A Patient Follow-up Data Management Platform Based on Microservices Architecture

Jingtao Sha, Junhao Gao, Pengtao Jia and Wenqian Dong

Abstract—**With the development of society and the improvement of people's living standards, the demand for medical services has been increasing. However, traditional medical management systems exhibit numerous deficiencies, particularly in handling electronic medical records and developing personalized treatment plans for patients. To address these issues, we have constructed a patient follow-up data management platform designed to resolve the various problems inherent in traditional medical information management systems. This platform leverages modern technology and medical service concepts and employs a five-layer architecture consisting of the presentation layer, application layer, Spring Cloud Gateway layer, backend service layer, and data storage layer. It offers comprehensive data management and personalized treatment plan formulation functionalities. Through this platform, doctors can conveniently access complete medical records of patients, thereby supporting the creation of individualized treatment plans, effectively enhancing communication between doctors and patients, and improving the quality and efficiency of medical services.**

***Index Terms*—Data Management Platform,Medical Services,Microservices Architecture,Online Healthcare.**

I. INTRODUCTION

As society progresses and living standards improve, people are becoming increasingly health-conscious, leading to a growing demand for medical services[1]. However, the existing healthcare system faces numerous issues and challenges. Focusing on colorectal diseases, a common ailment, we recognize the limitations of traditional medical management systems, particularly in managing patients throughout the entire care cycle, formulating personalized treatment plans, and analyzing electronic medical records[2].

On one hand, the medical industry generally exhibits a "focus on clinical practice, neglect of data" phenomenon. Medical data is characterized by large volumes but poor quality, a lack of unified standards, and data silos between medical institutions, all of which limit the development of health and medical big data[3]. On the other hand, the application and development of health and medical big data also face challenges such as data security, the quality of the talent pool, and standards for data sharing[4].

Therefore, leveraging the capabilities of an internet platform, we have developed a data management system specifically for colorectal diseases, aiming to address the numerous issues present in traditional medical information management systems[5]. This platform enables comprehensive storage and management of patient treatment data, including but not limited to clinical records, diagnostic results, electronic medical records, and treatment plans. It provides a reliable foundation for subsequent data analysis and processing, while also offering robust data support for future medical diagnoses[6].

Through this platform, doctors can more easily access a patient's complete medical history, understanding their treatment history and recovery status. This facilitates the creation of personalized treatment plans, enhancing the convenience and efficiency of medical services[7]. By integrating modern scientific technologies and medical service concepts, we are committed to promoting effective communication between doctors and patients, improving the quality and efficiency of medical services, and safeguarding patients' health and quality of life[8].

II. SYSTEM FRAMEWORK

The data management platform is designed to serve administrators and comprises two main components: the web frontend and the backend server. It enables functionalities such as user management, data administration, and operational monitoring. The platform is primarily developed using the Spring Cloud framework. Spring Cloud incorporates the principles of Inversion of Control (IOC) and Aspect-Oriented Programming (AOP), allowing developers to focus more on business logic. It integrates independent services based on Spring Boot and manages them through Spring Cloud Gateway. Additionally, Spring Cloud integrates various commonly used components like Ribbon and OpenFeign, facilitating the implementation of predefined functionalities. The frontend is predominantly developed using the Vue.js framework, known for its excellent scalability. The overall system architecture is depicted in Figure 1.

(1) Presentation layer

The presentation layer serves as the interface for user-system interaction, responsible for displaying medical data, diagnostic results, patient recovery status, and other

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pertinent information to aid physicians in better analyzing the patient's condition. In the data management platform for medical follow-up, the presentation layer provides intuitive and user-friendly visual interfaces to administrators and chief physicians through the web frontend. This enables doctors to easily access patient information, diagnostic results, and related treatment plans, significantly facilitating subsequent medical data analysis.

(2) Application layer

The application layer serves as the core of the system, encompassing the design and implementation of business logic and processes. It includes data management for different roles, clinical data management, and learning task data management, while also being responsible for monitoring operational data. The data management functionalities at the application layer not only assist physicians in better managing and utilizing data resources but also provide crucial support and foundation for subsequent data analysis and medical decision-making.

