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Research Article

Developing an Electronic Health Records System Based on the National Identity by Using Angular Web Application Framework

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ABSTRACT

Electronic Health Records systems provide a better management system for patients and the healthcare spiciest by providing an accurate, up-to-date, and complete information about patients at the point of care. Further, enabling fast access to patient records for more coordinated, efficient care. The core objective for this study is to connect the national identity with the electronic records for patients. This aims to obtain a secure and accurate identification and authentication of patients and their information as well as will enable information exchange between different healthcare centers. This research presents the design and implementation of an electronic health records (EHR) system with national ID integration to cover the mentioned significant objectives. The system utilizes the following technologies: [4] Angular, HTML, CSS, and Bootstrap for the frontend and NestJS, Prisma, and JWT for the backend, with a Postgres database. The project follows the Agile software development methodology and includes system analysis, design, implementation, testing, and evaluation. The system features separate interfaces for administrators, doctors, and patients with appropriate table relations, endpoints, and schemas. The system was tested using Jest and test Bed for functional, performance, and security testing. The results demonstrate that the EHR system with national ID integration can improve patient record management and access. Limitations and future improvements are also discussed. Overall, this project provides a valuable contribution to the healthcare industry and offers a solid foundation for further development and refinement.

1. INTRODUCTION

Electronic Health Records (EHRs) are digital versions of patient health records that contain detailed information about the patient's medical history, diagnoses, medications, allergies, and other relevant health information. EHRs provide a secure and efficient way of managing and storing patient health records, making it easier for healthcare professionals to access and share patient data. However, there are still challenges in implementing EHR systems, such as data accuracy, data privacy, and data security [3]. One solution to address these challenges is to integrate the patient's National ID with their health records. By using the National ID as a unique identifier, the system can ensure that the patient's data is accurate and that there are no duplicate records. Additionally, the use of National ID can improve data privacy and security, as it is a standardized and secure method of identifying individuals. Furthermore, this can increase the efficiency of patient management, improve the quality of treatment, reduce administrative burdens for patients, facilitate access to health insurance, reduce fraud, and improve data quality.

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The use of EHR systems provides a digital platform for healthcare providers to manage patient health records more efficiently and accurately. Also, it can potentially improve patient identification and verification, enhance data accuracy, and streamline access to patient records. Further, this integration could lead to improved patient care, reduced administrative burdens, and cost savings. Yet, there are also potential challenges associated with integrating these two systems. These include concerns around patient privacy and data security, as well as the potential for increased administrative costs and technical challenges during implementation. To gain a deeper understanding of the implications of integrating EHR systems with national identification systems, the study will examine the potential benefits and challenges of this trend in the healthcare industry [1, 2].

2. LITERATURE REVIEW

As the integration of electronic health records (EHR) with national identification systems is a relatively new area of research, there is limited literature available on the topic. However, existing research provides valuable insights into the potential benefits and challenges associated with this integration. So, the following is a general overview of the literature on this topic. Several studies have examined the potential benefits of integrating EHR systems with national identification systems. One key benefit is the ability to link patient health records with their unique national identification number. This can help to improve the accuracy and completeness of patient health records and facilitate the exchange of health information between different healthcare providers and organizations.

2.1 Case studies

A study by Jain (2018) analyzed the integration of EHR systems with national identification systems in India and found that this integration improved patient identification and reduced errors in health record management [1]. Another study by Kim (2021) examined the integration of EHR systems with national identification systems in South Korea and found that this integration improved the quality of healthcare services and reduced healthcare costs [2]. However, there are also challenges associated with the integration of EHR systems with national identification systems. One of the main challenges is the potential for breaches in patient privacy and data security. A study by Peltier (2018) analyzed the integration of EHR systems with national identification systems in the United States and identified concerns around patient privacy and data security [3].

3. METHODOLOGY

The used research methodology is a combination of qualitative and quantitative research methods. The qualitative research method will be used to understand the requirements and needs of healthcare professionals and patients regarding the EHR system with National ID integration. The quantitative research method will be used to evaluate the performance and effectiveness of the developed system. To begin with, the qualitative research will be conducted through semi-structured interviews with healthcare professionals and patients. The interviews will focus on understanding the challenges and needs related to managing patient health records and National ID integration. The data collected from the interviews will be analyzed using content analysis to identify the common themes and patterns related to the research questions [10, 11]. The next, the quantitative research will be conducted through system testing and evaluation. The system will be tested for functional and non-functional requirements, including accuracy, performance, and security. The data collected from system testing will be analyzed using statistical analysis to evaluate the performance and effectiveness of the system. Also, the Agile methodology can be adapted to fit the needs of any team size, whether it's a large team or a single person. While Agile was originally designed with large teams in mind, it has since been adapted to be used by teams of all sizes [10, 11]..

