Electronic Health Record (EHR) Information System

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Course: Information Systems in Health Care (WS25/26)

Submission Date: 17-01-2026

Abstract

Electronic Health Records (EHRs) have played an increasingly important role in contemporary healthcare environments as they facilitate secure and efficient storage and retrieval of patient data. The proposed project creates an EHR system specifically catering to doctors and has the facility for doctors to register and log into their accounts and perform CRUD operations on patient data. The patient data storage includes demographics, clinical history, lab test reports, medications, immunization dates, diagnosis report, and billing. The backend tech stack consists of Python, Flask and MySQL. The front end has been designed using HTML5, CSS3, and Bootstrap 5. Image upload facility and date selection options have been incorporated. A usability test has been done using a formal questionnaire and signifies the efficacy of this proposed system. This report presents the planning and design of the proposed project work and its future scope.

1. Introduction

An Electronic Health Record is also known as the computerized versions of an individual's medical history. EHRs are gradually replacing paper-based medical records. EHRs allow essential records to be centralized and accessed and utilized by designated practitioners for quality patient care. EHRs improve communication among practitioners, the prospect of mistakes being lower, and administrative tasks simplified. Moreover, EHRs also help in decision-making, and practitioners can observe results and create preventive strategies for their patients.

The EHR module developed in this project has been developed from scratch to meet the needs of single doctors individually handling patients. In contrast to full-scale hospitals, this module will cater to the required features so that single doctors will only be able to access their patients' records. The module is secure, user-friendly, and scalable. It includes all the required features such as demographic record entry, health conditions, gender selection using radio buttons, date pickers, and uploading images for medical reports. The ultimate solution has been provided in the area of EHR because it will enable the users to store their medical, diagnosis, treatment, and billing components.

The use of EHRs has undergone significant advancement from mere repositories of patient data to an intensive system containing lab tests, imaging, prescriptions, and decision support systems.

The establishment of the project increases the impact of such advancements by embracing the use of up-to-date web technology while ensuring ease of use and simplicity. The adopted design entails the use of the Python Flask development framework in conjunction with the MySQL database and an HTML5 and Bootstrap5 design for the frontend of the system, ensuring the system can function well in any setting.

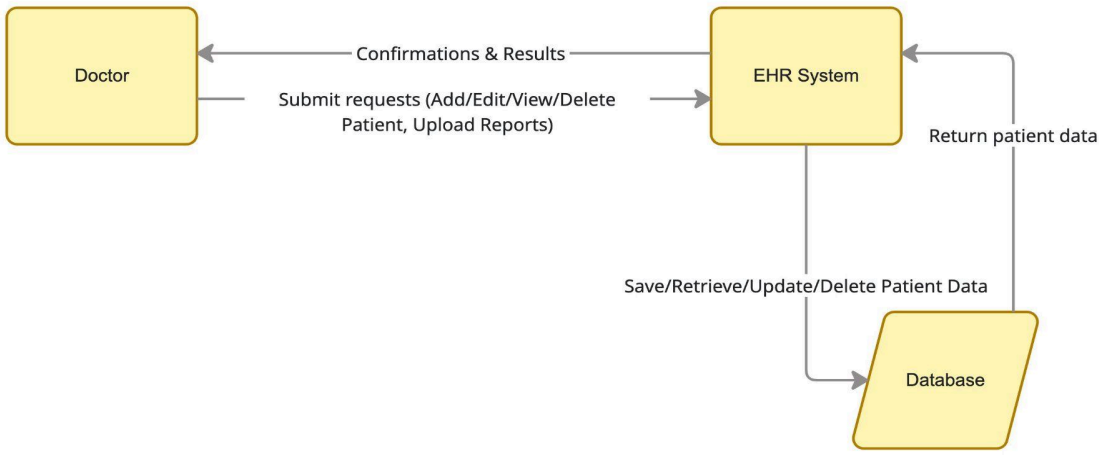


Figure 1 – Conceptual diagram showing doctor-patient data flow

2. Website Design and Technical Architecture

The design of the EHR system is based on three major components: the frontend, the backend, and the database. The frontend is the part of the system where the doctors will engage with the project. The frontend of the project will be developed using HTML5, CSS3, and Bootstrap5 and will give a similar look on all the devices because it is responsive in nature. The frontend of the system will contain the pages such as registration/login pages and patient pages.

The backend is developed in Python Flask (version 3.0.0) for all the backend operations. Then, the backend does not allow any unauthorized doctor to access their medical files. The backend also maintains confidentiality and security for all the critical inputs, for example, the history and results. In addition, the backend applies validation for all the inputs for the prevention of incorrect entries. The backend application utilizes the Flask-Mail (version 0.9.1) extension for the effective handling of emails, for example, the activation and resetting of the password.

For data storage, MySQL version 8.0.44 is utilized. The database design involves the inclusion of tables for storing data on doctors, patients, responses to the SUS system, and contact inquiries. Every patient is associated with a particular doctor to control access. The ‘patients’ table holds information on demographic characteristics, patient history, lab findings, medications,

immunization, diagnosis reports, and patient billing. Images are stored in the system file directory, with their path recorded in the database. An index is developed in the database on promising columns to efficiently handle big data.

This system architecture enables a clear distinction between the frontend, backend, and database, which is ideal for scalability and maintainability. Doctors are able to access the system using a frontend website via a web browser, and the backend handles all their requests and sends back some responses. This system architecture design is flexible enough for future expansions of additional functionalities such as reporting and data analysis.

