T.C.

ISTANBUL AYDIN UNIVERSITY

INSTITUTE OF GRADUATE STUDIES

Doctor Appointment System with Ai based diagnoses

TERM PROJECT

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Chapter 1: Introduction

This chapter will examine the project from several angles and dimensions, including:

1. The main problem the project intends to address fully.
2. The reasons for selecting this particular problem for the project.
3. The solutions proposed to solve the problem and the challenges faced in developing them.
4. Project limitations and constraints.
5. Project timetable and schedule.
6. Summary indicating the content of the rest of the chapters.

Overview

our AI Doctor Appointment and Diagnostic System is an advanced healthcare system that is designed to streamline patient-doctor interactions, optimize the diagnosis processes, and to provide efficient user-friendly experiences for both patients and doctors. By integrating the AI-based diagnostic system, the project will assist in medical assessments based on patient reported symptoms, which enhances the speed and accuracy of the medical process, The platform will also enable an easy appointment scheduling.

The Problem Needed to be Solved

There are several inefficiencies in patient management within the healthcare sector, from doctor appointment processes to conducting diagnoses. These major issues underline the requirement for an AI-powered Doctor Appointment with a blood diagnostic system:

1. Delays in Appointments

Patients often find it difficult to get appointments in time due to lack of availability of doctors.

Manual schedules are filled with delays caused by miscommunication on inefficiencies in time management.

2. Inability to Analyze Blood Tests with Efficiency

The conventional blood test reports need a manual interpretation from doctors, and at times this occurs in the late diagnosis.

Errors in reading the lab results by man can also reduce treatment effectiveness.

3. Lack of Centralized Patient Records

There are various instances in which records for patients' medical history get scattered amongst different clinics and hospitals.

Doctors expend even more time in gathering past records, thus slowing down diagnosis and treatment.

4. High No-Shows and Disorganized Reminder Systems

Patients forget to keep appointments or simply miss the appointments themselves due to ineffective reminder systems.

Clinics have revenue losses while other patients experience longer wait times because of the last minute cancellations.

5. Setting Barriers for the Remote Clients

Patients who live in remote areas or are unable to travel find it difficult to go to clinics for their simple consultation and blood work.

The absence of telemedicine puts healthcare a bit out of reach.

How Our System Tackles These Issues

Our AI-Powered Doctor Appointment System resolves the following problems:

✅ Automatically scheduling appointments to shorten waiting time.

✅ Analyzing blood reports using AI for instantaneous and precise preliminary diagnoses.

✅ Hospitals maintain EHR records from a central server, allowing doctors and patients to perform smooth interactions.

✅ Intelligent reminders via SMS/Email are sent to reduce no-shows.

✅ Remote consultations assisted by Telemedicine.

By pairing AI diagnostics with a fast, efficient booking system, healthcare becomes more accessible, precise, and efficient.

Project Aims

The goal of the project "AI-Enhanced Doctor Appointment System: Improving the diagnosis and the managing processes" is to use artificial intelligence to revolutionise healthcare delivery. which emphasises a number of important objectives:

1- enhancing patient experience.
2. Improving the efficiency of operations.
3. Increasing the precision of diagnosis.

Simplifying the appointment scheduling procedure is one of the main aims and objectives. Conventional scheduling techniques frequently lead to lengthy wait times, wasteful use of time, and administrative difficulties.

The system will automate the scheduling process by using AI algorithms to diagnose the patient and match them with the appropriate physician, making it easier and faster for patients to make appointments. Higher satisfaction levels are eventually the result of this automation, which also lessens patient annoyance and the administrative load on medical personnel.

data management is also an important topic of the project. The system will enable better tracking and analysis of patient data over time. healthcare providers can develop more personalized treatment plans and preventive measures, creating a proactive approach to health management systems.

Enhancing patient-doctor communication is another important objective. In order to help patients make better decisions and promote a team approach to their health, the system will integrate AI-guided chatbots to offer virtual assistants that can answer frequently asked questions and help patients navigate their healthcare journey.

