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Development of an E-Database System of Medical Records for Efficient Data Management and Analysis

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Abstract

This research presents the design and implementation of an e-database system of medical records. The system comprises various modules, including data entry, user login, data storage, data management, and query analysis. The data entry module enables the input of electronic medical record data, while the user login module provides secure access and identity authentication. The data storage module stores the medical records and user information, and the data management module handles data manipulation and user authorization. The query analysis module allows users to search and analyze medical records based on specified criteria. This system aims to enhance the management and analysis of electronic medical records, providing medical professionals with valuable insights for diagnosis and treatment.

Keywords: medical records, e-database system, data management, analysis, query, authentication, authorization

Introduction

In recent years, the digitization of healthcare records has revolutionized the way medical information is stored, accessed, and analyzed. Electronic medical records (EMRs) have replaced traditional paper-based systems, offering numerous advantages such as improved data accuracy, streamlined workflows, and enhanced patient care. To fully harness the potential of EMRs, it is essential to have a robust and efficient database system in place that can effectively manage and analyze the vast amount of medical data generated. This research focuses on the development of an electronic medical record database system that aims to address the challenges associated with data management and analysis in healthcare settings. The proposed system consists of several key modules, including data entry, user login, data storage, data management, and query analysis. These modules work together seamlessly to ensure the efficient handling and utilization of EMR data.[1]

The first module, the data entry module, is responsible for capturing and inputting electronic medical record data into the database. This module provides a user-friendly interface that allows healthcare

professionals to record patient information, medical histories, diagnoses, treatments, and other relevant details. By facilitating accurate and comprehensive data entry, the system ensures the integrity and completeness of the EMR database. To ensure secure access and protect patient confidentiality, the system incorporates a user login module. This module authenticates users and verifies their authority to access specific information within the database. User credentials and access rights are securely stored and managed to maintain data privacy and comply with regulatory requirements, such as HIPAA (Health Insurance Portability and Accountability Act).[2]

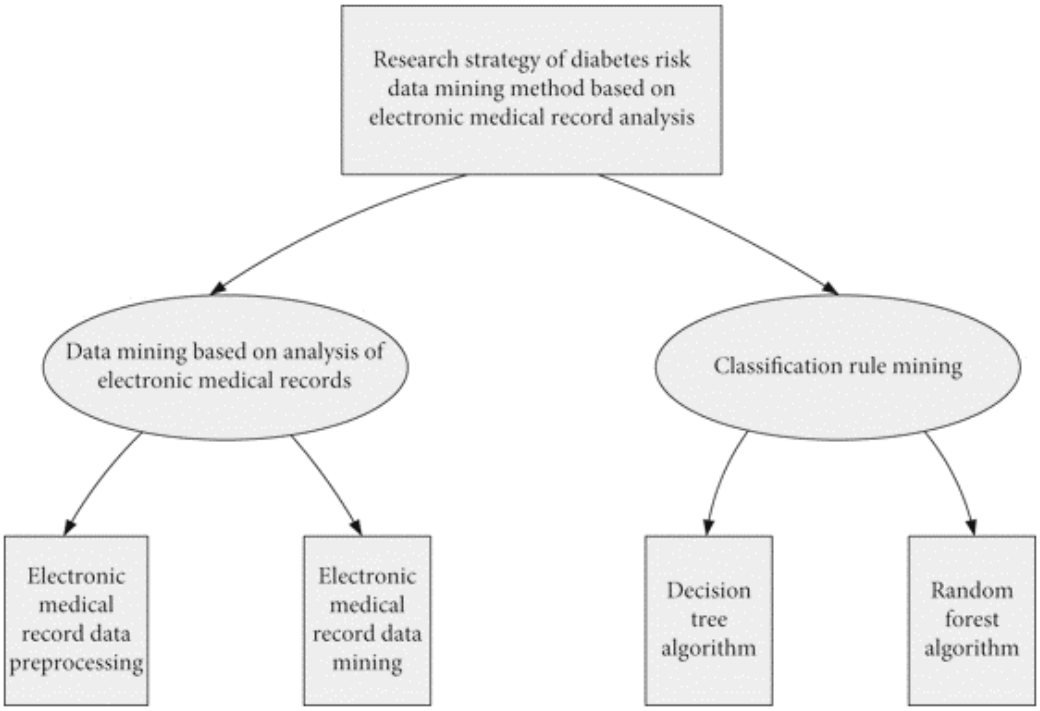

Figure 1. Technical process of this procedure

The data storage module serves as the repository for all electronic medical records and associated individual and authority information. It is designed to efficiently store and retrieve data, ensuring data integrity, security, and scalability. Robust data storage mechanisms, such as relational databases or cloud-based solutions, are employed to support the growing volume of EMR data and facilitate efficient data retrieval. The data management module plays a vital role in maintaining and administering the EMR database.[3] It allows authorized users, such as administrators and healthcare professionals, to manage individual information, user authority, and perform data manipulation tasks. Users with appropriate permissions can add, delete, and modify data within the database based on their authentication and identification results. This module ensures that data remains up-to-date, accurate, and relevant to ongoing patient care.[4]