Figure 2 – System architecture diagram showing frontend, backend, and database interactions

Figure 3 – Wireframe of dashboard Page

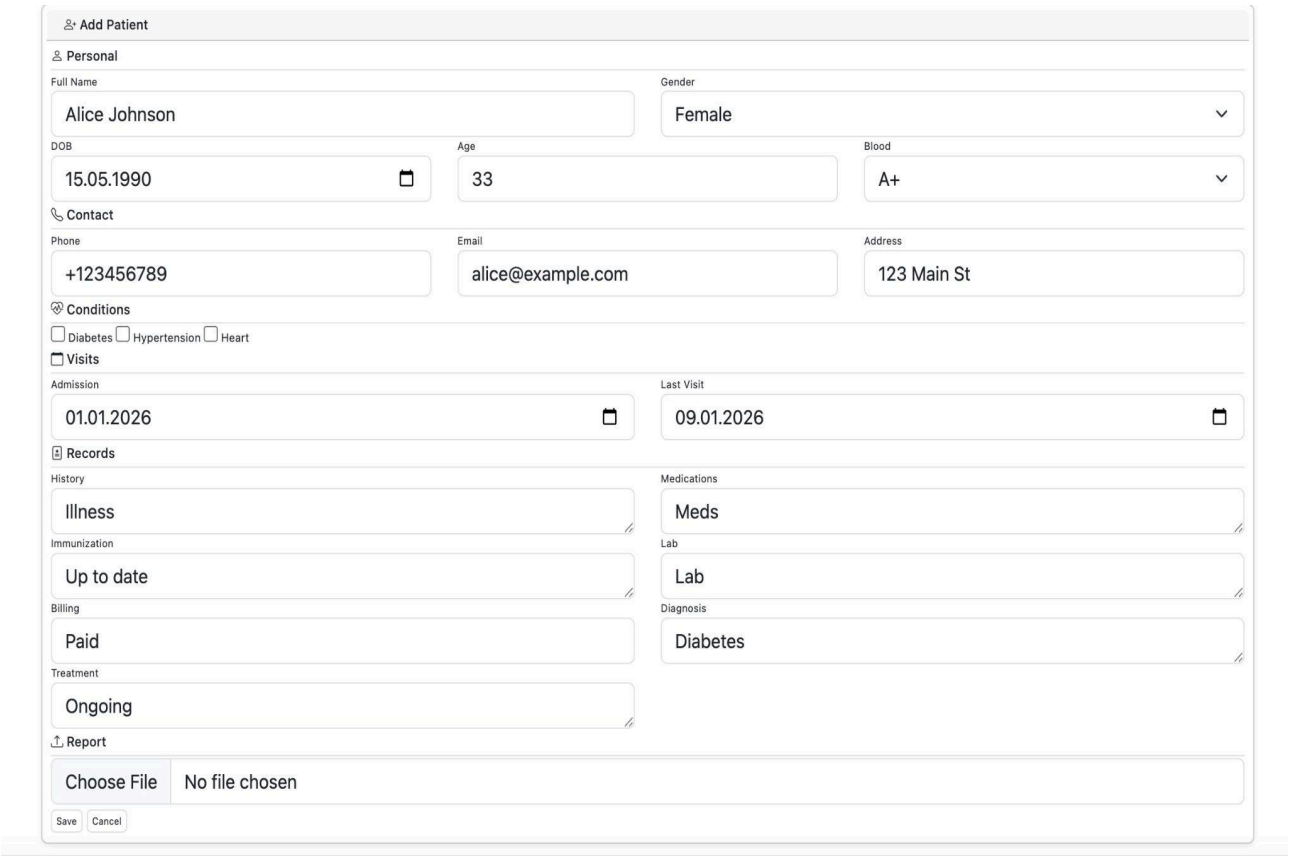