The system will also feature automated follow-up notifications and reminders, which will help patients stay involved and informed about their care appointments. This method improves the

overall quality of healthcare and strengthens treatment plans by encouraging constant communication between patients and providers, which eventually results in better health outcomes.

Finally, the project also aims to contribute to the ongoing research in AI applications and systems within the healthcare sector. By collecting data and insights from the implementation of our system, also it will provide valuable findings that can influence future developments in medical technology and patient care systems.

To summarize : the AI-Enhanced Doctor Appointment System aims to improve the efficiency, accessibility, and effectiveness of healthcare in general, which will result in a better patient experience and outcome.

The Solution

The platform Kara is the name of a vision for an AI-based healthcare aid that substantially improves triage, diagnosis, and doctor-patient matching process. By employing the state-of-art artificial intelligence in the medical appointment system, Kara makes the journey streamlined for both the patient as well as the physician.

At its heart, Kara is also an AI-assisted diagnosis system wherein patients enter symptoms and undergo a preliminary assessment of potential conditions. This knowledge of their ailments provides the patient with guidance in choosing the best specialist and thereby improving the actual doctor choice mechanism by reducing the uncertainty. Such a system can empower patients to obtain a better understanding of their symptoms, thus reducing their concern and preventing unnecessary visits that would impair the efficiency of healthcare.

Additionally, before supporting practitioners, Kara integrates AI blood test analyzer and AI MRI analyzer, assisting doctors in interpreting complicated diagnostic results. These tools act as a machine-learning algorithm to detect anomalies in suspicious findings and suggest potential diagnoses in the fastest way possible, minimizing human errors with AI support, thus facilitating informed swift decisions by the physician who hold ultimate responsibility regardless.

Kara sets out to close the chasm between patient self-assessment and physician knowledge to ensure more reliable diagnoses, better allocation of healthcare resources, and improved patient outcomes. This platform is a major step toward AI-integrated healthcare, where technology services working alongside human expertise to provide more efficient, accurate, and accessible medical services.

Needed Activities to Implement Solution

The Kara platform has a straightforward implementation for optimal efficiency as part of the patient and doctor workflow process. The following steps outline what patients' needs to do to utilize Kara's AI-powered health services:

1. Patient Signup and Onboarding:

- Accessing the Platform: The patient can either access the Kara web app or download the application onto their mobile device.
- Create an Account: Patients will create their account in determining a few important details (name, email, contact information) and creating a password.

2. AI-Based Symptom Assessment;

- Obtain Preliminary Diagnosis: AI of Kara analyses symptoms and suggests possible conditions with recommended next steps.

- ❖ Enter Symptoms: The patient describes his or her symptoms using an interactive questionnaire or simple voice input.
- ❖ Select Doctor: According to AI provided by the system, it recommends specialists suitable for the patient and availability of appointment slots.

3. How to Book a Doctor Appointment:

- ❖ Select Your Specialist: Choose from suggested doctors by examining their qualifications, their days in practice and what patients have said.
- ❖ Schedule an Appointment: Book a consultation whenever you need, with the opportunity to meet face-to-face or over video.
- ❖ Get Confirmation: Immediately see your appointment time, get reminders and find out what to prepare if needed.

4. **AI-Assisted Diagnostic Support (For Doctors):**

- ❖ Uploading the Test Results to the database: Physicians or lab technicians input blood test or MRI scan data into Kara's AI analyzer and it will be saved also in the database.
- ❖ AI Analysis : The system processes medical data, highlighting important and not normal conditions, potential diagnoses.
- ❖ Doctor Review with his Decision-Making: they receive AI-generated reports to aid in diagnosing and treating the patient.

Technologies

Our doctor appointment project employs a range of modern tools and technologies to ensure efficient development, maintainability, and scalability.

