# **AN INTERACTIVE E-TOOL FOR MAINTAINING AND MONITORING MEDICAL RECORDS USING BLOCKCHAIN TECHNOLOGY**

# **A PROJECT REPORT**

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#### **in partial fulfilment for the award of the degree**

#### **of**

**BACHELOR OF TECHNOLOGY**

***in***

**INFORMATION TECHNOLOGY**

**RAJALAKSHMI ENGINEERING COLLEGE, THANDALAM**

## **ANNA UNIVERSITY, CHENNAI**

**MARCH 2021**

## **ANNA UNIVERSITY, CHENNAI**

## **BONAFIDE CERTIFICATE**

Certified that this Thesis titled “**AN INTERACTIVE E-TOOL FOR MAINTAINING AND MONITORING MEDICAL RECORDS USING BLOCKCHAIN TECHNOLOGY**” is the Bonafide work of **MUNI PRASANNA KUMAR M (171001061), RESHMA A S (171001072) ,SAHANA K (171001078)** who carried out the work under my supervision. Certified further that to the best of my knowledge the work reported herein does not form part of any other thesis or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

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**EXTERNAL EXAMINER INTERNAL EXAMINER**

**ACKNOWLEDGEMENT**

We thank the Almighty God for the successful completion for the project. Sincere thanks to our Chairman **Mr. S. Meganathan** for his sincere endeavor in educating us in his premier institution.

We heartily thank our chairperson **Dr . (Mrs.) ThangamMeganathan** for her motivation and inspiration that paved for the completion of our project.

We also express our gratitude to our principal **Dr. S. N. Murugesan** who helped us in providing the required facilities in completing the project.

We would like to thank our Head of Department **Dr. (Mrs.) L. Priya** for her guidance and encouragement for completion of project.

We would like to thank **Dr. S. Baghavathi Priya** our supervisor for constantly guiding us and motivating us throughout the course of the project. We express our gratitude to our parents and friends for extending their full support to us.

We thank our Project Coordinator **(Mrs.) M. Sindhuja** for her invaluable guidance, ideas, advice and encouragement for the successful completion of this project.

**ABSTRACT**

Healthcare has become one of India’s largest sectors, both in terms of revenue and employment. With the increase in need of medical attention, the number of clinics and hospitals have also increased. The growing concern is to find the right doctor and adhere to medication as prescribed. This brings the necessity for a medium where one could find doctors and book appointments for consultation. Also, a reminder for which the inputs given need not be manually set by the patient. The proposed system provides a medium to discover doctors under certain specializations sorted based on user reviews, location, availability and book appointments for consultation. The doctor will be able to fill in a form replacing the traditional paper prescriptions that can be accessed by the patient at any time. All the other medical reports can also be stored in this application which will be secured with a password known only to the patient. For editing a prescription given, two passwords : 1 - Patient, 1- Doctor will have to be used. In addition to password protection, storing the records through blockchain will ensure data integrity and provide more security. This system also provides a way to make patients get alerted for taking pills, for next reviews, tests to be taken, and surgery dates. These reminders can be very useful to elderly people to ensure medication adherence. This application also comes with some additional features like an emergency button, tapping which a call will be connected to 108 ambulance services, a section containing medical articles, dietary information and details about health camps that help people maintain a healthy life.

**KEYWORDS** : Book appointment, Medical records, Reminders, Security, Doctors, medication adherence.

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**SYMBOLS AND NOTATIONS**

**Actor**

Standard UML icon for actor is “stick man” icon the name of the actor above or below the icon

**Use case**

Every use case must have a name.Use case is shown as ellipse containing the name of the use case.

An **association** between an actor and use case indicate that actor and the use case communicate with each other. An actor could be associated to one or several use cases.

**CHAPTER 1**

**INTRODUCTION**

**1.1 SYSTEM OVERVIEW**

Health refers to the well-being of an individual both mentally and emotionally. Health can affect job productivity through absenteeism and presentism. In order to maintain a good health comes the health care. The demand for health care is unlike the demand for most consumer products and services because while the desire for consumer products and services comes from direct consumption, the desire for health care is not derived directly from the consumption of the medical procedures themselves; rather, it comes from the direct value of improved health that is produced by health care.

With the fast-paced world, time spent on one's health is minimal. Medication non-adherence and non-compliance is a growing concern. This system is an attempt to address these issues and also help people find and manage their medical records easily. This system provides a way to search doctors based on their specializations specific to a location, book appointments. A secure system to store medical records with 2 factor authentication and also to set reminders.

The proposed system overcomes some of the major challenges in the existing applications especially this system concentrates on providing more security to the user data by providing 2 factor authentication while the recent survey states that 71% of the applications are vulnerable security [21]. Integrating block chain technology in storing medical records will play a major role in maintaining data security and integrity. This will also ensure that the prescriptions aren’t tampered by others.

**1.2 SCOPE OF THE PROJECT**

To develop an interactive tool that is helpful for both patients and doctors in order to connect with each other and also help patients maintain their personal health records and improve medication adherence. By using blockchain, sensitive data may be protected by ensuring a decentralized form of data storage. SHA – 256 algorithm is used in blockchain to get a constant hash of 256 bits every time. This algorithm is also a part of encryption technology. This mitigation method would make it harder and even impossible for hackers to penetrate data storage systems. Many storage service companies are assessing ways in which blockchain can protect data from hackers.

**CHAPTER 2**

**LITERATURE SURVEY**

A Smartphone Based Application for Health Care Management System is an Android application for booking an appointment, checking availability of beds, with pills remainder. This paper was proposed by Dr. Sangeetha. V et al [1], in the year 2020. Patients can find the right doctor based on ratings, location, and feedback from other patients. They can set reminders for medicines or drinking enough water. A person who is too busy or lazy to go to the clinic can chat with the respective doctor online at any time of the day. Anyone can upload prescriptions, medical reports etc. to keep them safe and hand. The patient can choose hospitals based on cost and quality. Application will provide an emergency button to make an emergency call for an ambulance. Provides facilities to choose the doctor based on the category of the disease and making an appointment with the doctor. Information about the hospitals and presenting their locations. · Application will provide a pills remainder. Major drawback is that prescriptions are uploaded as a picture which makes the patients difficult to understand and it also takes more space to save the images.

IoT-based Health Monitoring System with Medicine Reminder using Raspberry Pi is an health monitoring device which includes pulse and temperature sensors to quantify independently the patient's pulse and temperature. If either of these parameters exceed the specified value, the system sends the predefined message to the doctor immediately via the IoT. It was developed by M. Amru et al [2], in 2020. The time, date and number of capsules are provided to the system by using the personal computer and the device is turned on after it calculates and reminds the timing of the capsule consumption. It also gives the heartbeats and temperature of the user. The remainders are made on time. As it creates a bell sound it is easy to identify the remainders. Stores the prescription as compressed image. The capsule timings are entered by the user. It is main to use personal computer to enter the capsules. Other than pills remainders there is no searching of doctor applications. Cost of the hardware requirements are higher. Need to take care of hardware equipment.

Effective Online Medical Appointment System is a web application to view doctors and book appointments according to doctor’s schedule that overcomes the issue of managing and booking appointments according to user’s choice or demands. Here the user can select good doctors by viewing their details and reviews. S.Hema Kumar et al [3], developed this application in 2019. The doctor can see the patient request and sends the notification to the patients if the appointment is available. Does not provide a medium to store prescriptions and set reminders. Patient cannot choose the appointment time. This is the major drawback.

Fall Detection Application for the Elderly in the Family Heroes System proposed by MoustafaFayad et al [4], is a conventional machine learning approaches have been widely applied in fall detection and activity recognition, and results outperform those of threshold-based methods in studies that use wearable sensors. Approaches of deep learning are gaining popularity especially for visual sensors and sensor fusion and are becoming the state-of-the-art for fall detection and other activity recognition. Deep reinforcement learning is another promising research direction for fall detection. It provides technological solutions to address the issue of aging are now a necessity. Systems based on these solutions combine wearable and ambient sensors, processing software, and user interfaces. Their objective is to monitor dependent and frail elderly people in institutions and/or home. The healthcare monitoring for elderly people is a growing application axis thanks to the massive technology development. Fall Detector is a special app that alerts if an older person has fallen. If there is a longer-than-normal period of no movement, the signal will sound so one will be alerted and can check up on them. The major challenge they faced are the rarity of data of real falls, detection in real-time, security and privacy, platform of sensor fusion, limitation of location, scalability and flexibility.

An Android and Web based Application ‘Urban Healthcare Service’ is an assistance for individuals who think that it’s hard to choose hospital, pharmacy, any medical store for arrangement or looking for help in crisis circumstances. Also, it will enable the majority in their regular daily existence by giving healthcare information, medical service information, emergency services etc. This paper was proposed by Shah MdMonirul Islam et al [5] in 2018. Using this application, individuals can get several services like finding hospital information in the city, information about healthcare services, suggest suitable hospitals, feedback facility, information about emergency service, searching pharmacy information, searching optical store information, getting updated live traffic, showing path to the destination in Google map. This will preserve information about the hospitals, pharmacy and optical stores, search and find hospitals. Deals with record maintenance, recognizing instances of healthcare services. The challenge is very tough to give the perfect location through the app and difficult to show us the updated facilities of that hospitals and diagnostic centers. Gives less privacy for user data.

Android Application of Hospital for Karjat Taluka is an android application for Patients Appointment System and to view and manage appointments. This system will provide the patient to schedule an appointment with the doctor. It also provides the patient a medium to interact and communicate with doctors without making any physical appointments with them. It is a medium to book and manage doctor appointments. Also provides chat options to connect with a doctor. Only the doctor can see the history of the patient. It is made only for one specific hospital. No feature for searching other doctors or to set reminders. This paper was published by Rahul Raj Verma et al [6].

Scan Med: A Healthcare Application using QR Code was proposed by UndeGorakh Shankar et al [7]. The website contains a page which is entered by the nurse and contains the medical records for all the patients for a single hospital. This website has a QR code that makes easy access to get the hospital history records easily. The QR code is made for each and every patient and stored in the database (MYSQL).The implementation of the backend is made up of PHP. This application is mainly developed for the patients of the single hospital which is faster and stored in the single database which can be accessed easily by MySql. This application is made for a single hospital. Need to be maintained by a technical team. Prescriptions are made to be stored as pictures.

[TabSafe](https://www.tabsafe.com/) is an easy way to help parents stay on track with their medication. TabSafe has three components: the pill trays, the machine, and the website. Each machine can hold 4 pill trays at a time, with nearly 20 sections per tray. Simply portion the medication, place the trays into the machine, and hook it up to a phone line. It was developed by Frank Michelin et al [8]. TabSafe is an innovative medication dispenser that helps older adults keep track of their pills. With physical and audible cues, TabSafe has a more focused way to alert people that it is time to take their medicine. Comparatively, weekly pill cases do not have alerts, while many alarms are placed far from living areas and may not be heard. The TabSafe eliminates these problems completely. It has potential to save many lives and improve quality of life for individuals who consistently forget their medicine. Although every good option comes with downsides, such as cost and insurance acceptance, TabSafe is worth looking into. The manufacturer has limitations on the amount of pills, pill size, and suggests not using the machine for halved medication.

Smart Doctors Appointment and Prescription System was proposed by Md. Abdul Majid et al [9] in 2017. In this system a registered user can request for a particular doctor’s appointment then the system will send an acknowledgement to the patient if the doctor accepts the request and the doctor writes the prescription through the system. Doctor’s Appointment and Prescription system for Android to manage appointment and prescription for doctors and patients accordingly. Patients can take appointments with their doctor. Doctors can prescribe a patient based on an appointment in the system. Patients can see the prescription in apps. Only appointments can be made and prescriptions can be given. Cannot set alarms or reminders and there are no reminders for appointments made too.

Pillboxie is a software that is organized in two sections, one side is dedicated to the current day's pill schedule while the other side has been cleverly designed to look like medicine cabinet shelves. Tap on each individual, labeled pill bottle to access its specific information including scheduling, dose history, reason for taking, and a general instruction box. The general instruction box allows for needed flexibility to add more information such as pill dosage, the prescribing physician's name, refill date and any precautions. One can schedule reminders just by dropping pills into a pillbox. This app reminds the user on time, even if thier device is asleep. Pleasant reminder sounds make Pillboxie a comfortable addition to the day. Patients can customize their meds with tons of combinations of med types and colors. Pixel-perfect original graphics look great on Retina Displays. One can see a list of what meds are "due today" and check them. Pillboxie is complex since it has to remind all medicine names. This application sometimes gives wrong reminders as there are a lot of medicines to be notified with dosage. This app was developed by Jared Sinclair, RN et al [10].

MedMinder is a sophisticated pill dispenser, equipped with a number of special features. The four models are all big enough to be filled with medications for up to several weeks at a time. The internal cellular modem will notify specified caregivers if someone doesn’t take their medications after several visual and auditory cues. Individual pill compartments can be locked until a medication needs to be taken. This helps prevent users from taking the wrong medication. Locks are also an important safety feature if young children are around. MedMinder has its own emergency call center too. MedMinder also offers pharmacy services, similar to PillPack. This application was developed by Garland System, United States[11]. This system is designed to work on a schedule in which it gets filled weekly or every 2 or 4 weeks, depending on the number of medications. It can be set up to remind a caregiver, and to notify a caregiver if the "refill" has not taken place. The system is designed to be plugged in to the power outlet. It includes a battery backup, which the company says lasts for 48 hours. Because it is connected to the Internet, it is theoretically possible someone could hack into and gain control of the system.

Medical Appointment Application is a meeting between a patient with a physician or doctor to get health advice or treatment for a symptom or condition. Appointments are strongly encouraged so that Medical Services staff may be sensitive to any time constraints. The methodology model that will be used in the application is the prototype model. It is to allow the practices’ administrators to display the available appointment time for the user to choose and to make an email notification or any sort of notification for appointment rejection. Medical Appointment application is a web-based mobile application designed to help in patient scheduling with practice. Users can easily book their appointment with the practice they wanted avoiding a long queue at the clinic. This paper was published by Noorsyahira Ismail et al [12]. The application is unable to allow practices’ administrators to show the unavailable appointment time. It only allows the user, the patient to fill in the appointment form without knowing which appointment time is available for them.

A Smartphone based Application to Improve the Health Care System of Bangladesh is an Android application proposed by Ahmed Imteaj et al [13] in 2016. It is an online cabin booking system. Has information about facilities of hospitals and their locations. It is an alert system to take medicines in a fixed time. Provides special features such as Body Mass Index (BMI) calculator. Any user can find a suitable hospital and Request for a cabin. Payment facilities can be made online. The alerts need to be set manually. No location based filtering or specialisation based view of doctor’s list. There is no feature to store medical records.

OnlineAppointment Reservation and Scheduling for Healthcare is an online reservation and scheduling system will allow individuals to securely and safely make their appointment reservations online. Organize daily appointments ballots of patients. Provides features such as enrol time groove to every patient. Fixed appointments can be aborted. Audit Doctors vacancy for patient’s appointment. Avoids double booking. Provides SMS appointment details to patients. This application is available only for doctors. Patient will have to go to the clinic/hospital to make an appointment. Does not provide a medium to store prescriptions and set reminders. The paper has been published IrinSherly. S et al [14].

ArduMed - Smart Medicine Reminder for Old People is an android application which creates a reminder to tell the user (old people) to take their medicine at a time and store the prescription. It is linked with mobile’s calendar and makes reminders by using the alarm based on the mobile timings and it uses MongoDB for storing the prescription. The remainders are made on time. As it creates an alarm sound it is easy to identify the remainders. Stores the prescription as a compressed image. It just reminds about the pills and dosage but it doesn’t give reminders for others and online appointment booking is also not available. This paper was published by MayureshWaykole et al [15].

Medication Reminder and Healthcare – An Android Application was proposed by DeeptiAmeta et al [16] in 2015. It is an Android-based application in which an automatic alarm ringing system is implemented. It focuses on doctor and patient interaction. The proposed system is based on Android Operating system which will remind the users to take medicines on time through notification and automatic alarm ringing system. Patients can get notifications through SMS and they can schedule appointments. Manual entry of tablets to be taken by the patient. They cannot view past consultations.

An Android based Application for Determine a Specialized Hospital Nearest to Patient's Location is a asic and up-to-date medical category application designed to help the patients and caregivers to determine the nearest hospital with a specific specialization field. The hospital names along with their address and route are determined by Smartphone GPS receiver within five km of radius. With the help of Google Map, the distance and route to each hospital is displayed for the user. This application is greatly useful in emergency cases as well as for the non-resident person of the city of Karachi. The paper has been published by Muhammad WasimMunir et al [17]. This research work was conducted in two steps. The first step was an informative survey and it was conducted to gather the latest information about hospitals and doctors. The second step was to implement an application for android Smartphones, so that it will be available to all android users. Later it will be implemented for another mobile operating system. The people of karachi got helped by this application. It is easy to use by the patients. This application is implemented for a single city (Karachi in Pakistan). Drug remainders, Lab test remainders, Pills remainders are not available. Prescriptions are given manually for the patients.

iTriageHealth is a software founded by two ER doctors [18] that contains Symptoms, Doctors, Facilities, Conditions, Medications, Procedures, My iTriage, Hotlines, News, About, Survey of each and every patient. It covers all registered physicians or doctors using iTriage Doctor Search tool. Maintains an exhaustive database of information related to diseases, medical symptoms, conditions, medications. Easy to locate the nearby healthcare facilities. It maintains a comprehensive list of symptoms and diseases with vetted work-ups and treatment options.

It takes a lot of power into the hands of the consumer. It is a low cost to the end user to promote adoption, this could easily get viral. Interface is challenging and does not appear to be designed with the average consumer in mind. Far too many of the diseases listed for a given symptom are in obscure medical terminology that is difficult to decipher. This may be fine once a medical professional has confirmed a diagnosis and one wishes to know standard work-up and treatment, but as an entry point into self-triage, not so sure this is the best approach.

MedTouch: Towards the Development of Smartphone-based Software Solutions for Mobile Health Care was published by ArvieCarpio et al [19]. This application iteratively using Scrum software development method also conducted functional testing and usability evaluations followed by further refinements to the system. MedTouch is a smartphone-based software application that enables patients to manage their vital statistics information, medical prescriptions including reminder alarms, transmission of medical information to health care providers including photographs, and application settings. It provides some features such as view a quick summary, view the history of measurement of each vital statistic through a list view or a chart view. It is mainly focused on maintaining a history of all the vitals checked during reviews. Dosn’t provide a medium to store prescriptions and set reminders.

MediSafe is an android application that was developed by Brian Carr et al [20]. It learns about each user’s unique situation, so it can deliver custom notifications for appointments and refills, medication updates, personalized health recommendation and discounts to help stay organized, informed and on budget. And it tracks progress correlated with measurements like blood pressure and glucose levels to show the direct health benefit of taking meds as prescribed. Patient will get automatic drugs reminders. Medicine box can be created for the senior and other family member. Even when the elder person is sleeping, it will remind the user like alarm clock. It will record and sync measurements with HealthKit as per blood glucose, pulse, weight, blood pressure, temperature etc. User can track progress and share with physicians or nurse in PDF format. They can also earn savings with latest coupons and discounts available on medicines. It is visual and easy to use. Data will be backed up in the Medisafe cloud. Even if the user were ever to lose phone, one could Login on another phone and get access to the user’s data again. Doctor’s appointments only sync with Gmail. Although the Help and Support section offers a large Frequently Asked Questions section, there is no search functionality so the user needs to scroll through the list of questions to see if the answer is there. Can’t add an image to a medication or create a stand-alone report of notes.