Figure 4 – Wireframe of Add Patient Page

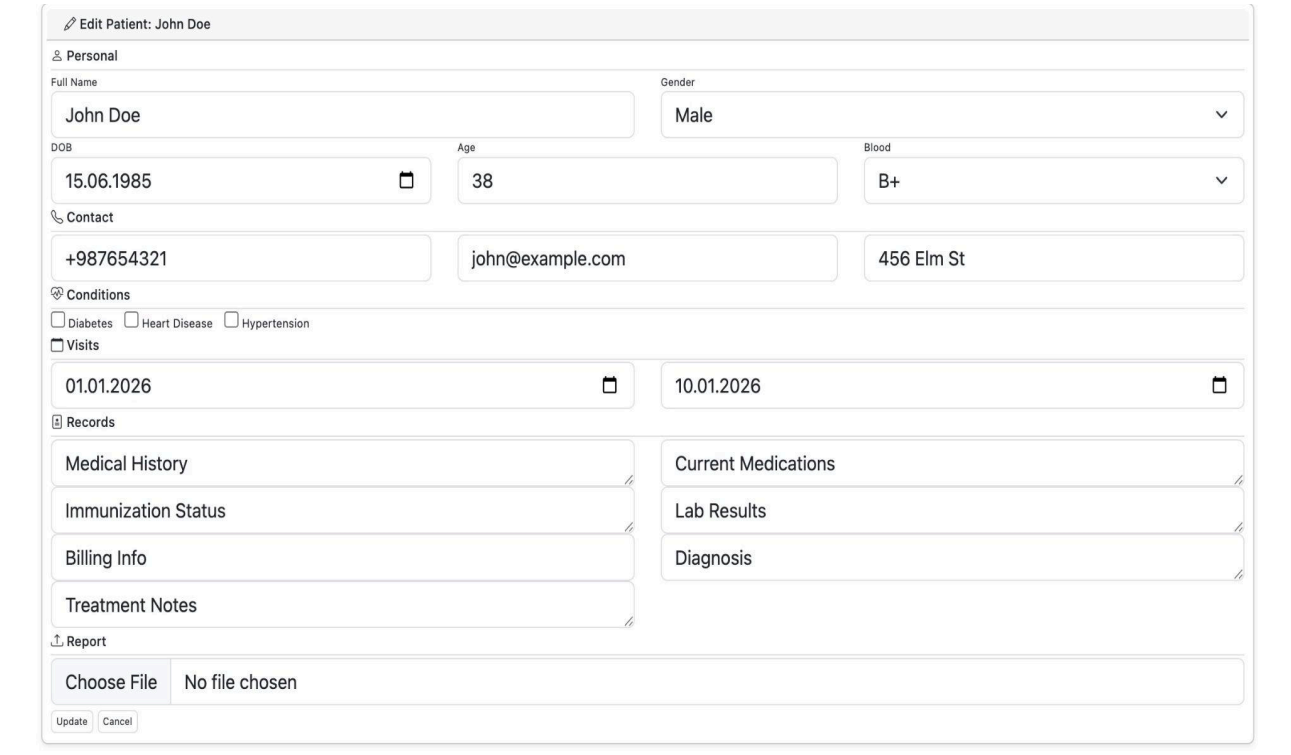


Figure 5 – Wireframe of Edit Patient Page

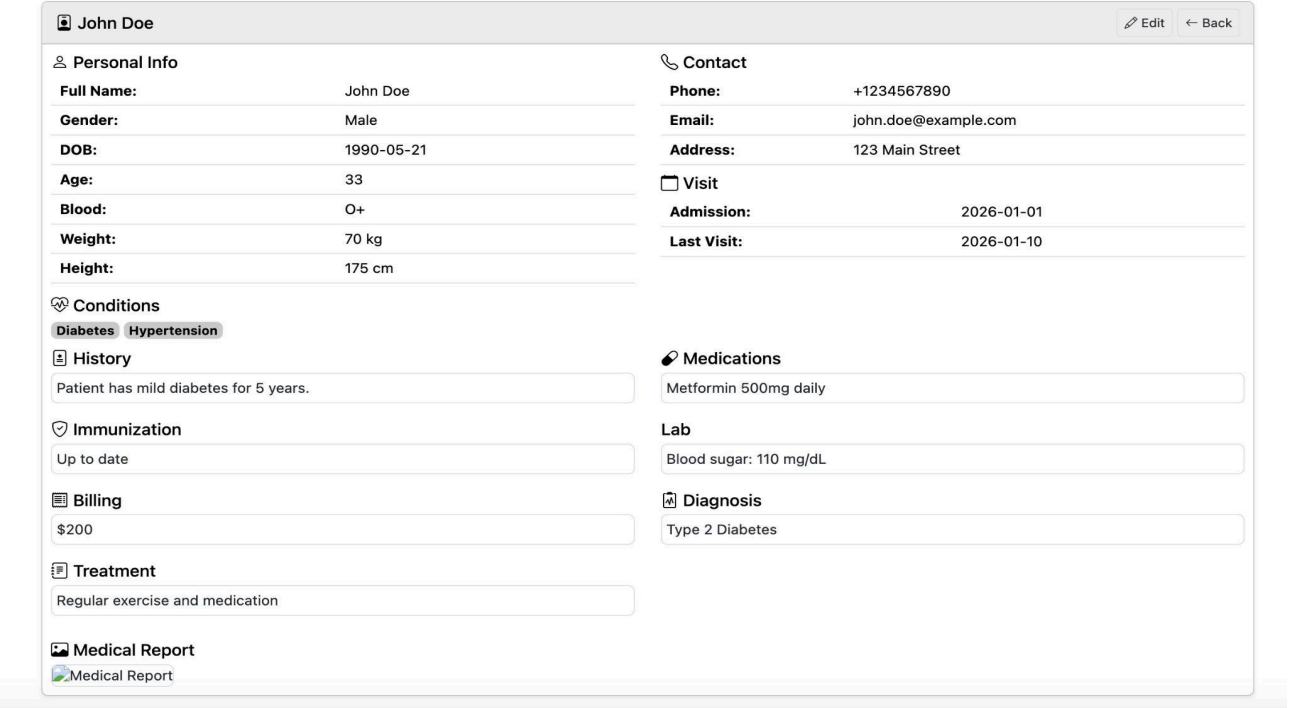
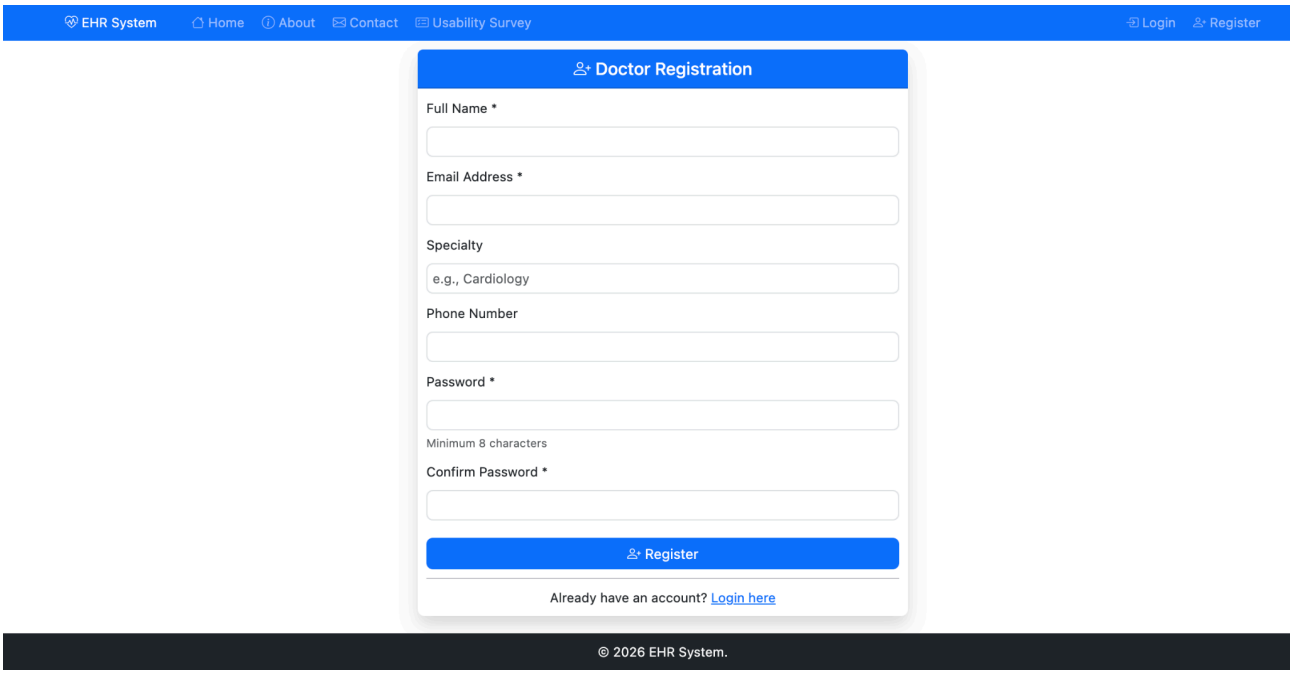