The query analysis module is a key component that enables users to extract specific information from the EMR database based on their query criteria. This module allows healthcare professionals to search for medical records that meet certain conditions, such as specific diagnoses, treatments, or patient demographics. The query analysis module not only retrieves relevant records but also provides analytical capabilities to further analyze and interpret the retrieved data. It empowers medical professionals with valuable insights that can support clinical decision-making, research, and quality improvement initiatives.[5] The proposed electronic medical record database system addresses the limitations of traditional paper-based systems and existing EMR management approaches. It establishes a centralized and standardized repository for patient data, enabling efficient data management and facilitating seamless information exchange among healthcare providers. The system not only improves data accessibility but also enhances the accuracy and completeness of medical records, promoting patient safety and continuity of care. This research aims to develop an electronic medical record database system that offers efficient data management and analysis capabilities. By leveraging advanced technologies and modules such as data entry, user login, data storage, data management, and query analysis, the proposed system seeks to enhance healthcare data management, promote data-driven decision-making, and ultimately improve patient outcomes.[6]

Related Work

Medical history information plays a crucial role in various aspects of healthcare, including medical treatment, teaching, and scientific research. However, traditional medical history information is primarily stored in paper-based formats. This reliance on physical records poses significant challenges in terms of writing, collection, organization, storage, and retrieval of medical history information. As hospitals expand in size and patient volume increases, the management of paper-based medical records becomes increasingly complex, leading to several notable issues. One of the main drawbacks of paper-based medical records is the potential for illegible handwriting by healthcare professionals, making it difficult for others to decipher the information accurately. Additionally, the manual nature of record-keeping can result in delays and partial information, leading to gaps or missing details in the medical history. Moreover, the lack of standardized record formats among different healthcare providers further complicates the efficient management and exchange of information.[7] The extended collection cycle of paper records also increases the risk of loss or misplacement. The inherent limitations of paper-based medical records have led to a shift towards electronic health records (EHRs). Electronic health records aim to overcome the challenges associated with paper records by digitizing and storing medical history information electronically. This transition offers numerous benefits, including improved legibility, timely documentation, standardized record formats, streamlined data collection, reduced storage requirements, and enhanced data analysis capabilities.[2]

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By adopting electronic health records, healthcare institutions can eliminate the issues associated with paper-based systems. The electronic format ensures that the medical history information is legible, eliminating the potential for misinterpretation due to handwriting. Timely recording of patient data becomes possible, as healthcare professionals can enter information directly into the electronic system. Standardized templates and data fields enable consistent and comprehensive documentation, ensuring that no critical information is overlooked.

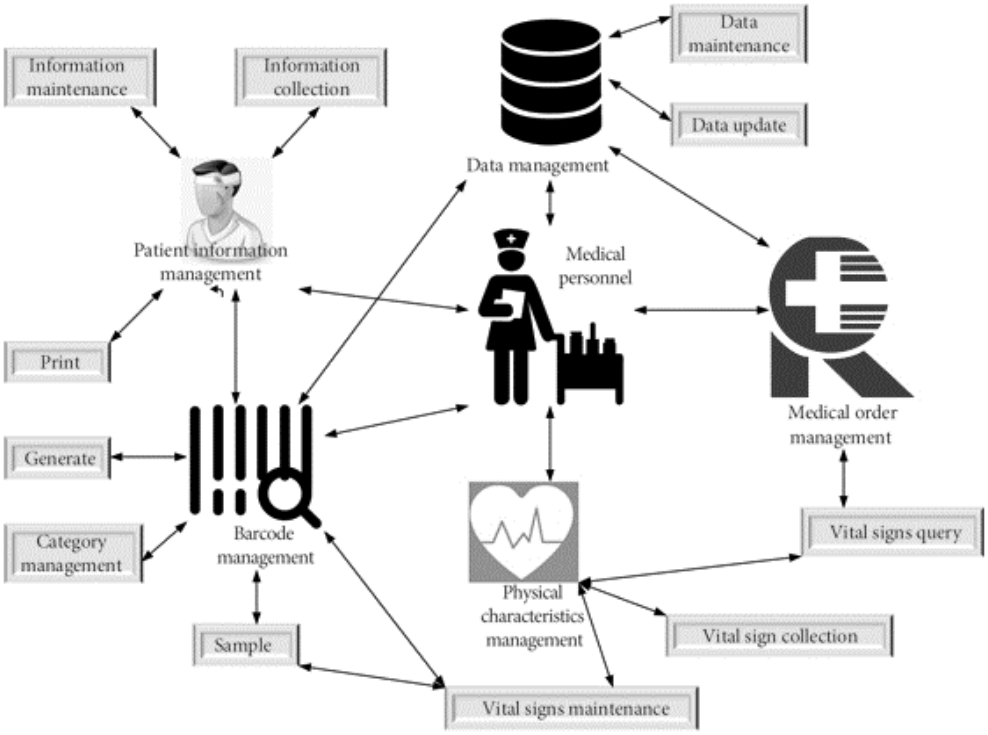

Figure 2. The Entity-Relationship (E-R) model of the data excavation framework created through this study.