**CHAPTER 3**

**SYSTEM ANALYSIS**

**3.1.1 EXISTING SYSTEMS**

All the system available are mostly an android application. It doesn’t have proper security for storing data. The users are either doctor and patient or admin and patient. Anyone can register as doctor and access the records. There will be no confirmation message from doctor after booking appointments.

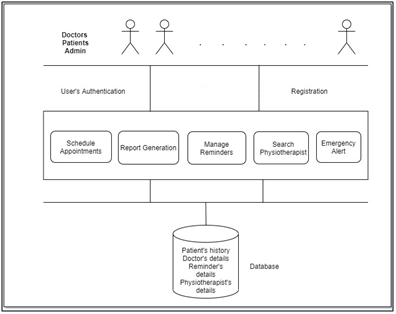
Pills reminder is also not efficient since notifications will be sent to registered emails. More space needed since prescriptions should be scanned and uploaded. Incase of emergency, there is no provision to call doctor immediately. If the doctor is not available due to unavoidable conditions, patients will not be notified about the change in appointment timing. All the existing systems are centralized and specific to one hospital.

**3.1.2 PROPOSED SYSTEMS**

The main goal of the systems is to makeit easier for the patients to find and book appointments with doctors based on the problems they’re facing, from a single platform. The patient can view a list of doctors and filter doctors based on specializations and needs. The medical history of each and every patient will be maintained in a centralized store allowing for easy access. Data of the patients will be secured, meaning that the patient will not have to worry about the leakage of personal data.

The doctor will be able to fill in and upload prescriptions which can be viewed by the patient through a two factor authentication. Reminders will be based on the timings set in the prescriptions to notify the patient accordingly. The medicals records are stored using encryption algorithm to ensure that the records cannot be tampered or viewed by third party.

**3.2.1 ARCHITECTURE DIAGRAM**

  
**Fig 3.2.1.1 Architecture Diagram**

The above diagram explains how this architecture work. User can identify themselves as Patient, Doctor and Admin and authenticate by entering login credentials. The role of the admin is to maintain patient and doctor lists. Doctor can upload prescriptions manage the appointments and contact the patient whereas the patient can search doctors, book appointments and upload/View medical records and also make use of the reminders.

The main goal is to provide security to the records stored. This is done by encrypting the details using SHA – 256 encryption algorithm. Only the authorised person with correct credentials will be able to access them.

**3.3 REQURIEMENT SPECIFICATION**

**3.3.1 HARDWARE REQUIREMENTS**

* + - 1. System : Minimum Petium IV 2.4GHz
      2. Harddisk : 50 GB
      3. Monitor : 15 VGAcolor
      4. RAM : 4Gb or above
      5. Android Phone

**3.3.2 SOFTWARE REQUIREMENTS**

* + - 1. Android studio
      2. Android OS 6 or above
      3. Java Development Kit (JDK) 7
      4. PyCharm
      5. SQLite

**3.4 SOFTWARE SPECIFICATION**

**JAVA**

      Java is Platform Independent. Java is an object-oriented programming language developed initially by James Gosling and colleagues at Sun Microsystems. It implements a strong security model, which prevents compiled Java programs from illicitly accessing resources on the system where they execute or on the network. Popular World-Wide Web browsers, as well as some World-Wide Web servers and other systems implement Java interpreters. These are used to display interactive user interfaces, and to script behavior on these systems.

**ANDROID STUDIO**

Android Studio is the official IDE for android application development.It works based on **IntelliJ IDEA.** Android App Development is mostly done in two IDE i.e. Eclipse and Android Studio. Earlier Eclipse was the popular IDE but now Android Studio has taken over it. This is because Google has ended the support for Eclipse and now only focused on Android Studio. Google also recommended developer to import their Android projects and use Android Studio. At present, more than 76.6% of the Smartphone’s, including HTC, LG and Samsung Models use Android as their operating system (OS), and expecting that Android will be in smart watches, laptops, car very soon. Android powered devices including tablets have become the foremost need of all the tech-savvy people across the world and the prime reason is it provides an open source platform for the development of great apps plus allows app developers to immediately publish them. Instead lots of developers want to get associated with Android application because of incredible growth.

Android Studio uses the quick growing Gradle build system that is so integrated, and Gradle is really a great tool. If one has decided to go with Eclipse than yet say to look at Gradle’s features and try it out and see if it fits with the project. In case one wants to go with Android Studio, no need to worry about being stuck with Gradle system because it is really good. Eclipse uses Apache Ant as its prime build system that is an extremely robust XML based build system and lots of Java developers have been already familiar with it.

**PyCHARM**

PyCharm is an integrated development environment (IDE) used in computer programming, specifically for the Python language. It is developed by the Czech company JetBrains. It provides code analysis, a graphical debugger, an integrated unit tester, integration with version control systems (VCSes), and supports web development with Django as well as data science with Anaconda. PyCharm is cross-platform, with Windows, macOS and Linux versions. The Community Edition is released under the Apache License, and there is also Professional Edition with extra features – released under a proprietary license.

**SQLite**

SQLite is a C-language library that implements a small, fast, self-contained, high-reliability, full-featured, SQL database engine. SQLite is the most used database engine in the world. SQLite is built into all mobile phones and most computers and comes bundled inside countless other applications that people use every day.

The SQLite file format is stable, cross-platform, and backwards compatible and the developers pledge to keep it that way through the year 2050. SQLite database files are commonly used as containers to transfer rich content between systems and as a long-term archival format for data. There are over 1 trillion (1e12) SQLite databases in active use.

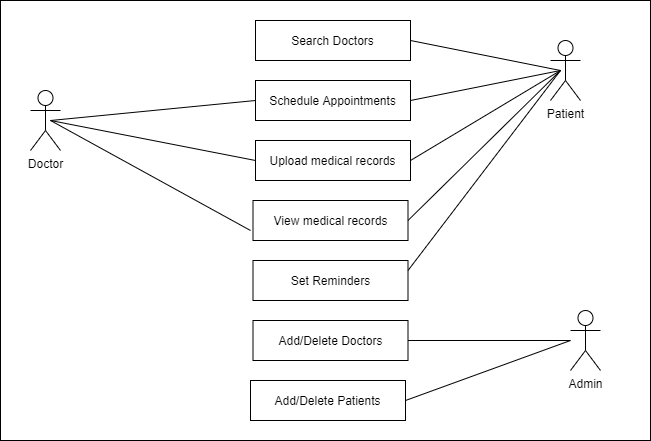
SQLite source code is in the public-domain and is free to everyone to use for any purpose.

**CHAPTER 4**

**SYSTEM DESIGN**

**4.1 SYSTEM DESIGN**

This section focuses on describing the individual components of the system and how they interact with each other. The system design in explained by using UML diagrams and data flow diagrams. Unified modelling language is a rich language to model software solutions, application structures, system behavior and business processes.

  
**Fig 4.1.1 UML Diagram**

The Unified Modeling Language (UML) is general purpose, developmental, modeling language in the field of software engineering. The actors involved with this system are the system administrators, patients and doctors.

Patients can search doctors based on the specialisations they need and book appointments with them. The doctor can either accept or change appointments. They can view patient records with patient’s permission and upload new prescriptions. The reminders will be set directly through the timings provided by the doctor in the prescription.

The doctors are added to the application after the system administrator runs a background check on the applications given by the doctor. They can also delete a doctor or a patient.

**CHAPTER 5**

**SYSTEM IMPLEMENTATION**

The proposed system is to develop both web and android applications that provide a medium to make interaction between doctor and patient easier. Also, an automatic alarm ringing system that can be used to set reminders to take pills, take tests or to go for appointments. The system will also help to find all the prescriptions and reports in one place.

Initially, users will be directed to a login page where a new user can register by entering their personal details. Every user will be given an unique user ID and using their password, one can login.  There are three types of users, the administrator, the doctor and the patient. The administrator does the role of managing the doctors. If any doctor wants to get started with this platform, then he/she has to go through the admin, after which, if his/her credentials are approved, any patient can book an appointment with that doctor.

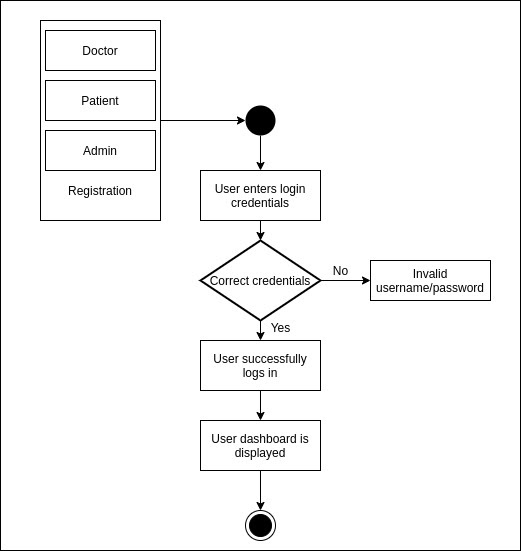
An index of doctors is developed, so that the patients can search for doctors all over the country. This process has to start from a small area and then branch out to other areas, and eventually other cities. The registered doctors will have a time window setup from their dashboard, and a patient is allowed to book appointments only between the time windows that the doctor entered. The doctor can also update his status as unavailable, in such cases, the patients who’ve booked an appointment will be notified of the cancelled appointments.

On medical consultation, the doctor will update the prescription to the online form, which will set up reminders based on the inputs provided by the doctor, making sure the patient takes the medication correctly. This reminder system also works for reminding the patients of their upcoming tests, surgeries and the next reviews. For editing a patient's medical records, both the patient and the doctor have to authorize the edit. This prevents any unauthorized edits to the medical records. Either the doctor or patient can view the records, but if a new doctor wants access to the records, then the patient has to authorize the request. This provides Security on the Logical layer.

To secure data on the data layer, all the patient data is hashed so that the data is not immediately legible. All the patient’s data is tied to an ID, and no personal information is stored along with the medical data, which will prevent the exploitation of the data even in case of unauthorized access to the data.

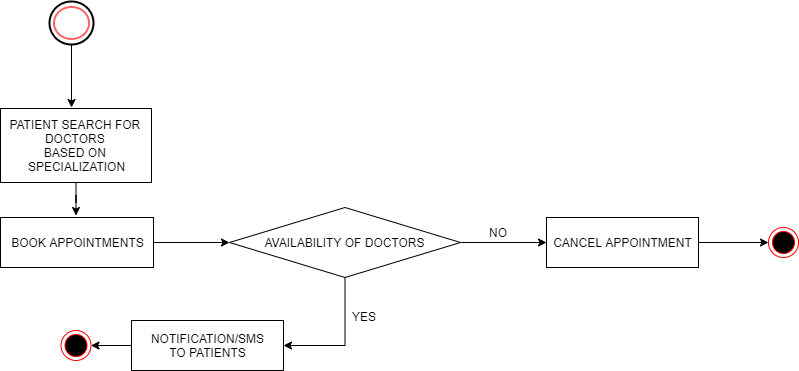
The proposed system consists of five modules.

1. Login Module
2. Appointment Module
3. Reminder Module
4. Authentication –Blockchain
5. Integration of web interface
6. **Login Module**

 **Fig 5.1 Login Module**

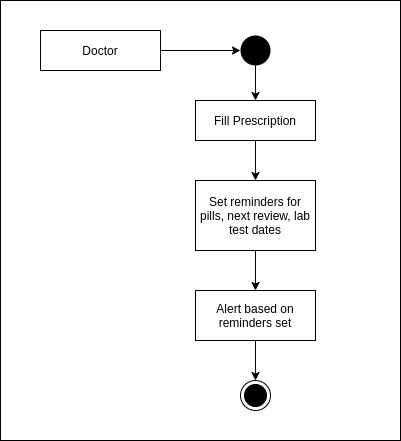
* Three different types of login : Admin, Doctor, Patient.
* Initially the user registers themselves as doctor or patient
* With the correct credentials, the user is logged into the system successfully.
* Respective dashboard is displayed.

1. **Appointment Module**

  
**Fig 5.2 Appointment Module**

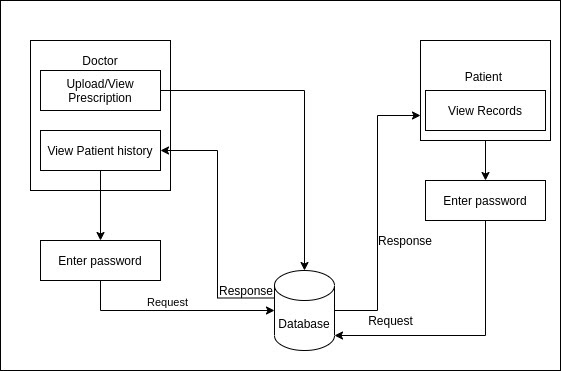
* Patients will be able to view list of doctors based on specialisation and user reviews.
* For the selected doctor, based on availability appointments can be booked.

1. **Reminder Module**

  
**Fig 5.3 Reminder Module**

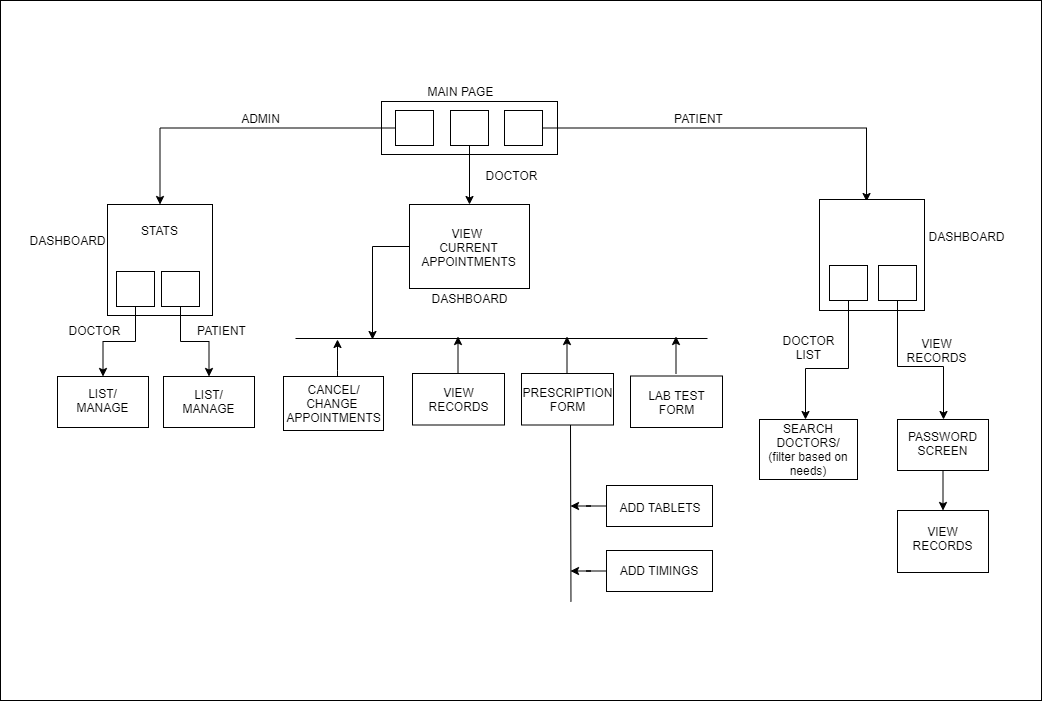
* The doctor will be given a form through which prescription can be filled.
* Based on the prescription given, reminders are set for pills, lab tests and next reviews.
* Patient will get alerted for the reminders set.

1. **Authentication – Blockchain**

  
**Fig 5.4 Authentication using blockchain**

* Doctors will be given a form with which they can upload  the prescription.
* Patient and doctors can access the records using a One time Verification Code or a password they set initially.

1. **Integration of web  interface**

 **Fig 5.5 Web interface**

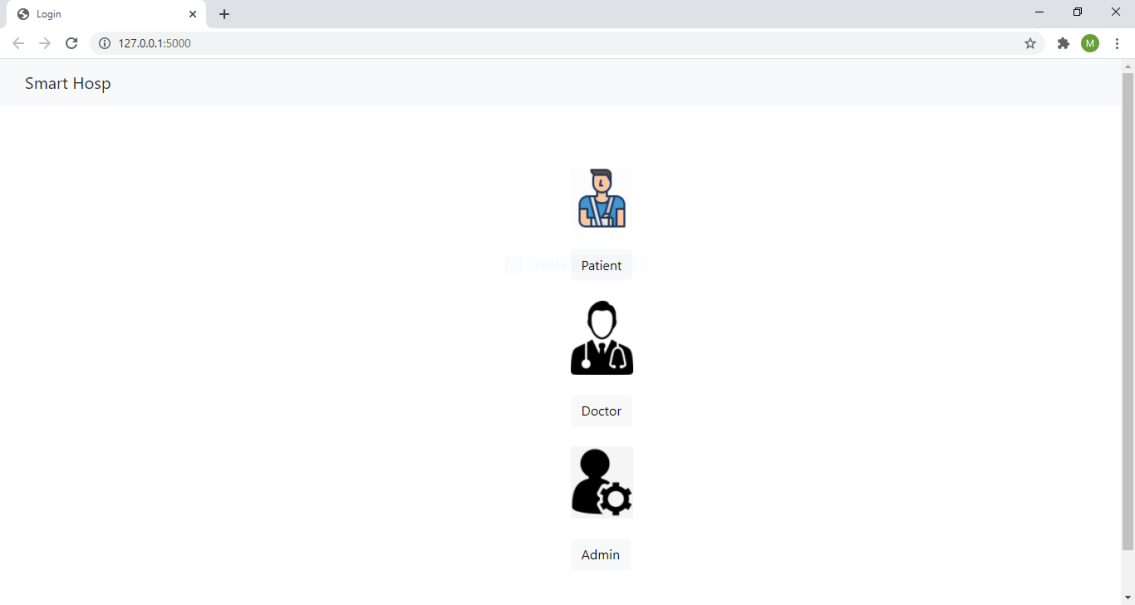
* Web application provides some of the features that the android application provides such as searching doctors and uploading/viewing medical records.
* The doctor will be given a prescription form where one can enter all the details about tablets – timings, dosage etc..and also enter the details of the lab tests that need to be taken.