1. Frontend Development

- ➢ **Next.js (is a React-based framework):**
  - **This would be used to make a fast user-friendly and responsive web app.**

- **We will use Dynamic routing to allow for patients and doctors to have individual dashboards.**

➢ **JavaScript (JSX) & Tailwind CSS**

- **JavaScript (JSX) is the most common language for the frontend logic and React component structure making.**

- **Tailwind CSS is the utility first CSS framework which is built for a faster UI workflow and also keeping a neat design system consistent.**

2. Backend and API Development

➢ **Python (with Uvicorn support for ASGI):Uvicorn is an ASGI server able to run Python-backed services, thus serving asynchronous requests at a very high speed.**

➢ **Fast API(Flask): Probably used to build APIs RESTful, given Python's compatibility with AI/ML libraries (if any).**

3. Database & Cloud Storage

➢ **MySQL in Aiven:**

our relational database for storing the structured patient records along with the appointment and diagnostic data and the doctor data.

Aiven Cloud provides a fully managed, secure, and scalable MySQL workspaces with a lot of features such as the automated backup and the high availability.

➢ **Fast API (or Flask):**

Being the most probable choice of framework used for building RESTful APIs, given Python's compatibility with AI/ML libraries (if any).

4. AI/ML Development & Tools

➢ **the Python Libraries that we used for the AI Diagnostic codes**

- **Scikit-learn: For the classical ML algorithms with symptom classifiers being included.**

- **TensorFlow/PyTorch: we used it for the learning frameworks that we used to train our models for MRI and blood tests.**

- **OpenCV tools: we used it For the preprocessing of our medical imaging data and the data in general.**

- **Pandas & NumPy: we used it For the data manipulation and the numerical computing of our structured medical dataset.**

- **NLP Libraries: to Describe the patient symptoms through an input made in KARA.**

➢ **Jupyter Notebook & Anaconda**

- **Jupyter Notebook (.ipynb):we used it to Build the prototypes for the AI models and to visualize datas for the iterative testing.**

- **Anaconda: For easing trouble with Python environment and dependency management along AI/ML workflows.**

5. Development Environment Tools

➢ **Visual Studio Code (VSCode)**

- **Widely used as code editor with support for Python, JavaScript, and Database extensions.**

- **Debugging support, Version Control (Git), Integrated Jupyter Notebooks.**

➢ **Version Control (Git/GitHub/GitLab)**

ARCHITECTURAL DESIGN

The architecture of the platform is designed using a **three-tier architecture model** to ensure modularity, scalability, and ease of maintenance. This model divides the application into three independent layers, each handling a specific set of responsibilities.

1. Presentation Layer

Technology: For the Front-end technologies well be using Next.js and Tailwind CSS.
they have to accomplish:

- Rendering the interfaces for both patient and doctor to book the appointments and other things including entering symptoms and obtaining AI reports etc... .
- To Present the visualizations for the AI insight, like potential diagnoses or blood/MRI test results.
- also Facilitate doctors with filters and recommendation.

2. Business Logic Layer

Technology: for the logic we use Python (FastAPI, RESTAPI) and Node.js Express.JS.
they have to accomplish:

- they Manage scheduling times and the reminders and the doctor matching with patient.
- As an AI Integration/connection Gateway.
- Also it Handles the authentication + the roles (patient or doctor).

3. Data Access Layer

Technology: we used MySQL (relational data) + Node.JS Express.JS.
they have to accomplish:

- We use it to store the data of both patient and doctor + displaying or calling the needed data.

