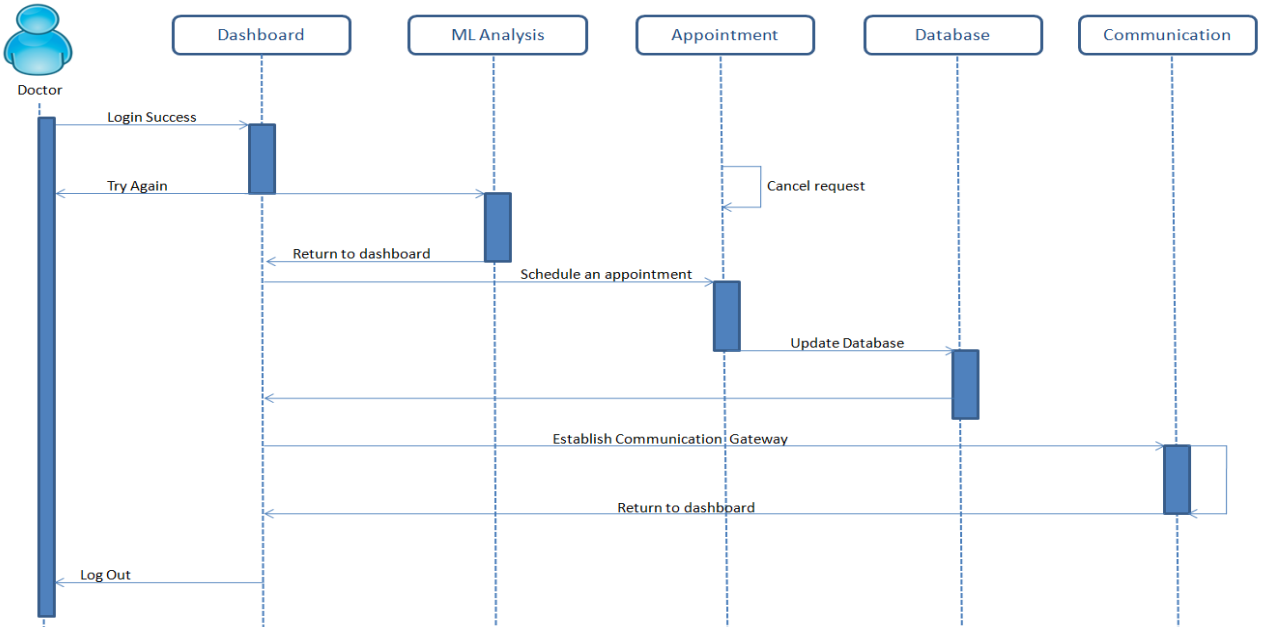


Fig : 3.3.5.3 Sequence Diagram for Doctor

3.3.6 Class Diagram:

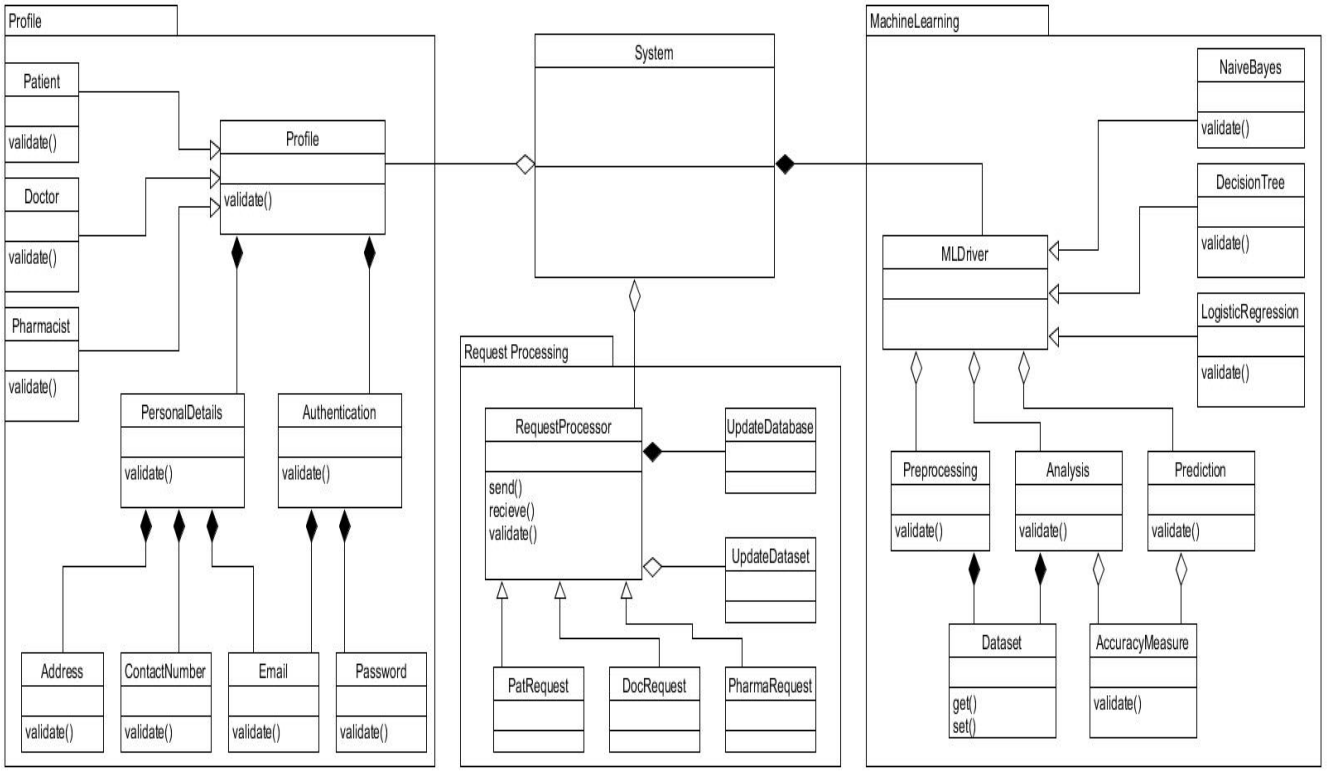


Fig : 3.3.6.1 Class Diagram

3.3.7 Deployment Diagram:

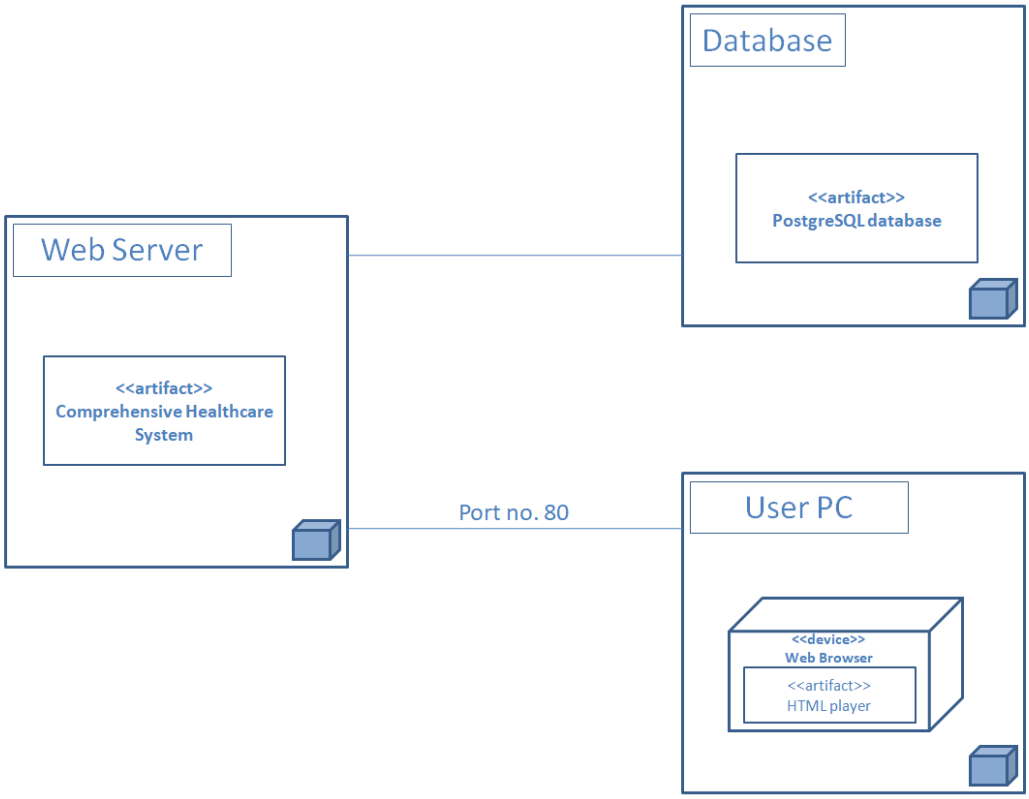


Fig : 3.3.7.1 Deployment Diagram

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.

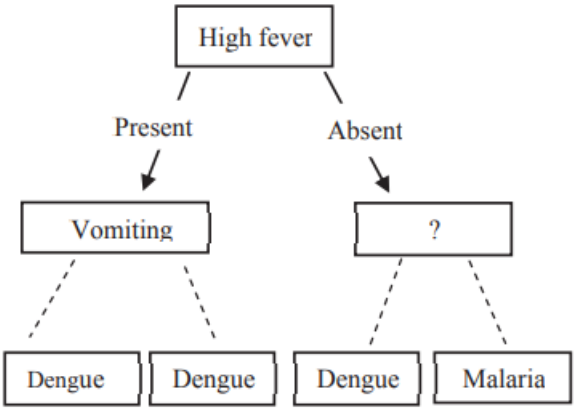
4.2 Operational Details

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).



4.2.1.1.1 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 Byes algorithm is based on Bayes theorem given by:

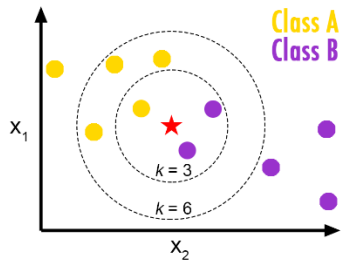
$$P(s/h) = \frac{P(h/s)P(s)}{P(h)}$$

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 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 naïve_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=Tru
e))
         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.

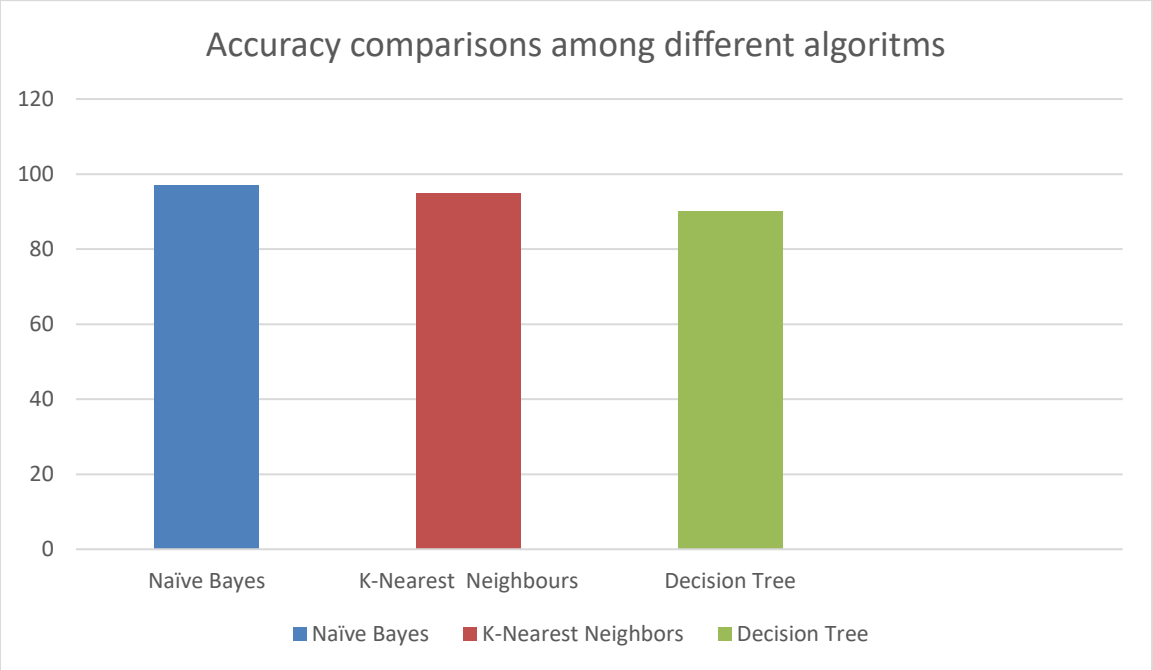
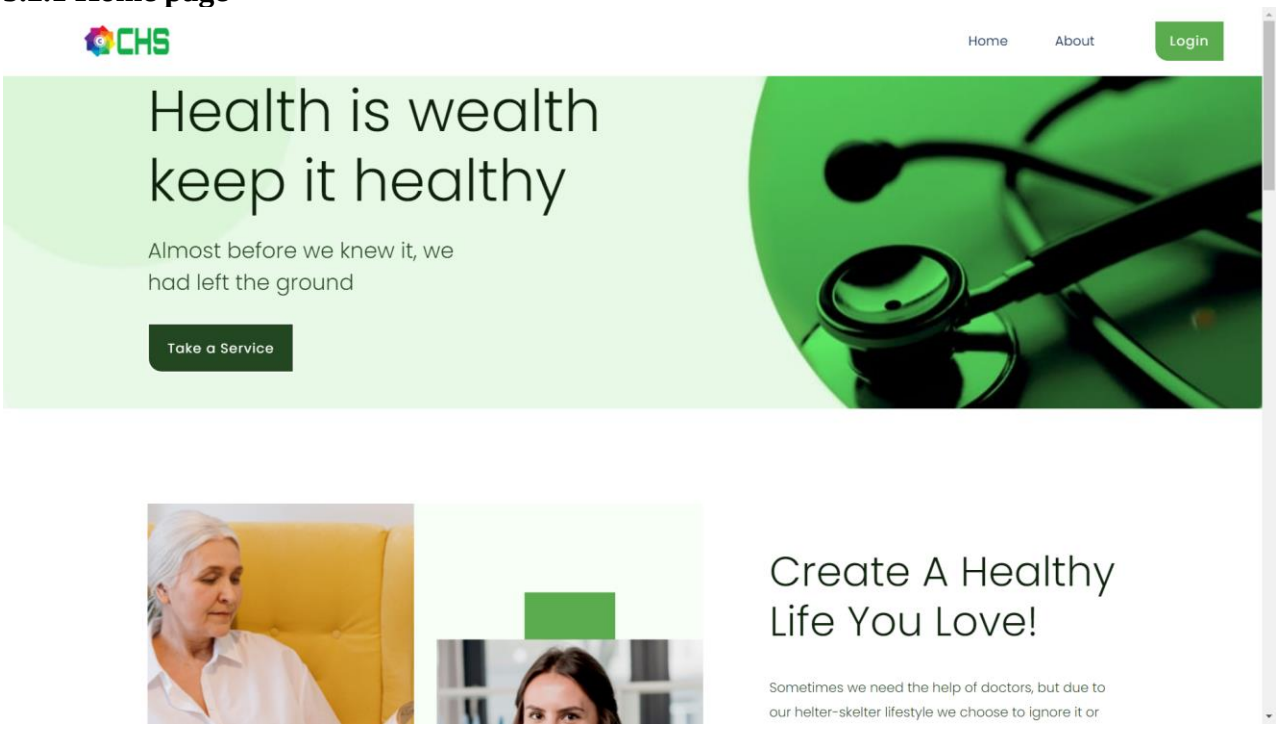
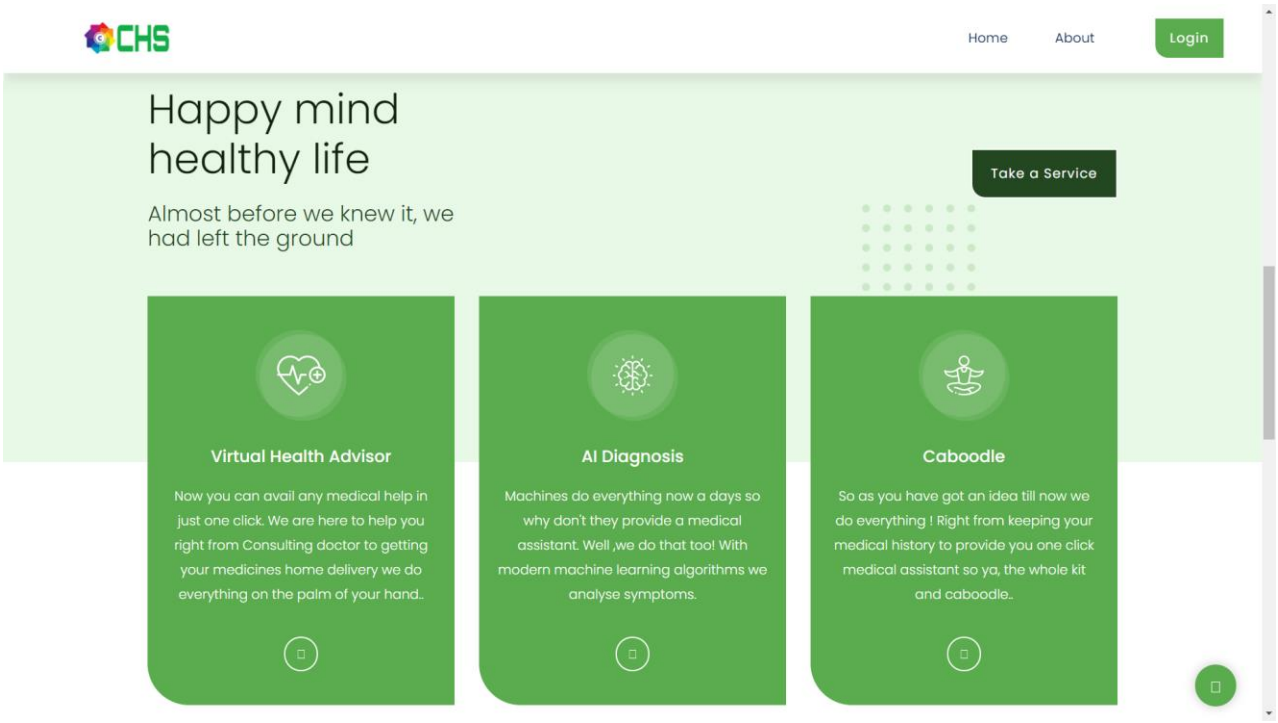