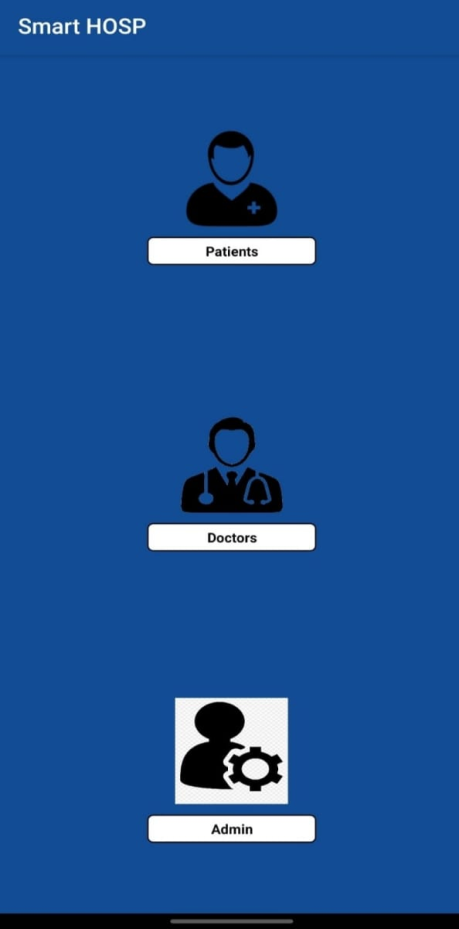
**CHAPTER 6**

**IMPLEMENTATION AND RESULTS**

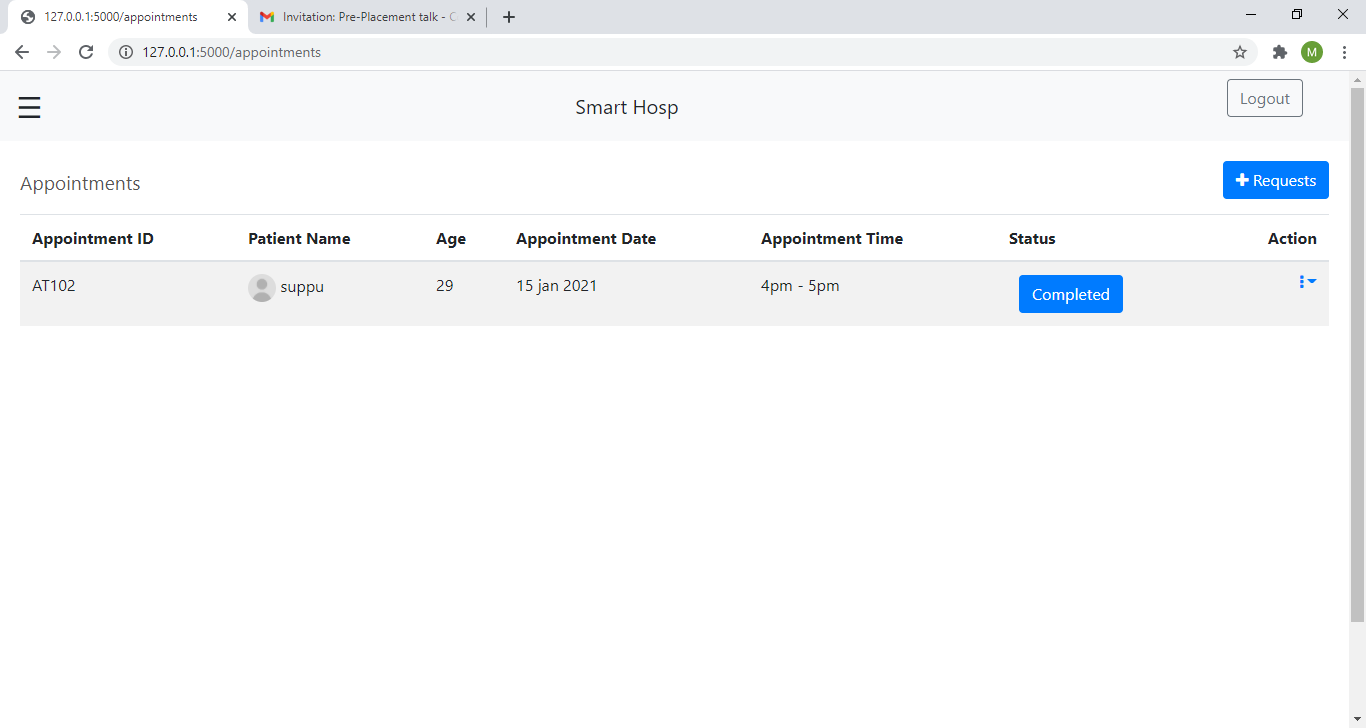
* This work mainly focused on providing security to the patient records, provide a medium to store, and access the same easily.
* The data is encrypted using SHA – 256 algorithm before storing it into the database.
* In comparison with the existing system, the proposed system provides an user friendly interface – both web and mobile.
* In addition to the features provided by the existing system like appointment booking and reminders, the proposed system ensures integrity of the message being stored.

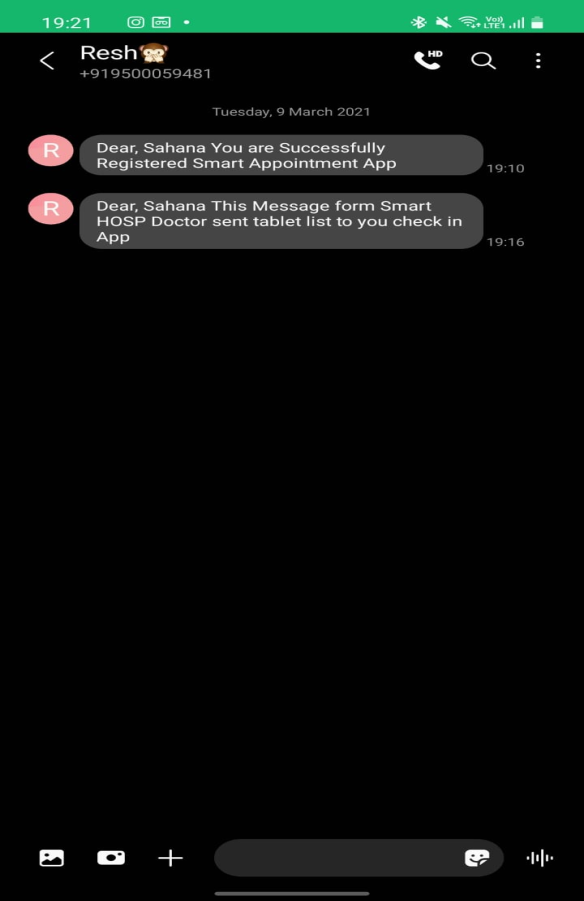
**6.1 LOGIN MODULE**

**  
Fig 6.1.1 Web Login**

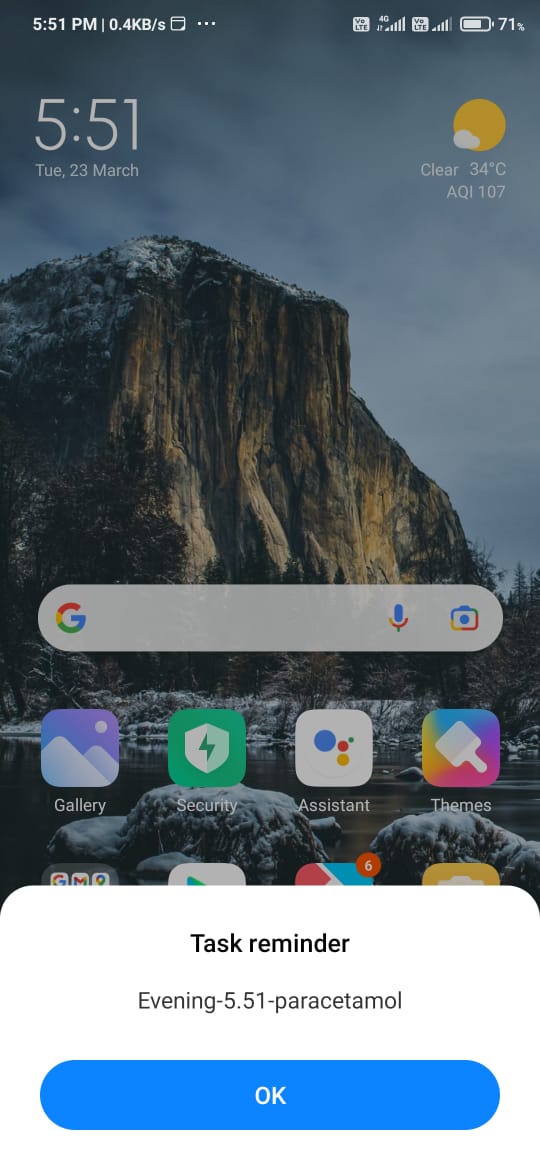
 **Fig 6.1.2 Mobile login**

**6.2 APPOINTMENT MODULE**

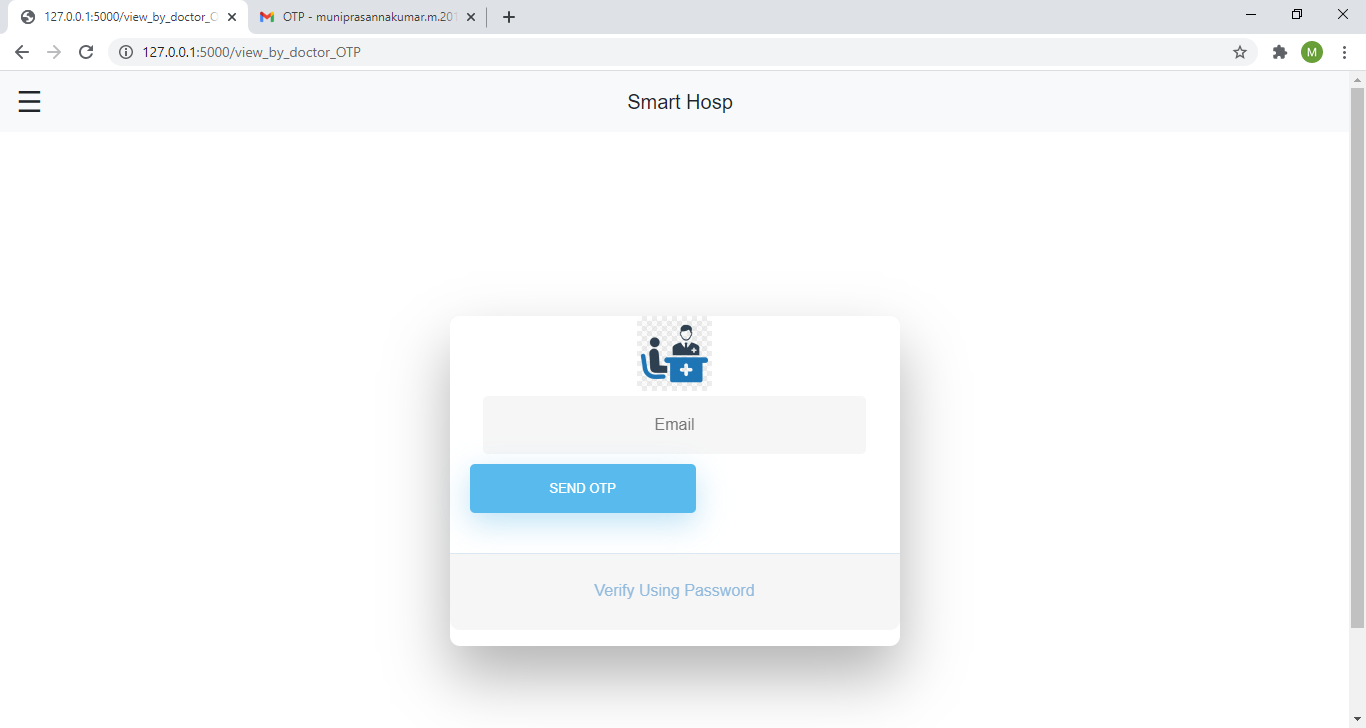
 **Fig 6.2.1 Doctor appointment dashboard**

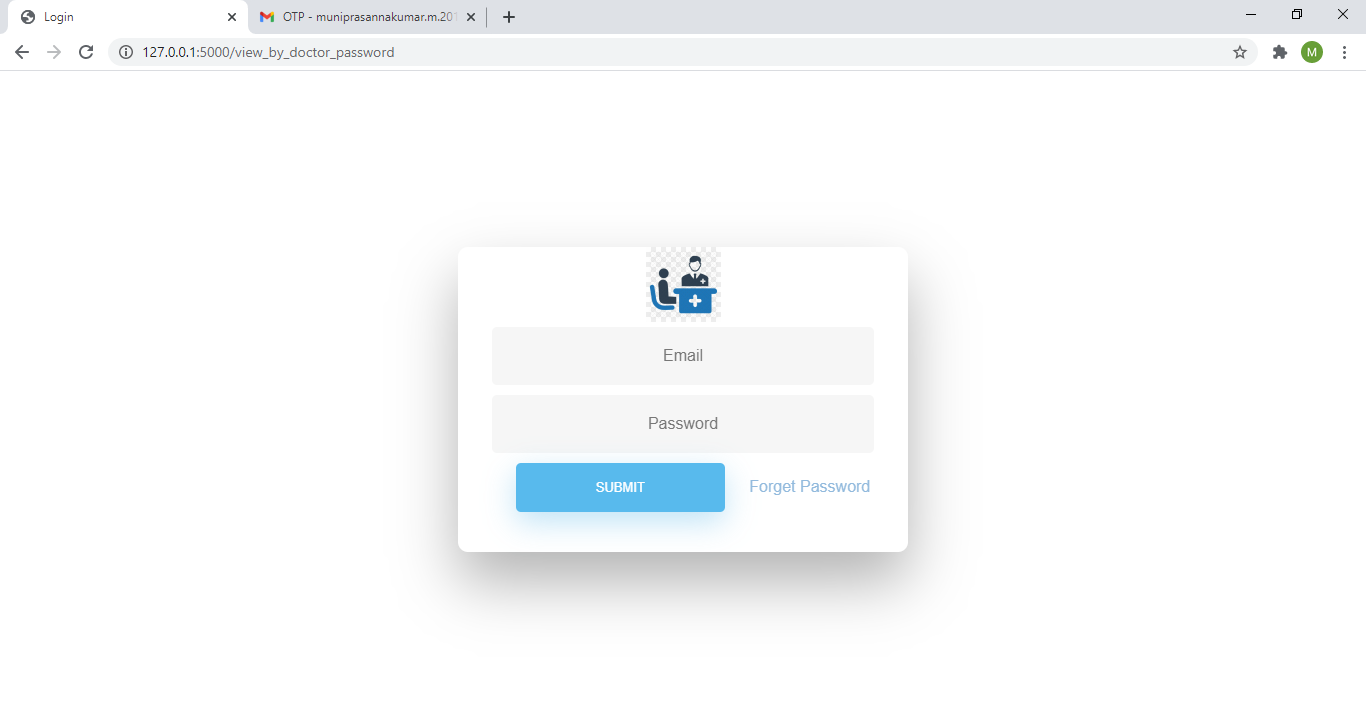
 **Fig 6.2.2 Patient appointment confirmation**

**6.3 REMINDER MODULE**

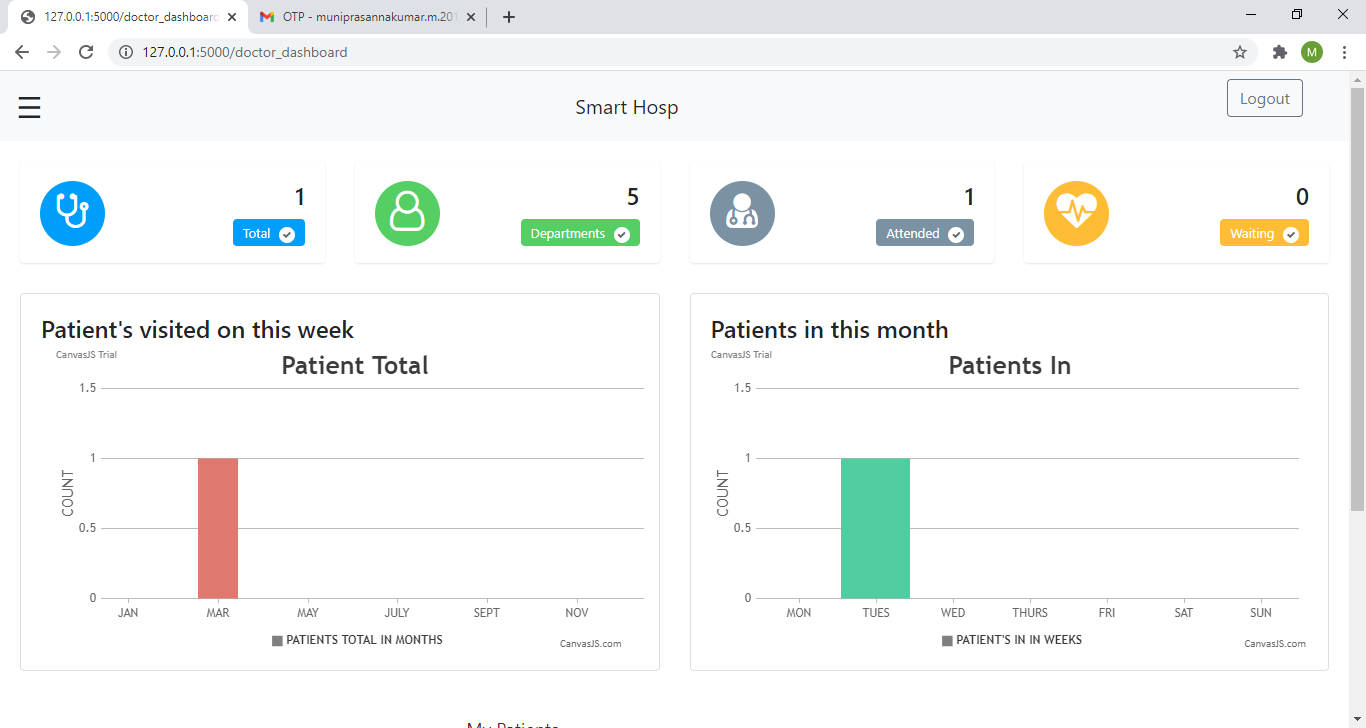
**  
Fig 6.3.1 Prescription reminder**

**6.4 AUTHENTICATION – BLOCKCHAIN**

**  
Fig 6.4.1 Verify using OTP**

**  
Fig 6.4.2 Verify using Patient credentials**

**6.5 INTEGRATION OF WEB INTERFACE**

**  
Fig 6.5.1 Doctor Dashboard**

**CHAPTER7**

**CONCLUSION AND FUTURE ENHANCEMENTS**

**7.1 CONCLUSION**

The major goal of this application is to create an interactive medium to solve the basic needs of the people. Through this app, patients can book their appointments with the doctor and they are provided with the facility to schedule alerts for all the health related reminders. It is made sure that no medical records can be tampered or accessed by intruders.

To make sure that the application is available to all and easily accessible, both web and android applications are available in order for user convenience.

**7.2 FUTURE ENHANCEMENT**

The system can be enhanced further in future by providing some more functionalities such as video call consultation, 24/7 chat facilities with doctor and ordering medicines through online pharmacy.

More features, such as sentiment analysis for the user reviews can be added. Also, a FYI section can be added to keep the users updated about the current trends in the medical world.