3.1 Agile

In the Agile methodology, the system development is broken down into smaller, manageable tasks called sprints. Each sprint has a defined timeline and a set of objectives to be completed. At the end of each sprint, the team delivers a working software that can be reviewed by stakeholders, providing continuous feedback and allowing for adjustments to be made along the way. The Agile methodology also emphasizes close collaboration between the development team and stakeholders. Figure 1 below shows the process of agile model [16].

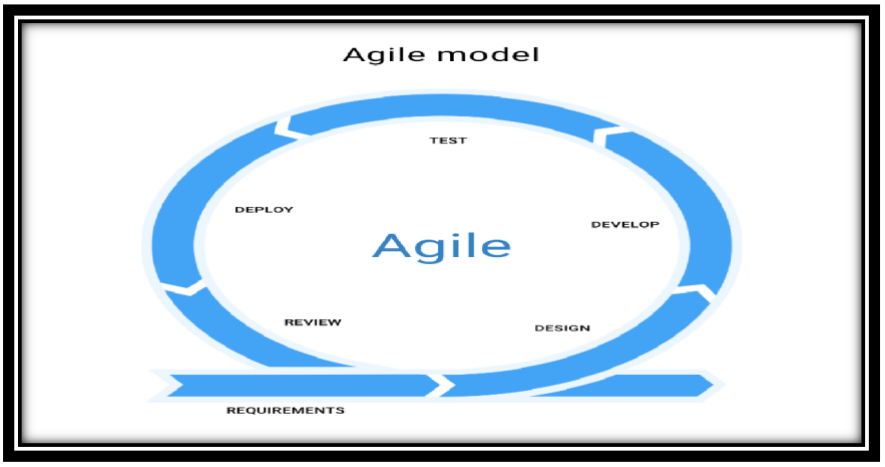

Fig. 1. Agile Model.

4. SYSTEM ANALYSIS, DESIGN & IMPLEMENTATION

4.1 System analysis

System analysis is a crucial phase in software development that involves defining the requirements and features of a system before proceeding with the design and implementation. During this phase, the software development team analyzes the business requirements, user needs, and system constraints to create a detailed plan for the system [13, 14, and 16]. System analysis consist of two main components that are: Functional Requirements and Non-Functional Requirements. The first one describes the features and capabilities that the system must have to meet the needs of its users. These requirements are typically expressed in terms of use cases, which describe the steps that a user takes to interact with the system [15]. On the other hand, the second one specifies the performance, security, and usability characteristics that the system must exhibit. These requirements include factors such as response time, reliability, scalability, and maintainability, among others [15].

4.2 System design

System design is the process of defining the architecture, components, modules, interfaces, and data for a system to satisfy specified requirements. It involves translating the requirements identified in the system analysis phase into a design that can be implemented in code [16, 17, and 18].

4.2.1 Database design

One critical aspect of system design is the database schema. The database schema is the blueprint for the database that defines how data will be stored and organized. In this study, the database schema will be designed using Postgres, which is a popular open-source relational database management system. The database schema will include tables for patient information, healthcare providers, appointments, and other relevant data [8, 16, 17, and 18].

4.2.2 Interface design

Another important aspect of system design is the user interface design. The user interface is the means by which users interact with the system. In this study, the user interface will be designed using Angular, HTML, CSS, and Bootstrap. The user interface will be designed to be intuitive and easy to use, allowing healthcare providers to access patient records and manage appointments quickly and efficiently. Figure 2 shows the interface design for doctors' dashboard [16, 19, 20, 21, 22, and 23].

Fig. 2. Interface Design Doctors Dashboard

4.3 System implementation

The EHR system with National ID integration will be developed using a modern tech stack that includes Angular, NestJS, Prisma, and Postgres. Angular will be used for the frontend, while NestJS and Prisma will be used for the backend development. The development environment for the project will be set up using Node.js and will include a number of libraries and tools that are necessary for building robust web applications. For instance, the Angular framework provides a powerful set of tools for building scalable and responsive user interfaces, while NestJS is a modern, fast, and efficient Node.js framework for building server-side applications. In addition, Prisma will be used as the ORM (Object-Relational Mapping) tool to connect to the Postgres database. Prisma simplifies database access by generating type-safe query builders and automatically validating database schemas during runtime. The entire project will be built using TypeScript, a popular open-source programming language that is a superset of JavaScript. TypeScript offers features such as static typing, object-oriented programming, and strong type inference, which make it easier to write robust and maintainable code. To ensure that the EHR system with National ID integration is secure, we will be using JWT (JSON Web Tokens) for authentication and authorization. JWT provides a way to securely transmit information between parties by encoding data as a JSON object [6, 7, 8, 15, and 18].