Fig 5.1.1: Accuracies of algorithms

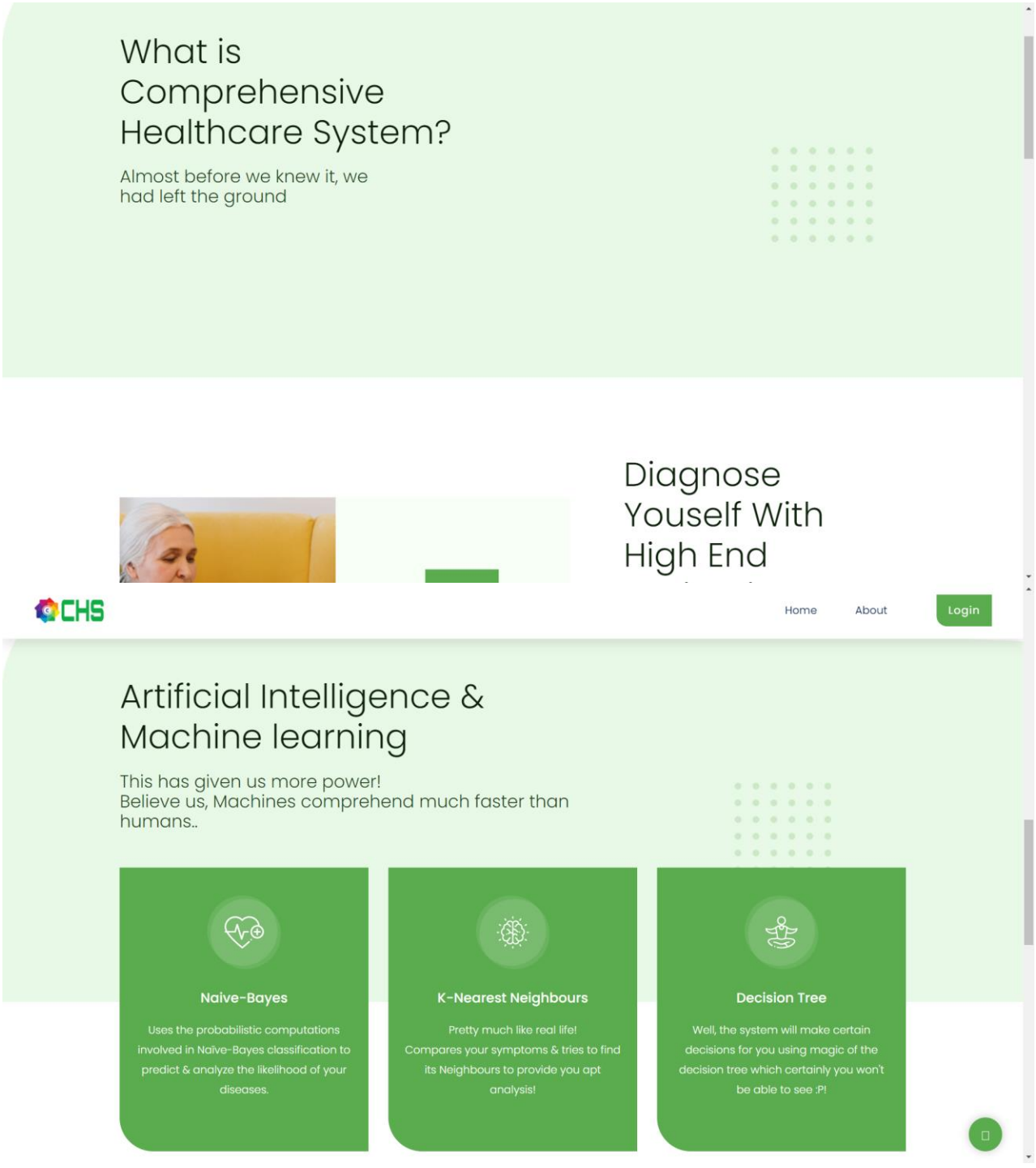
5.2 Snapshots of User Interface

5.2.1 Home page

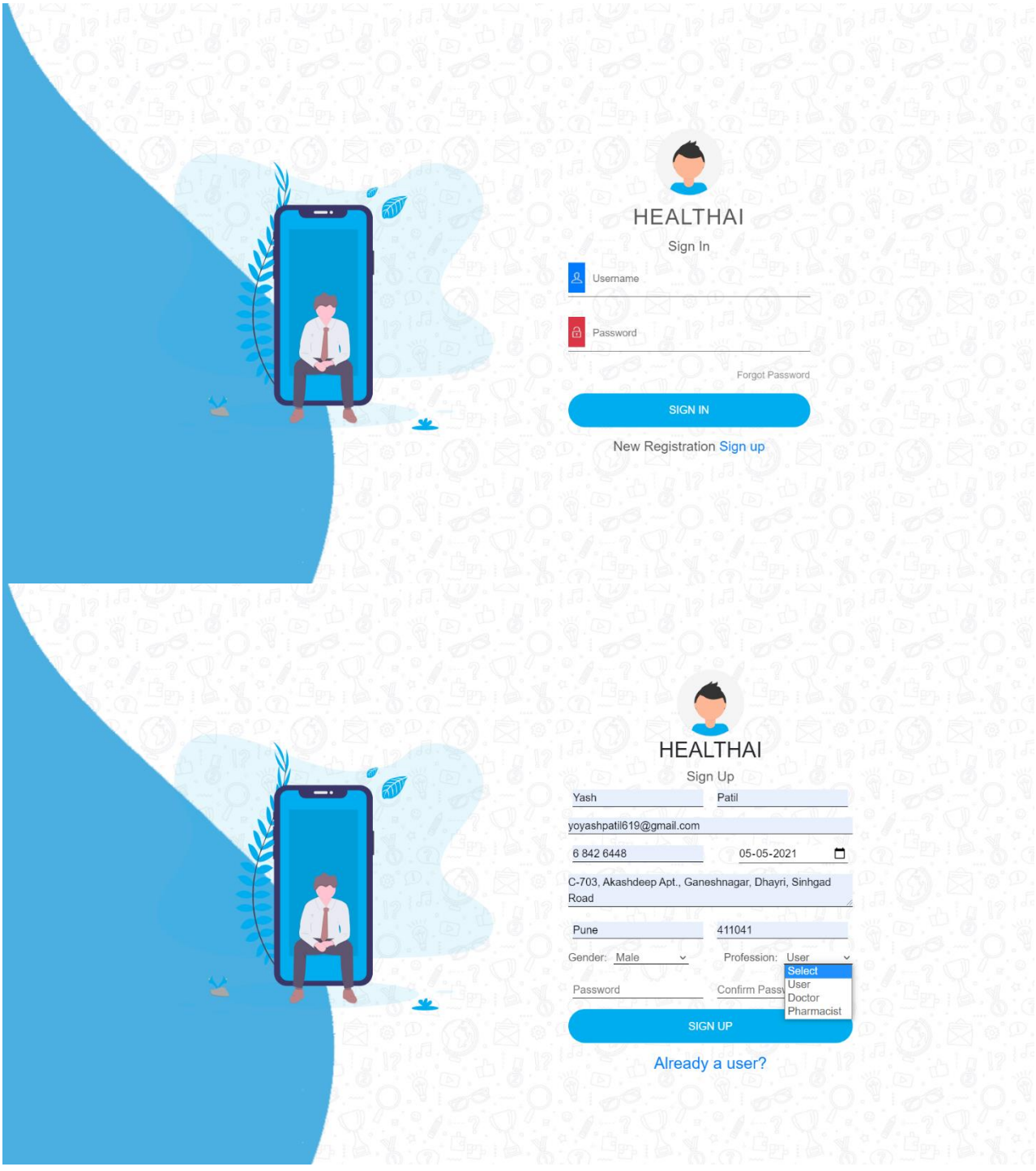




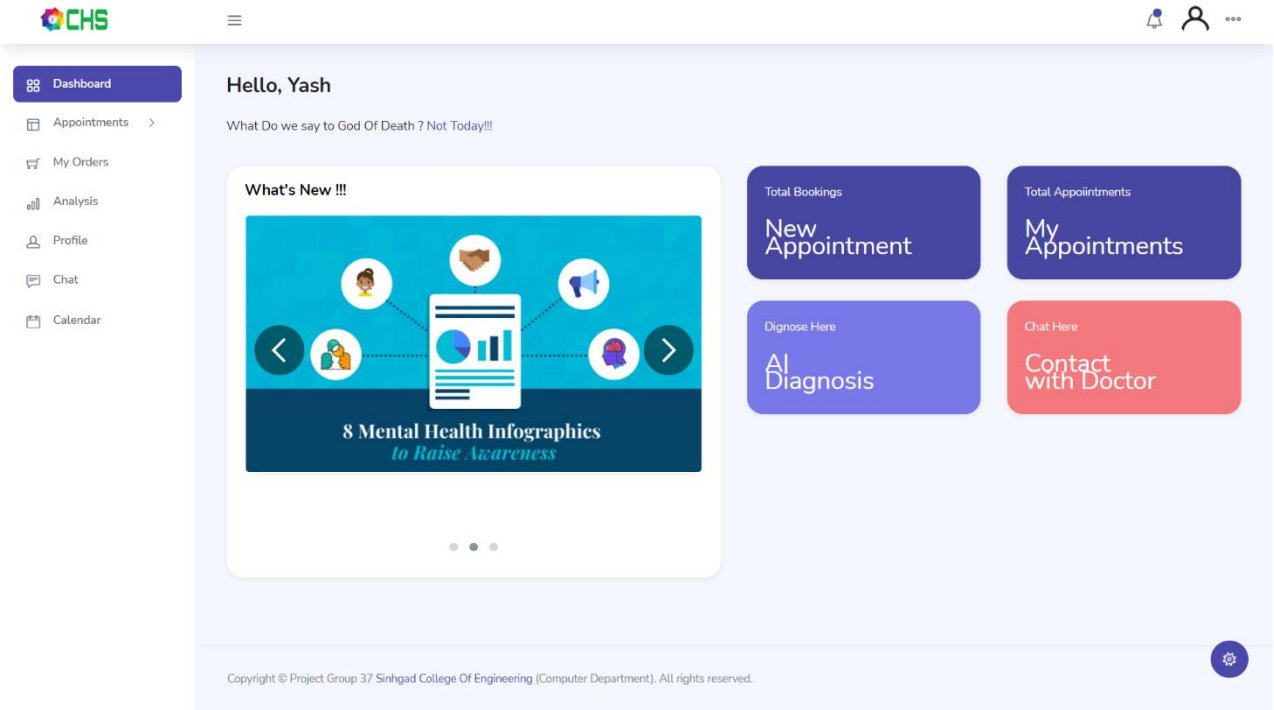
5.2.2 About page:


What is Comprehensive Healthcare System?
Almost before we knew it, we had left the ground
Diagnose Youself With High End
CHS
Home
About
Login
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 Naïve-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!