Figure 6 – Wireframe of dashboard and patient CRUD pages

3. EHR Information System – Functionality

3.1 Registration and Login

The processes of doctor registration start with the doctor registering for a new account. The doctor has to supply the following information: name, email, and password. Additional information including specialization and phone number may also be supplied. This activates the account after receiving a confirmation email. There are tight password rules followed for increased security. The login form allows a registered doctor to log into the system using his/her credentials. The forgot password facility allows a doctor to change his/her password.



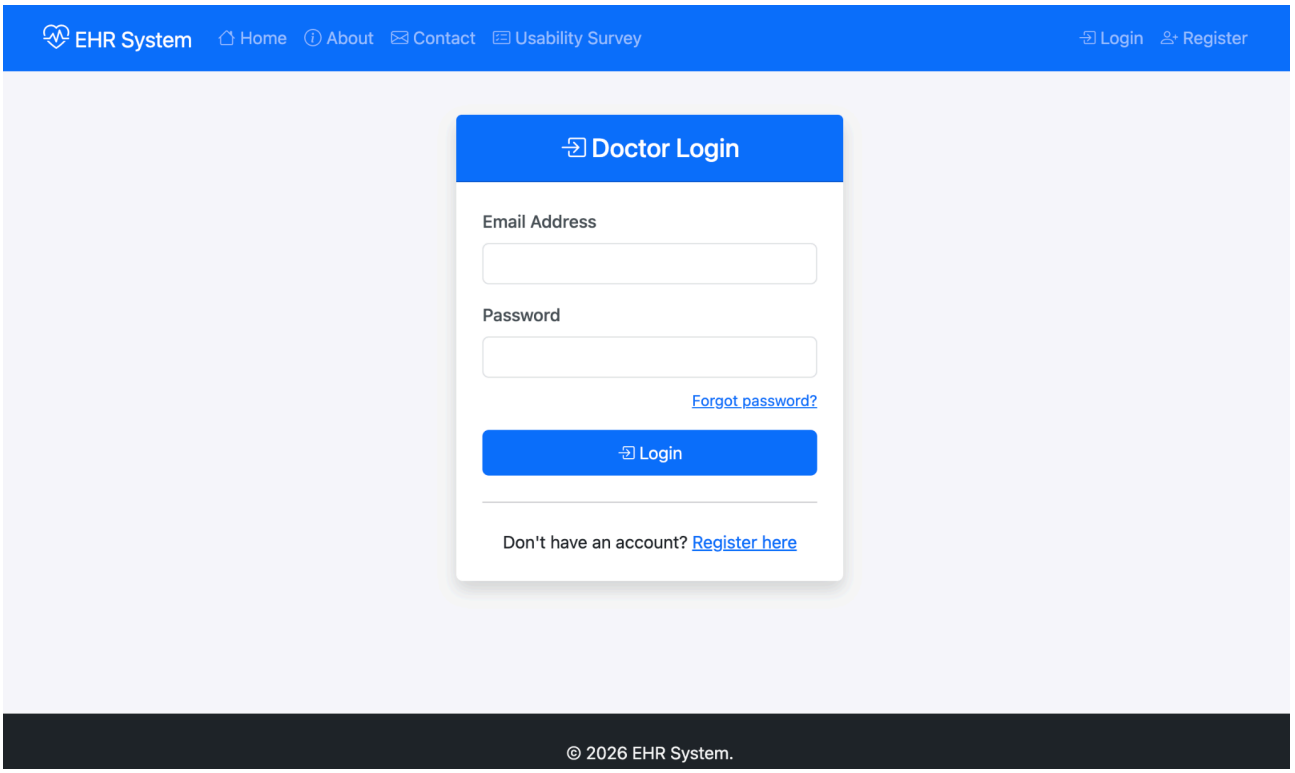


Figure 7: Screenshot of registration and login pages

3.2 Dashboard

After the login is successful, the doctors can access the dashboard, which offers them the entire summary of their patient files as well as the option to perform any CRUD operation and reference the static pages. The dashboard is created to be user-friendly and responsive.