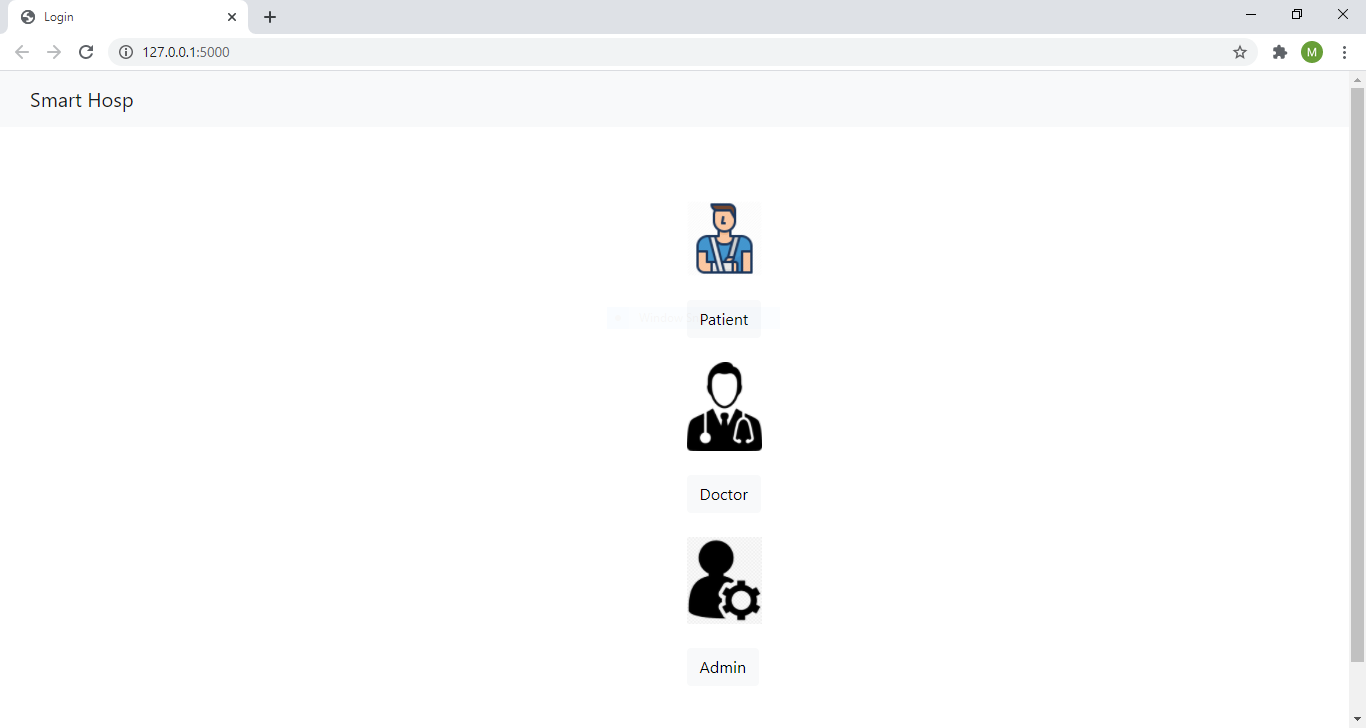
**APPENDIX 1 – CODE**

**SAMPLE CODE**

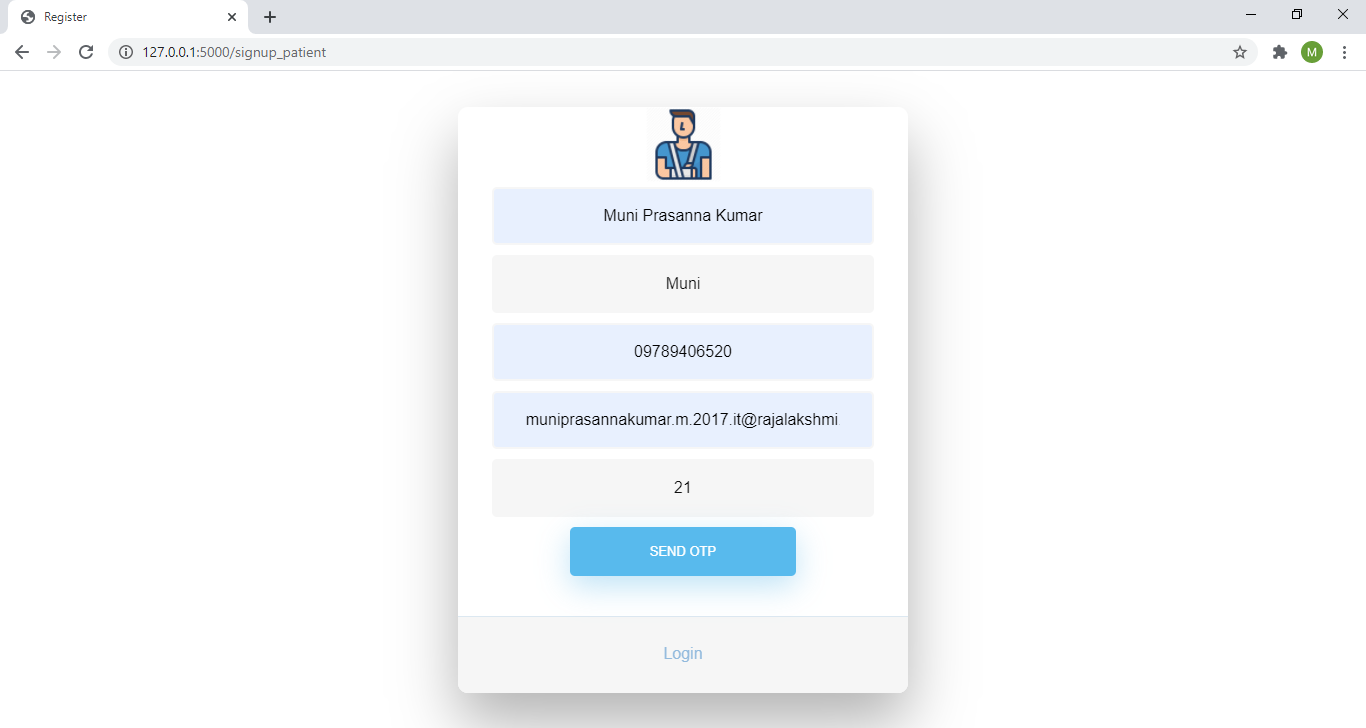
|  |
| --- |
|  |
|  | import os: |
|  | from flask import \* |
|  | from flask\_mail import \* |
|  | from random import \* |
|  | from PIL import Image,ImageDraw,ImageFont |
|  | from datetime import date |
|  | import mysql.connector |
|  | from werkzeug.utils import secure\_filename |
|  | import hashlib |
|  | import hmac |
|  |  |
|  | mydb = mysql.connector.connect( |
|  | host="localhost", |
|  | user="root", |
|  | password="root", |
|  | database = "webapp" |
|  | ) |
|  | mycursor = mydb.cursor() |
|  | app = Flask(\_\_name\_\_) |
|  | app.secret\_key = 'secret' |
|  | UPLOAD\_FOLDER = 'static/images/upload\_doc\_image/' |
|  | app.config['UPLOAD\_FOLDER'] = UPLOAD\_FOLDER |
|  | app.config['MAX\_CONTENT\_LENGTH'] = 16 \* 1024 \* 1024 |
|  | mail = Mail(app) |
|  | app.config["MAIL\_SERVER"]='smtp.gmail.com' |
|  | app.config["MAIL\_PORT"] = 465 |
|  | app.config["MAIL\_USERNAME"] = 'mmpkvelammal@gmail.com' |
|  | app.config['MAIL\_PASSWORD'] = 'mmsap@1234' |
|  | app.config['MAIL\_USE\_TLS'] = False |
|  | app.config['MAIL\_USE\_SSL'] = True |
|  | mail = Mail(app) |
|  | otp = randint(000000, 999999) |
|  | @app.route('/', methods=['POST','GET']) |
|  | def main(): |
|  | if request.method=='POST': |
|  | patient = request.form.get('patient') |
|  | doctor = request.form.get('doctor') |
|  | admin = request.form.get('admin') |
|  | if(patient == 'Patient'): |
|  | return redirect(url\_for('login\_pat')) |
|  | elif (doctor == 'Doctor'): |
|  | return redirect(url\_for('login\_doc')) |
|  | elif(admin == 'Admin'): |
|  | return redirect(url\_for('login\_admin')) |
|  | return render\_template('mainmainpage.html') |
|  | @app.route('/signup\_patient',methods=['POST','GET']) |
|  | def signup\_pat(): |
|  | if(request.method == 'POST'): |
|  |  |
|  | name = request.form.get('name') |
|  | uname = request.form.get('username') |
|  | mob = request.form.get('c') |
|  | email = request.form.get('login') |
|  | age = request.form.get('age') |
|  | session['username'] = uname |
|  | send\_otp = request.form.get('send\_otp') |
|  | submitform = request.form.get('submitform') |
|  | submitotp = request.form.get('submitotp') |
|  | print(name) |
|  | print(uname) |
|  | print(mob) |
|  | print(email) |
|  | print(submitform) |
|  | sql = "select email from patient\_details where email = '" + email + "'" |
|  | mycursor.execute(sql) |
|  | myresult = mycursor.fetchall() |
|  |  |
|  | if(send\_otp == "Send Otp" and len(myresult)==0): |
|  | # msg = Message('OTP',sender = 'mmpkvelammal@gmail.com', recipients = [email]) |
|  | # msg.body = name+uname+str(mob)+email+str(otp) |
|  | # mail.send(msg) |
|  | return render\_template('register\_patient.html',name=name,uname=uname,mob=mob,email=email,age=age,visible='none',visible1='block',visible2='none') |
|  | elif(submitotp == "Submit Otp"): |
|  | enter\_otp = request.form.get('enterotp') |
|  | print("enter\_otp "+enter\_otp ) |
|  | print("otp ",otp) |
|  | # if(int(enter\_otp) == otp): |
|  | return render\_template('register\_patient.html', name=name, uname=uname, mob=mob, email=email,age=age, |
|  | visible='none', visible1='none',visible2='block') |
|  | elif(submitform == "Submit"): |
|  | password = request.form.get('password') |
|  | confirm = request.form.get('confirm') |
|  | print(password) |
|  | print(confirm) |
|  |  |
|  | if(password == confirm): |
|  | # msg1 = Message('OTP', sender='mmpkvelammal@gmail.com', recipients=[email]) |
|  | # msg1.body = "Successfully Registered as patient" |
|  | # mail.send(msg1) |
|  | password\_to\_encrypt = password.encode() |
|  | salt\_key = os.urandom(16) |
|  | password\_hash = hashlib.pbkdf2\_hmac("sha256", password\_to\_encrypt, salt\_key, 100000) |
|  | #%s, %s, %s,%s,%d,%s |
|  | sql0 = "Select email from patient\_details where email = '"+email+"'" |
|  | mycursor.execute(sql0) |
|  | myrs = mycursor.fetchall() |
|  | if len(myrs) != 0: |
|  | return redirect(url\_for('signup\_pat')) |
|  | sql = "INSERT INTO patient\_details (name,username,phone,email,age,password) VALUES (%s, %s, %s,%s,%s,%s)" |
|  | val = (name,uname,mob,email,age,password\_hash) |
|  | mycursor.execute(sql, val) |
|  | mydb.commit() |
|  | sql1 = "Insert into pat\_hash values(%s,%s)" |
|  | val1 = (email,salt\_key) |
|  | mycursor.execute(sql1, val1) |
|  | mydb.commit() |
|  |  |
|  | return redirect(url\_for('login\_pat')) |