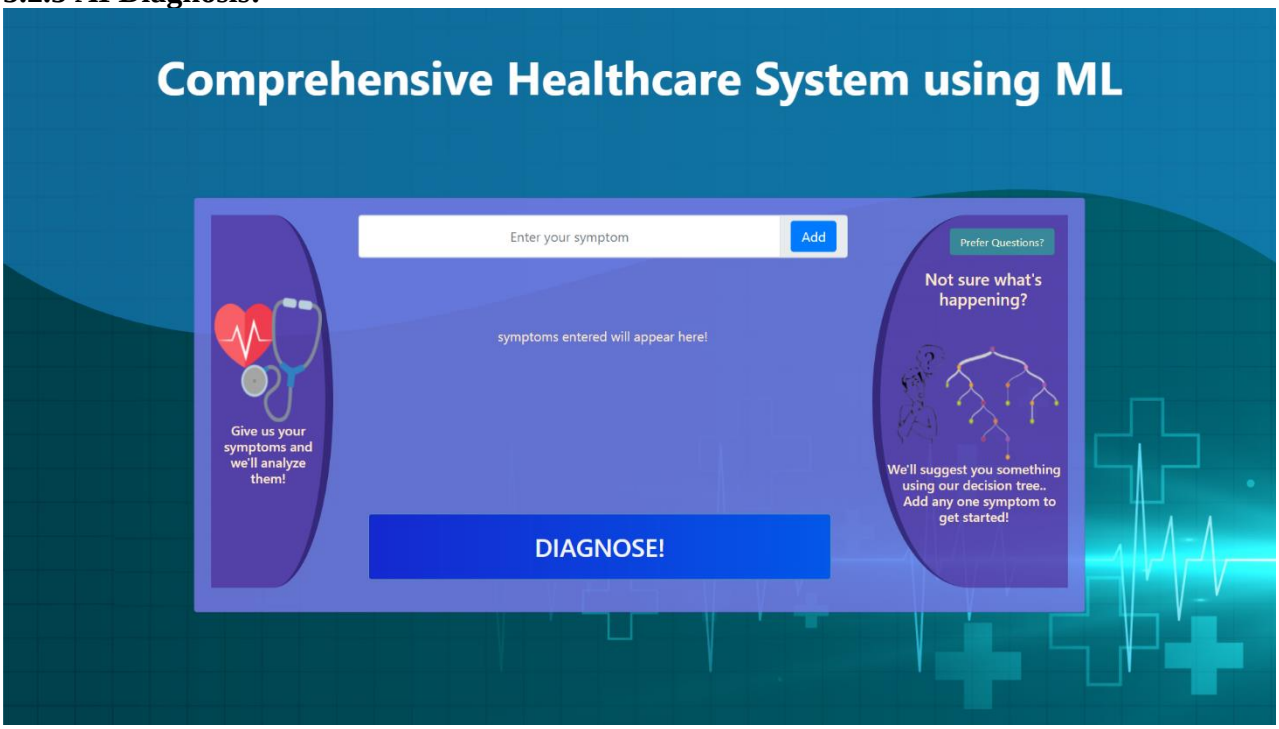
5.2.3 Login and Signup

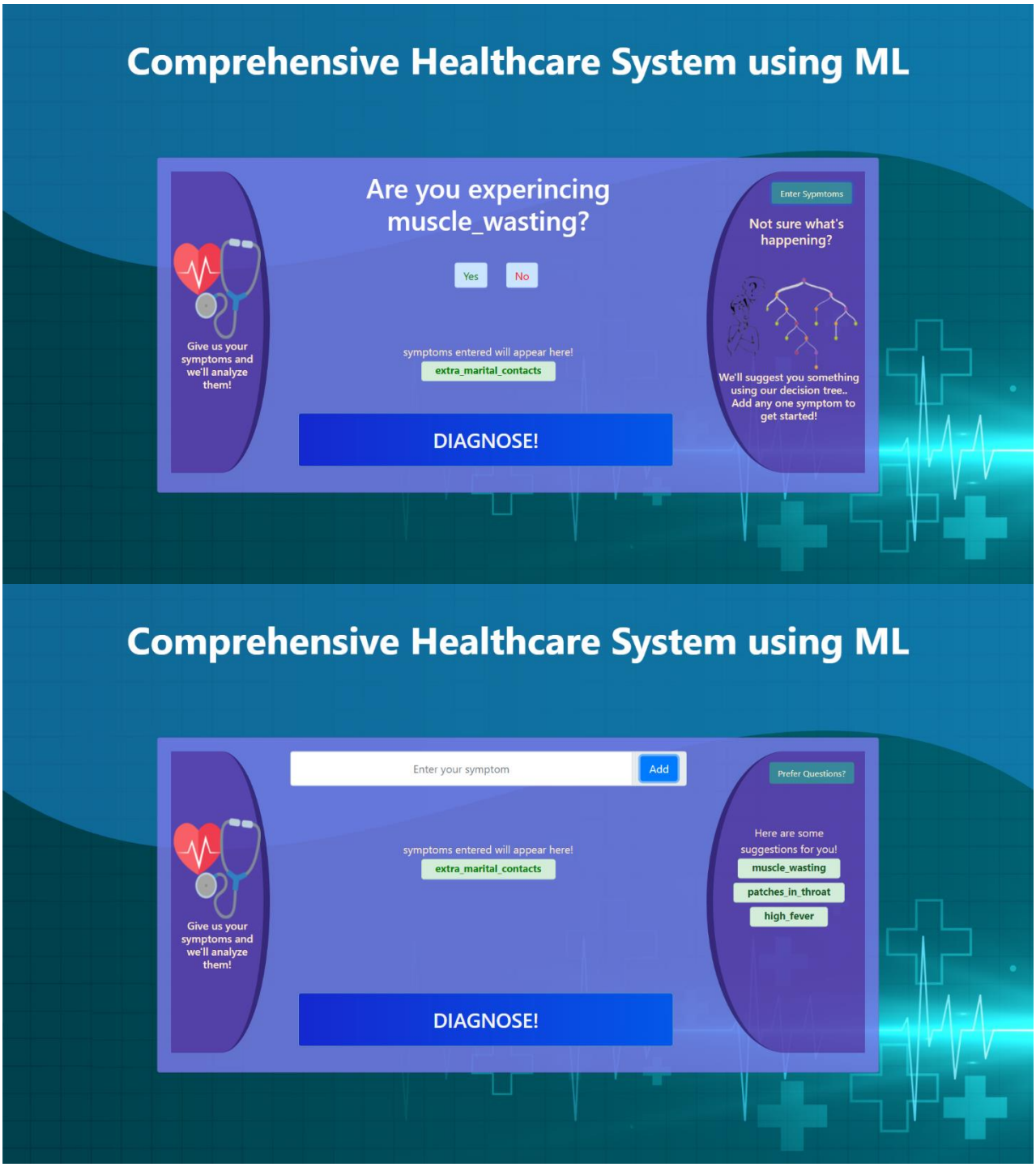


5.2.4 User Dashboard:

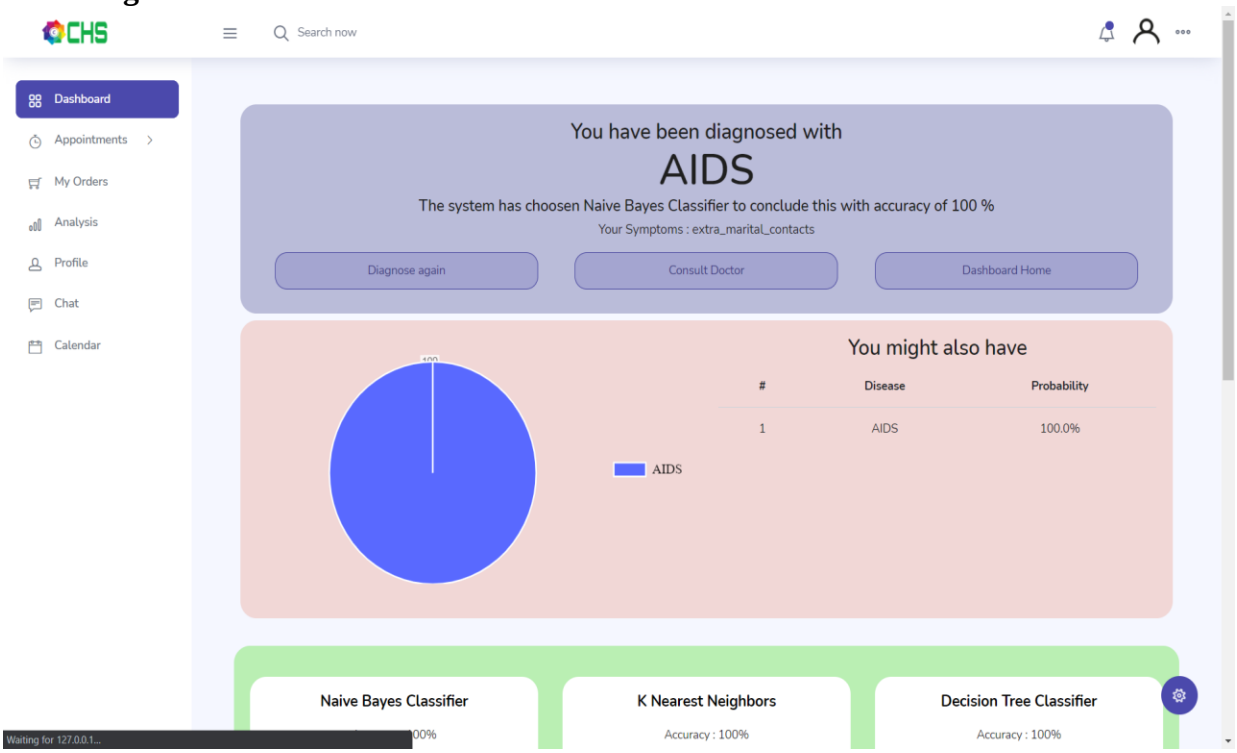


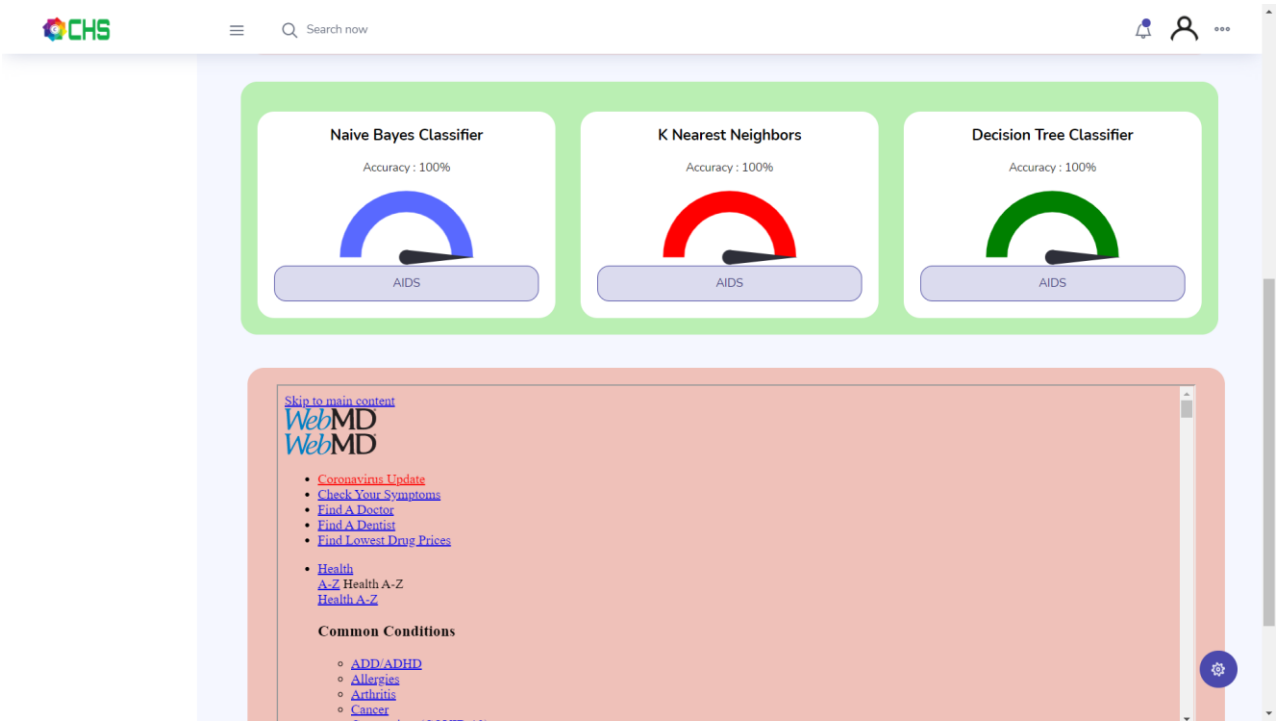
5.2.5 AI Diagnosis:



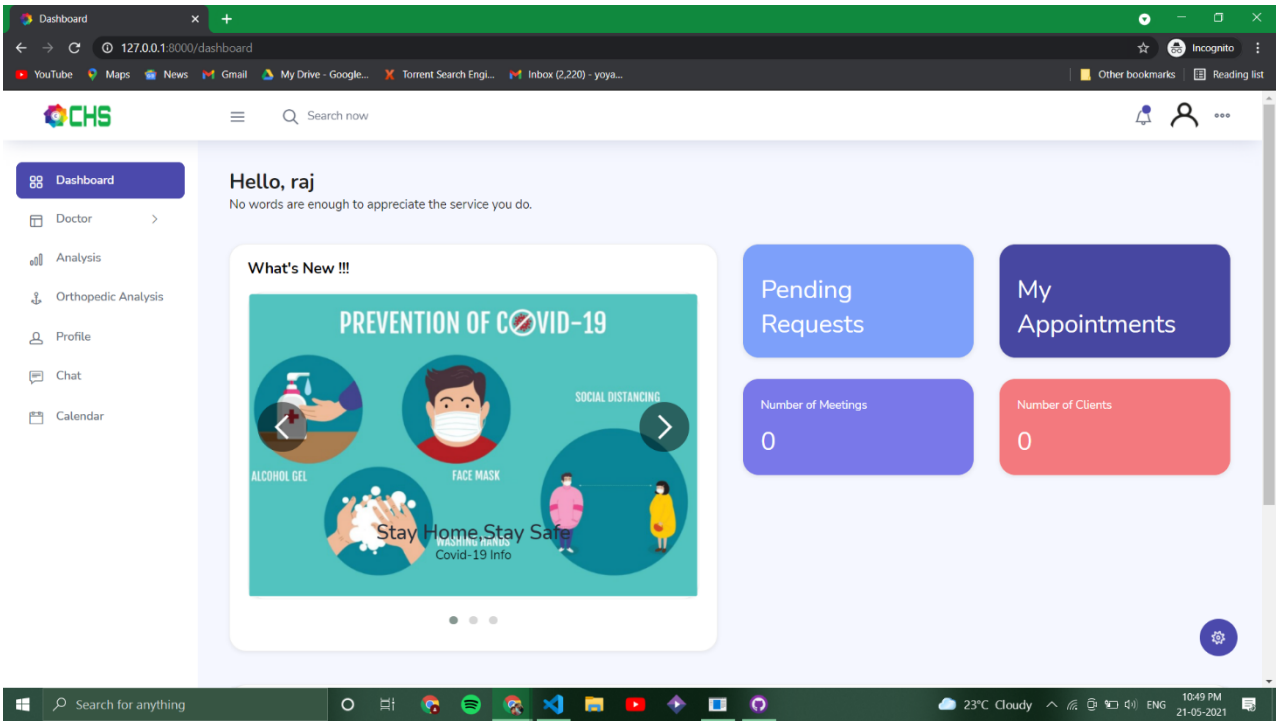

Comprehensive Healthcare System using ML
Are you experincing muscle_wasting?
Yes
No
symptoms entered will appear here!
extra_marital_contacts
DIAGNOSE!
Give us your symptoms and we'll analyze them!
Enter Sypmtoms
Not sure what's happening?
We'll suggest you something using our decision tree.. Add any one symptom to get started!
Comprehensive Healthcare System using ML
Enter your symptom
Add
symptoms entered will appear here!
extra_marital_contacts
DIAGNOSE!
Give us your symptoms and we'll analyze them!
Prefer Questions?
Here are some suggestions for you!
muscle_wasting
patches_in_throat
high_fever

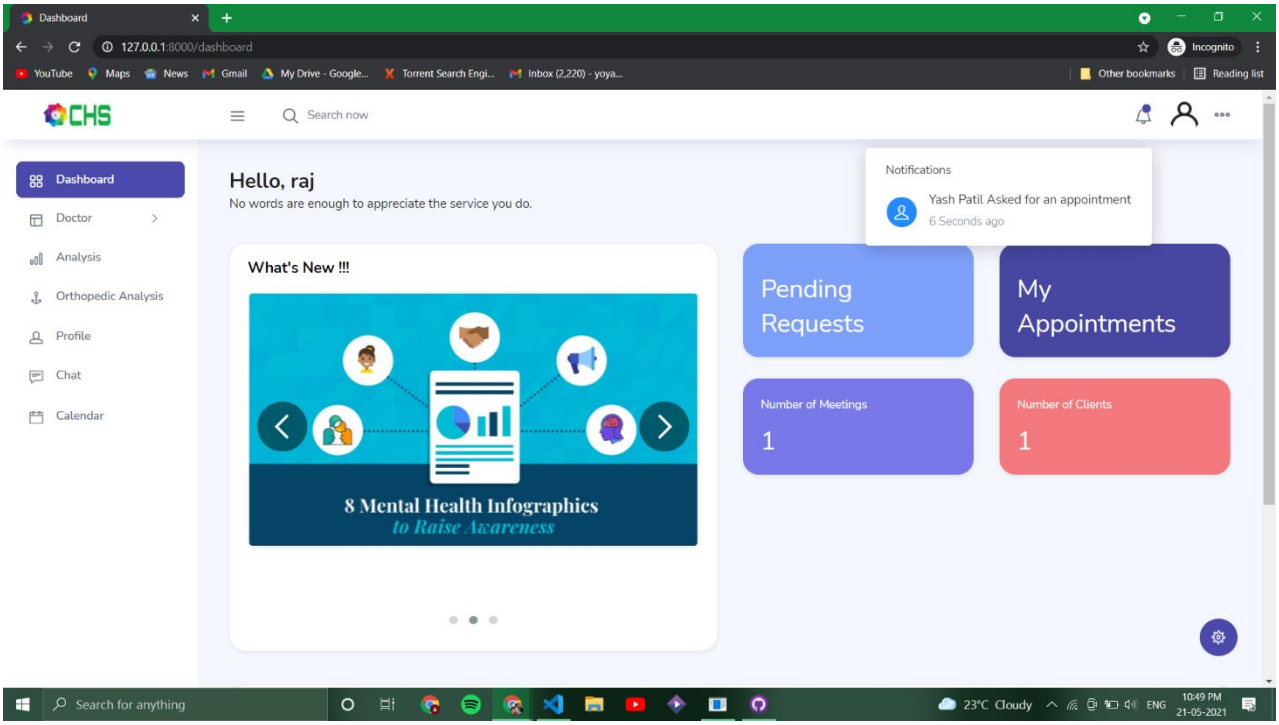
5.2.6 Diagnosis Result:



