

## SAVEETHA SCHOOL OF ENGINEERING

## SAVEETHA INSTITUTE OF MEDICAL AND TECHNICAL SCIENCES

## CHENNAI-602105

**AI-Powered System for Early Detection of Skin Diseases Using CNN**

## A CAPSTONE PROJECT REPORT

*Submitted in the partial fulfillment for the completion of the course*

**CSA4307INTERNETPROGRAMMINGFORCLIENTSERVERMODEL IN**

**COMPUTERSCIENCEANDENGINEERING**

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**MAY2025**

## BONAFIDECERTIFICATE

I, **Jayaharini.J** student of **Bachelor of Engineering in the Department** of Computer Science and Engineering Saveetha School of Engineering, Saveetha Institute of Medical and Technical Sciences, Chennai, here by declare that the work presented in this Capstone Project Work entitled **AI-Powered System for Early Detection of Skin Diseases Using CNN** is the outcome of our own bonafide work and is correct to the best of our knowledge and this work has been undertaken taking care of Engineering Ethics.

Jayaharini.J 192371034

Date:

Place:Chennai

**INTERNALEXAMINER EXTERNALEXAMINER**

# ABSTRACT

Skin diseases affect millions of people worldwide and range from minor conditions to life-threatening illnesses such as melanoma. Early diagnosis plays a critical role in preventing complications and improving treatment outcomes. However, traditional diagnostic methods often rely on dermatological expertise, which can be limited by accessibility and human subjectivity. This project proposes an AI-powered system for the early detection and classification of skin diseases using Convolutional Neural Networks (CNNs), leveraging the capabilities of deep learning to provide accurate, fast, and scalable solutions.

The system is designed to analyze skin lesion images and classify them into predefined categories such as eczema, psoriasis, acne, benign nevi, and melanoma. By training CNN models on publicly available datasets like the ISIC (International Skin Imaging Collaboration) archive, the system learns to identify complex patterns and textures in skin lesions that are often subtle and difficult for the human eye to discern. The model architecture is fine-tuned to enhance accuracy while reducing overfitting, and it is validated using metrics such as precision, recall, F1-score, and confusion matrix analysis.

A user-friendly web or mobile interface is also envisioned, allowing users to upload images of skin lesions and receive instant predictions along with confidence levels. Such a system not only supports dermatologists in decision-making but also serves as a preliminary screening tool in remote or underserved regions.

This AI-based solution demonstrates the transformative potential of deep learning in healthcare, particularly in dermatology. The project highlights the integration of computer vision with medical diagnosis and provides a foundation for future enhancements such as multi-disease classification, real-time mobile diagnostics, and integration with telemedicine platforms. By making skin disease detection more accessible and efficient, this system contributes toward improving global skin health outcomes.

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## INTRODUCTION

Intoday’s fast-paced world, accessing quality healthcare hasbecome more important—and more challenging—than ever. Many people, especially those living in rural or remote areas, often struggle to visit hospitals due to long distances, busy schedules, or a lack of nearby medical facilities. Even in urban areas, patients may experience long waiting times, overcrowded clinics, and difficulties in scheduling appointments. These problems became even more obvious during the COVID-19 pandemic, which forced people and healthcare systems to rely heavily on digital solutions. This shift opened up new opportunities for using technology to improve the way healthcare services are delivered.

This project focuses on building a **web-based platform** that allows patients and doctors to connect virtually for medical consultations. The idea is simple but powerful: insteadoftraveling to ahospitalor clinic, patientscantalk to doctorsfromthecomfort oftheir homesusing asecure, easy-to-use website. Through this platform, users can create accounts, schedule appointments, consult with licensed medicalprofessionalsvia video call, receive digitalprescriptions, and store their medical records safely online. The goal is to make healthcare more convenient, accessible, and efficient for everyone.

The motivation behind this project comes from the growing demand for remote healthcare services and the increasing availability of internet access around the world. Byoffering a virtual consultation system, we aim to reduce the pressure on hospitals, save patients time and money, and ensure that even people in distant or underserved communities can receive timely medical attention. The platform is designed to be user-friendly for both doctors and patients, keeping in mind people of all ages and technical skill levels.