5. DATA DESCRIPTION

The data used in this research include different medical files contain essential demographic information, gathered by the reception of Alkafeel Super Specialty Hospital, alongside the patient's medical history and presenting medical problem. Throughout the patient's course of treatment, the files track initial and final diagnoses, clinical examination findings, and vital signs, including blood pressure, temperature, respiratory rate, and oxygen concentration. Additionally, medication details, administration instructions, and prescribed diets are meticulously recorded. For surgical patients, the files encompass operative and anesthesia notes, providing a detailed account of the procedures performed. The discharge summary encapsulates the patient's overall progress and plan for continued care. Within the files, one can find pertinent information such as room details, floor number, the attending specialist's name, resident and nurse details, and their corresponding signatures.

6. SYSTEM EVALUATION & RESULTS

6.1 System evaluation

Testing and evaluation for the implemented system are crucial aspects of any software development project, and the EHR system with National ID integration is no exception to this important test. In order to ensure that the system is working as expected and meets the requirements of the users, several types of testing will be performed [23, 24]. The testing include, first, the functional testing that will be conducted to verify that all of the system's features are working as intended. This will involve testing each of the system's endpoints and verifying that the data is being stored correctly in the database. The testing will be performed using automated testing frameworks to ensure that the system is functioning properly [25, 26, and 27]. Second, performance testing that will also be conducted to ensure that the system can handle a large number of users and requests without slowing down or crashing. This will involve testing the system's response time under different loads and optimizing the system's performance where necessary [25, 26, and 28]. Lastly, security testing that will be applied to identify any vulnerabilities in the system and ensure that sensitive patient data is protected. This test will involve testing the system's authentication and authorization mechanisms, as well as its data encryption and access control features [27].

6.2 Result

The implementation of the Electronic Health Records (EHR) system with National ID integration has been successfully completed. The system has been designed and developed using Angular, NestJS, Prisma, and Postgres. The system allows for the creation, management,

and sharing of electronic patient records securely and efficiently with National ID integration. This integration that can improve patient care and healthcare administration. The system provides a unified platform for healthcare professionals to manage patient records and provides patients with secure access to their medical information.

Fig. 3. The Implementation of Patient Dashboard.

7. CONCLUSION & FUTURE WORK

7.1 Conclusion

In conclusion, this Research aimed to design and develop an EHR system with national ID integration to enhance the management of patient health records in healthcare institutions. The project followed a software development methodology that ensured the system's functionality met the user requirements, and the implementation utilized various technologies such as Angular, NestJS, Prisma, and Postgres. The system design included a robust database schema and user-friendly interfaces for the admin, doctor, and patient roles. The testing and evaluation phase focused on ensuring the system's functionality, performance, and security met the set standards. Results from the testing phase showed that the system functioned as expected and met the set requirements. However, there were limitations, such as the lack of real-world testing due to time and resource constraints, which may affect the system's effectiveness in an actual healthcare institution setting. Nonetheless, this project contributes to the body of knowledge in the area of EHR systems, and the developed system may serve as a foundation for future research and development of similar systems.

7.2 FUTURE WORK

7.2.1 Continuous security enhancements

To maintain the utmost security of the National EHR System, ongoing efforts must be made to identify and address emerging threats. This involves conducting regular security audits and vulnerability assessments to identify potential weaknesses in the system. By staying up-to-date with the latest security protocols and technologies, the system can provide a robust defense against cyber-attacks and unauthorized access attempts.

7.2.2 Biometric authentication expansion

While the initial implementation of biometric authentication provides a strong layer of security, future work can focus on expanding the range of biometric modalities supported by the National EHR System. This could include integrating technologies such as facial recognition, voice recognition, and even retina or fingerprint scans. By offering multiple biometric options, users can choose the method that suits them best, enhancing both security and user experience.

7.2.3 Integration of blockchain technology

To ensure data integrity and immutability, the National EHR System can explore the integration of Blockchain technology. Blockchain offers a decentralized and transparent platform for storing healthcare records securely. By leveraging the power of Blockchain, the system can provide patients and healthcare providers with an immutable audit trail, preventing tampering and ensuring trust in the data stored within the system.

7.2.4 Intelligent risk assessment and anomaly detection

By harnessing the power of AI technologies, the National EHR System can develop intelligent risk assessment and anomaly detection mechanisms. AI algorithms can continuously analyze user behavior, access patterns, and system logs to identify suspicious activities or potential security breaches. This proactive approach can enable early detection and mitigation of threats, safeguarding sensitive healthcare information.

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Conflicts Of Interest

The authors affirm the absence of any conflicts of interest in relation to this research.

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