

# DEVELOPMENT OF A SECURE INFORMATION SYSTEM WITH WEB INTERFACE

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This paper researches the methods for design and programming of a secure information system of a hospital based on SQL Server database and a rich Web interface utilizing the programming frameworks Spring Boot and Vue. The designed database schema, information system structure and the protection system are presented. The developed protection system ensures data security and prevents unauthorized access and database attacks.

**Keywords:** information system; database; web interface; information protection.

# РАЗРАБОТКА БЕЗОПАСНОЙ ИНФОРМАЦИОННОЙ СИСТЕМЫ С ВЕБ-ИНТЕРФЕЙСОМ

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В статье исследованы методы проектирования безопасной информационной системы госпиталя, основанной на базе данных SQL Server и веб-интерфейсе с использованием фреймворков Spring Boot и Vue. Представлены разработанные диаграммы базы данных, структура информационной системы и средства защиты данных. Разработанная система защиты гарантирует безопасность и предотвращает несанкционированный доступ и атаки на базу данных.

**Ключевые слова:** информационная система; база данных; веб-интерфейс; защита информации.

Nowadays, hospital information management systems enhance the quality of medical services by digitally storing and processing patient information. However, existing hospital management systems have many security vulnerabilities, such as weak authentication mechanisms and insufficient encryption measures, which can potentially lead to patient information leaks. Therefore, developing a secure hospital management system with multiple protective measures is essential [1]. This system uses Java and JavaScript as backend and frontend development languages, respectively, and adopts a front-

end and back-end separation architecture. SQL Server is deployed at the bottom layer to store and manage business data, ensuring data persistence and integrity. At the same time, multiple protective measures such as encryption suites, TLS protocols, JSON Web Token (JWT), and Spring Boot Security framework are integrated to ensure the security of data transmission and storage.

This paper employs the E-R modeling method to perform information modeling for the hospital management system. First, core entities and their attributes are identified, followed by an analysis of the relationships between entities. Adhering to the database normalization theory, the table structures are standardized to eliminate data anomalies. Entities are mapped to data tables, attributes correspond to table fields, and relationships are represented through foreign key constraints between tables [2]. After consideration, 19 core table structures were determined. E-R diagram is shown in Figure 1.