This introduction sets the stage for a deeper look into the design, features, development process, and impact of the web-based virtual consultation system. The platform is more than just a website—it’s a step toward making healthcare smarter, faster, and more patient-focused. Withthe right tools and thoughtful design, we can create a healthcare experience that fits today’s digital lifestyle without compromising on quality or safety.

## PROJECTDESCRIPTION

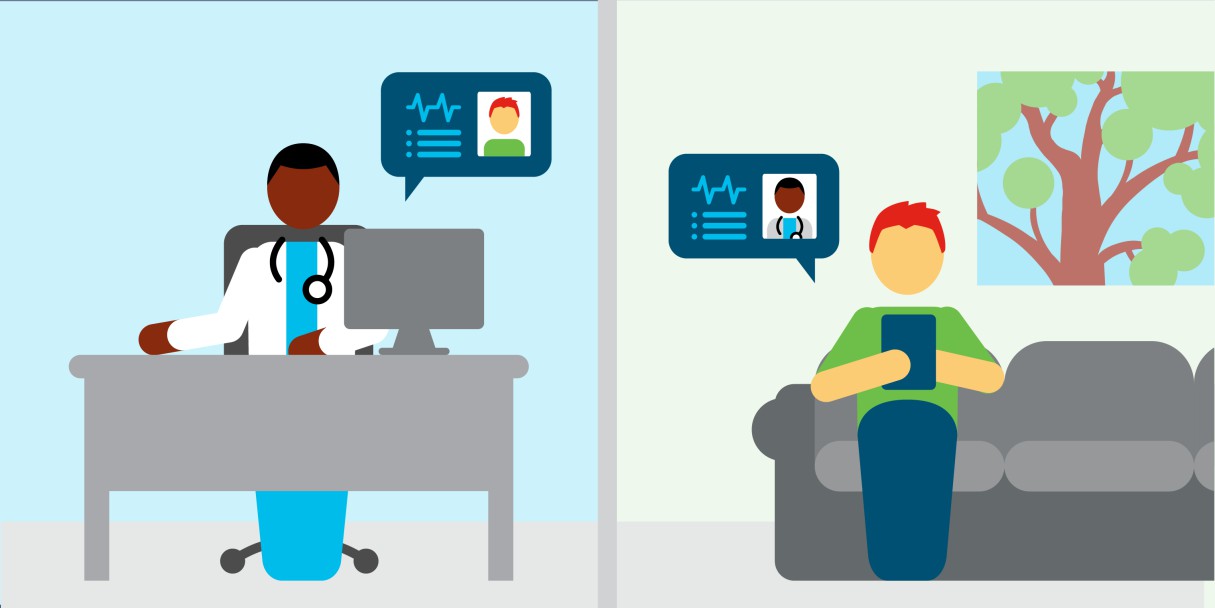
The project **"A Web-Based Platform for Virtual Hospital Consultations"**aims to develop a secure, accessible, and user-friendly web application that enables patients to connect with healthcare professionals remotely. By offering features such as online appointment booking, video consultations, electronic medical records (EMRs), and digital prescriptions, the platform seeks to reduce the need for in-person hospital visits, especially for patients in remote or underserved areas.

Built using modern web technologies like HTML, CSS, JavaScript (front end), Node.js, and MongoDB (back end), the system is designed for efficiency, scalability, and data security. It includes secure login for patients and doctors, real-time video conferencing, and encrypted storage of medical data. The platform is responsive and works across devices, allowing users to access healthcare services from anywhere with an internet connection.

Thissolutionaddressescurrent challenges inhealthcareaccessibility, hospitalovercrowding, and communicationgapsbetweenpatientsand doctors.It isespeciallyrelevant during timesofcrisis, such as pandemics, when traditional healthcare systems face overwhelming demand. By digitizing consultations, the platformhelps improve healthcare delivery, save time and costs, and enhance the overall patient experience.

To ensure a seamless user experience, the platform incorporates intuitive navigation, personalized dashboards for both patients and doctors, and automated reminders for upcoming consultations. Patients can view and update their personal information, access their consultation history, and download prescriptions or medical reports. Doctors, on the other hand, can manage their appointment schedules, access patient records in real-time, and generate digitalprescriptions during consultations. The integration of role-based access control ensures that sensitive medical information is only accessible to authorized users, thereby maintaining patient confidentiality and compliance with healthcare data regulations. Overall, the project bridges the gap between technology and healthcare, offering a scalable and adaptable solution for modern medical needs.