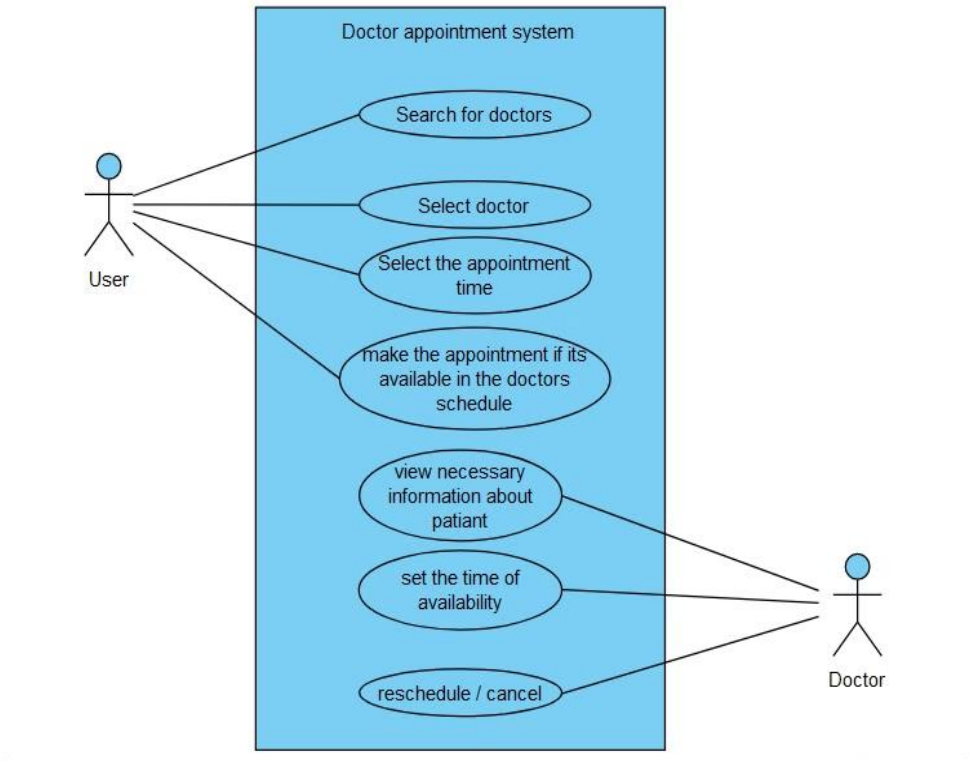
Detailed Design

This is our detailed design that specifies the core modules, the classes structures, and also the workflow for all operations.

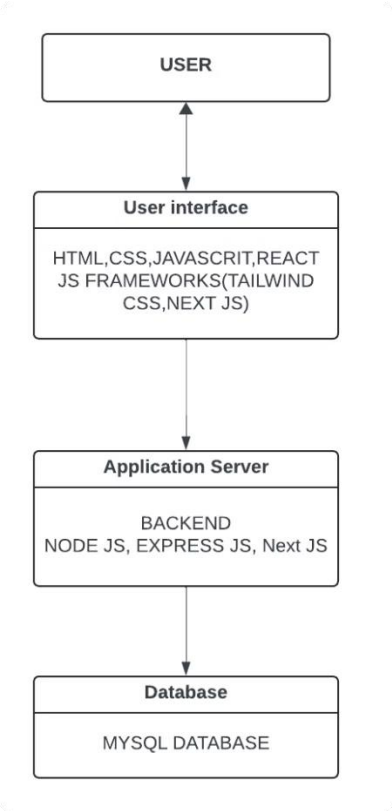
1. User Module

What does it do?
It has a dual role management for the (patient or doctor) and profile handling.

- **Technologies:** NextAuth from Next.JS, JWT (JSON Web Tokens)
- **Classes:** patient, doctor etc.....
- **This is an early use case diagram design from the early stages of planning:**



2. Early system design before the ai(after ai the difference is that we used python in the back-end)



3. The design pattern

Is MVC or (Model, View, Controller)

The model is the data for Patients, Doctors, Appointment, AI CSVs.

The View is the user interface for the web app made by the technologies above.

The Controller manages the interactions between the two above.

Security Design

The security of the platform is one of the most critical parts of the all-round architecture. we incorporated a multi-layer security which we designed to protect both the patient and doctor privacy and to ensure secure operations.

1. Authentication and Authorization

- The system we designed will make use of **NextAuth** along with **JWT (JSON Web Tokens)** for the secure authentication and good session management.