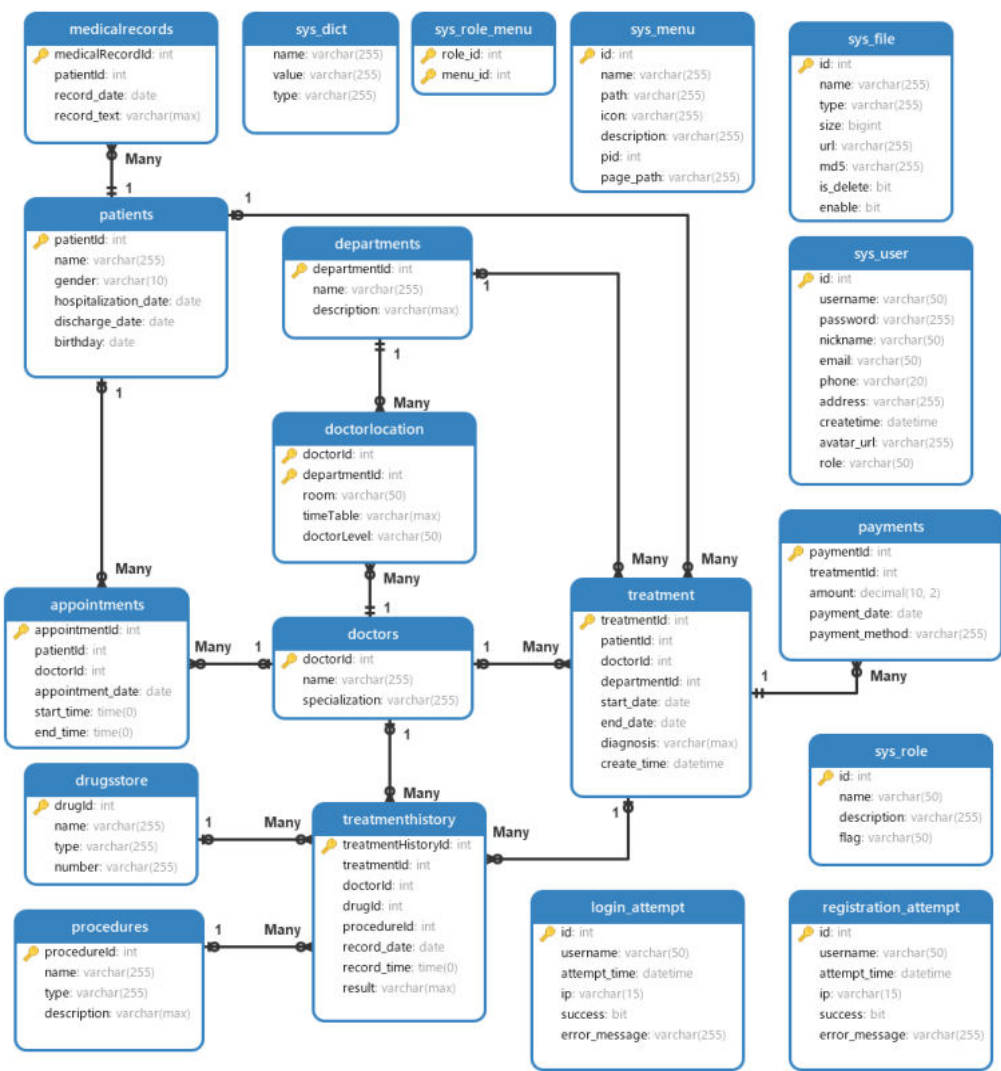


Fig. 1. E-R diagram

The developed system consists of three main layers: the front-end presentation layer, the back-end logic layer, and the data persistence layer and implements front-end and back-end communication following the RESTful architectural style. The front-end UI is built with Vue framework and managed by VueRouter for page routing. Vuex [3] ensures state consistency and reactivity, while Axios handles asynchronous HTTP requests to back-end services. Element UI is used for UI components, and the development environment is supported by webpack-dev-server on Node.js [4]. The back-end uses the Spring Boot framework with an embedded Tomcat server to provide RESTful services. MyBatis Plus handles data access operations, facilitating communication with the database. Auxiliary libraries like Lombok and Hutool simplify routine tasks, and Apache POI processes Excel documents. HTTP protocol standards govern data exchange between the front-end and back-end.

The SQL Server Database manages and stores business data, ensuring data persistence and integrity. The complete architecture of the designed system is shown in Figure 2.

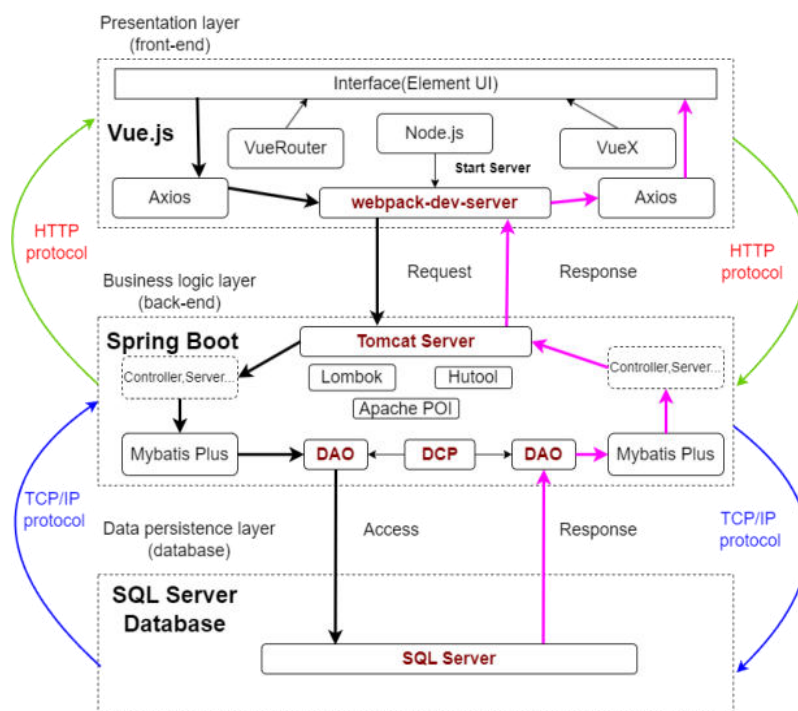


Fig. 2. System structure

To achieve comprehensive security protection for the system, more than basic Role-based access control and menu access control key measures have been taken to fortify data transmission security, request access control, and defense against web-based attacks. It is proposed to set filters at data input and encrypt important information before transmission to the back end. The back end integrates the Spring Boot Security framework [5] and leverages JWT

interceptors for access control. Important information is encrypted again using the SHA-256 algorithm before being transmitted to the database. Meanwhile, data within the database is encrypted using TDE to prevent unauthorized access and protect sensitive information [6].

Additionally, all data transmitted is encrypted through various TLS protocols, preventing unauthorized data interception during communication [7]. Overall security structure is shown in Figure 3.

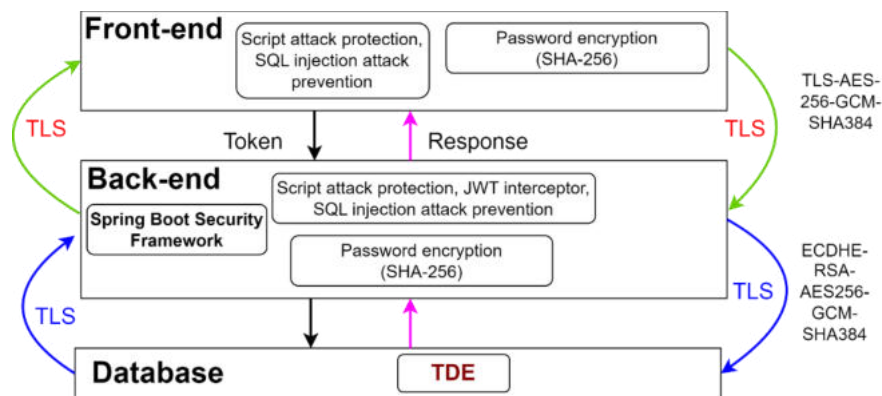


Fig. 3. Overall security structure

After a comprehensive analysis of the existing hospital business processes and management system structure, a secure hospital management system with a web interface was successfully developed, ensuring the usability, reliability, and security of the management system.

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