**FIG.1:** VIRTUALCONSULTATION



**PROJECTOBJECTIVES:**

#### DevelopaWeb-BasedSystemforSecureVirtualConsultations:

Build a user-friendlyplatformfor real-time doctor-patient video consultations. Ensure smooth and secure interaction between users.

#### ReducePhysicalHospitalVisitsThrough OnlineMedicalServices:

Offer medical services like consultations and prescriptions online. Help reduce hospital crowding and patient travel time.

#### ImproveAccesstoHealthcareforRuraland RemotePopulations:

Provide digital healthcare to areas with limited medical access. Enable patients to connect with doctors from any location.

#### EnableAppointmentSchedulingandPrescriptionGeneration Online:

Let patients book appointments and receive e-prescriptions digitally. Simplify the process from booking to treatment.

#### EnsureDataSecurityandCompliancewithHealthcarePrivacy Laws:

Protect sensitive health data using encryption and secure login. Follow legal standards like HIPAA and GDPR.

## PROBLEMDESCRIPTION

Access to timely and quality healthcare remains a significant challenge in many parts of the world. Patients often face long waiting times, travel difficulties, and limited availability of healthcare professionals, especially in rural or remote areas. Traditional hospital visits can be time-consuming, costly, and inconvenient, particularly for individuals with disabilities, chronic illnesses, or transportation issues. These barriers not only delay treatment but also increase the burden on healthcare facilities that are already operating at full capacity.

Additionally, the COVID-19 pandemic revealed major gaps in the healthcare system, especially in terms of preparedness for remote medical service delivery. During lockdowns and outbreaks, many patients were unable to visit hospitals for non-emergency issues, resulting in untreated conditions and poor health outcomes. While telemedicine solutions exist, many are either expensive, lack proper data security, or are not tailored to the needs of local communities and healthcare providers.

Furthermore, communication between patients and doctors outside of physical visits is often limited, with minimal access to digital tools for managing appointments, viewing medical records, or receiving prescriptions. This lack of a centralized, user-friendly system reduces efficiency and hinders the overall patient experience.

There is a clear need for a reliable, secure, and accessible web-based platform that can support virtual consultations and help bridge the gap between patients and healthcare providers. Such a platform should simplify the process of connecting with doctors, reduce physical visits to hospitals, improve record-keeping, and ensure medical care is available to more people— regardless of location or circumstance.

This project aims to address these challenges by developing a comprehensive online system for virtual hospital consultations. It will focus on enhancing accessibility, streamlining communication, protecting patient data, and supporting healthcare systems with digital tools for efficient service delivery.

## TOOLS

In this virtual hospital consultation project, various key operations are implemented to manage users, doctors, appointments, and consultationsefficiently. Below are the primaryoperationsand the corresponding data storage requirements for the system:

#### StorePatientInformation

* + **FullName:**Eachpatient'snameisstoredforidentificationandpersonalizedinteraction.
  + **UniquePatientID:**Assignedtoeachpatientforsecureaccessandaccuraterecord tracking.
  + **Contact Details:** Includes email, phone number, and residential address for communication and consultation purposes.
  + **Medical History:** Records of past diagnoses,medications, allergies, and treatments are stored securely for future reference.

#### StoreDoctorInformation

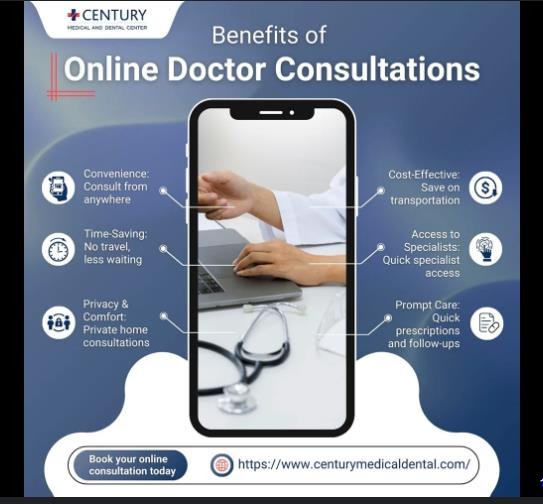
* + **FullNameandSpecialization:**Storedtohelppatientsfindsuitablemedical professionals based on their needs.
  + **Unique Doctor ID:** A unique identifier assigned to each doctor for system tracking and secure login.
  + **Contact and Availability Info:**Includes email,phonenumber,and workinghours for scheduling consultations.
  + **Credentials and Experience:** Stores qualifications, certifications, and work experience for transparency and trust.