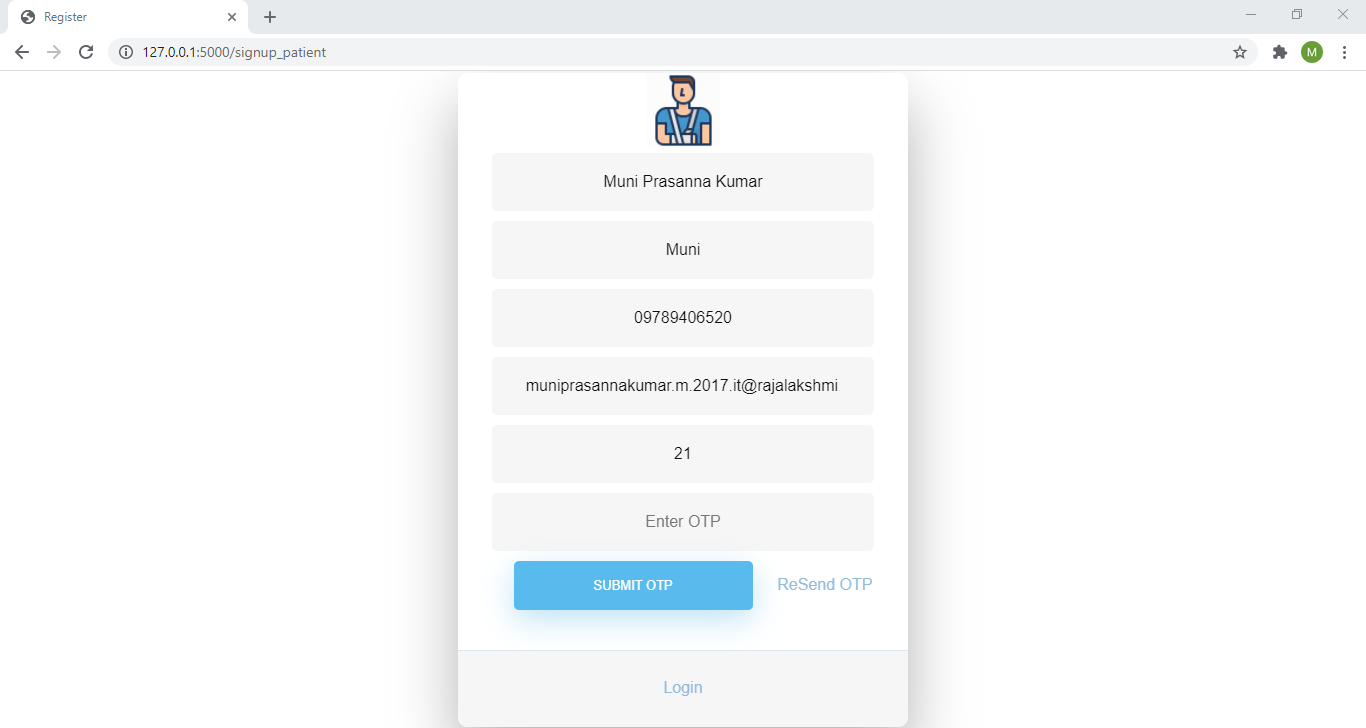
**APPENDIX 2 – OUTPUT SCREENSHOTS**

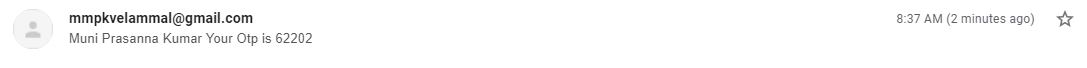
**LOGIN PAGE**

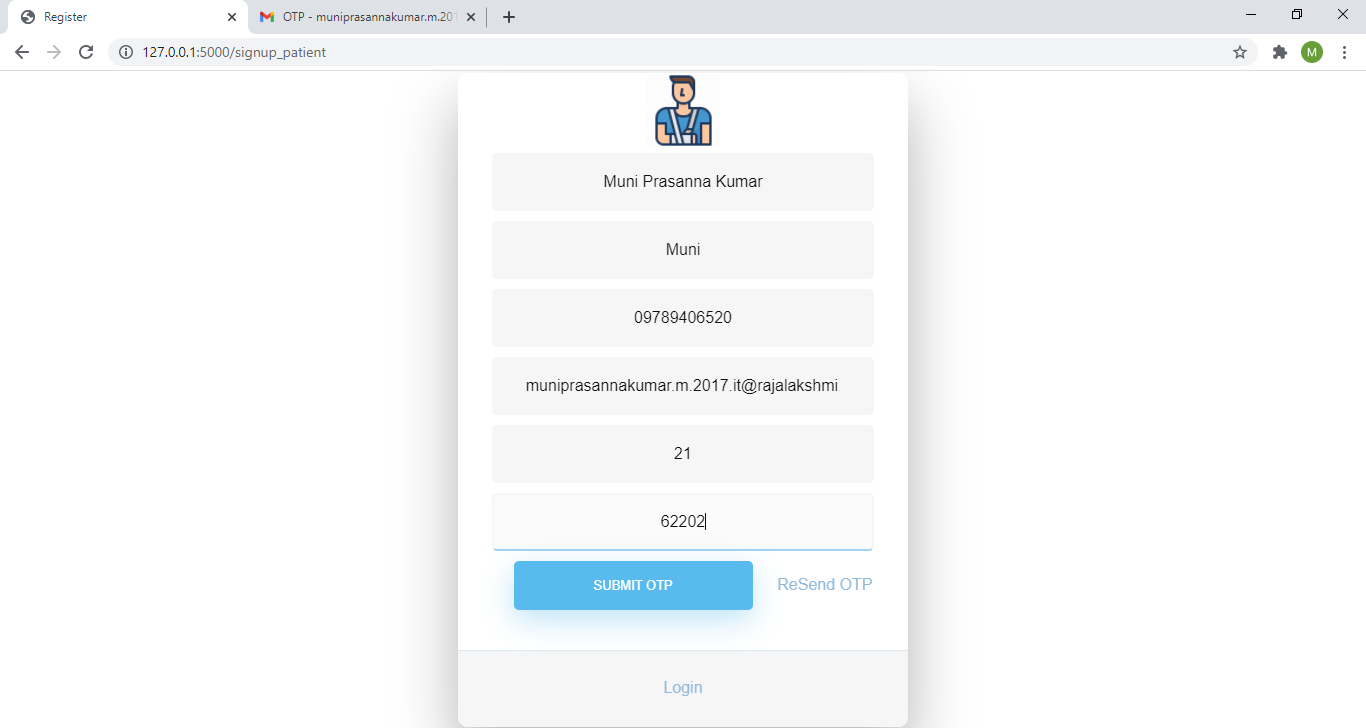


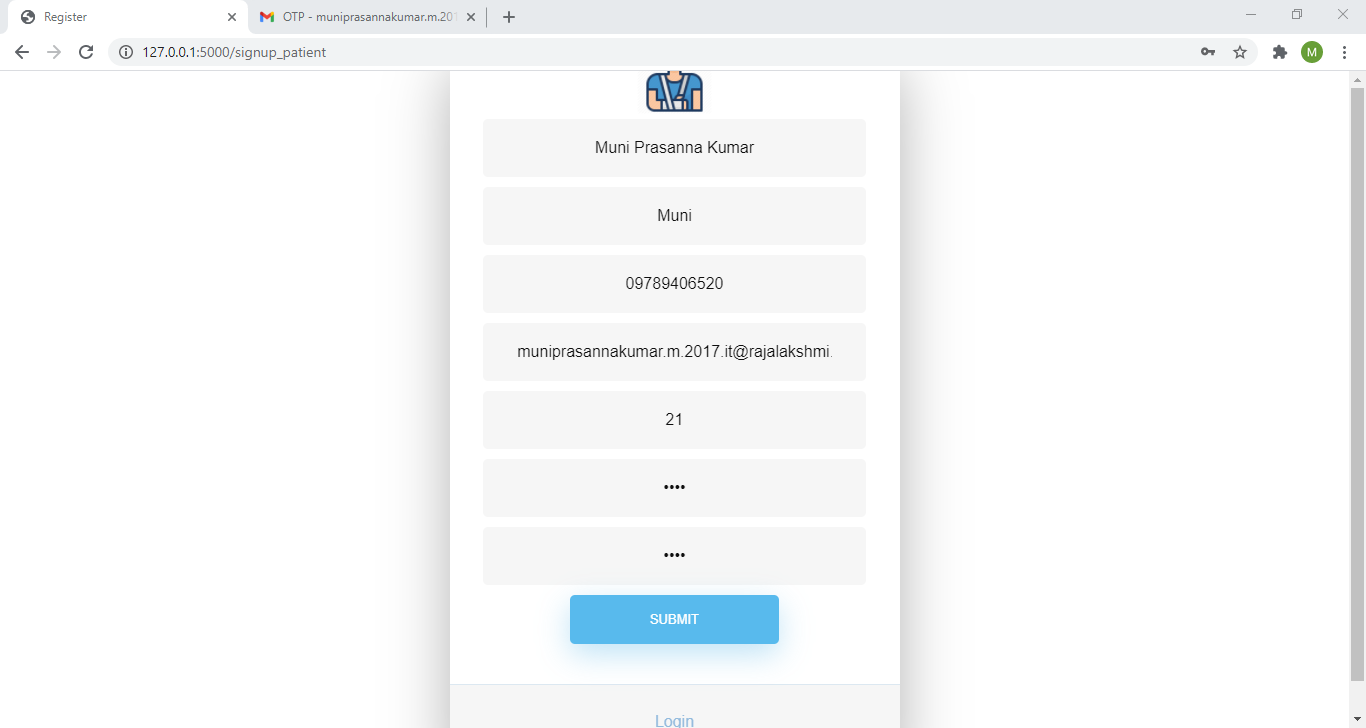
**SIGN UP PAGE**

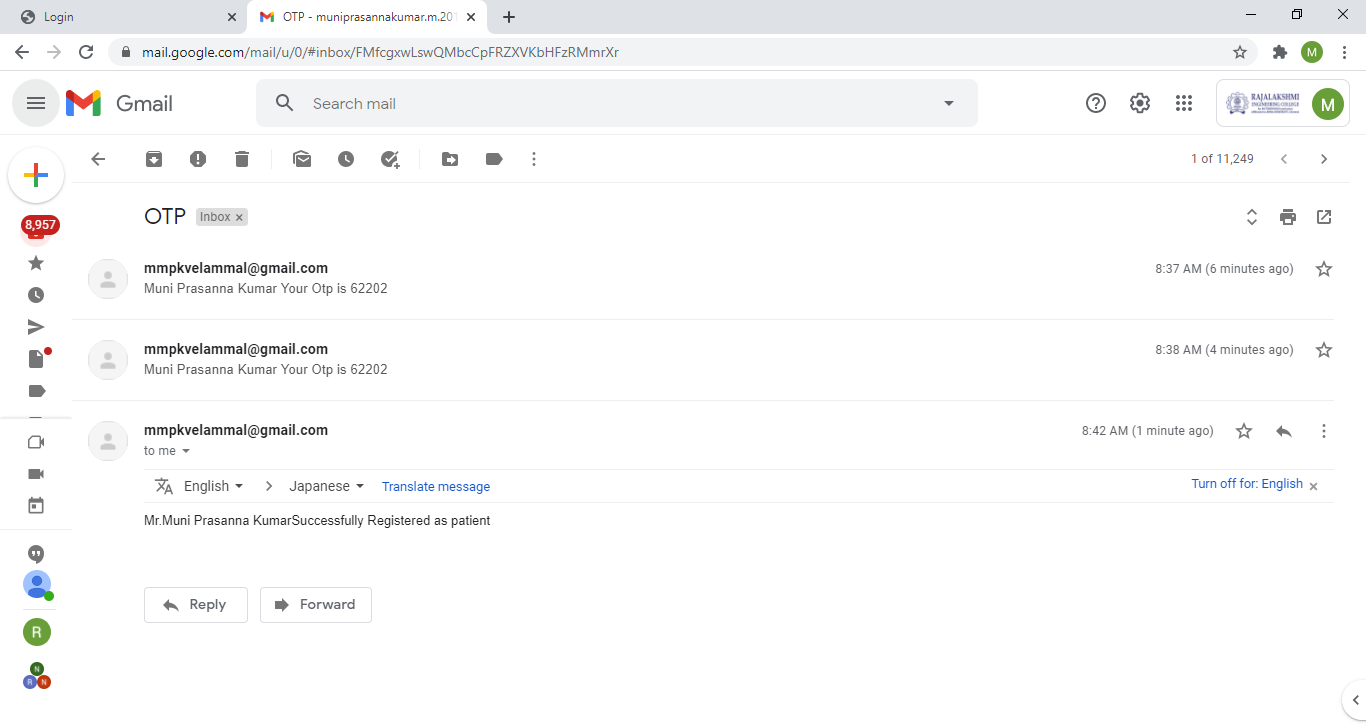




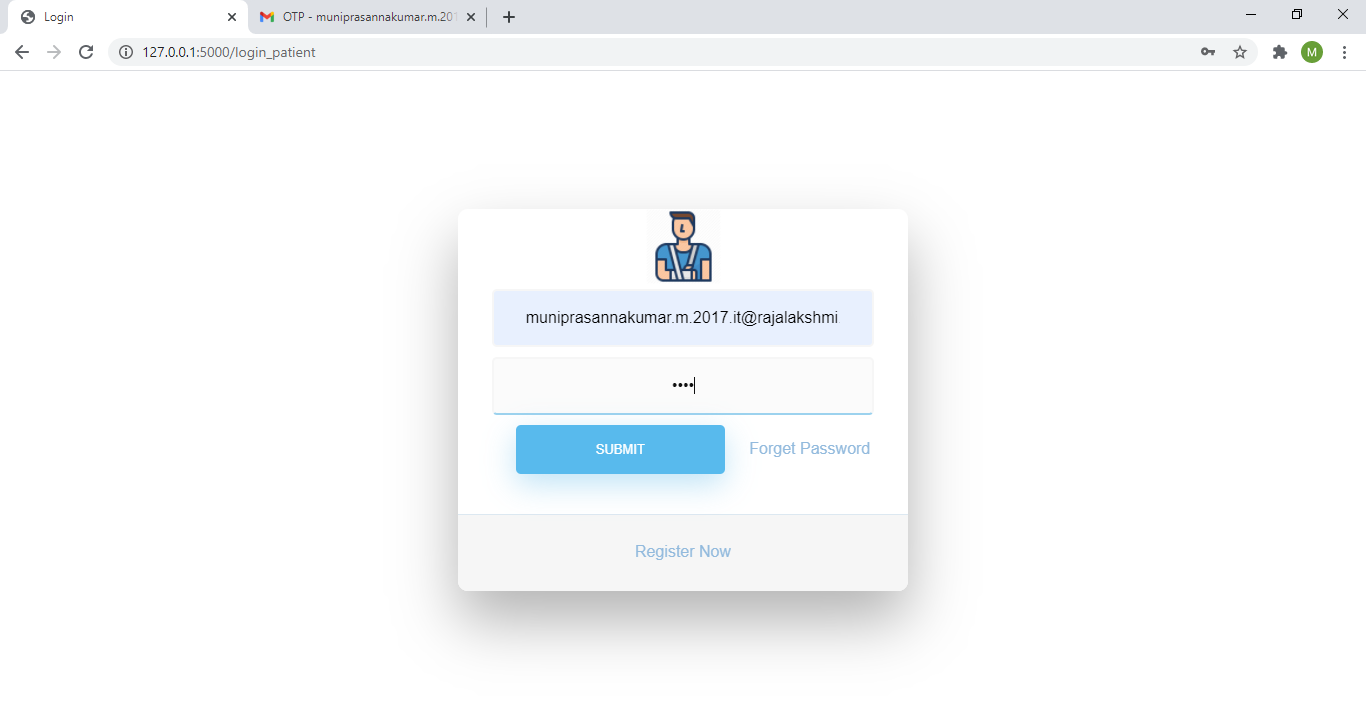




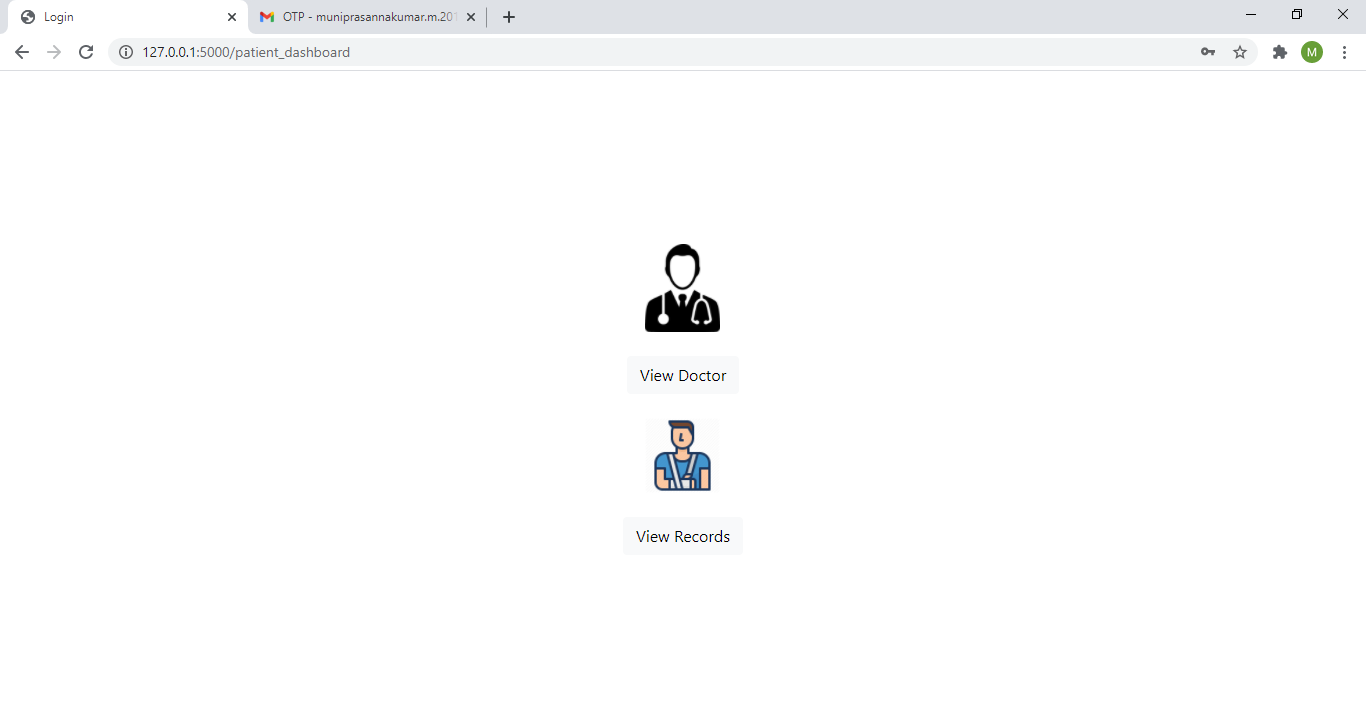




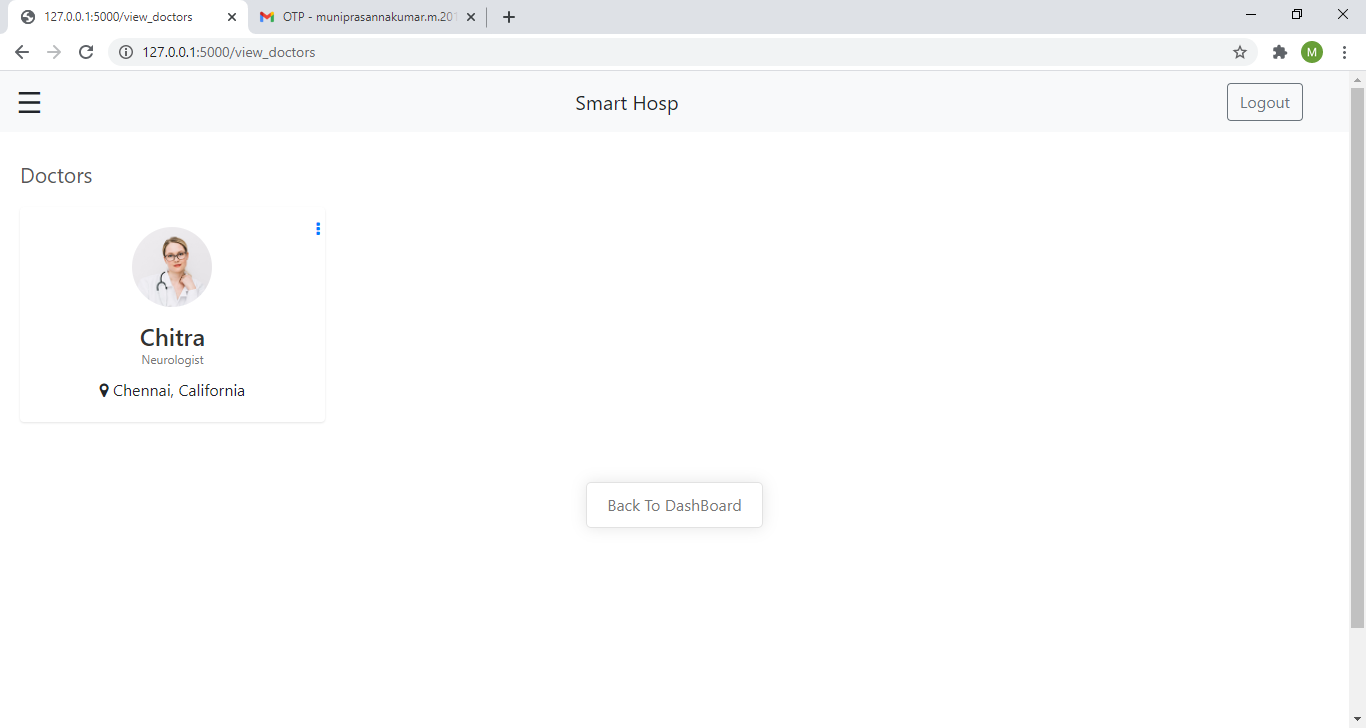
**PATIENT LOGIN**

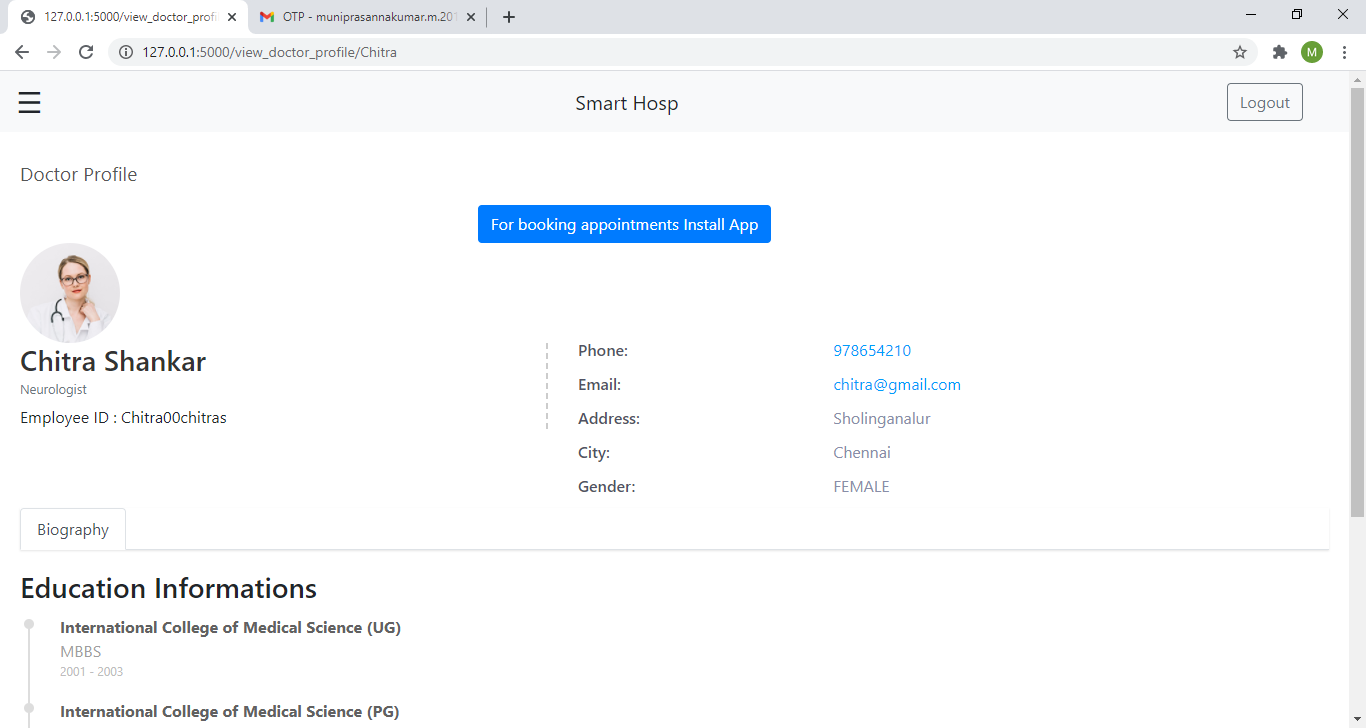