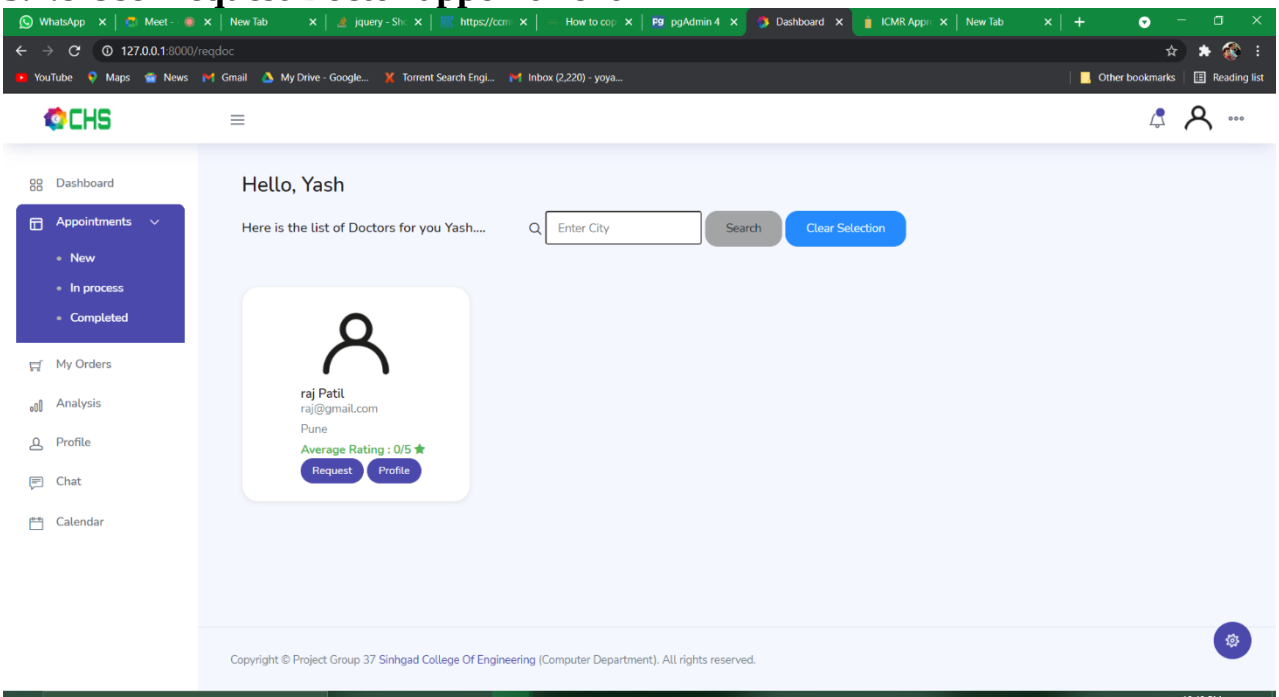


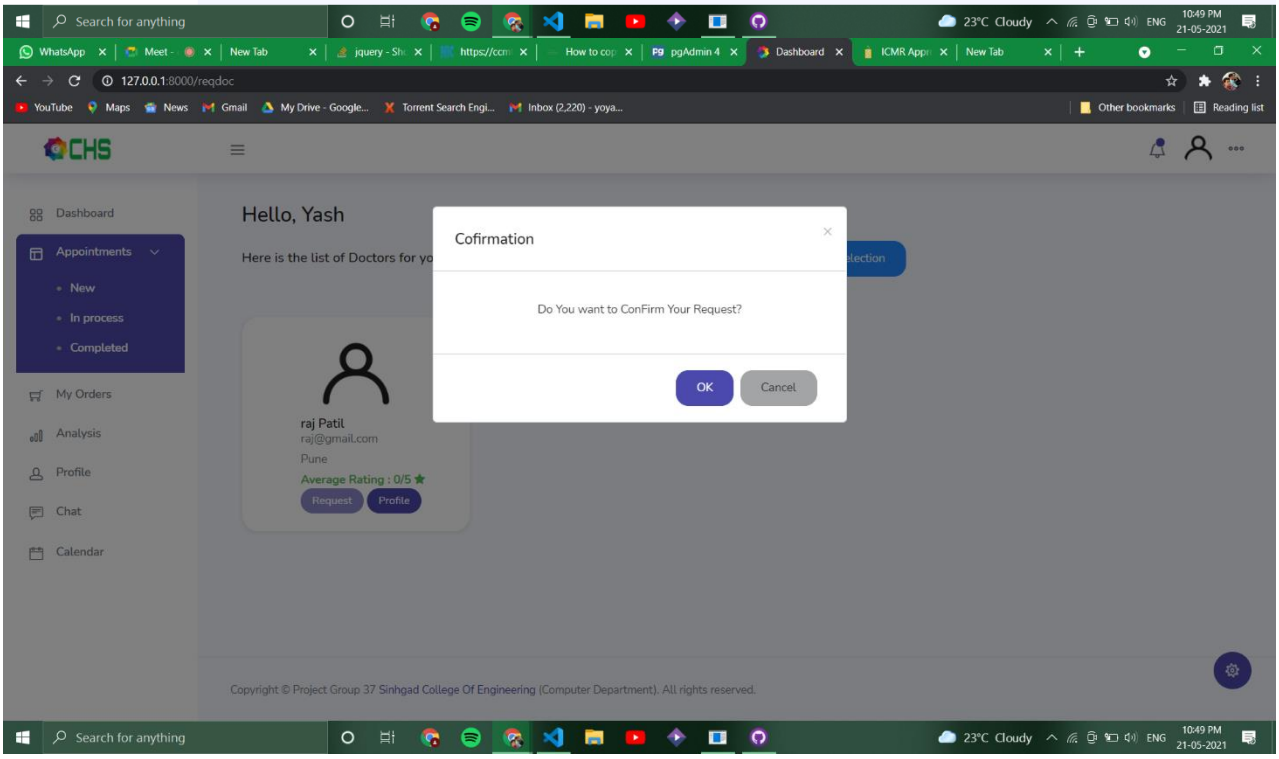
5.2.7 Doctor Dashboard



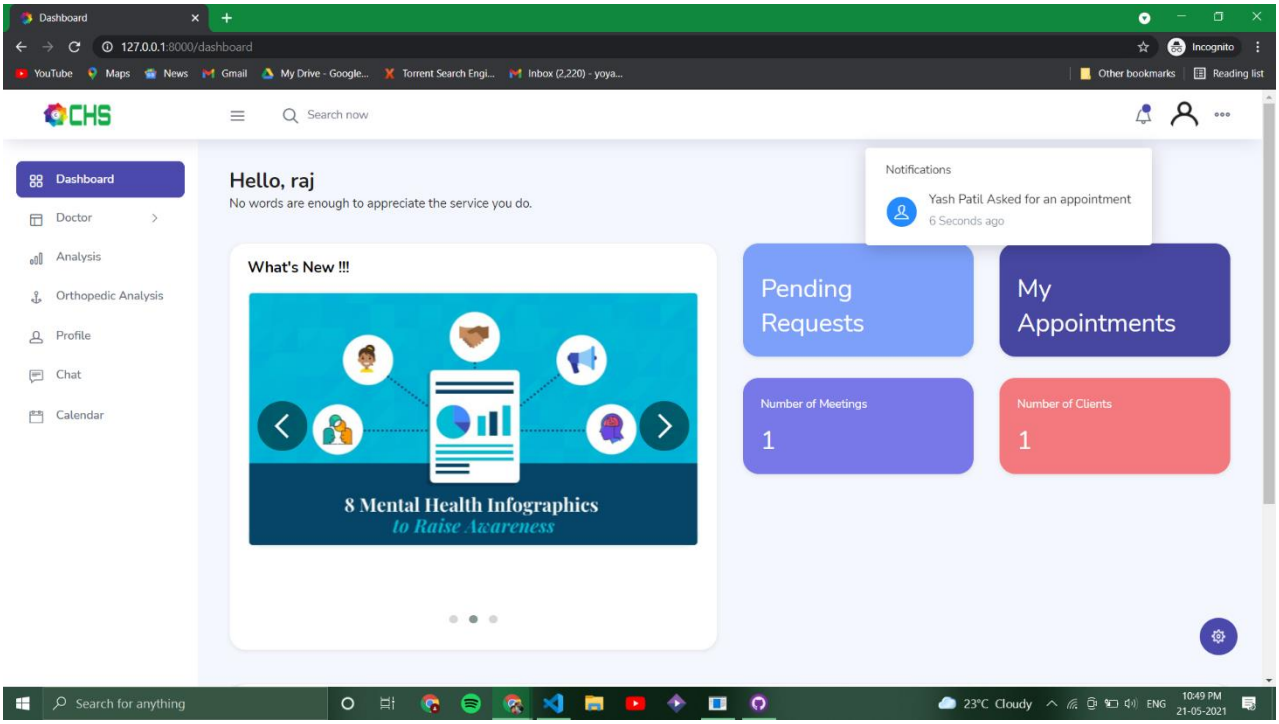


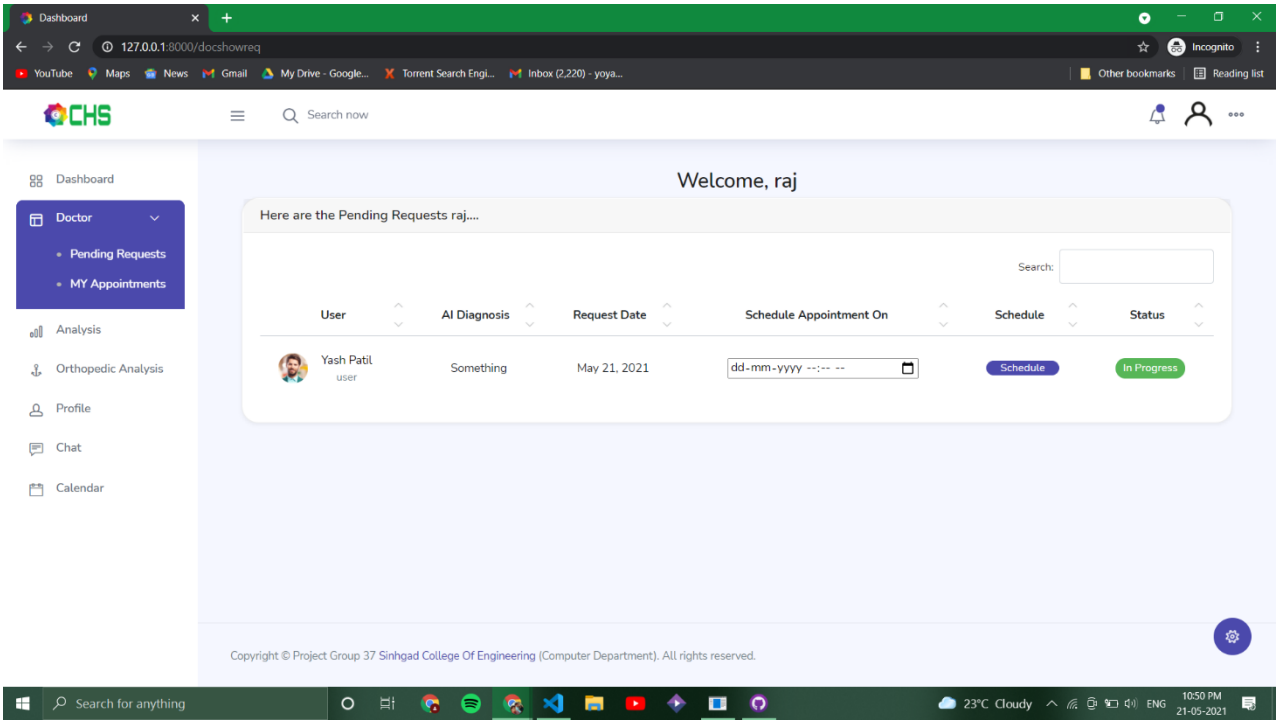
5.2.8 User request Doctor appointment

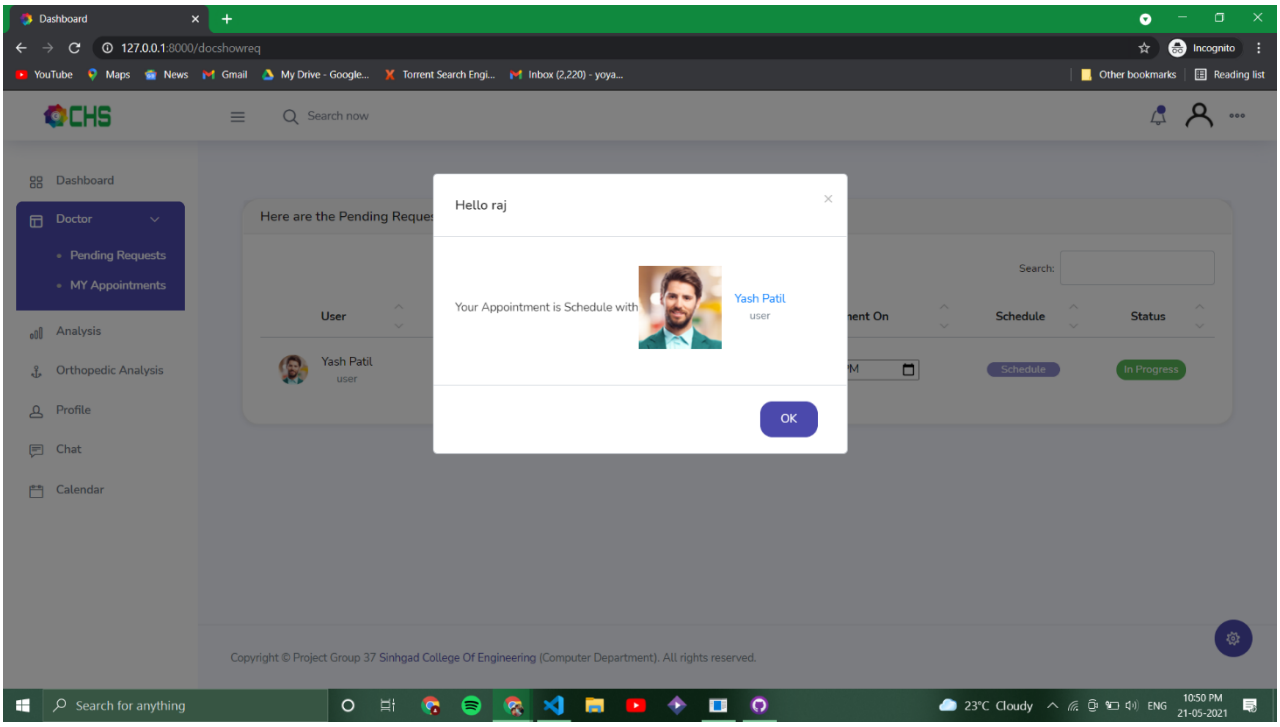




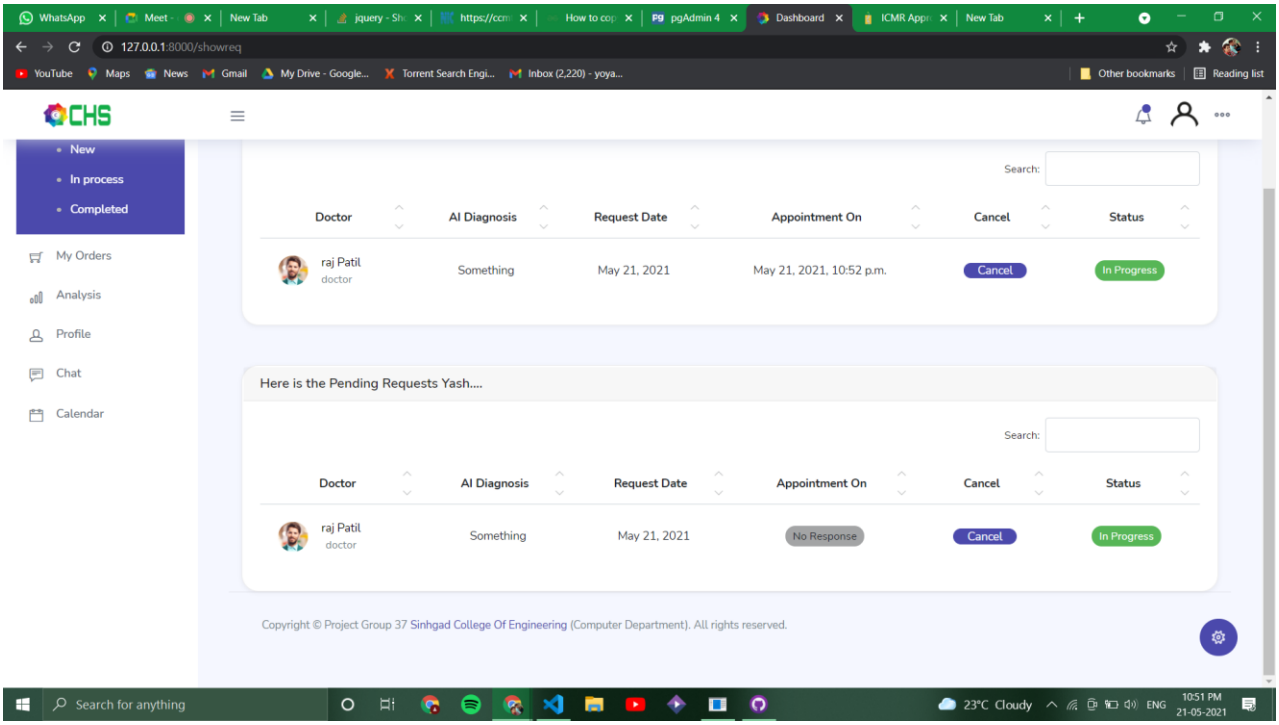
5.2.9 Doctor schedules appointment

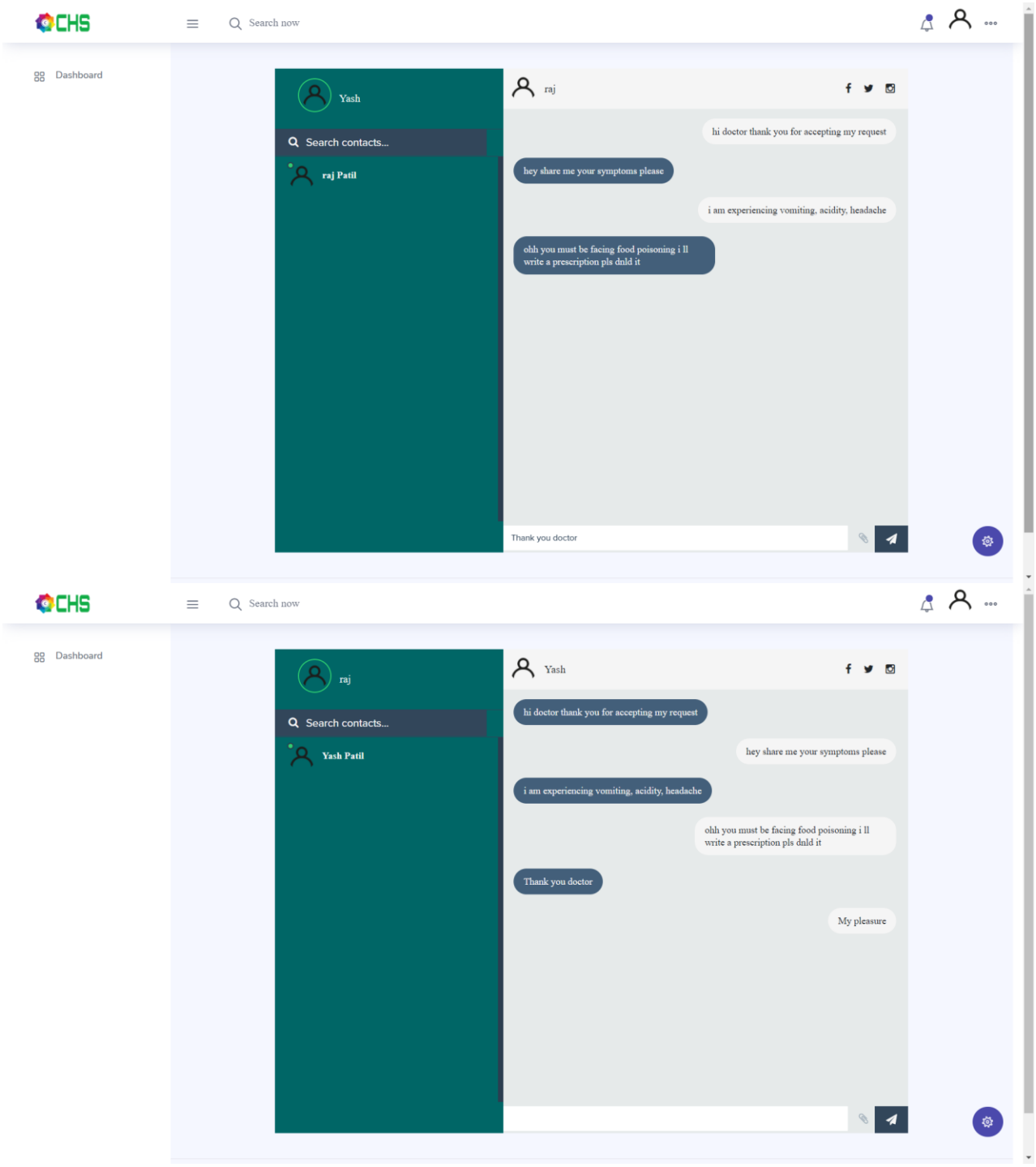




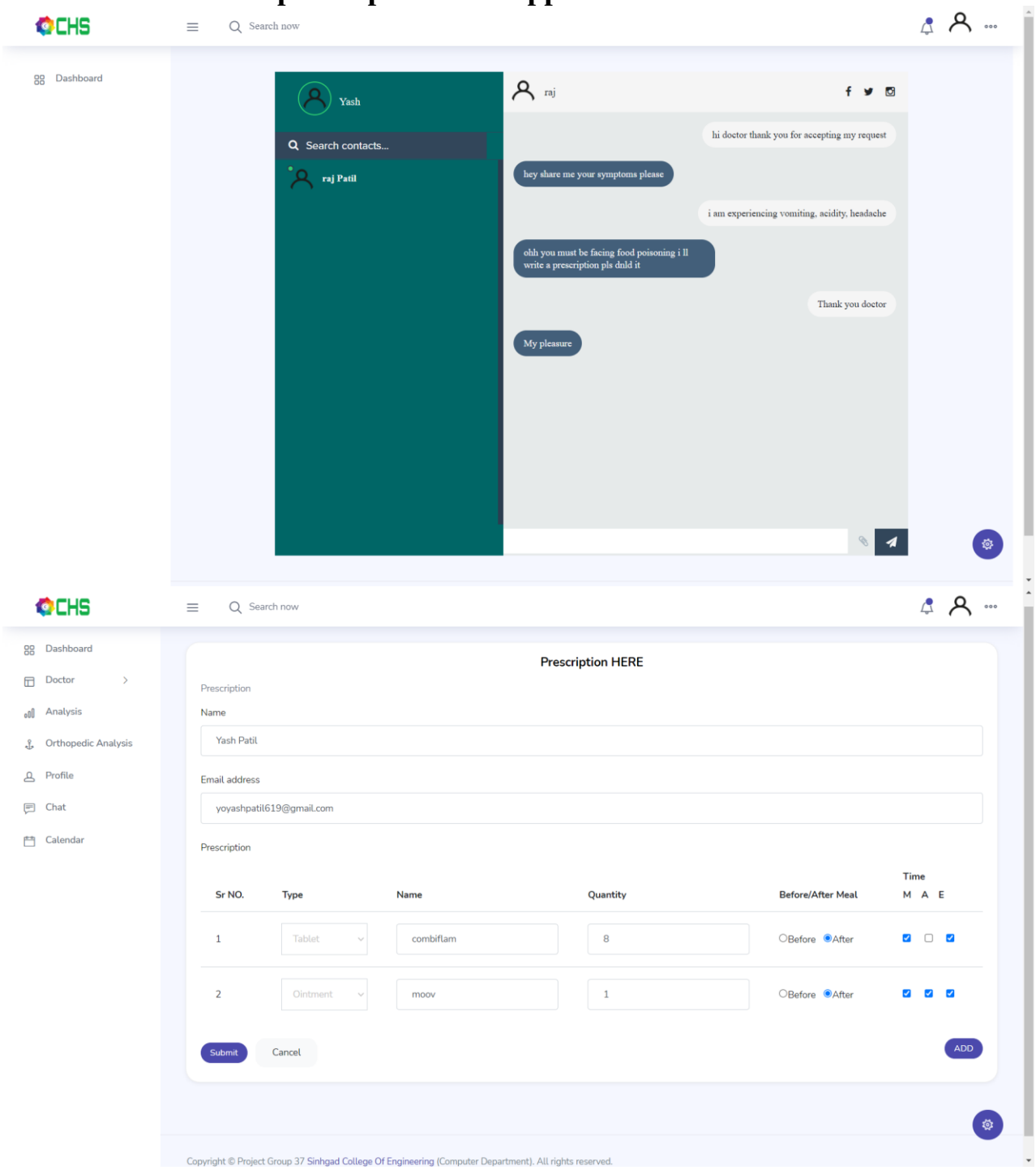


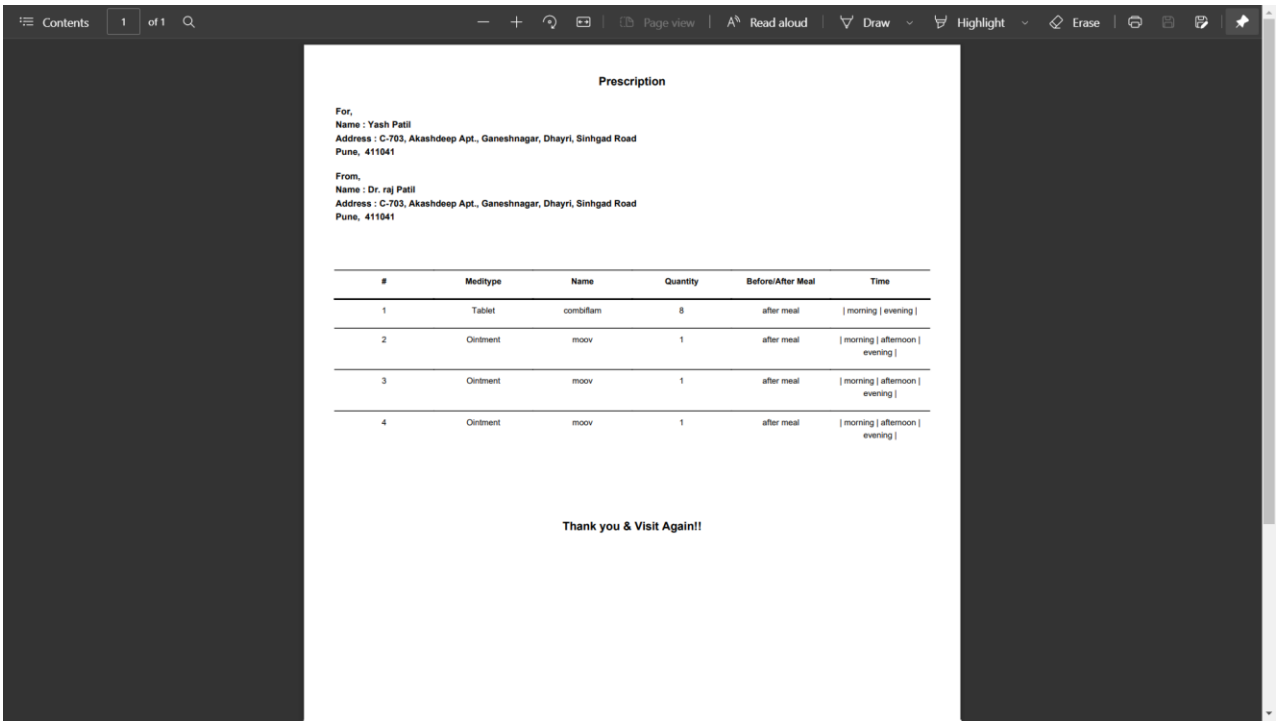
5.2.10 User attends the appointment




CHS
Search now
Dashboard
Yash
Search contacts...
raj Patil
raj
hi doctor thank you for accepting my request
hey share me your symptoms please
i am experiencing vomiting, acidity, headache
ohh you must be facing food poisoning i ll write a prescription pls dnld it
Thank you doctor
CHS
Search now
Dashboard
raj
Search contacts...
Yash Patil
Yash
hi doctor thank you for accepting my request