#### StoreAppointmentandConsultationInformation

* + **AppointmentID:**AuniqueIDforeachappointmentforschedulingand tracking.
  + **PatientID&DoctorID:**Linkseachconsultationtoaspecificpatientanddoctorfor record-keeping and future reference.
  + **Date&Time:**Scheduledtimeoftheappointmenttomanageavailabilityandavoid conflicts.
  + **ConsultationNotes:**Digital recordsof diagnoses,treatmentplans,anddoctor’snotes from each session.
  + **PrescriptionData:**Storesthemedicinesprescribed,dosage,andanymedicaladvice issued during the consultation.

1. **Security & Access Management:** Implements secure login, role-based access, and data protection measures to ensure only authorized users access sensitive information, in compliance with healthcare privacy laws like HIPAA and GDPR.

**FIG2:**BENEFITSOFVIRTUALCONSULTATION



## OPERATIONS

The virtual hospital platform allows patients to register and securely log in using their unique credentials. Once logged in, patients can update their personal information, including contact details, age, gender, and medicalhistory. The dashboard providesa user-friendlyinterface where patients can browse through available doctors, categorized bydepartment or specialization. This helps users quickly find the right doctor based on their health concern.

Patientscan book appointmentsbyselecting adoctor, choosing adateand time, and submitting a request. Upon confirmation, appointment details are updated on their dashboard. On the scheduled day, patients can join real-time video consultations through an embedded video conferencing module, allowing them to consult with doctors without physically visiting a hospital. After the consultation, patients can view prescriptions, download them as PDF files,and access their consultation history at any time.

For doctors, the web application provides a separate login panel with role-based access. Doctors can manage their profile, update their availability, and view their daily appointment schedules. During consultations, they have access to the patient's medical history and can upload notes and prescribe medications directlythrough the system. These digitalprescriptions are saved securely and madeavailabletopatientsinstantly. Doctorscanalso markappointmentsascomplete, cancel sessions, and reschedule if necessary.

Additional features include automated notifications and reminders for both patients and doctors via email or SMS. There is also a feedback system where patients can rate their consultation experience. Admin users, if included, can monitor all system activities, manage users, and generate reports. All operations are performed within a secure, encrypted environment to ensure confidentiality, making the platform a reliable and efficient solution for remote healthcare delivery.

## MODULEDESCRIPTION

The virtualhospitalconsultation platform is developed using a modular architecture, where each major function is built as a separate, independent module. This approach improves maintainability, scalability, and simplifies future upgrades. Each module is responsible for specific tasks within the system, and together, they form a unified digital healthcare solution. Below is a breakdown of the core modules and their functionalities:

#### UserAuthenticationModule

**Functionality:** Manages secure registration, login, and access control for patients, doctors, and admins.

#### Features:

* + Newuser (patientordoctor) registrationwithencryptedpasswordstorage.
  + LoginsystemwithJWT-based authentication forsecure access.
  + Role-basedaccesscontroltolimituserpermissionsbasedonrole.
  + Profilemanagement andpasswordresetfeatures.
  + Ensuresonlyverified andauthorized userscanaccessspecificsystemfunctionalities.

#### PatientInterfaceModule

**Functionality:**Providespatientswithaccesstoconsultations,appointment booking,and medical records.

#### Features:

* + Viewavailabledoctorsbyspecializationand scheduleconsultations.
  + Book,reschedule,orcancelappointmentswithreal-timeavailability.
  + Accesspast medicalhistory,prescriptions,andconsultationsummaries.
  + Receivedigitalprescriptionsand healthtipspost-consultation.
  + Offersasimpleandintuitiveexperiencetailoredtopatientneeds.

#### DoctorInterfaceModule

**Functionality:** Enablesdoctorsto manage their profiles, view appointments, and conduct virtual consultations.

#### Features:

* + Profilesetupwithspecialization,credentials,and workinghours.
  + Dashboardtoviewscheduledappointmentsandpatientdetails.
  + Conductvideoconsultationsviaintegratedconferencingtools.
  + Addnotes,uploadmedicaldocuments,andissueprescriptions.
  + Streamlinestheconsultationworkflowandenhancesdoctorproductivity.