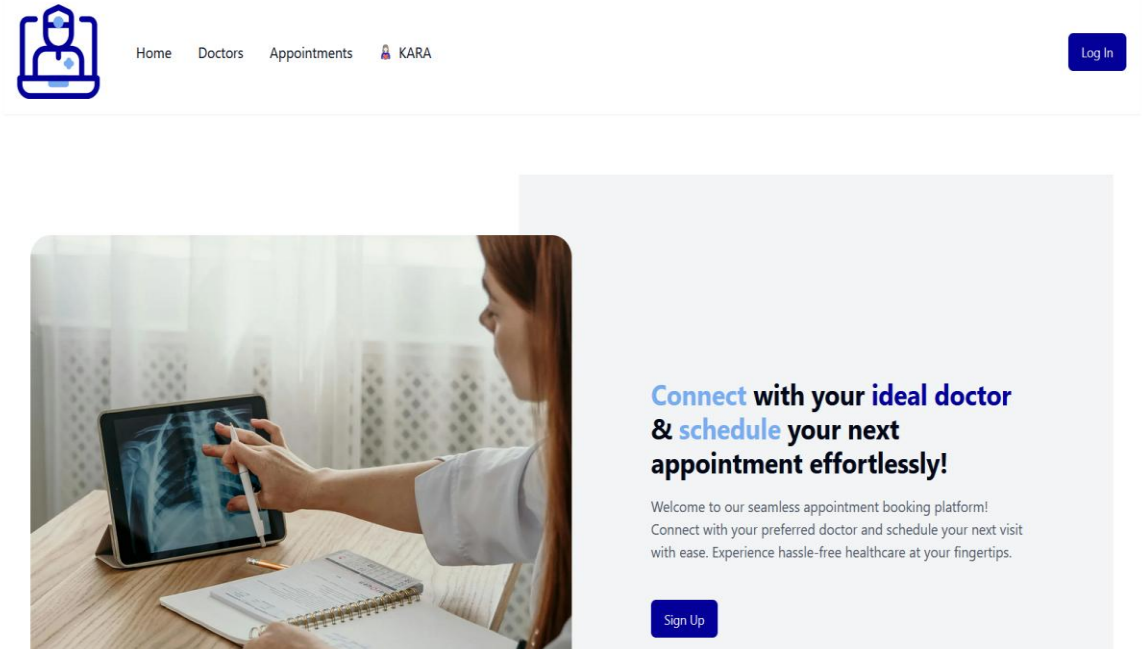
2. Secure API Design

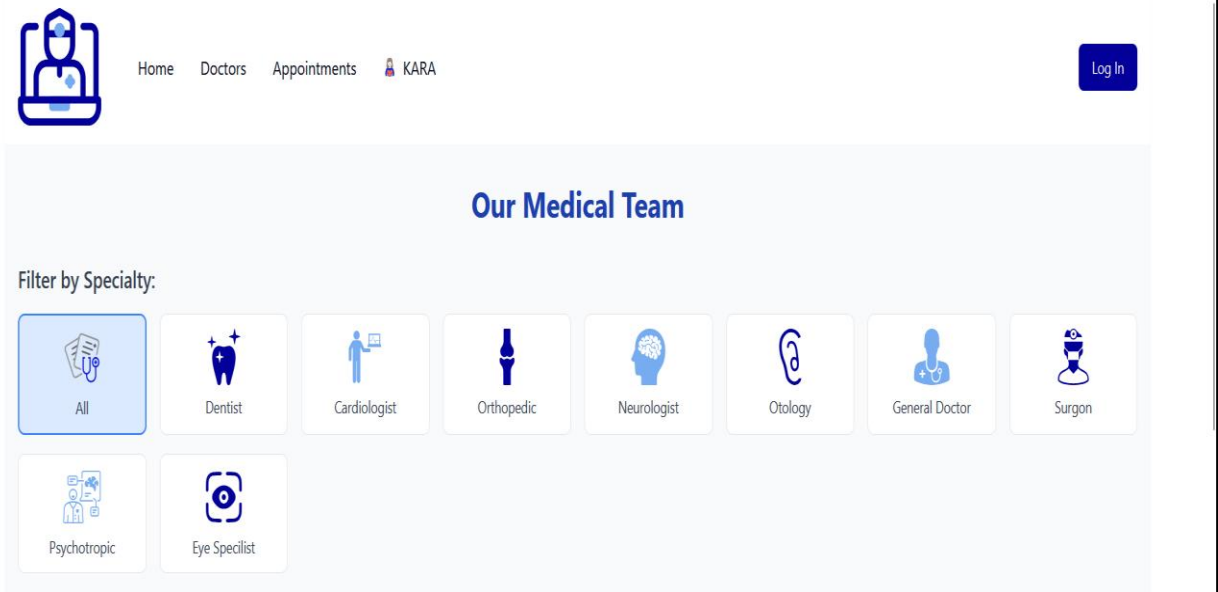
- We designed our RESTful APIs with security in mind with the connection closed after its not needed.
- Rate limiting and throttling mechanisms were used to prevent the abuse like denial-of-service (DoS) attacks and (DDoS) attacks.