hey share me your symptoms please
i am experiencing vomiting, acidity, headache
ohh you must be facing food poisoning i ll write a prescription pls dnld it
Thank you doctor
My pleasure

5.2.11 Doctor Writes prescription after appointment





Prescription

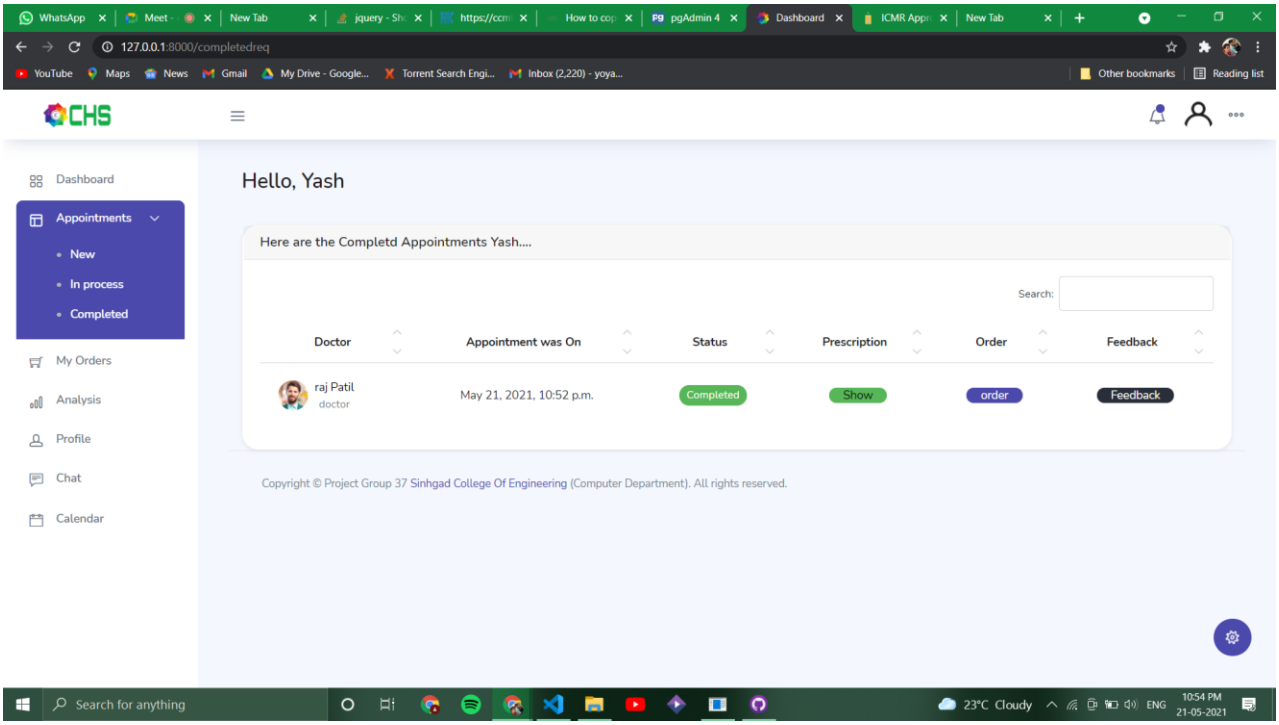
For,
Name : Yash Patil
Address : C-703, Akashdeep Apt., Ganeshnagar, Dhayri, Sinhgad Road
Pune, 411041

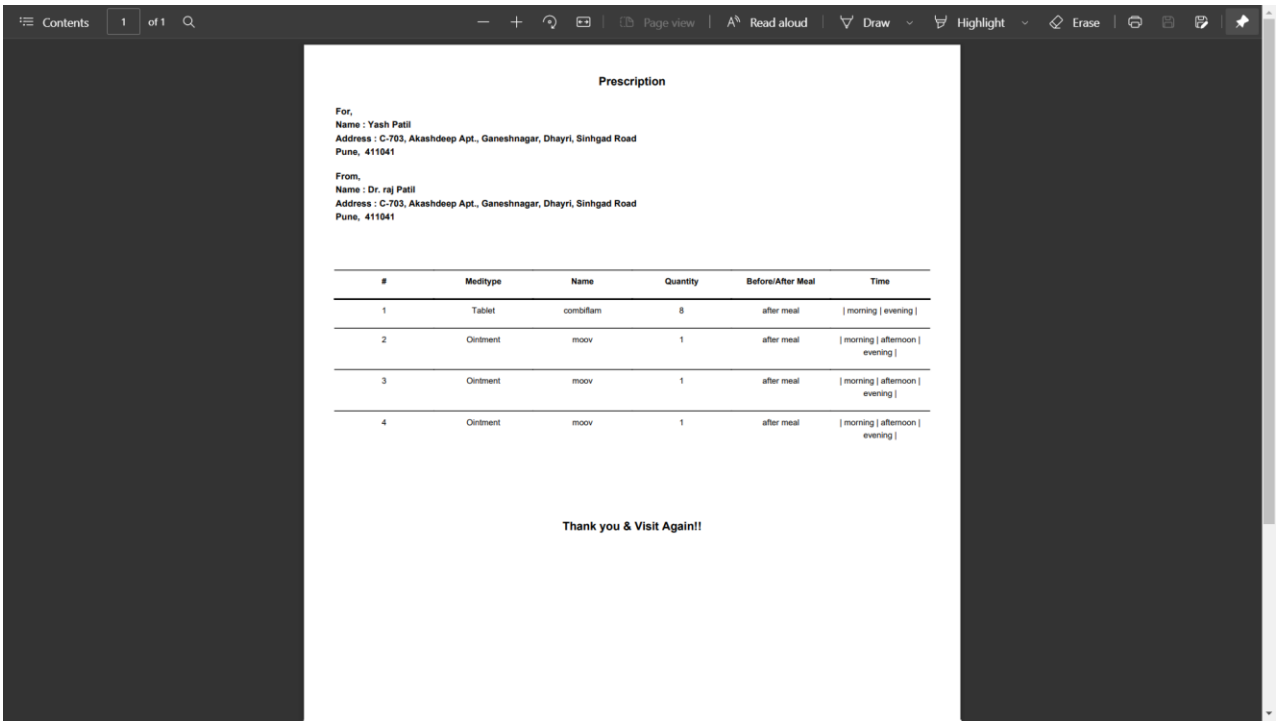
From,
Name : Dr. raj Patil
Address : C-703, Akashdeep Apt., Ganeshnagar, Dhayri, Sinhgad Road
Pune, 411041

#	Meditype	Name	Quantity	Before/After Meal	Time
1	Tablet	combiflam	8	after meal	| morning | evening |
2	Ointment	moov	1	after meal	| morning | afternoon | evening |
3	Ointment	moov	1	after meal	| morning | afternoon | evening |
4	Ointment	moov	1	after meal	| morning | afternoon | evening |

Thank you & Visit Again!!