#### Appointment&ConsultationManagementModule

**Functionality:**Overseesappointmentscheduling,consultationtracking,andpost-consultation tasks.

#### Features:

* + Real-timeappointmentbookingandavailabilitychecking.
  + Auto-remindersforupcomingappointments(email/SMSnotifications).
  + Storesconsultationnotes,diagnoses,andtreatmentplans.
  + Facilitateseasyfollow-upsandfuturereferencefor bothpatientsanddoctors.
  + Managesthefulllifecycleofvirtualconsultations efficiently.

#### AdminManagement Module

**Functionality:** Gives system administrators controlover user management, systemsettings, and platform monitoring.

#### Features:

* + Manageusers(patientsanddoctors),includingapproval,suspension,ordeletion.
  + Monitorplatformusage, appointmentlogs,anderrorreports.
  + Configuresystem-widesettingssuchasworkinghours,notificationsettings,and emergency protocols.
  + Ensuresplatformstability,security,andefficientoperation.

The modular architecture of this platform ensures that each component can be independently developed, tested, and maintained, leading to greater flexibility and ease of updates. As healthcare needs evolve, the platform can seamlessly integrate new functionalities, such as AI- based diagnostics, telemedicine tools, or integration with wearable health devices, without disrupting the existing system. Additionally, the modular approachallows for efficient scaling as the user base grows, whether it's adding more doctors, expanding patient support features, or accommodating a larger volume of consultations. This level of scalability and adaptability is crucial for ensuring the platform remains relevant and effective in meeting future healthcare demands.

**FIG 3 ;**HOWDOES ITWORKS



Furthermore, the modular design promotes a secure and robust system by isolating critical components, ensuring that sensitive data, such as patient records and consultation details, are protected with the highest security standards. Each module can be fine-tuned for performance, security, and usability, allowing developers to address potential vulnerabilities or bugs in onepart of the system without affecting others. This reduces downtime and ensures a seamless experience for both patients and doctors. By decentralizing key functionalities, the platform is more resilient, easier to maintain, and better equipped to adapt to changes in healthcare regulations and technological advancements.

The system is divided into key functional modules including user authentication, appointment management, video consultation, electronic medical records (EMR), and prescription management. The user authentication module handles secure login and role-based access for patients and doctors. The appointment management module allows patients to book, reschedule, or cancel appointments, while doctors can manage their availability. The video consultation module enablesreal-time communicationthroughintegrated video conferencing tools. The EMR module stores and retrieves patient history, clinical notes, and reports securely. Finally, the prescription management module lets doctors issue digital prescriptions, which patients can download or access anytime. Each module is interconnected, ensuring seamless and efficient healthcare delivery through the platform.

Theplatformisdesignedwitha modularapproachtoensurescalabilityand maintainability. Each module operatesindependentlywhile seamlessly interacting withothersto provide a unified user experience. The front-end interface handles user input and presents dynamic content, while the back-end logic manages database operations, session handling, and security protocols.Additional supporting modules include notification services for appointment reminders, a feedback module to gather patient reviews, and an admin panel to monitor system performance and user activities. This modular structure allows for future enhancements, such as integrating AI-based health recommendations or expanding to include pharmacy and lab services.

## IMPLEMENTATION

### UserModel.js(forUserAuthentication&Management)

importuserModelfrom"../models/userModel.js"; import jwt from "jsonwebtoken";

import bcrypt from "bcrypt"; importvalidatorfrom"validator";

//Login User

const loginUser=async(req,res)=>{ const{email,password}=req.body; try {

constuser=awaituserModel.findOne({email}); if (!user) {

returnres.json({success:false,message:"Userdoesn'texist"});

}

constisMatch=awaitbcrypt.compare(password,user.password); if (!isMatch) {

returnres.json({success:false,message:"Invalidcredentials"});

}

consttoken=createToken(user.\_id); res.json({ success: true, token });

} catch (error) { console.log(error);

res.json({success:false,message:"Error"});

}

};

constcreateToken=(id)=>{

returnjwt.sign({id}, process.env.JWT\_SECRET);

};