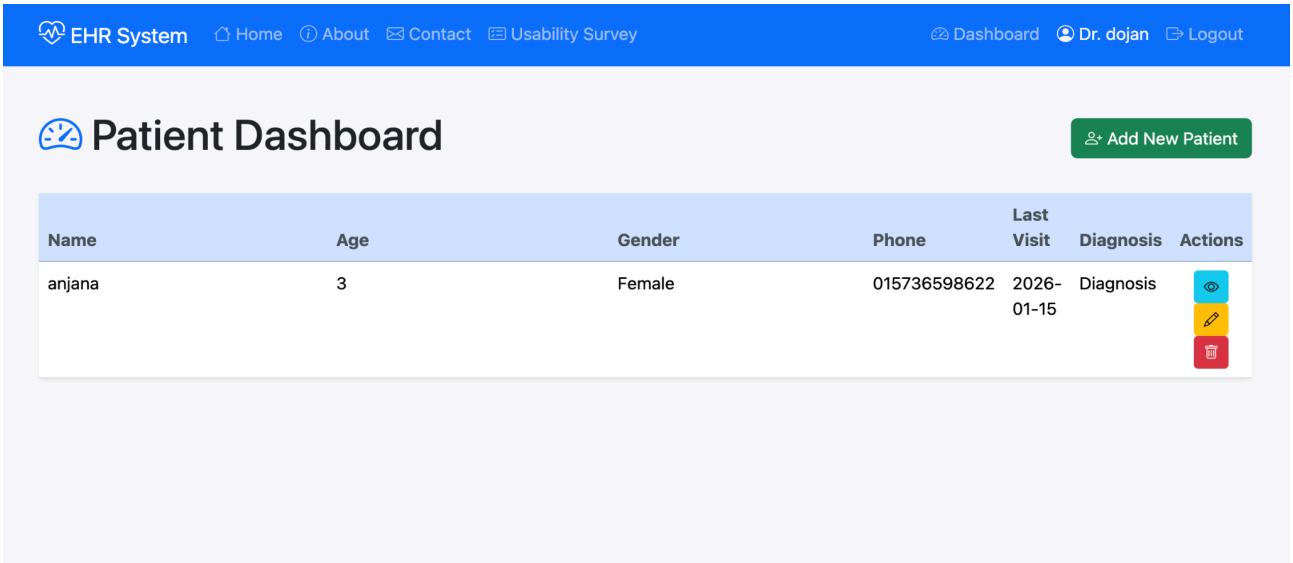


Figure 8: Screenshot of dashboard

3.3 Patient Management

Doctors have full CRUD capabilities on patient records. Creating a new patient requires filling in data like name, age, weight, height, blood type, gender, health conditions (through check-boxes), dates of birth, admission dates, and last visit dates. Updating a patient record fills in previously entered data so that changes can be made in every field. Retrieving a patient record displays every detail of the record in a read-only fashion. Removing a patient record requires a confirmation request so as not to delete patient data accidentally.