**PATIENT - DASHBOARD**

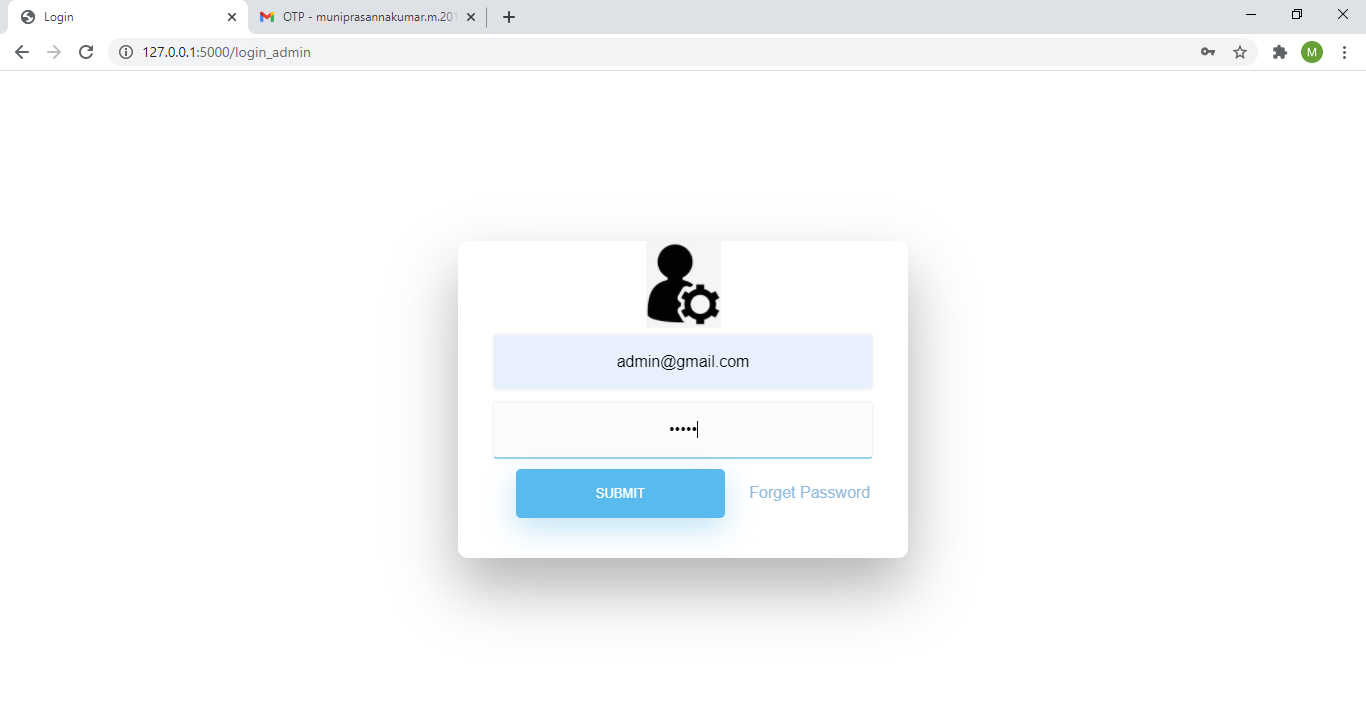


**VIEW DOCTORS BY PATIENT**

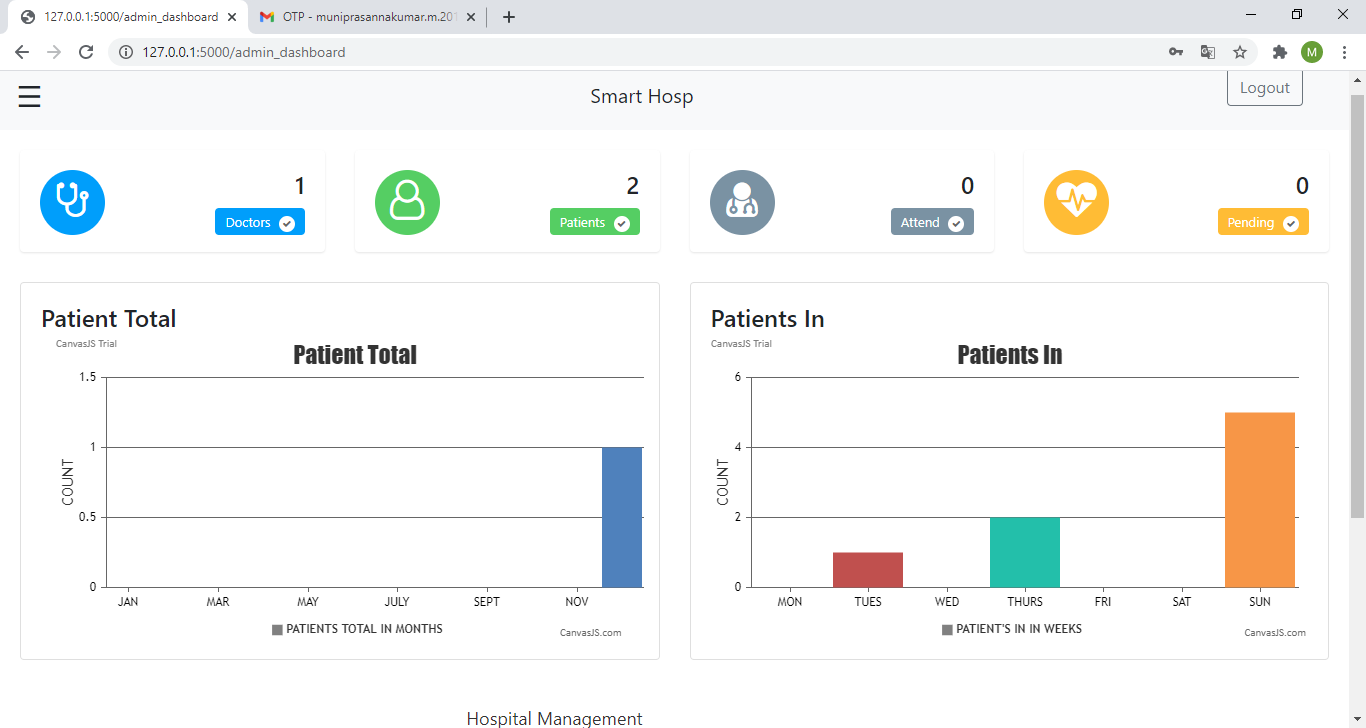




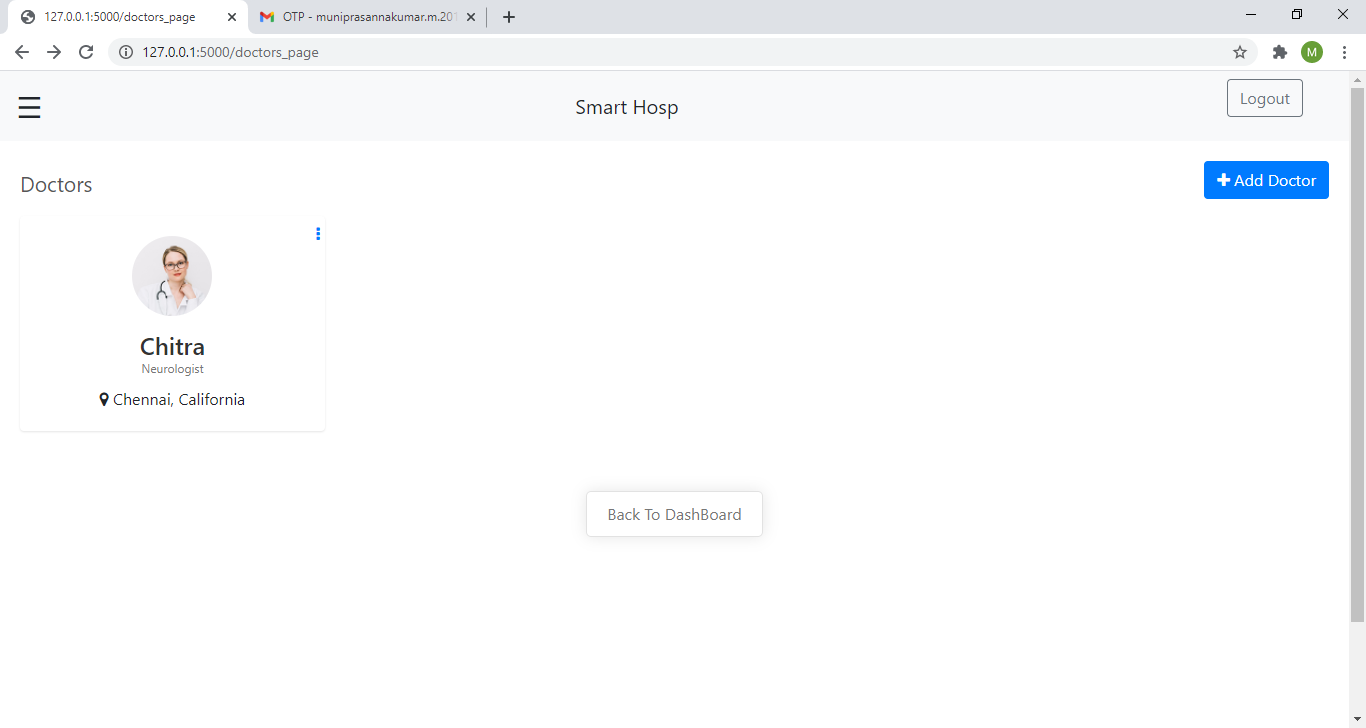
**ADMIN LOGIN**



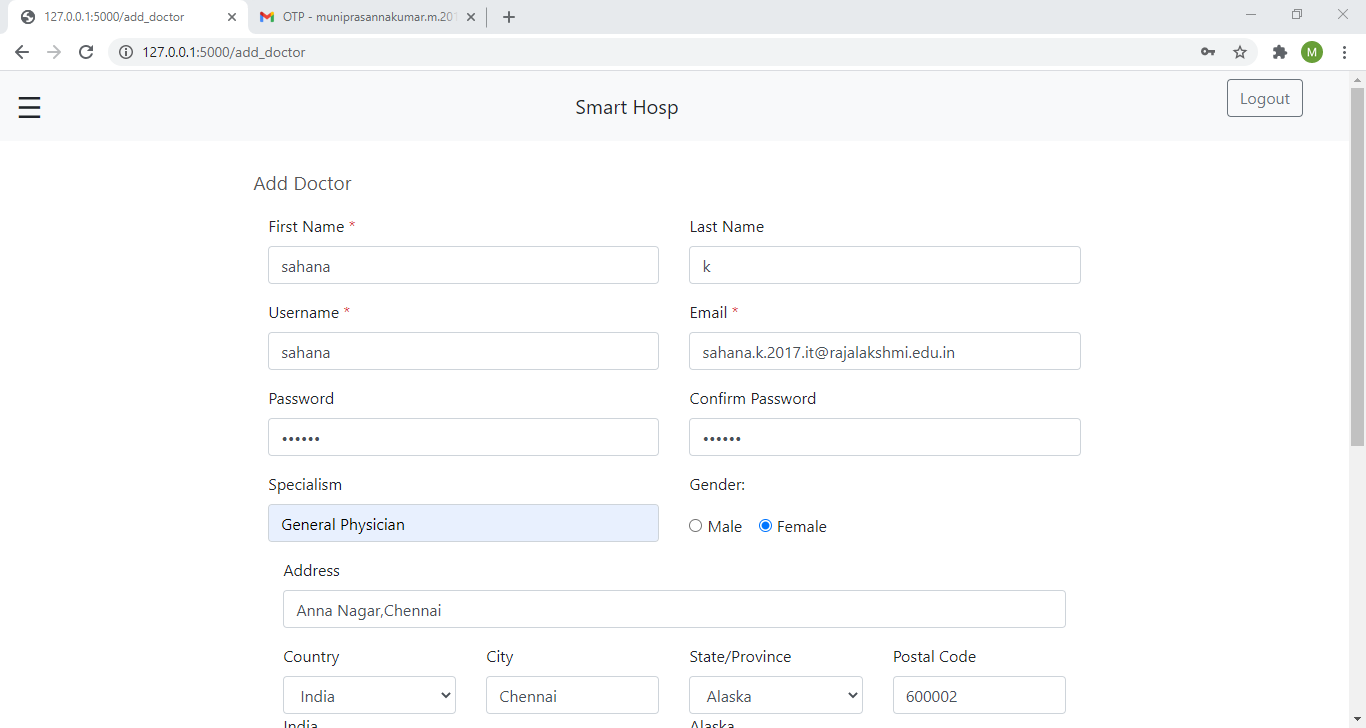
**ADMIN-DASHBOARD**



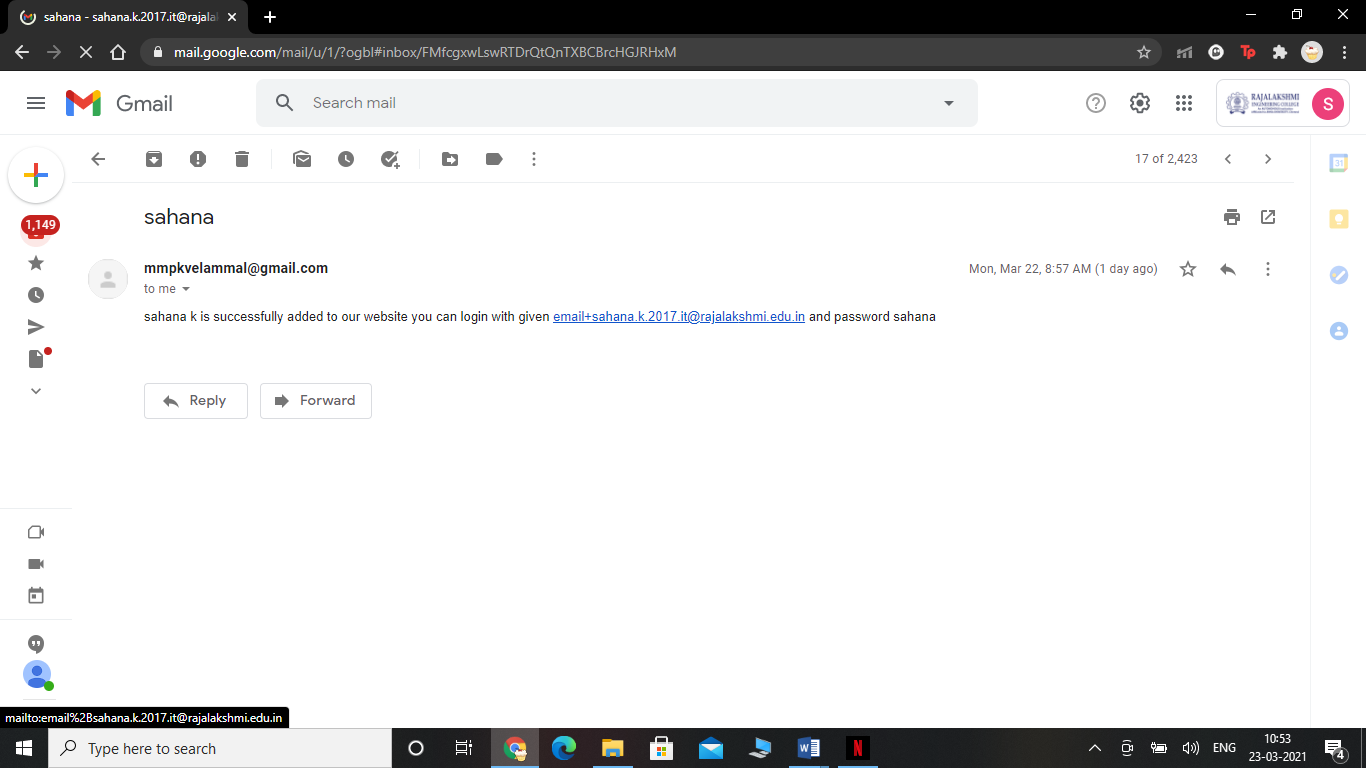
**VIEW DOCTORS BY ADMIN**

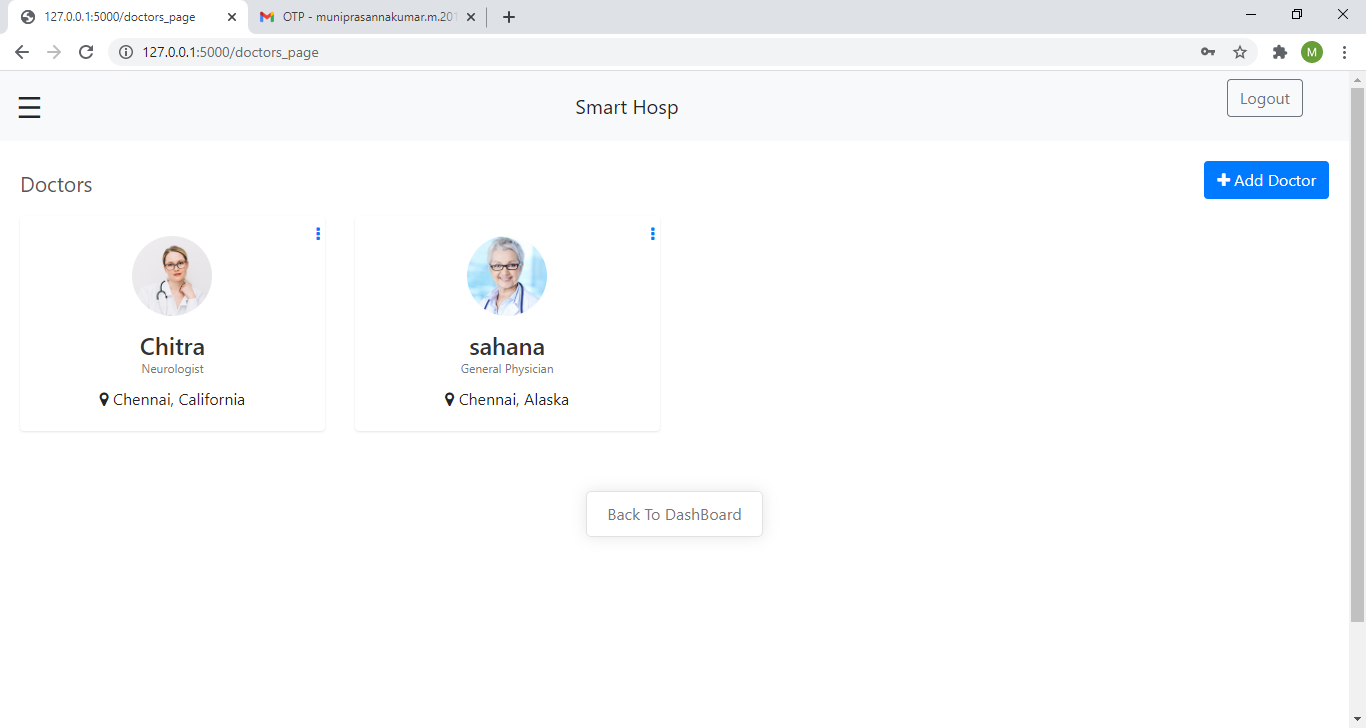


**ADDING DOCTORS BY ADMIN**

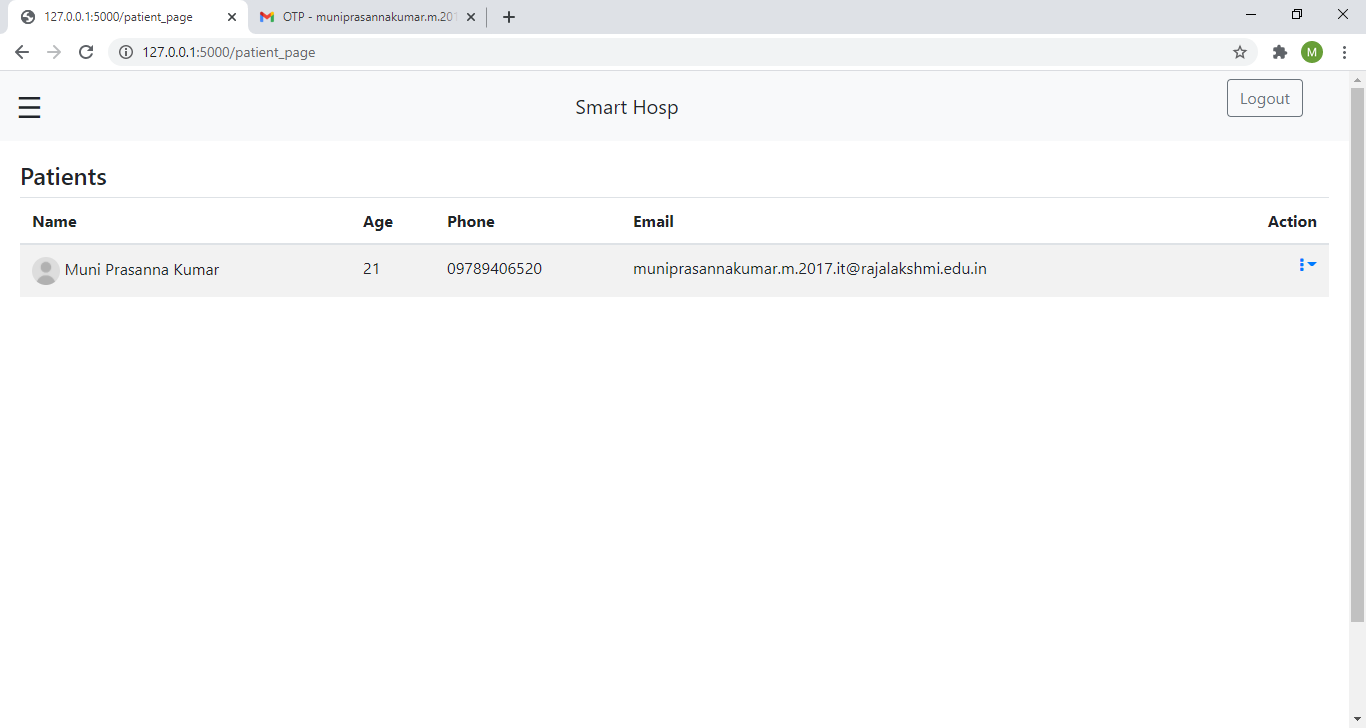