//RegisterUser(Patient/Doctor)

constregisterUser=async(req, res)=>{

const{name,email,password,role}=req.body; try {

constexists=awaituserModel.findOne({email}); if (exists) {

returnres.json({success: false,message:"Useralreadyexists"});

}

if(!validator.isEmail(email)){

returnres.json({success: false,message:"Pleaseenteravalidemail"});

}

if(password.length<8) {

returnres.json({success:false,message:"Passwordmustbeatleast8characters" });

}

constsalt=awaitbcrypt.genSalt(10);

consthashedPassword=awaitbcrypt.hash(password,salt); const newUser = new userModel({

name,

email,

password:hashedPassword, role, //"patient"or"doctor"

});

awaitnewUser.save();

res.json({success:true,message:"Userregisteredsuccessfully" });

} catch (error) { console.log(error);

res.json({success:false,message:"Error"});

}

};

export{loginUser,registerUser};

### DoctorModel(DoctorModel.js)

importdoctorModelfrom"../models/doctorModel.js"; import bcrypt from "bcrypt";

constregisterDoctor=async(req,res) =>{

const{name,email,password,specialization,availability}=req.body; try {

constexists=awaitdoctorModel.findOne({email}); if (exists) {

returnres.json({success:false,message:"Doctoralreadyexists"});

}

constsalt=awaitbcrypt.genSalt(10);

consthashedPassword=awaitbcrypt.hash(password,salt) const newDoctor = new doctorModel({

name, email,

password:hashedPassword, specialization,

availability,

});

awaitnewDoctor.save();

res.json({success:true,message:"Doctorregisteredsuccessfully" });

} catch (error) { console.log(error);

res.json({success:false,message:"Error"});

}

};

constlistDoctors=async(req,res)=>{ try {

constdoctors=awaitdoctorModel.find({}); res.json({ success: true, data: doctors });

} catch (error) { console.log(error);

res.json({success:false,message:"Error"});

}

};

export{registerDoctor,listDoctors};

### DoctorConsultationController(ConsultationController.js)

importconsultationModelfrom"../models/consultationModel.js"; const startConsultation = async (req, res) => {

const{patientId,doctorId,appointmentId}=req.body; try {

constconsultation=newconsultationModel({ patientId,

doctorId, appointmentId,

status:"Ongoing",

});

awaitconsultation.save();

res.json({success:true,message:"Consultationstarted"});

} catch (error) { console.log(error);

res.json({success:false,message:"Errorstartingconsultation"});

}

};

constendConsultation=async(req,res) =>{

const{consultationId,notes,prescription}=req.body; try {

constconsultation=awaitconsultationModel.findById(consultationId);

if(!consultation){

returnres.json({success:false, message:"Consultationnotfound"});

}

consultation.status = "Completed"; consultation.notes = notes; consultation.prescription=prescription;

awaitconsultation.save();

res.json({success:true,message:"Consultationcompleted" });

} catch (error) { console.log(error);

res.json({success:false,message:"Errorendingconsultation"});

}

};

export{startConsultation,endConsultation};

## APPOINTMENTMODEL.JS(SCHEMA)

importmongoosefrom'mongoose';