5.2.12 User can write doctor feedback and down lad prescription





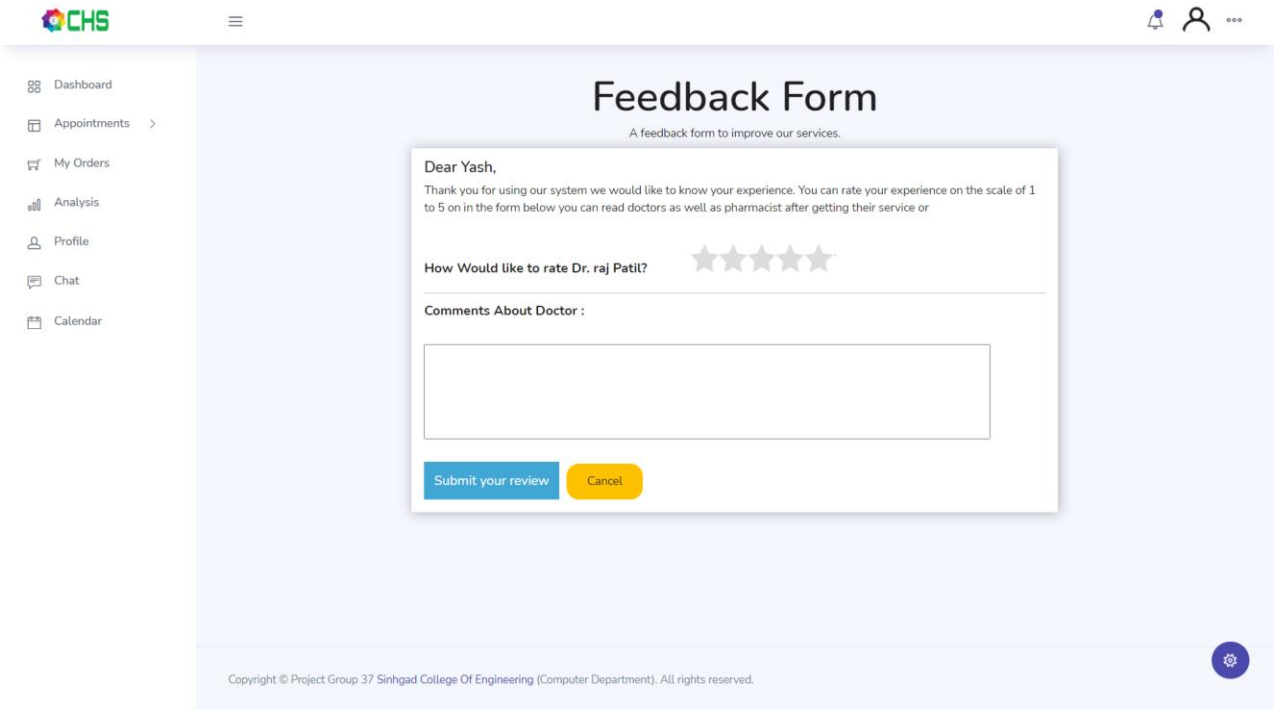
Prescription

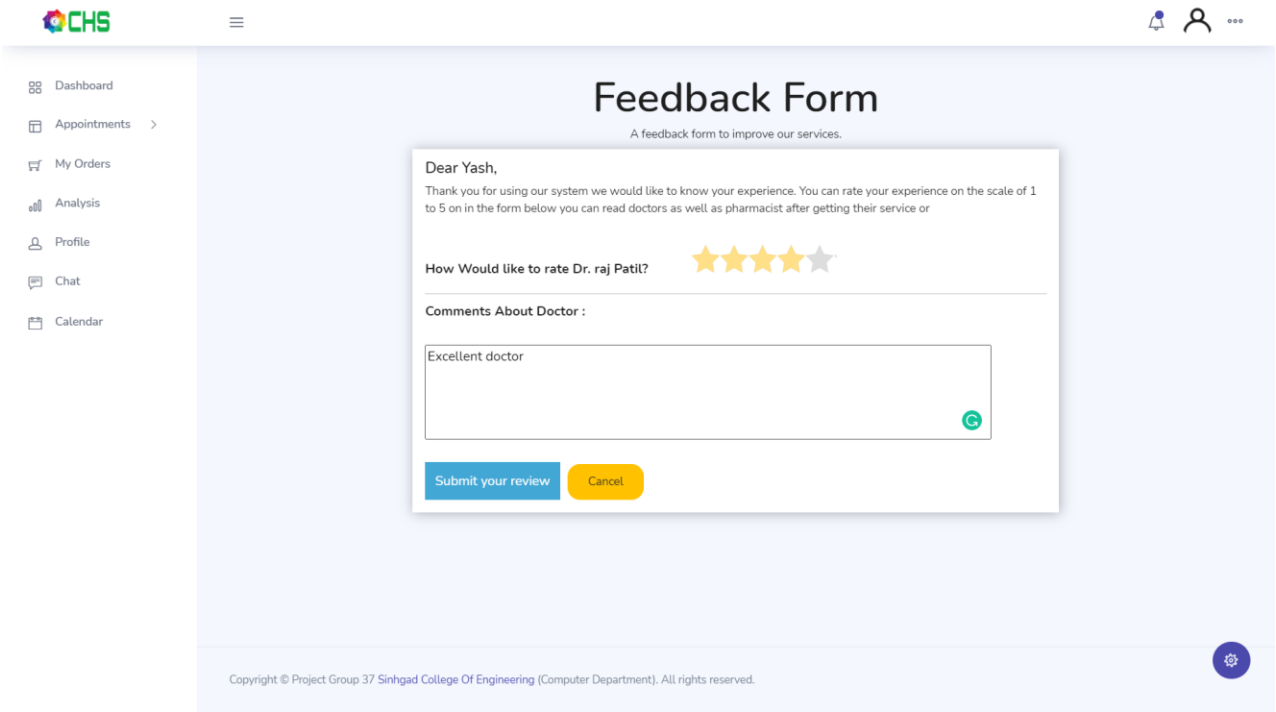
For,
Name : Yash Patil
Address : C-703, Akashdeep Apt., Ganeshnagar, Dhayri, Sinhgad Road
Pune, 411041

From,
Name : Dr. raj Patil
Address : C-703, Akashdeep Apt., Ganeshnagar, Dhayri, Sinhgad Road
Pune, 411041

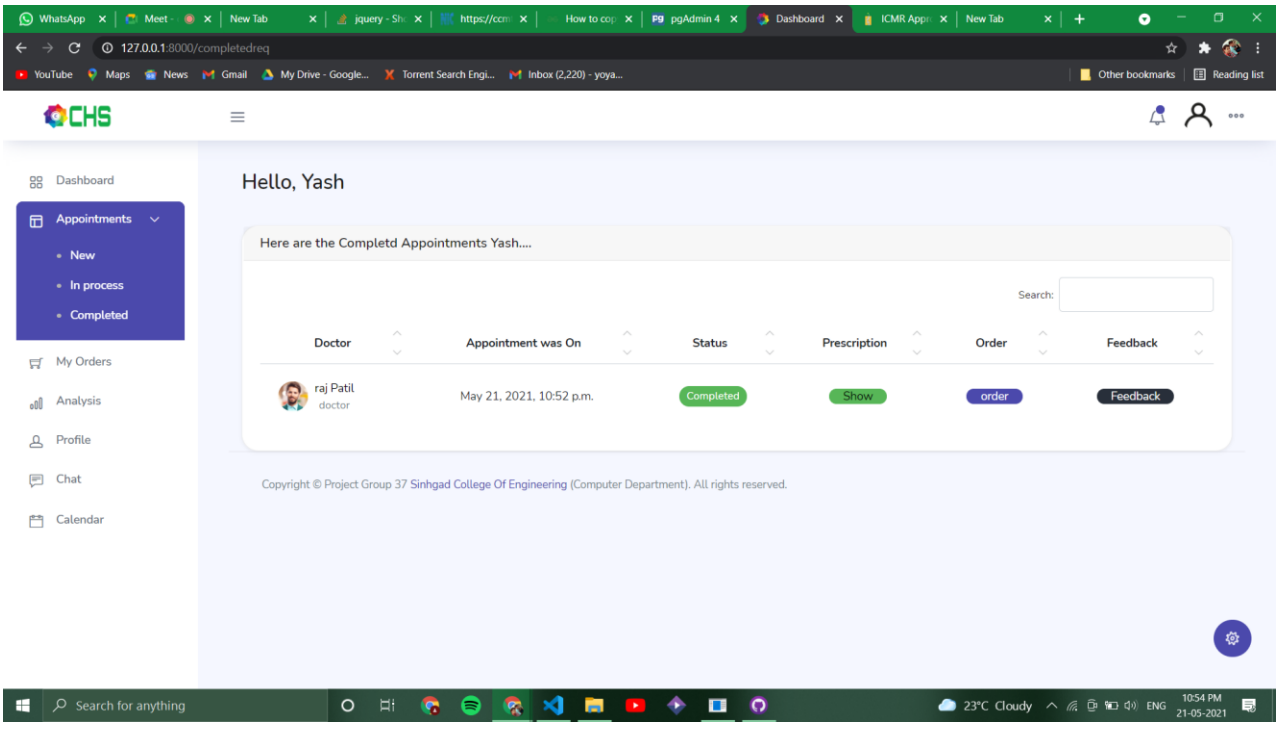
#	Meditype	Name	Quantity	Before/After Meal	Time
1	Tablet	combiflam	8	after meal	| morning | evening |
2	Ointment	moov	1	after meal	| morning | afternoon | evening |
3	Ointment	moov	1	after meal	| morning | afternoon | evening |
4	Ointment	moov	1	after meal	| morning | afternoon | evening |

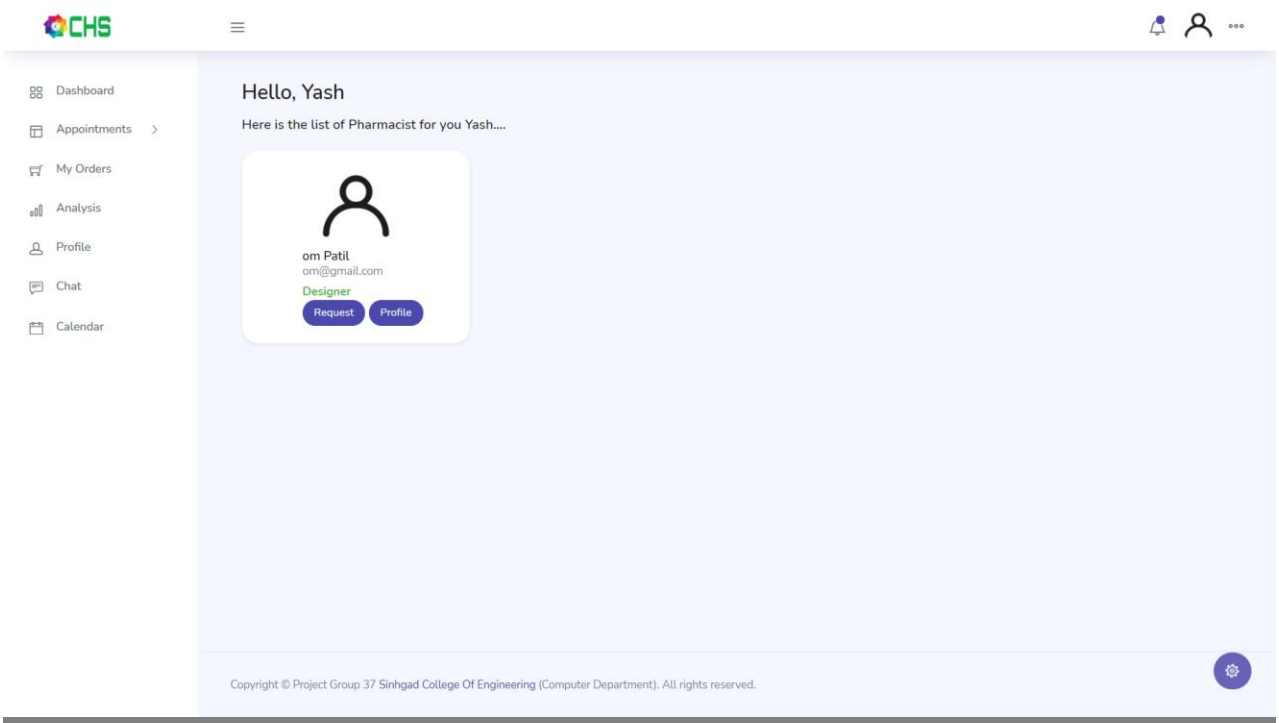
Thank you & Visit Again!!