**ADDITION OF DOCTOR CONFIRMATION**

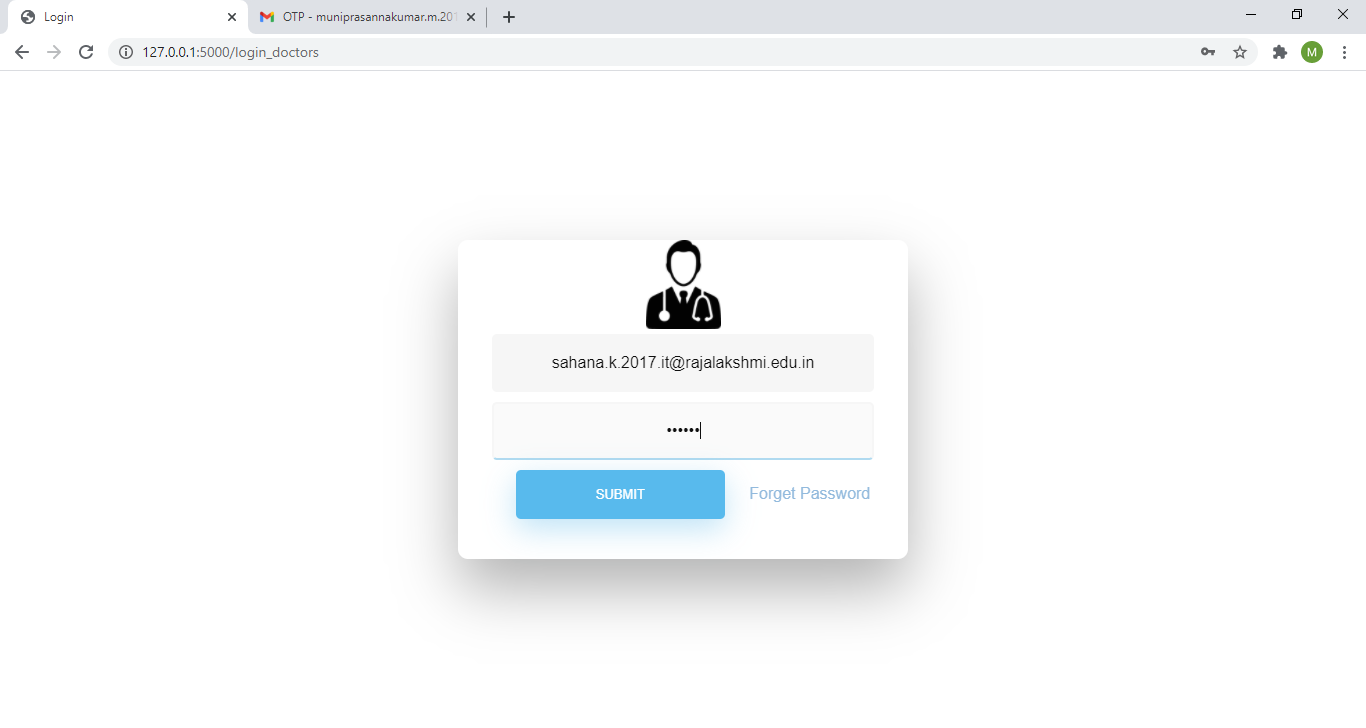




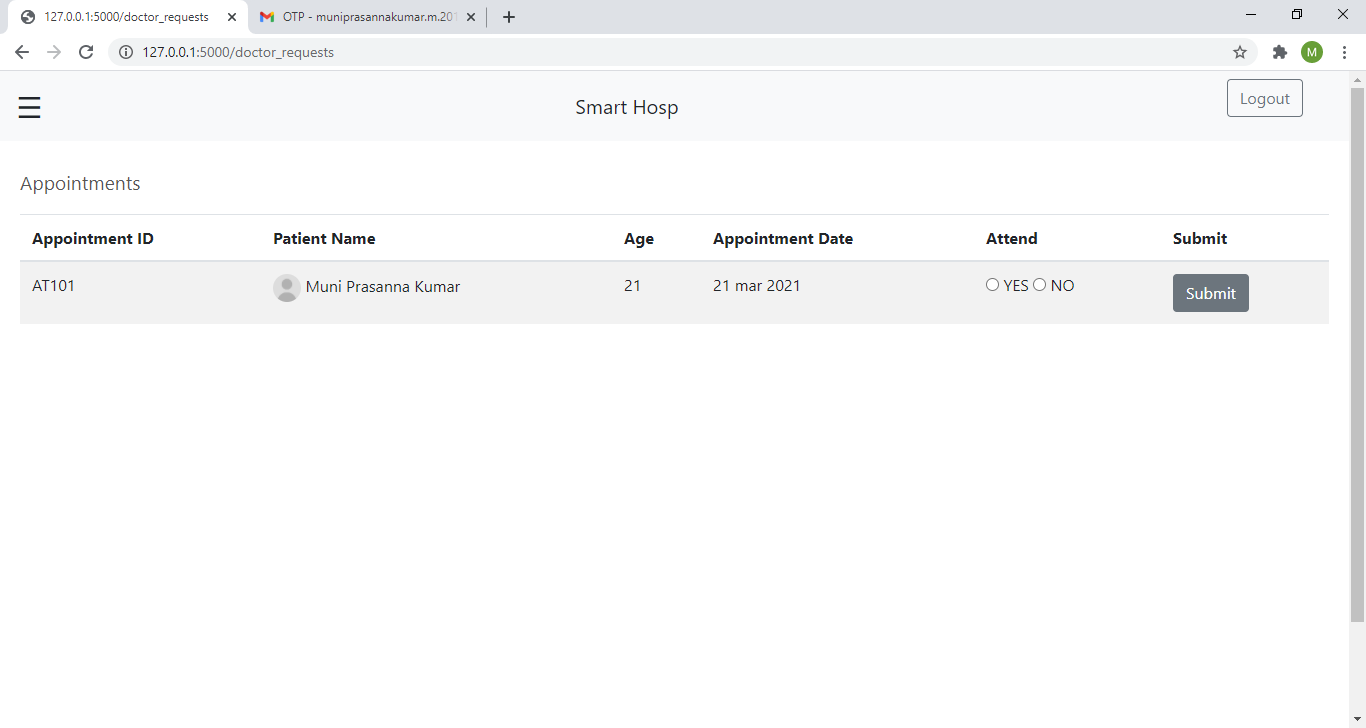
**VIEW PATIENTS BY ADMIN**



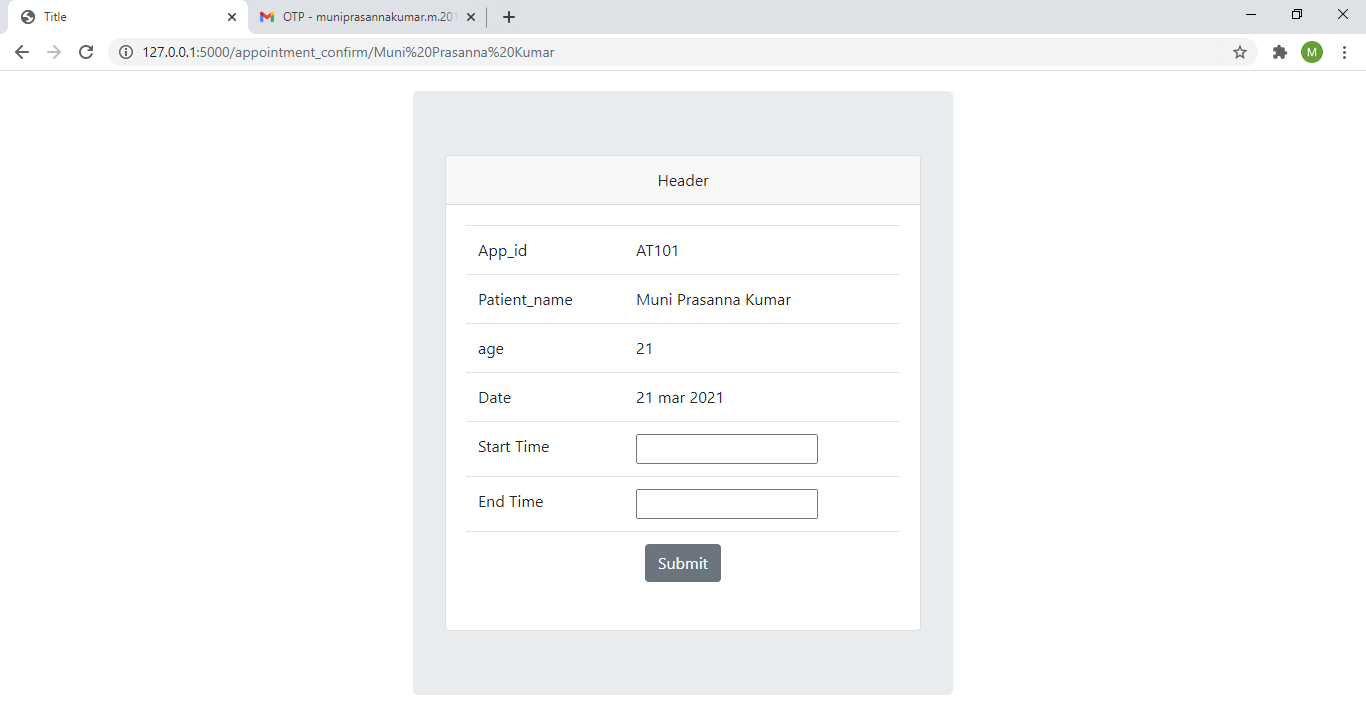
**DOCTOR LOGIN**

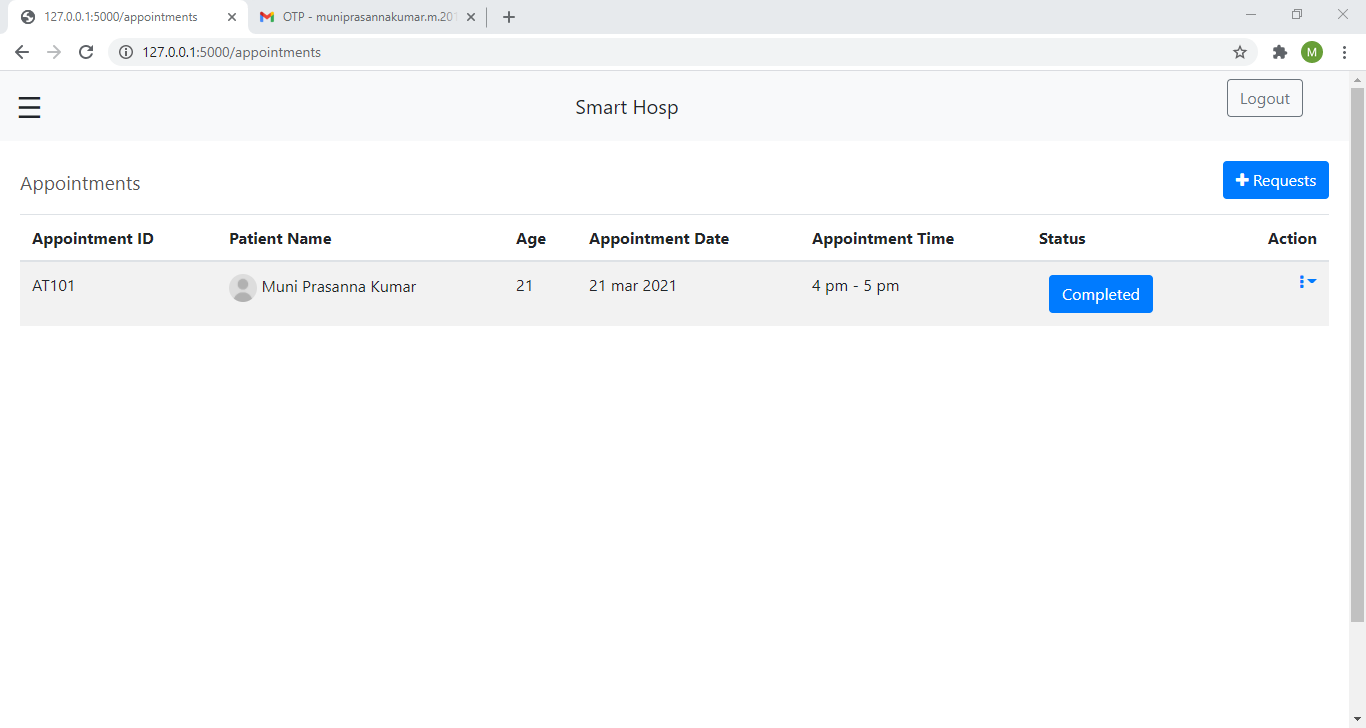


**PATIENT’S REQUEST**

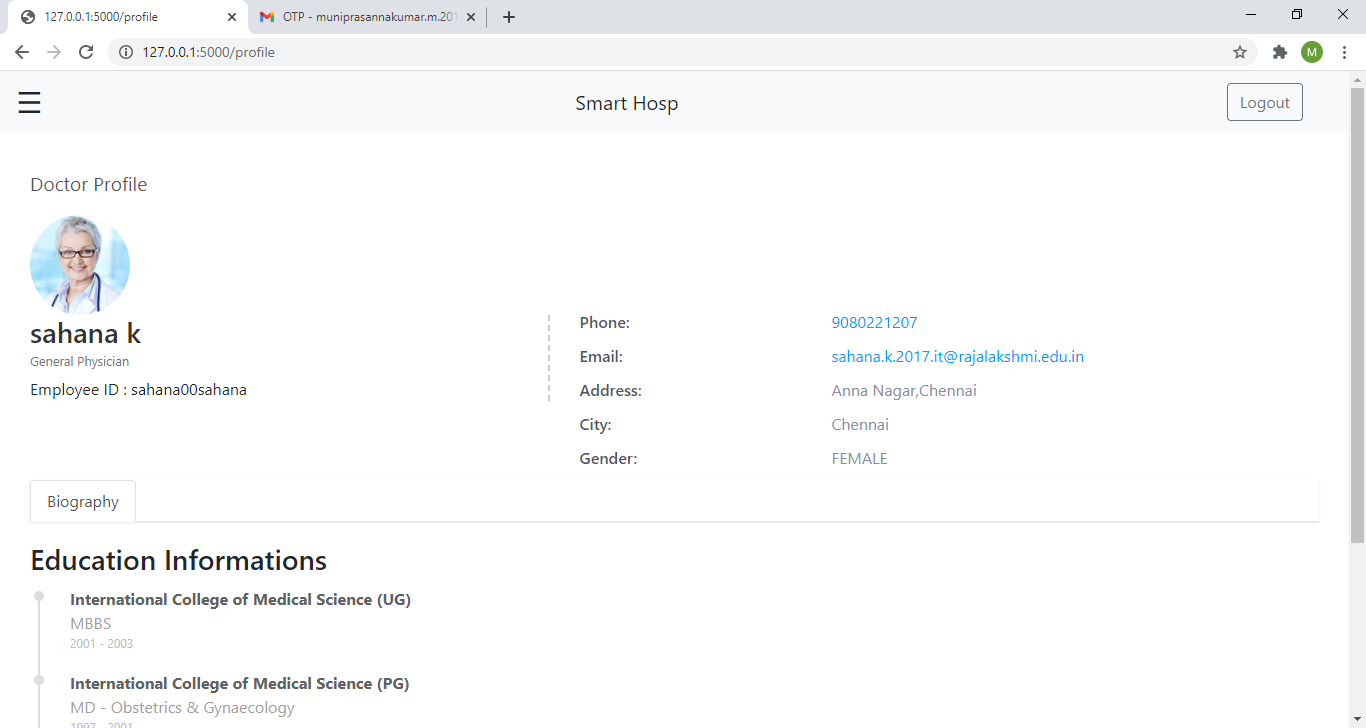


**SCHEDULING TIME**

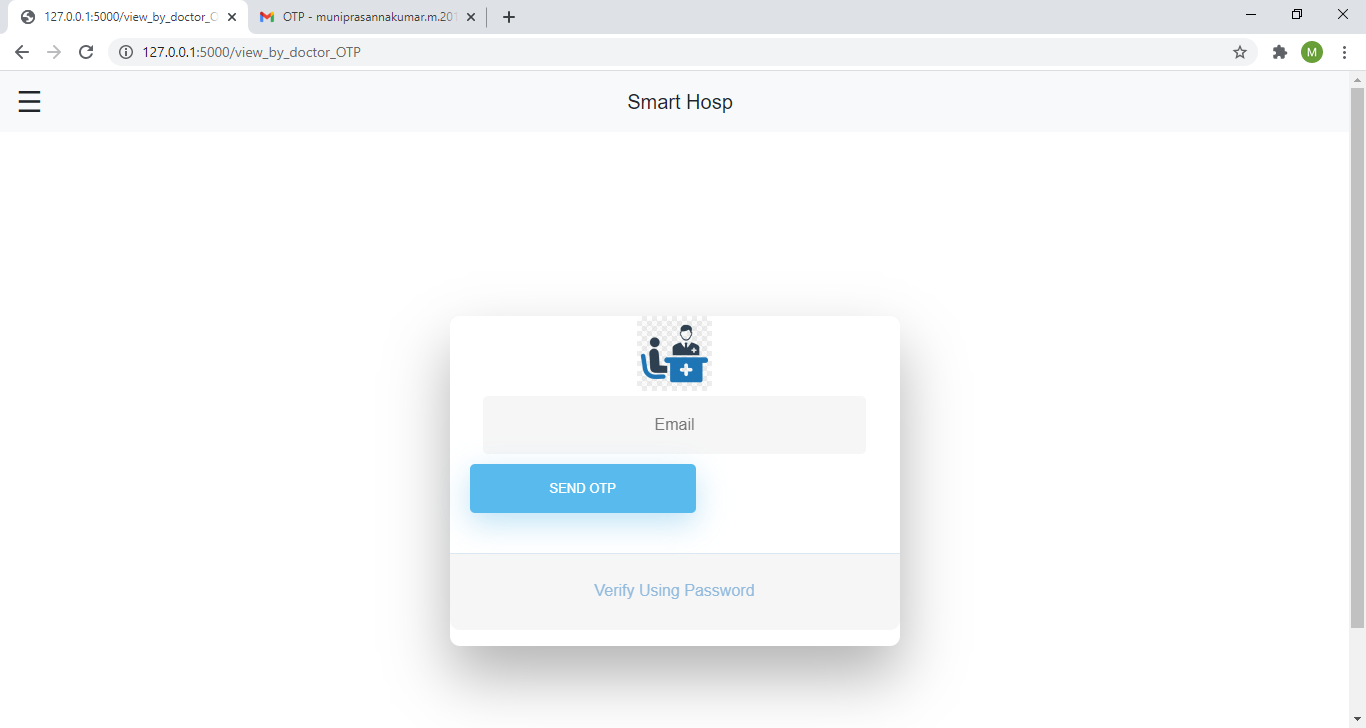




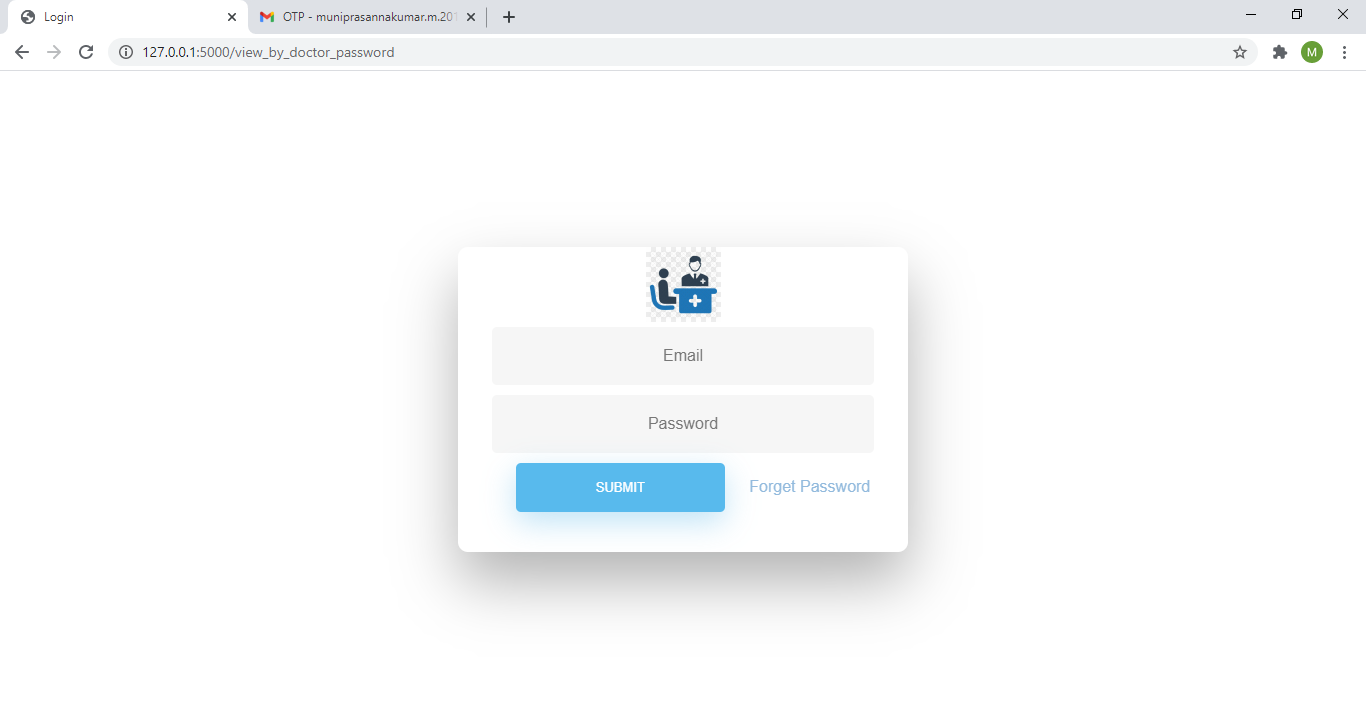
**DOCTOR’S PROFILE**



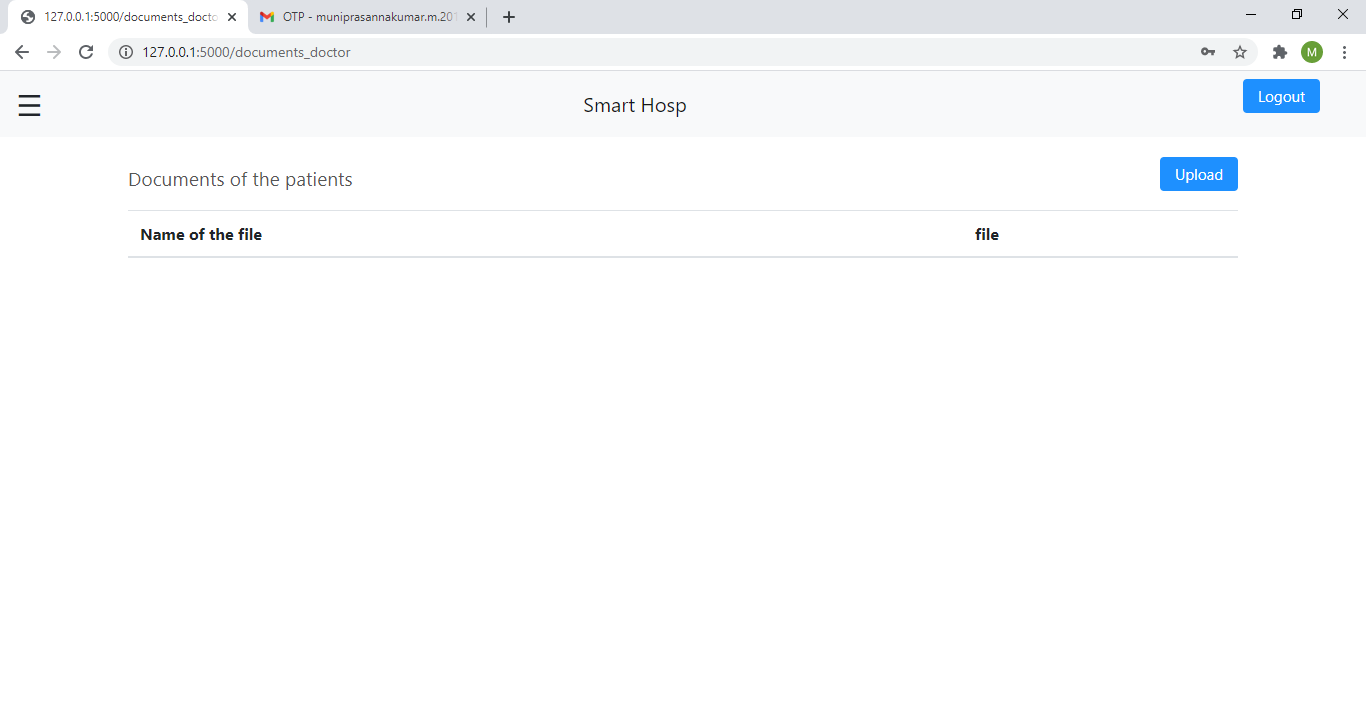