constappointmentSchema=newmongoose.Schema({ patientId: {

type:mongoose.Schema.Types.ObjectId, ref: 'User',

required:true

},

doctorId:{

type:mongoose.Schema.Types.ObjectId, ref: 'Doctor',

required:true

},

date: {type:Date,

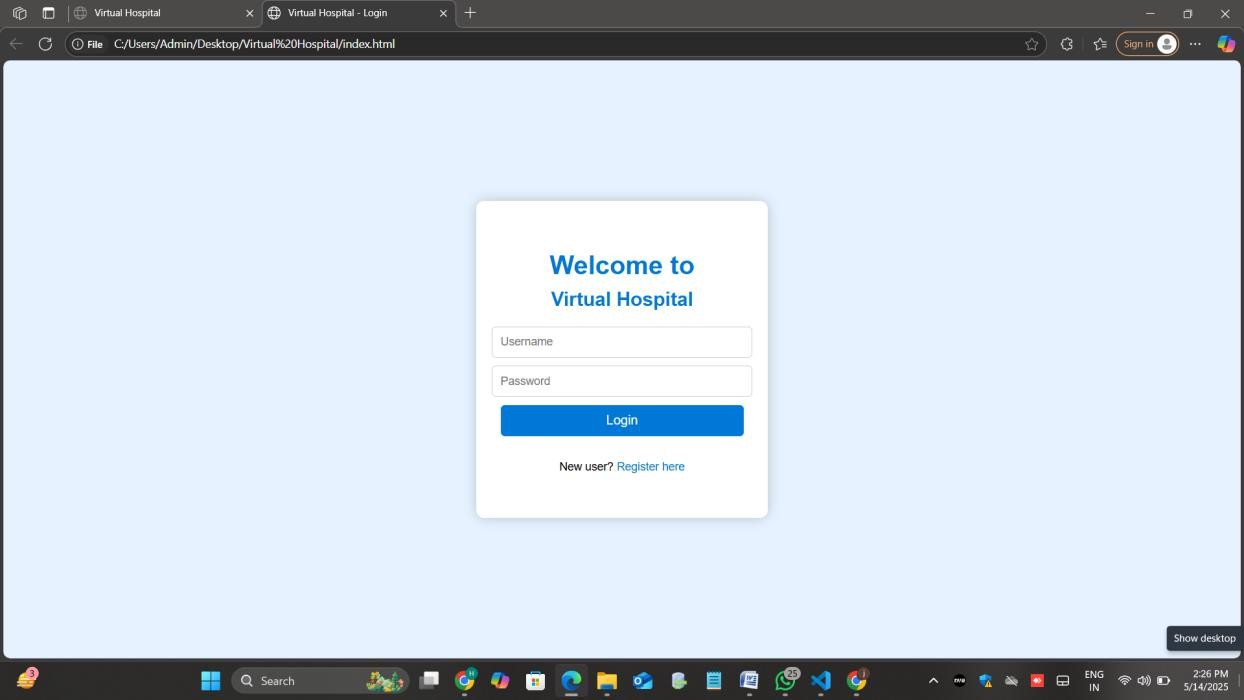
required:true

},

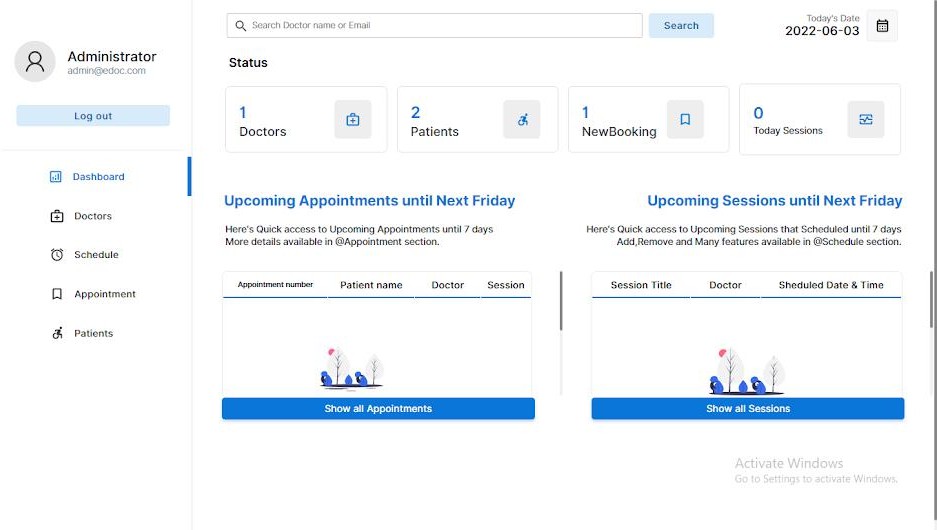
constAppointment=mongoose.model('Appointment',appointmentSchema); export default Appointment;