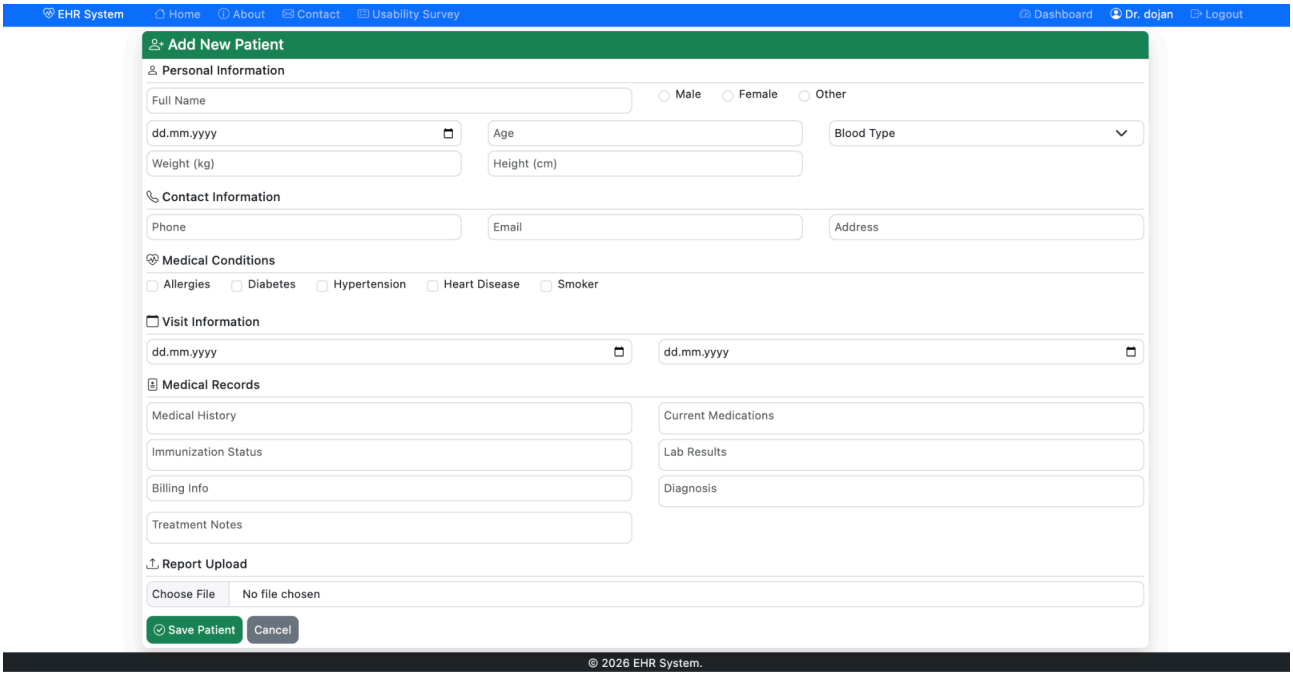


Figure 9: Screenshots of Add Page

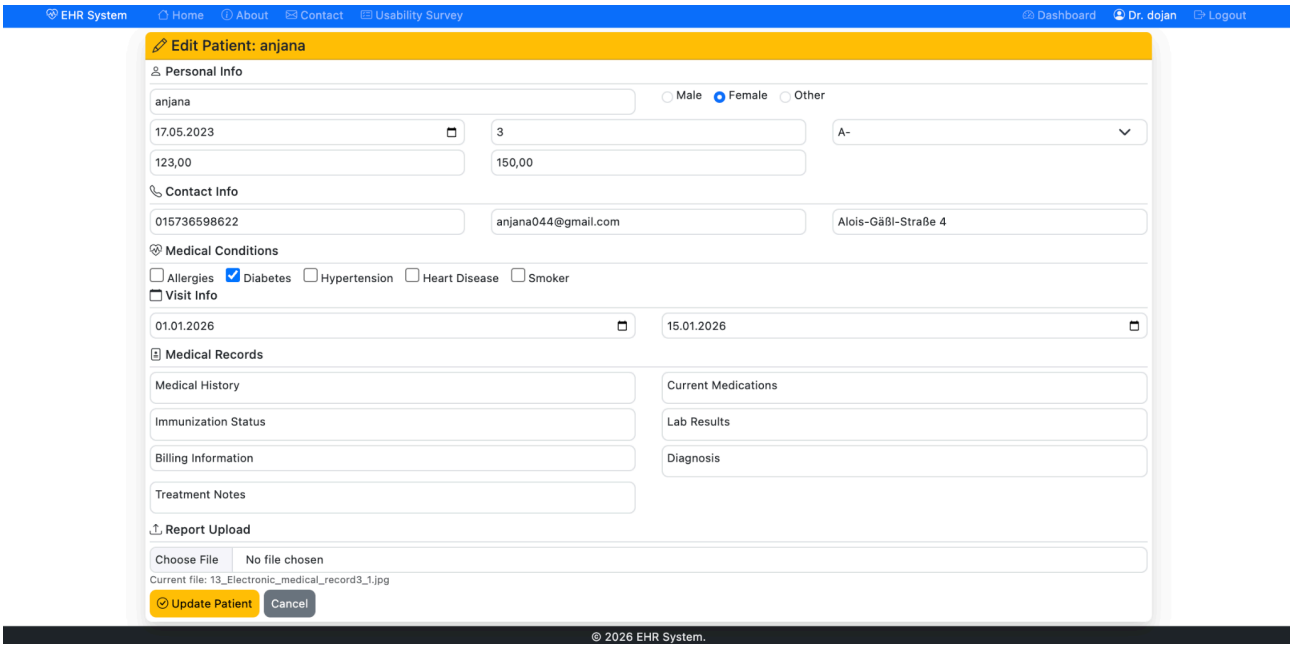


Figure 10: Screenshots of Edit Patient Page

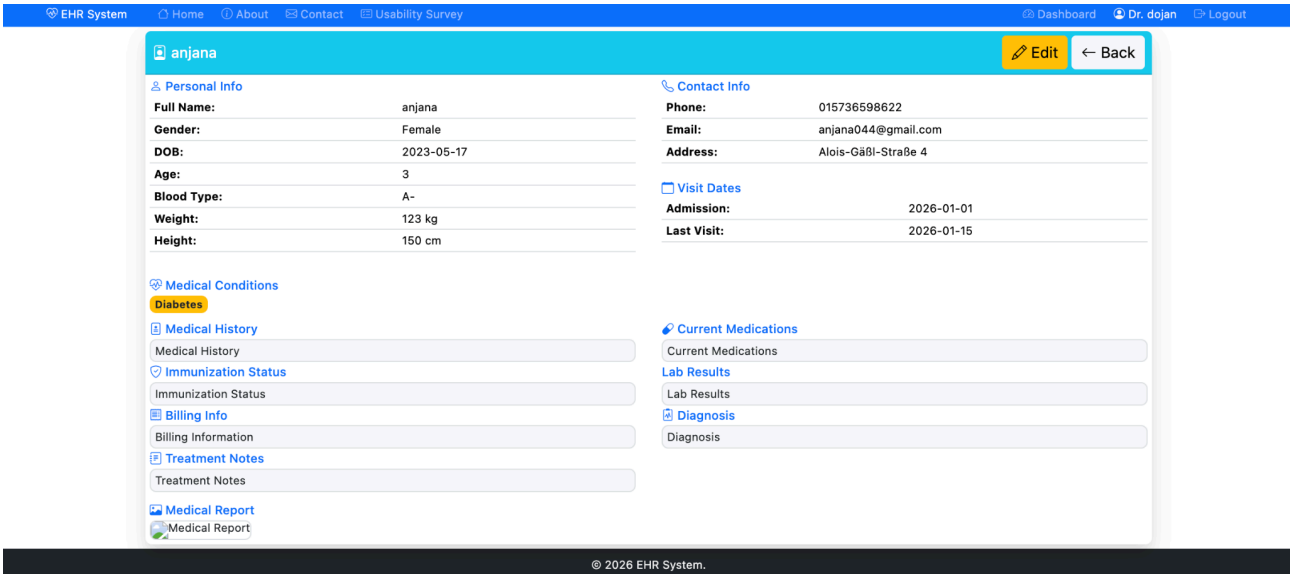


Figure 11: Screenshots of View patient pages

3.4 Image Upload and Date Selection

This system supports the upload of medical reports in formats like PNG, JPEG, GIF, and PDF, and they are saved in a secured folder with their paths recorded in the database. Date pickers are used to choose dates in the various fields, such as date of birth, admission, and last visit.

4. Evaluation

To identify the usability aspects of the EHR system, the standardized System Usability Scale was utilized. Ten standardized questions were used to provide insights into the system complexity, ease of use, and user confidence. Answers to the questionnaire are recorded on a scale of one to five, and based on which, the system usability score is calculated. This testifies to the fact that the system offers a simple and intuitive interface and easy and efficient patient record management. More in-depth testing is required to generate more insights; however, the test proves the system is user-friendly in its intended manner.

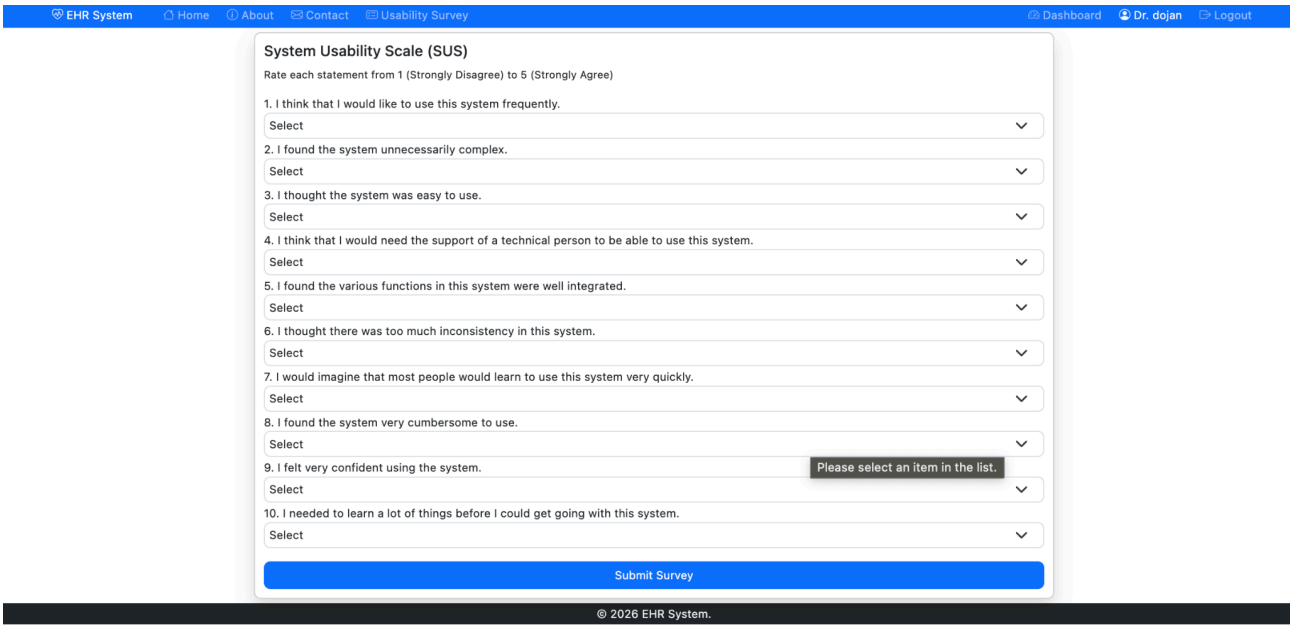


Figure 12: Screenshot of SUS questionnaire form

For understanding the usability of the EHR system, the System Usability Scale (SUS) questionnaire was used. This was carried out among all registered doctors, and they were required to answer the questionnaire. The calculated score for the SUS questionnaire was obtained for each participant, and it was discovered that the average score was 42 out of 50. Ranging from 36 to 48, the result obtained clearly states that all participants rated the EHR system to be intuitive, easy to understand, and simple to use. This test proves that the EHR system indeed offers a clean and well-organized user interface and is efficient in managing patient records, and its usability standards are met for its intended task.

5. Technical Implementation Details

The backend is developed using the Python Flask framework, incorporating the following main features: Routing, CRUD operations, Form handling, Image uploading, Sessions, and email services via Flask-Mail. SQL queries will be implemented to handle the MySQL database for

inserting, updating, selecting, and deleting patient and doctor entries. Authentication and Authorization will be implemented to enable doctors to handle and operate on only their patients' entries. The Frontend would be developed using HTML5, CSS3, and Bootstrap 5.