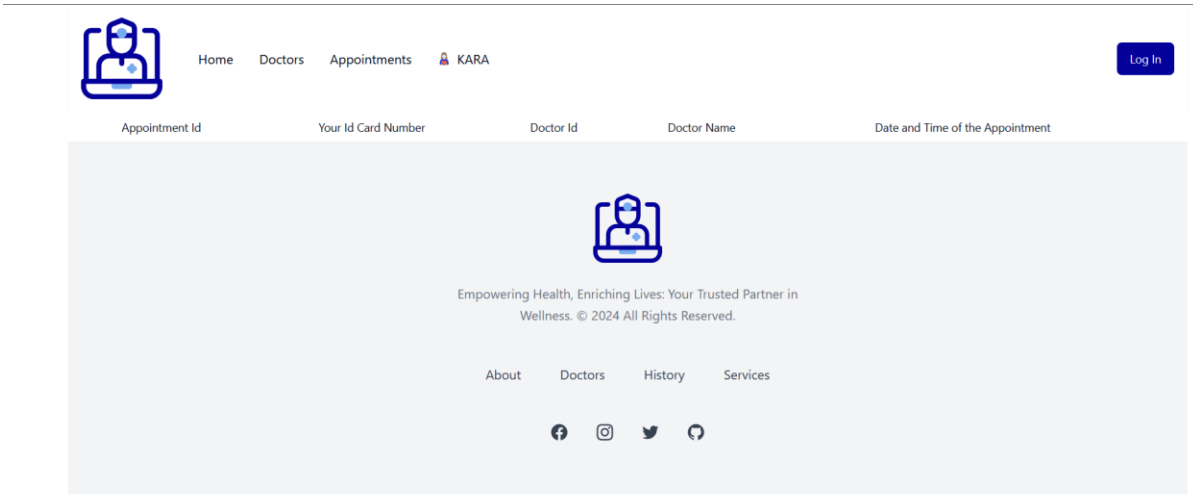
3. Database Security

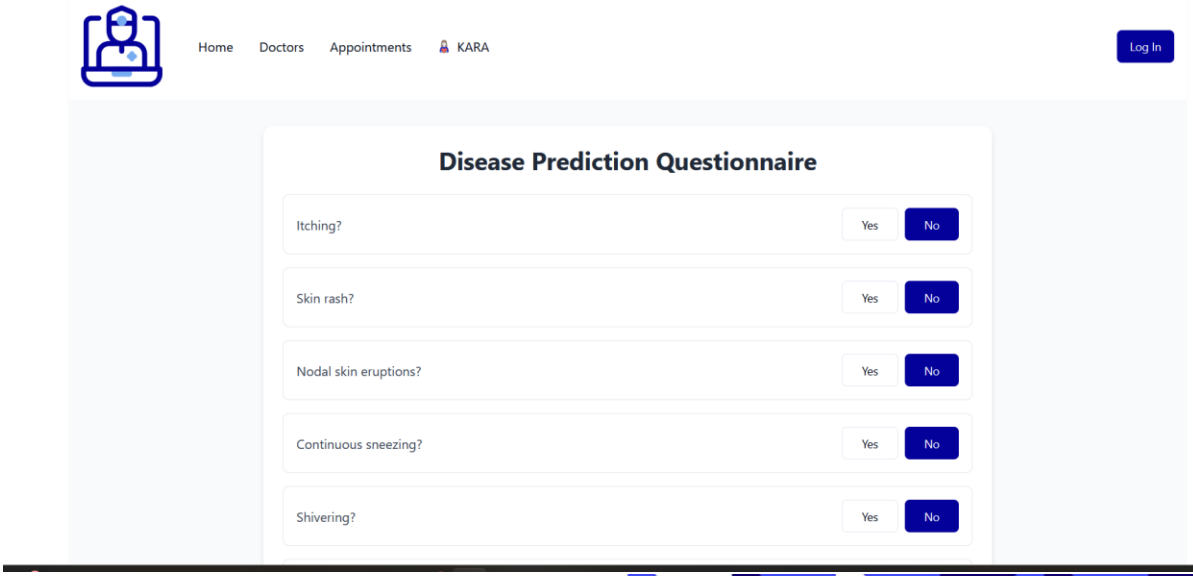
- Database access will be limited to the important and needed services and the essential stuff only.
- There will be Regular backups and of course role-based database access to prevent all the unauthorized accesses and deny data losses.