**VIEW RECORDS BY DOCTOR USING OTP**



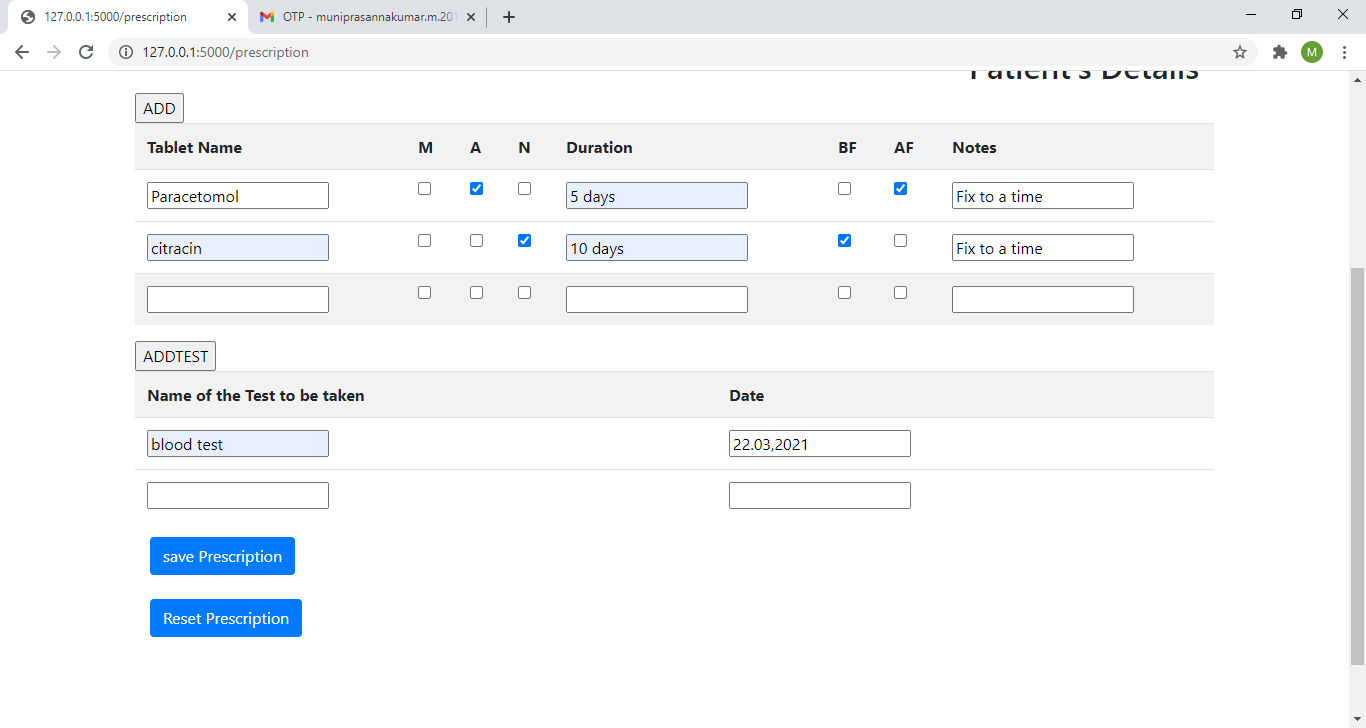
**VIEW RECORDS BY DOCTOR USING PASSWORD**

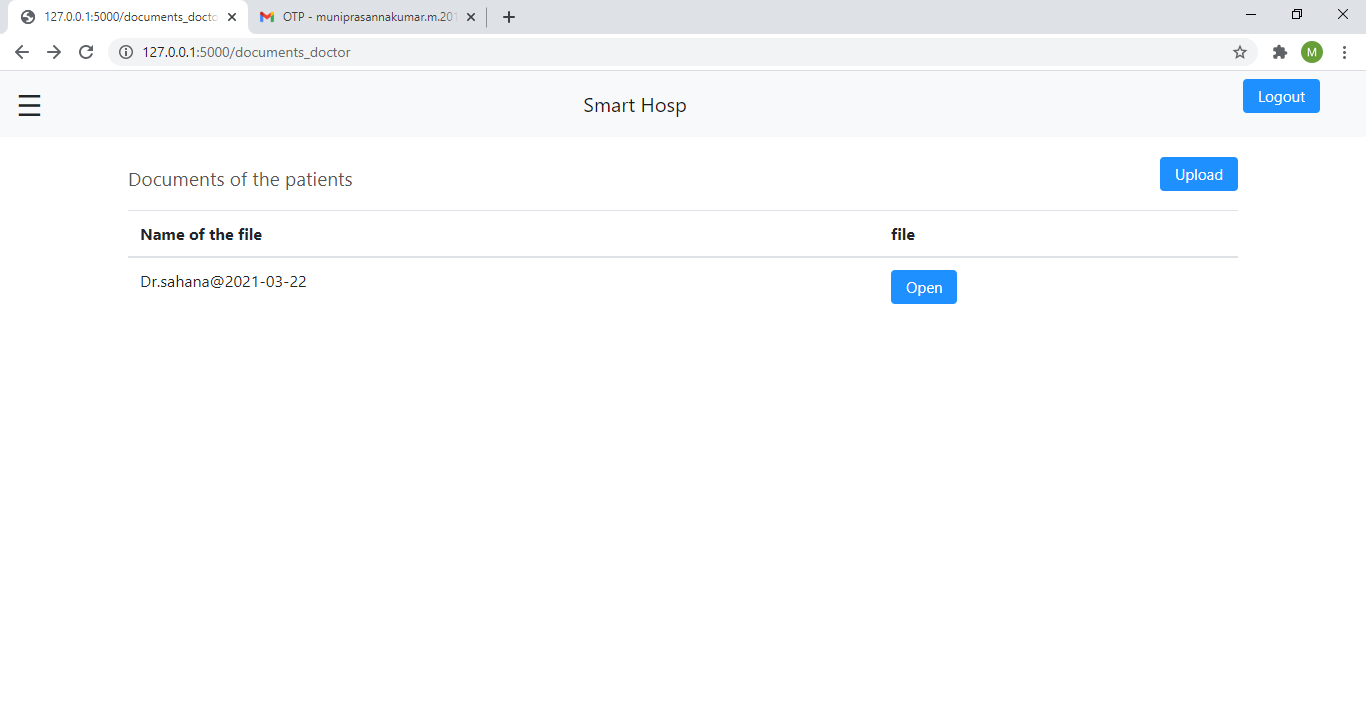


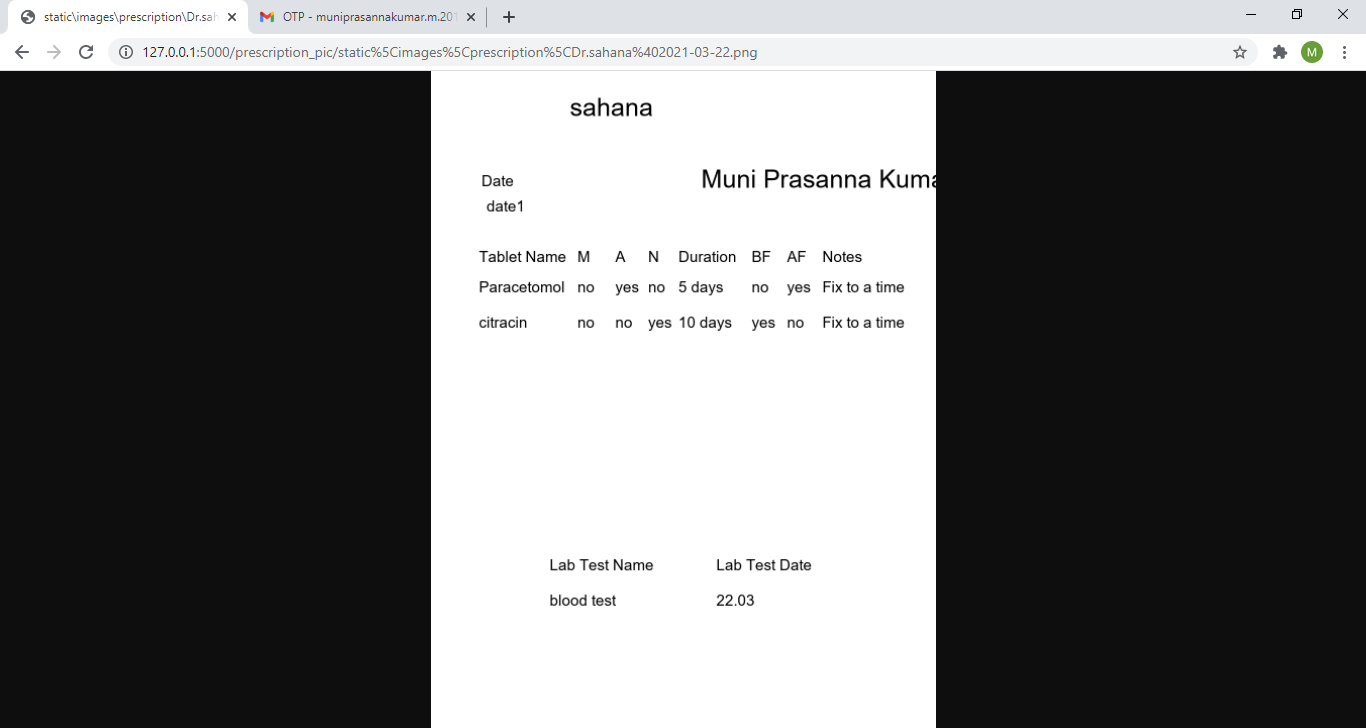
**DOCUMENT UPLOADING PAGE**



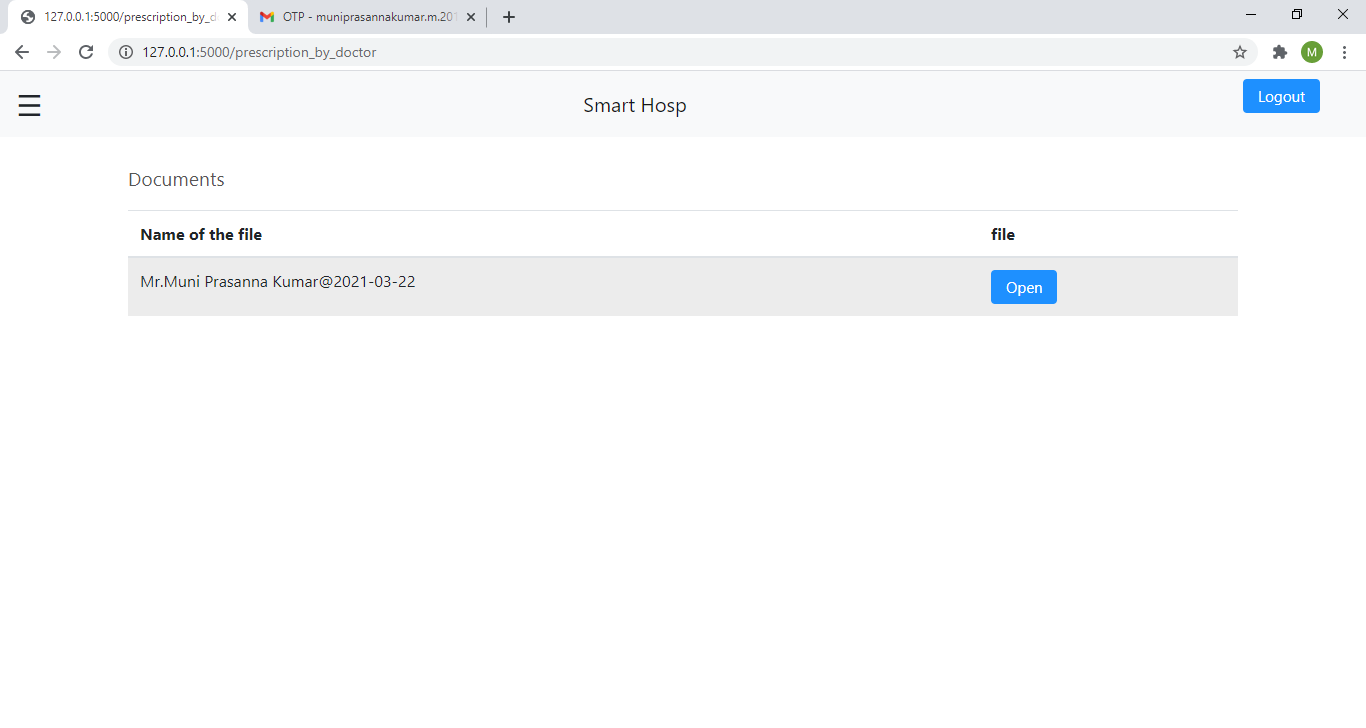
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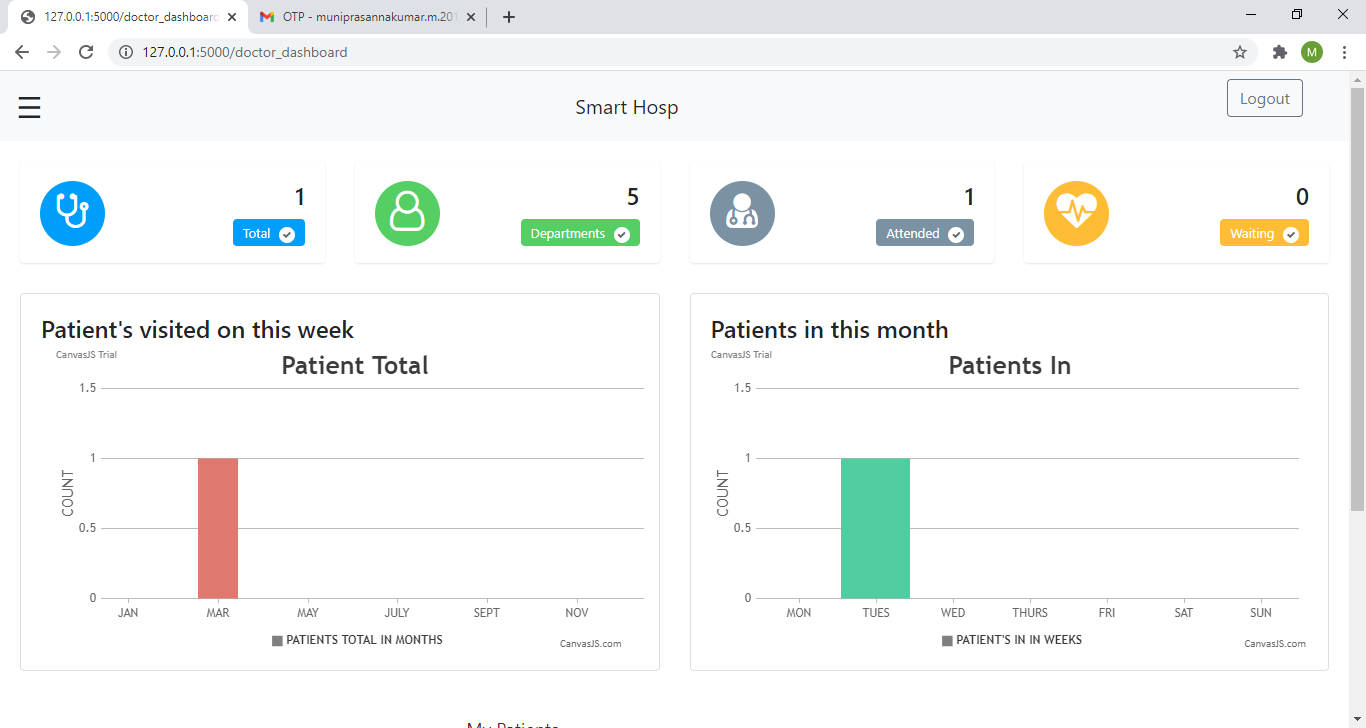




**PRESCRIPTION**



**DOCTOR’S DASHBOARD**



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