# RESULT

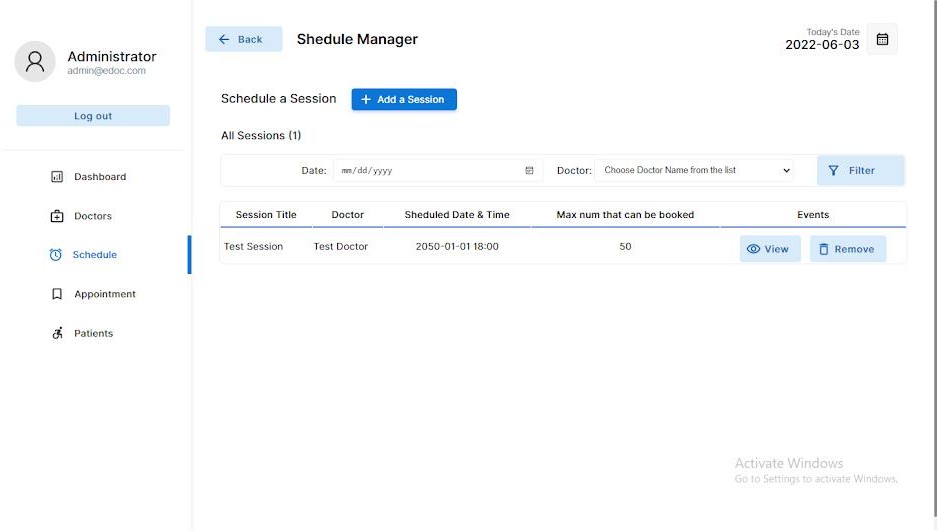
**LOGIN PAGE**

****

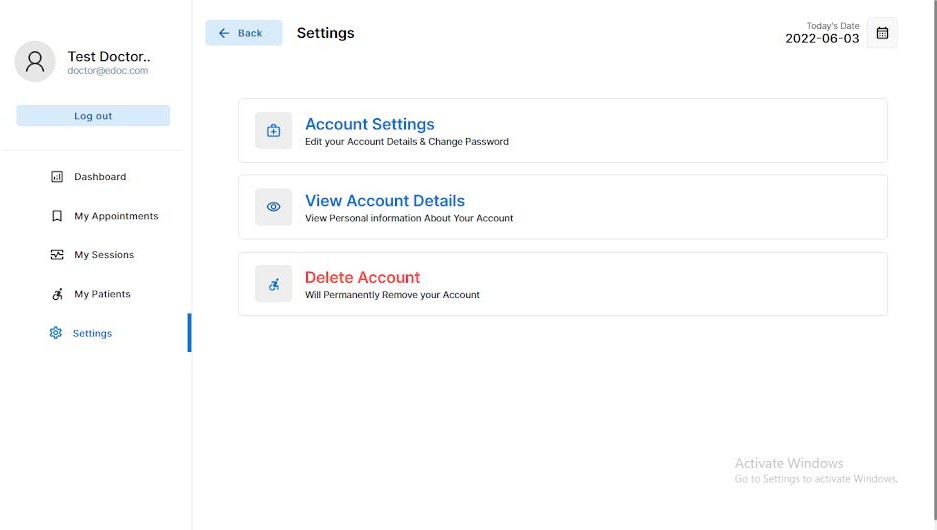
**APPOINTMENTPAGE**

****

**SHEDULEMANAGERPAGE**

****

**SETTINGSPAGE**

****

# CONCLUSION

The development of the **Web-Based Platform for Virtual Hospital Consultations** marks a significant step forward in modernizing the healthcare experience. By leveraging the power of web technologies, this platform provides a secure and efficient method for patients andhealthcare professionals to interact remotely. With features like user authentication, doctor registration, appointment scheduling, and virtual consultations, the platform bridges the gap between healthcare providers and patients, regardless of geographic location.

Through a modular and scalable design, the platform ensures that both current and future needs are met. The user-centric approach guarantees ease of access for patients, while healthcare professionals can effectively manage their schedules and patient data. Security features, such as encrypted logins, role-based access control, and compliance with healthcare regulations, ensure that sensitive medical information remains protected.

By offering a seamless virtual consultation experience, the platform significantly reduces the need for physicalvisitsto healthcare facilities, making healthcare more accessible, especially for patients in rural or remote areas. This approach not only improves the quality of care but also enhances patient convenience. Looking ahead, the platform is poised for future expansions, including mobile app integration and AI-driven diagnostic tools, ensuring that it remains adaptable to the ever-evolving healthcare landscape.

Insummary, this web-based platformoffers a comprehensive solutionto the challenges faced by modern healthcare systems, paving the way for more efficient, secure, and accessible healthcare services. It exemplifies how technology can positively impact the delivery of healthcare, providing both immediate benefits and long-term potential for growth and innovation in the healthcare sector.

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