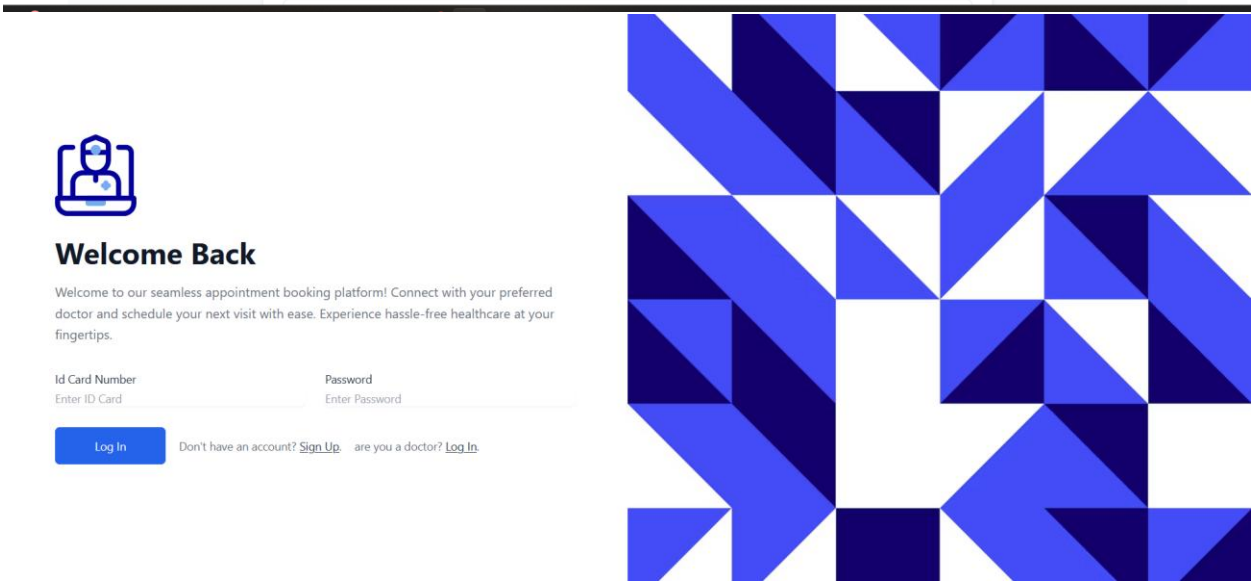
Interface Design

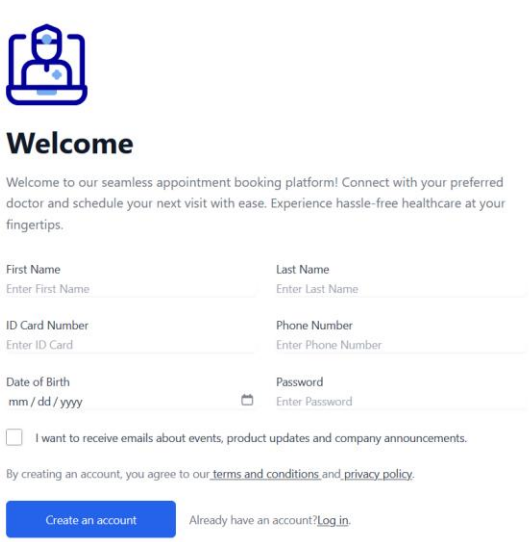


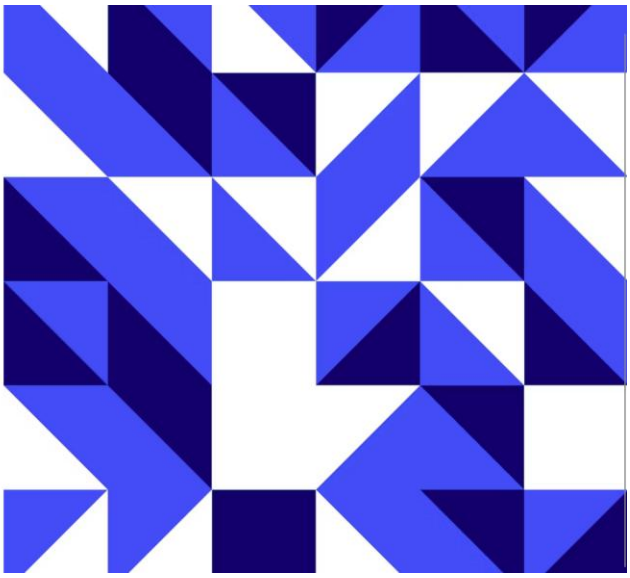



Home
Doctors
Appointments
KARA
Log In
Appointment Id
Your Id Card Number
Doctor Id
Doctor Name
Date and Time of the Appointment
Empowering Health, Enriching Lives: Your Trusted Partner in Wellness. © 2024 All Rights Reserved.
About
Doctors
History
Services


Home
Doctors
Appointments
KARA
Log In
Disease Prediction Questionnaire
Itching?
Yes
No
Skin rash?
Yes
No
Nodal skin eruptions?
Yes
No
Continuous sneezing?
Yes
No
Shivering?
Yes
No


Welcome Back
Welcome to our seamless appointment booking platform! Connect with your preferred doctor and schedule your next visit with ease. Experience hassle-free healthcare at your fingertips.
Id Card Number
Enter ID Card
Password
Enter Password
Log In
Don't have an account? Sign Up.
are you a doctor? Log In.





Estimation of Resources

The successful development of our project required a careful estimation for all resources, including the human resources who made it. The following is going to be our breakdown of the resources/roles we made to help finish the project throughout our semester.

- **Human Resources**
  - **The Project Manager (leader) (1):** he is Responsible for the overall coordination, planning, and monitoring of the project through all the phases.
  - **Frontend Developers (2):** They Designed and implemented the user interface using Next.JS, TailWind CSS and JavaScript.
  - **Backend Developers (2):** They Developed the server-side logic using JavaScript and Python, they also made and integrate the database using Aiven.
  - **Database Administrator (2):** They Designed and managed the database, to ensure the data integrity and fine optimize the performance.
  - **UI/UX Designer (2):** They Created the early mockups and designs to ensure a user-friendly and functional, beautiful design.
  - **QA/Test Engineer (2):** They Conduct the testing to ensure the functionality, the performance, and the security of the system.

Test Plan Documentation

We designed a structured and a comprehensive testing strategy which was very important to make sure it meets our quality, reliability, and usability rules that we set for the project. The goal of all these tests and test plans is to validate that the project will function correctly and smoothly under all the expected and the unexpected conditions and test scenarios, and meets the user requirements, and ensuring a secure and seamless user experiences.

- **Objectives**
  - To Verify that all the features will work and function as intended by our design.
  - To Identify and fix the bugs or the vulnerabilities before deployment if found.
  - To make sure that the system will be secure and user-friendly.
  - To Validate that both functional and non-functional requirements will be met.
  - We will send you the test scenarios document via email to check it for your knowledge.

The End