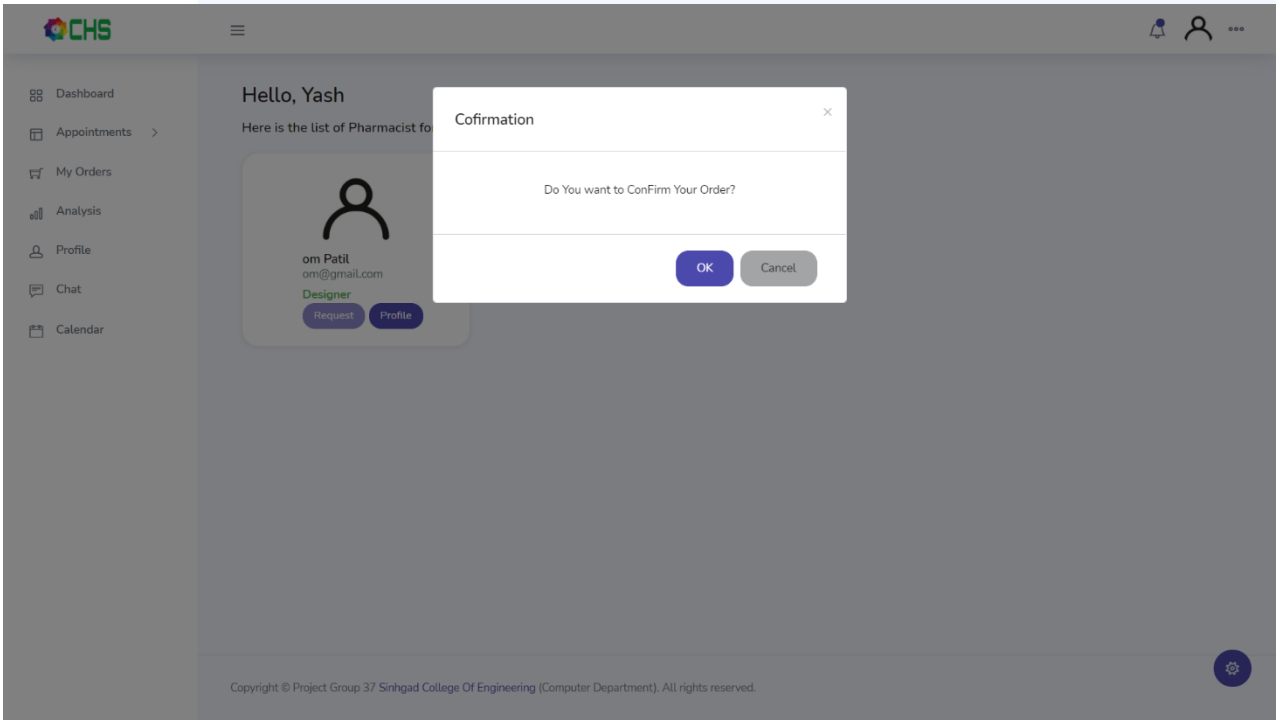




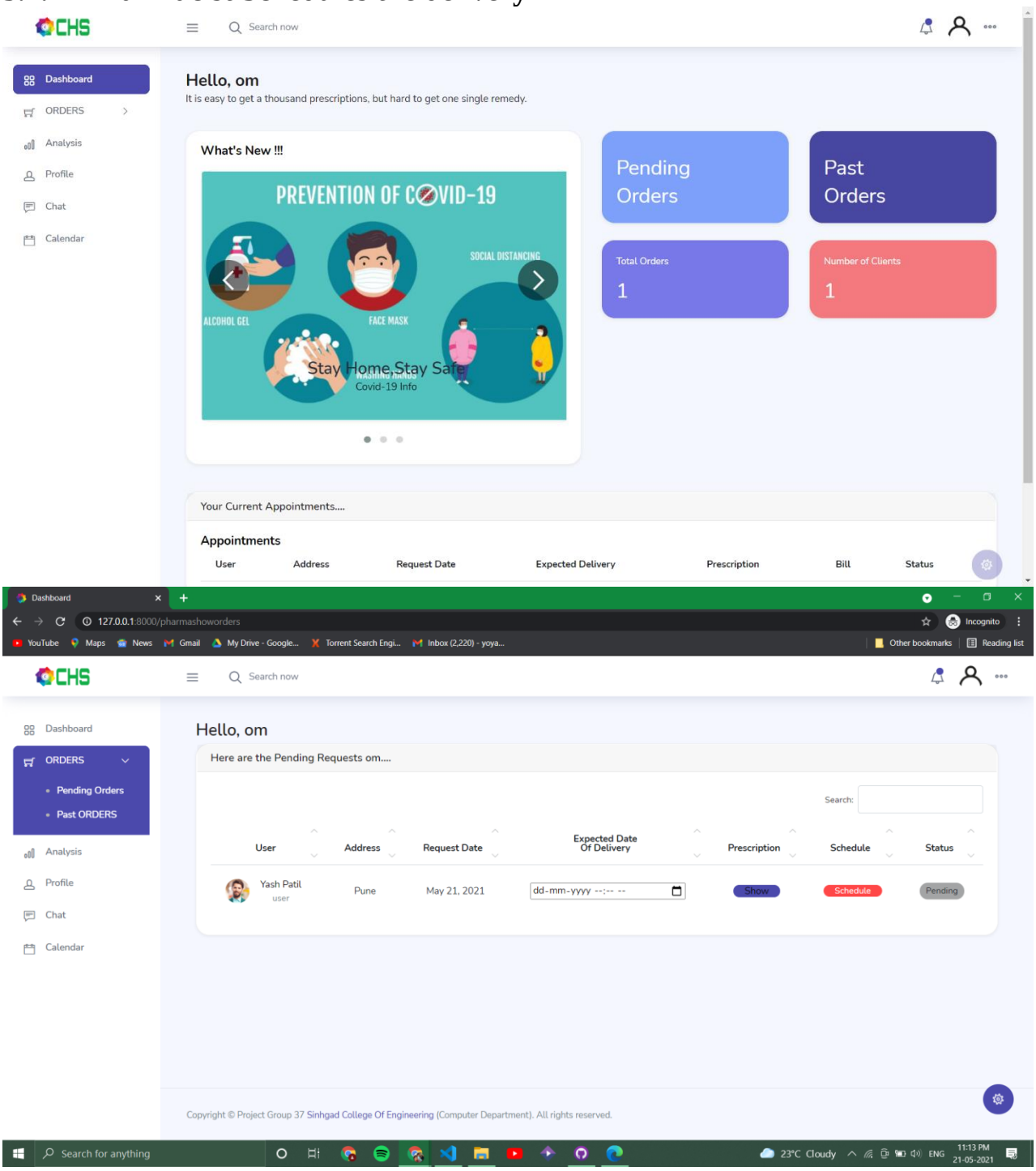
5.2.13 Order the prescribed medicine

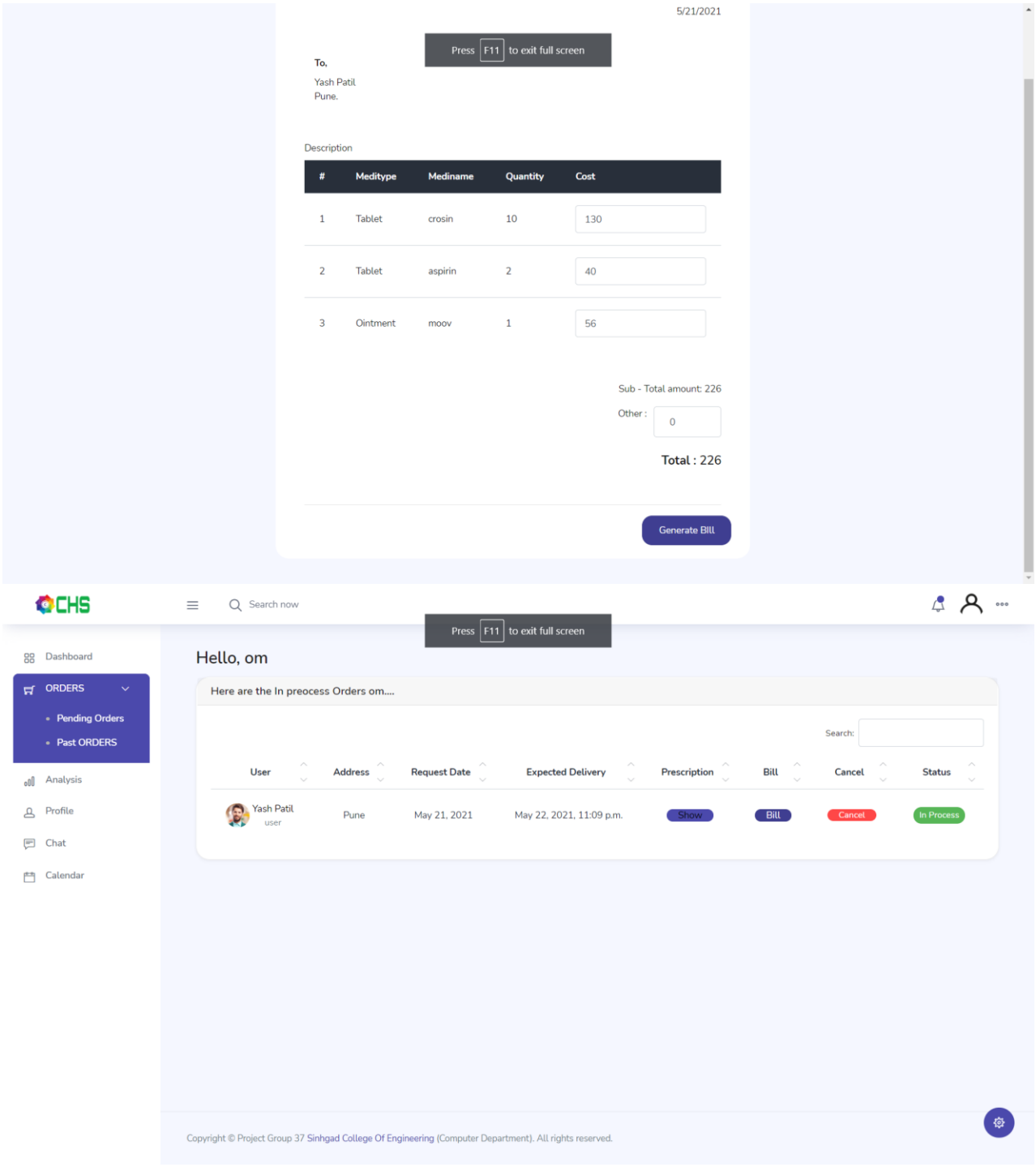



CHS
Dashboard
Appointments
My Orders
Analysis
Profile
Chat
Calendar
Hello, Yash
Here is the list of Pharmacist for you Yash....
om Patil
om@gmail.com
Designer
Request
Profile
Copyright © Project Group 37 Sinhgad College Of Engineering (Computer Department). All rights reserved.


CHS
Dashboard
Appointments
My Orders
Analysis
Profile
Chat
Calendar
Hello, Yash
Cofirmation
Do You want to ConFirm Your Order?
OK
Cancel
om Patil
om@gmail.com
Designer
Request
Profile
Copyright © Project Group 37 Sinhgad College Of Engineering (Computer Department). All rights reserved.

5.2.14 Pharmacist Schedules the delivery




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
Dashboard
ORDERS
Pending Orders
Past ORDERS
Analysis
Profile
Chat
Calendar
Hello, om
Here are the In preocess Orders om....
Search:
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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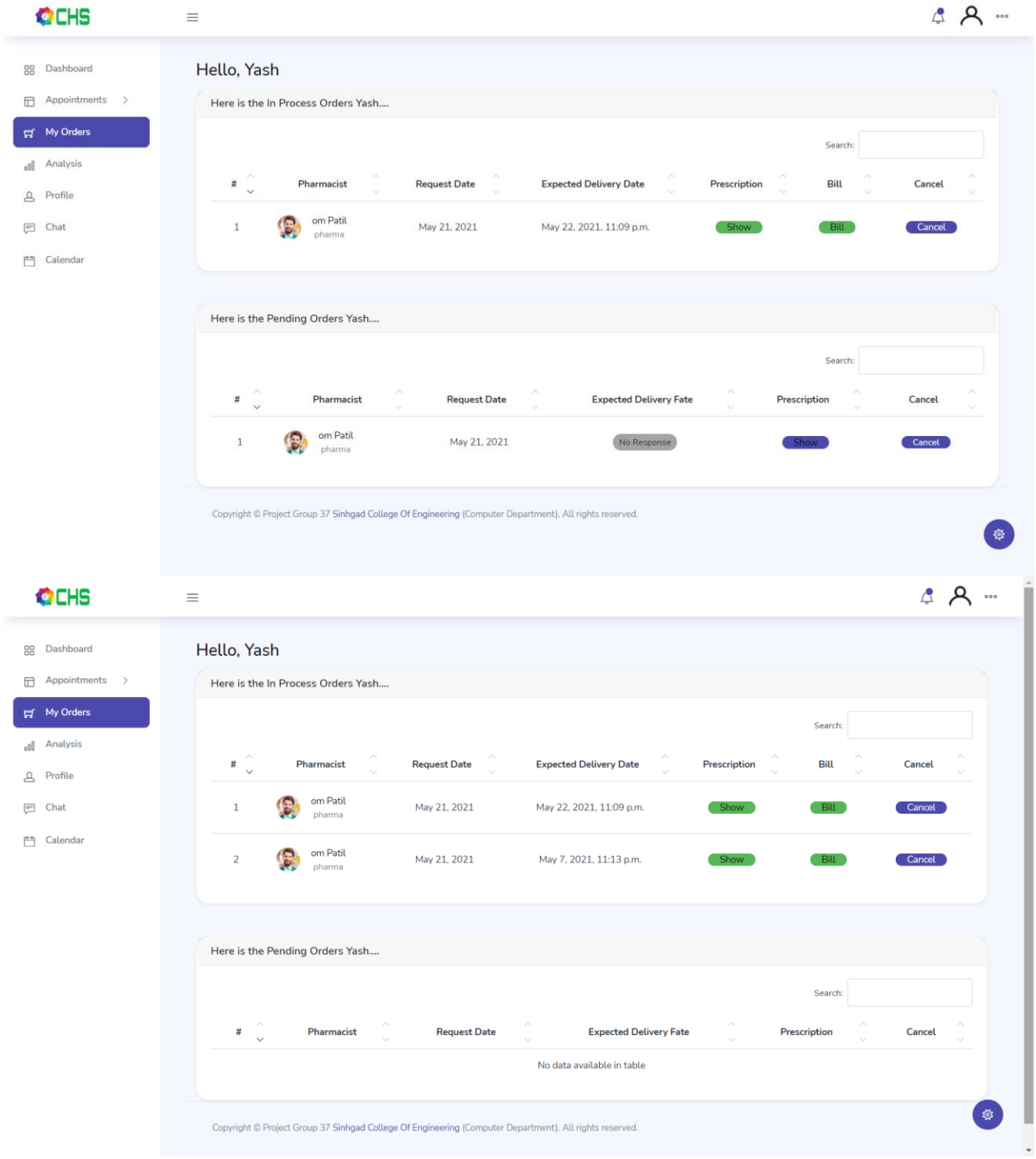
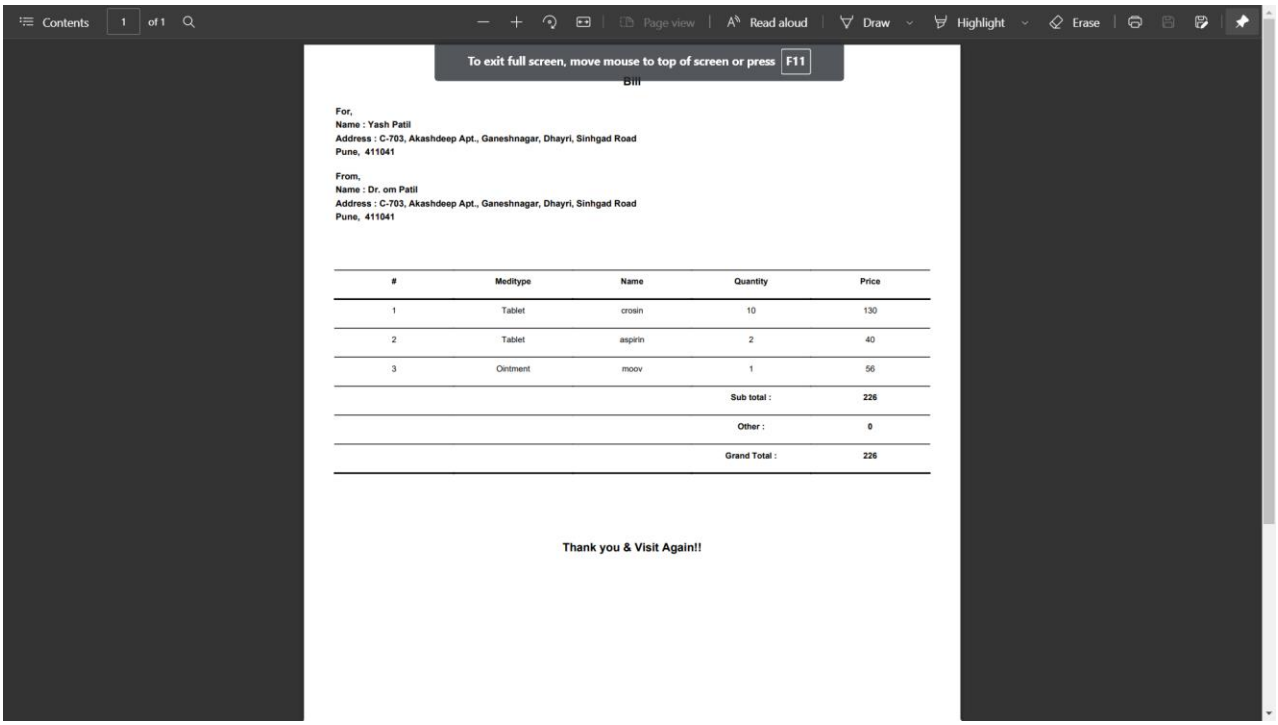
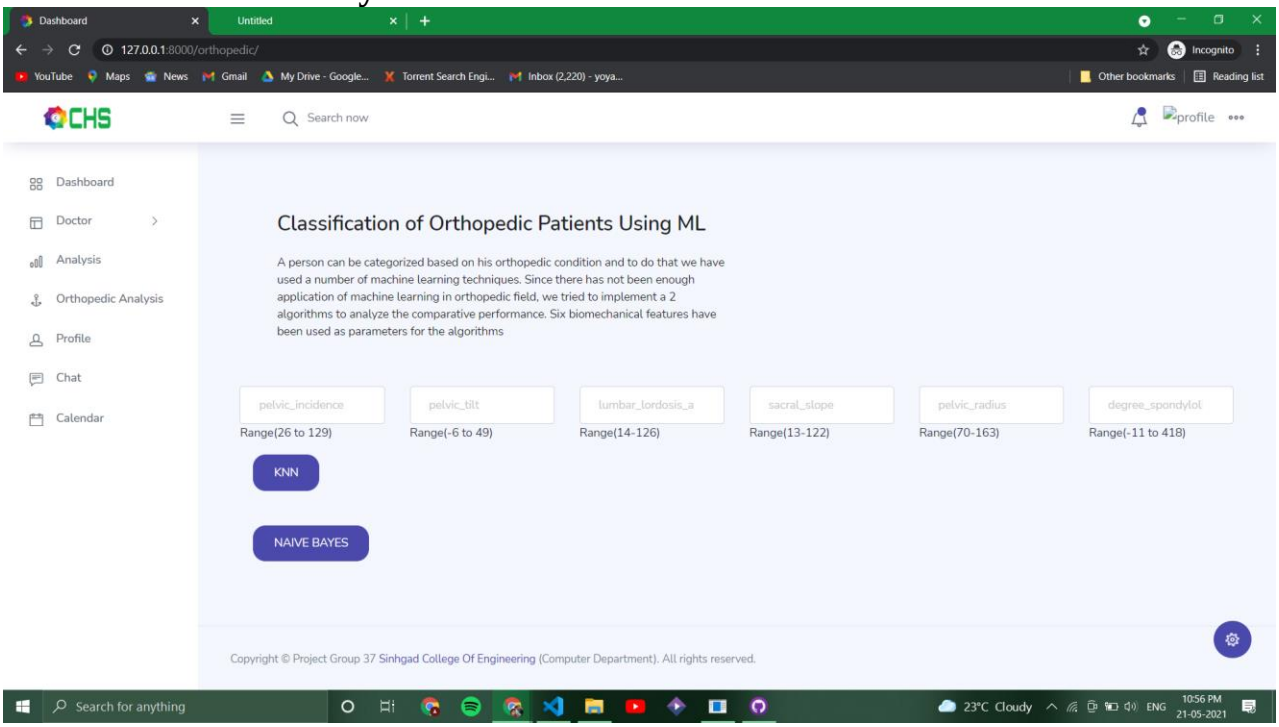
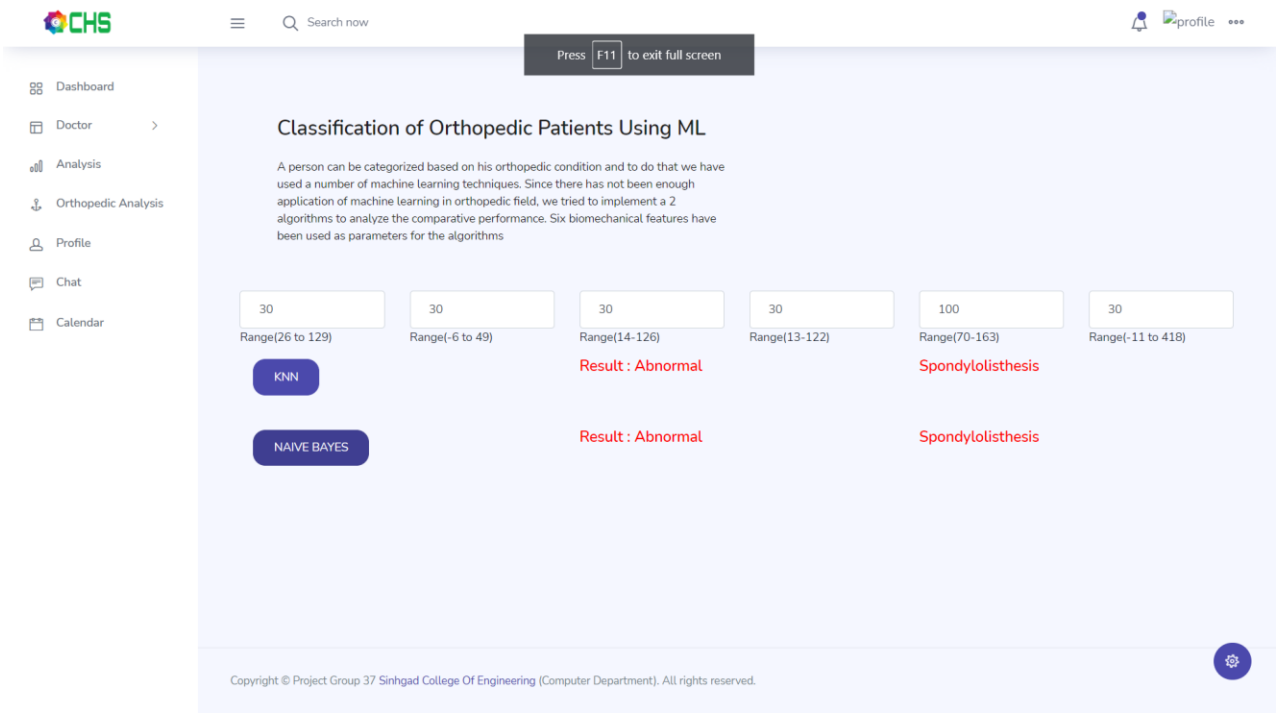
5.2.15 User can see bill after order confirmation