The database structure consists of these primary tables: doctors, patients, susponses, and contact inquiries. All these tables have been created with appropriate data types along with all necessary keys such as primary keys and foreign keys, and appropriate indexes have also been created on these tables.

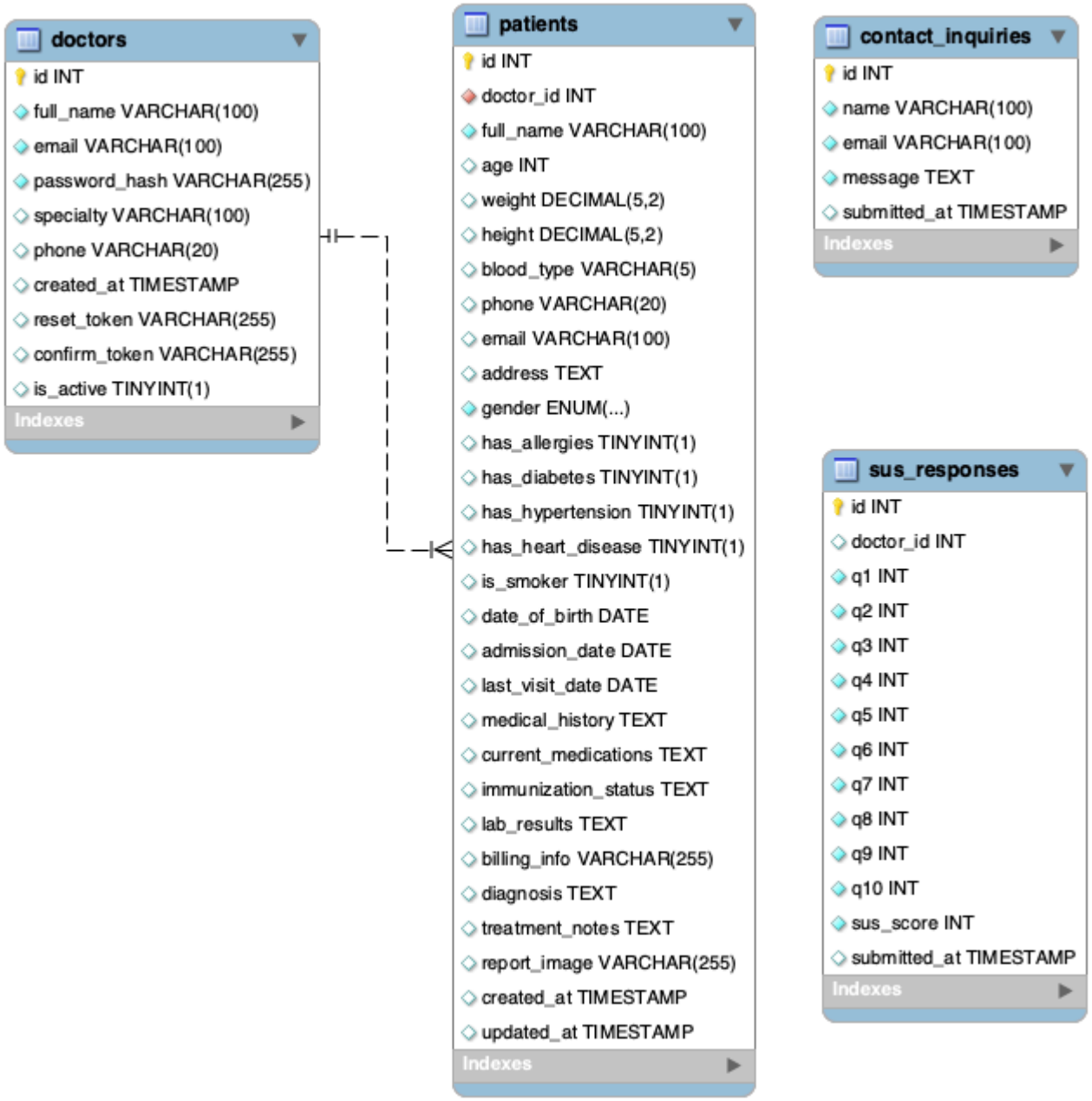


Figure 13 – Database schema diagram

6. Conclusion

The EHR solution developed offers a secure, functional, and user-friendly interface for doctors to handle the records of patients. The solution is equipped with all the necessary functionalities to handle patient data such as demographics, medical history, lab results, medications, immunization records, diagnosis, treatment information, and billing information. The solution is user-friendly and offers ease of functionality and use. Future enhancements could be made to integrate the solution with other lab information systems.

As the sole developer of the project, I am responsible for the design of the system architecture, development of the frontend and the backend components of the site, design of the database schema, implementation of the email and image upload functionality subsystems, user evaluation of the site's usability, and the writing of this report.

7. References

1. Cahill, M., Cleary, B. J., & Cullinan, S. (2025). *The influence of electronic health record design on usability and medication safety: systematic review*. BMC Health Services Research.
2. Zhang, J., & Walji, M. F. (2011). *Usability evaluation of electronic health record systems: analysis of vendor user-centered design processes*. Journal of the American Medical Informatics Association, 22(6), 1179–1186.
3. Holmgren, A. J., et al. (2024). *Electronic health records usability, satisfaction, and burnout for family physicians*. JAMA Network Open.