The **Entity-Relationship (E-R)** diagram serves as a means for database designers to depict and impose data constraints based on the user's viewpoint. E-R modelling entails encapsulating a data model through the analysis of entities and their interconnections. This typically necessitates a thorough requirement analysis to identify entity types, establish relationships between entities, define attribute sets, and ultimately construct the E-R model. Due to the presence of multiple attributes for each entity, only the primary relevant attributes are enumerated within each entity. The E-R model of the data excavation framework developed within this research is illustrated in **Figure 2**.

The conversion of paper-based medical records into electronic health records also simplifies data management processes. Electronic records can be stored in a centralized database, allowing for efficient organization, retrieval, and analysis of patient information. This streamlined approach reduces the administrative burden, eliminates the need for extensive physical storage, and facilitates data sharing among authorized healthcare providers.[8]

Moreover, electronic health records enable advanced data analysis techniques, such as data mining and decision support systems. These capabilities allow healthcare professionals to identify patterns, trends, and correlations within the medical history data, supporting evidence-based decision-making, research endeavors, and quality improvement initiatives.[6] The transition from paper-based medical records to electronic health records offers significant advantages in terms of efficiency, accuracy, standardization, and data analysis. By embracing electronic health records, healthcare institutions can overcome the limitations of paper-based systems, streamline data management processes, and unlock the full potential of medical history information for improved patient care, education, and research.[9]

Research Objective

The objective of this research is to develop an electronic medical record database system that offers efficient data management and analysis capabilities. The specific goals include:

1. Designing and implementing a data entry module to facilitate the input of electronic medical record data.
2. Developing a user login module that ensures secure access, identity authentication, and authority identification within the database system.
3. Creating a data storage module to store electronic medical records, individual information, and user authority details securely.
4. Designing a data management module to manage user information, user authority, and perform data manipulation operations based on user input and authentication results.
5. Implementing a query analysis module to enable users to search, analyze, and obtain relevant medical record data based on specific query criteria.
6. Standardizing data management practices and providing an efficient approach for medical professionals to analyze and diagnose patients based on electronic medical records.

E-Medical Record DB System for Efficient Data Management and Analysis

The electronic health record (EHR) database system is designed to simplify and improve the management of medical records. It consists of the following components:

1. Data typing module: This module is responsible for typing and entering electronic health record data into the system. It allows healthcare professionals to input various types of medical information, such as outpatient department data (related to patients receiving treatment without being admitted to the hospital) and/or ward data (related to patients admitted to the hospital). The module ensures that the data is accurately organized and categorized within the system.

2. User log-in block: The user log-in block serves as the gateway for accessing the EHR database system. It requires users to log in with their credentials, such as username and password. The block verifies the identity of the user and performs authentication to ensure that only authorized individuals can access the system. Additionally, it assigns and manages different levels of authority or permissions to users, allowing them access to specific features or data based on their roles and responsibilities.
3. Data memory module: The data memory module is responsible for storing and managing the electronic health record data entered through the data typing module. It securely stores the medical records, including outpatient department data, ward data, and any other relevant information. Additionally, it stores the personal information of the users who access the EHR system, ensuring the privacy and security of sensitive data. The module also maintains authority information, such as the roles and permissions assigned to each user.
4. Data management module: The data management module handles the administration and management of the electronic health record data and user information stored in the system. It allows authorized users, such as healthcare administrators or designated personnel, to set up and manage individual user profiles and their associated permissions. This module enables users to perform various operations on the data, such as adding new records, deleting obsolete information, and making revisions or updates to existing data. These actions are carried out based on the user's assigned authority level, which is determined by the authentication and recognition results from the user log-in block.
5. Query analysis module: The query analysis module enables users to search and retrieve specific electronic health record data based on their input criteria. Users can enter search parameters such as patient demographics, medical conditions, dates, or other relevant details to retrieve relevant records. The module then processes the search request, retrieves the matching records from the data memory module, and presents the query results to the user. Additionally, this module can perform statistical analysis and generate reports based on the queried data, providing valuable insights and summarized medical record information for decision-making and analysis purposes.

Overall, the EHR database system streamlines the management and access of electronic health records. It allows for efficient data entry, secure user authentication and authorization, secure data storage, flexible data management, and effective search and analysis capabilities. The system enhances the organization, standardization, and accessibility of patient medical records, empowering healthcare professionals with valuable tools for analysis and diagnosis.

Conclusion

In conclusion, this research introduces an electronic medical record database system that facilitates efficient data management and analysis. The system enables the entry, storage, management, and analysis of electronic medical records, as well as provides secure access and authentication for users. By standardizing data management practices, the system enhances the organization and retrieval of patient information, thereby offering valuable insights for medical care personnel. The developed database system provides a comprehensive approach to managing electronic medical records, improving healthcare services, and aiding medical professionals in diagnosis and treatment decisions.

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