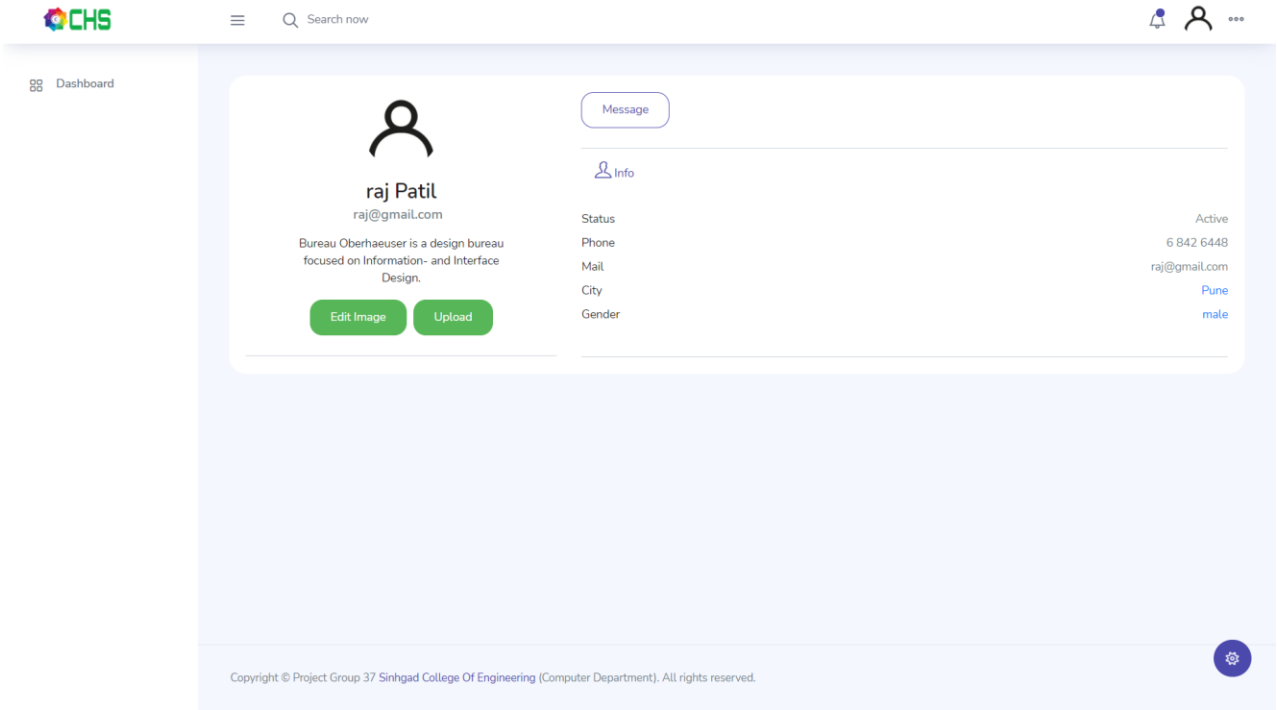


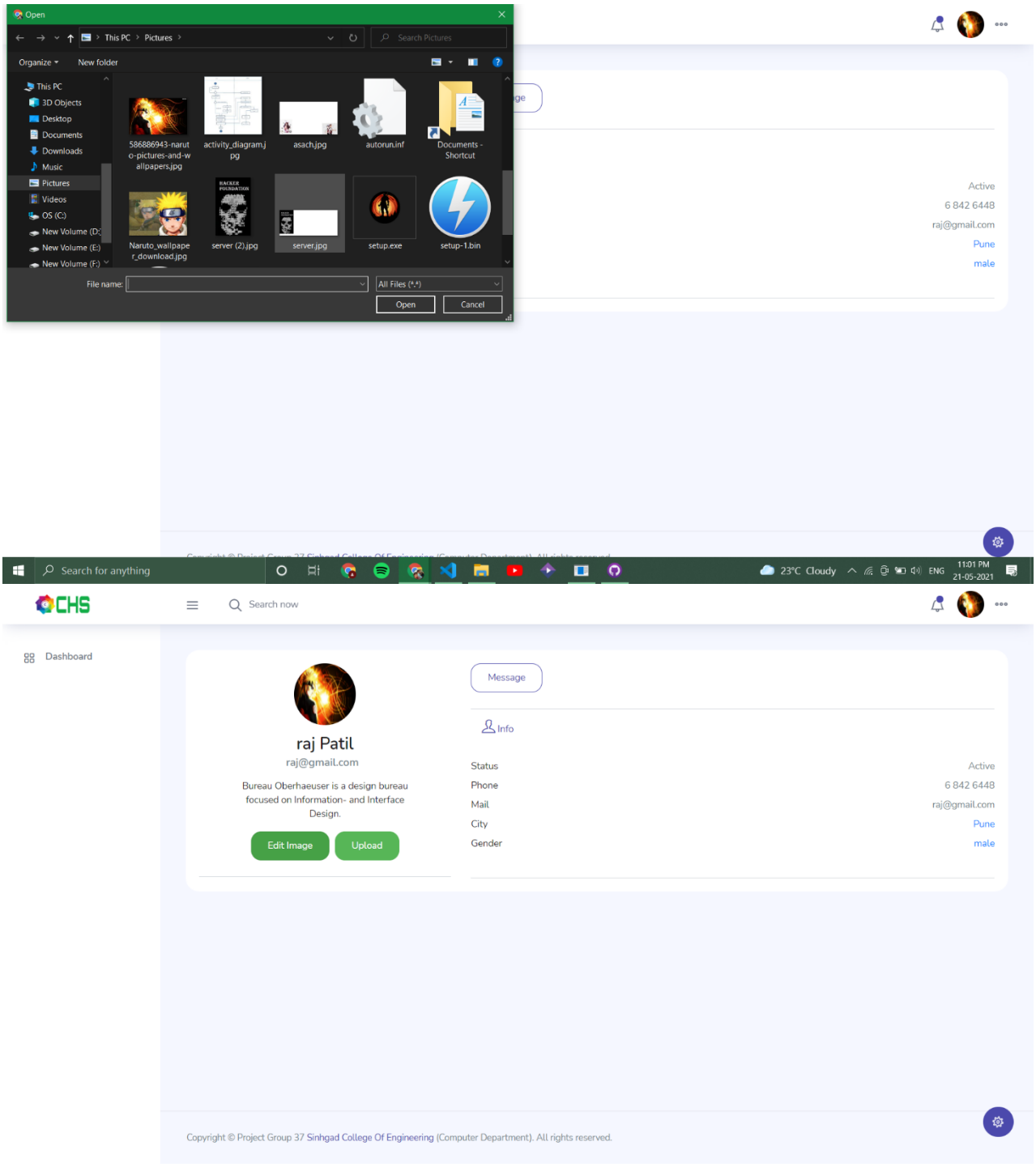
5.2.16 Doctor can analyze biomechanical values in this module:





5.2.17 User Profile




Open
This PC › Pictures ›
Search Pictures
Organize
New folder
This PC
3D Objects
Desktop
Documents
Downloads
Music
Pictures
Videos
OS (C:)
New Volume (D:)
New Volume (E:)
New Volume (F:)
586886943-naruto-pictures-and-wallpapers.jpg
activity_diagram.jpg
asach.jpg
autorun.inf
Documents - Shortcut
Naruto_wallpaper_download.jpg
server (2).jpg
server.jpg
setup.exe
setup-1.bin
File name:
All Files (*.*)
Open
Cancel
Active
6 842 6448
raj@gmail.com
Pune
male
Search for anything
23°C Cloudy
ENG
11:01 PM
21-05-2021
CHS
Search now
Dashboard
Message
Info
raj Patil
raj@gmail.com
Bureau Oberhaeuser is a design bureau focused on Information- and Interface Design.
Edit Image
Upload
Status
Phone
Mail
City
Gender
Active
6 842 6448
raj@gmail.com
Pune
male
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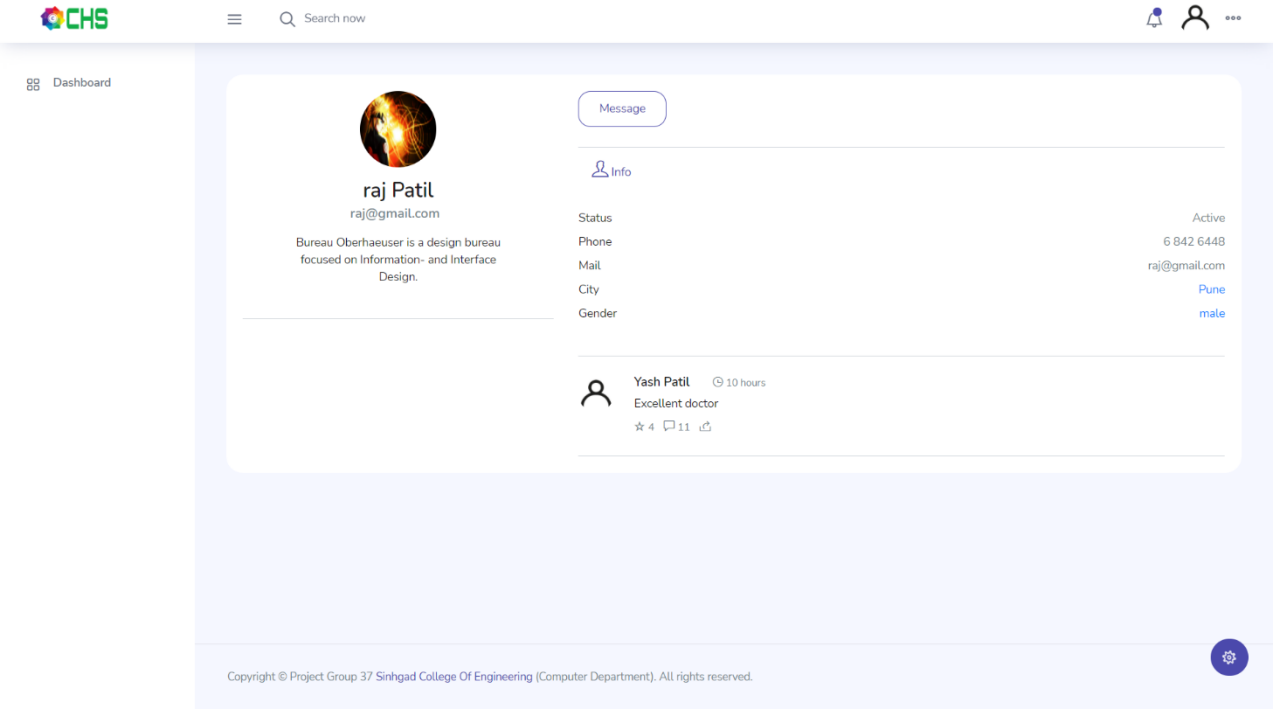
5.2.18 User can see doctor feedback before consulting



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.

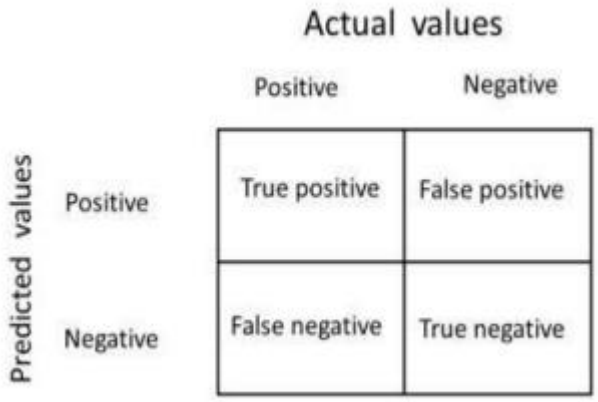


Fig 5.3.1 Generalized example of confusion matrix

- Precision: Shows how relevant the result is:

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

- Recall or Sensitivity: Measures the returned relevant results.

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

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

$$F1 = \frac{2}{\frac{1}{Precision} + \frac{1}{Recall}}$$

$$= 2 \times \frac{Precision * Recall}{Precision + Recall}$$

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.

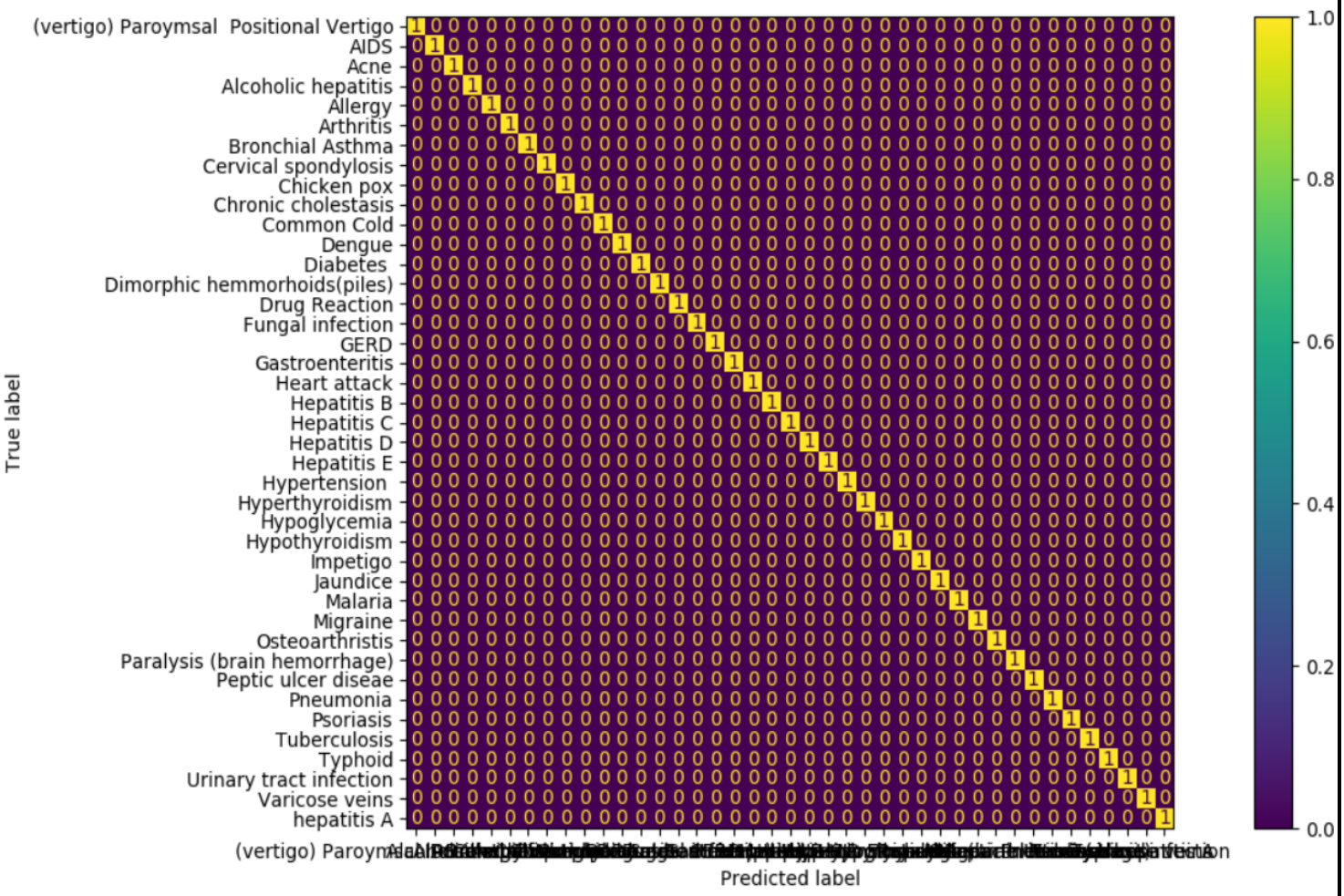


Fig 5.3.2 Confusion Matrix

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.

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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.