(3) Spring Cloud Gateway

The Spring Cloud Gateway layer serves as the API gateway for the entire system, responsible for unified request management and distribution. It ensures the security and reliability of requests through route configuration (routing requests to corresponding backend service modules) and filter configuration (implementing request filtering and processing, including authentication and request forwarding).

(4) Backend service layer

The backend service layer serves as the server-side implementation of the system, developed using the Spring Boot framework. In the data management platform, the backend service layer includes modules for user login, role data management, medical data management, learning task data management, appointment data management, popular science education data management, article and video follow-up data management, operational data monitoring, and other data management functions. The backend service layer plays a critical role in the data management platform, serving as the core component responsible for implementing various system functions and ensuring stable system operation.

(5) Data storage layer

The data storage layer is responsible for the persistent storage and management of data, using the relational database MySQL as the data storage service. In the data management platform, the data storage layer primarily stores user basic information, patient medical records, diagnosis results, and other data to ensure data integrity and security. Additionally, the data storage layer supports operations such as data querying, updating, and deletion, facilitating the analysis and processing of medical data in later stages.

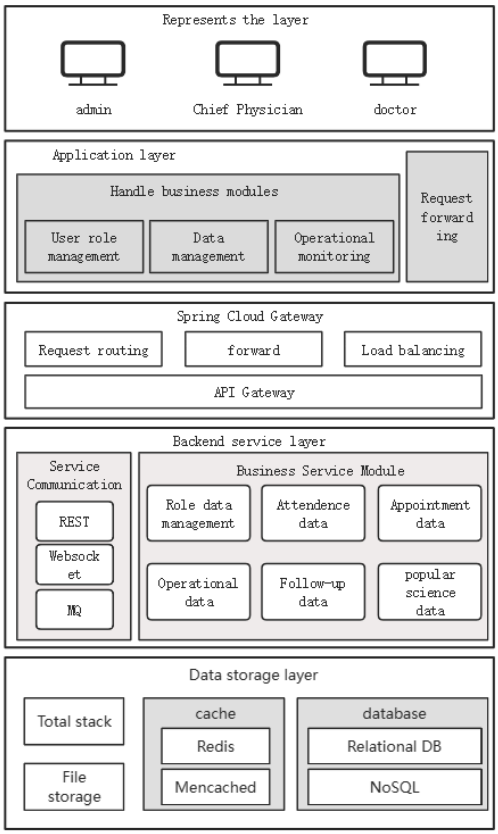

Figure 1 Overall Architecture Design of the Platform

III. SOFTWARE STRUCTURE

The medical follow-up data management platform provides services to administrators and is mainly divided into nine service modules: user login module, user role data management module, medical visit data management module, learning task data management module, appointment data management module, popular science education data management module, follow-up data management module, operational data monitoring management module, and other data management module. The system functional structure diagram is shown in Figure 2.

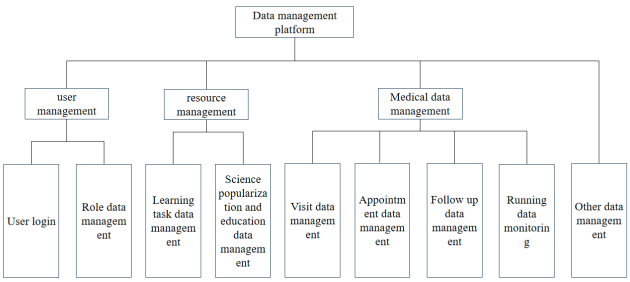

Figure 2 System Functional Structure Diagram

(1) User Login Module: The primary function of the user login module is to differentiate between various login users and assign permissions based on different user roles to achieve risk control. Users can log in through the WeChat Mini Program and complete their personal information to obtain a login account for the management backend. By default, regular users do not have permissions to view or modify data.

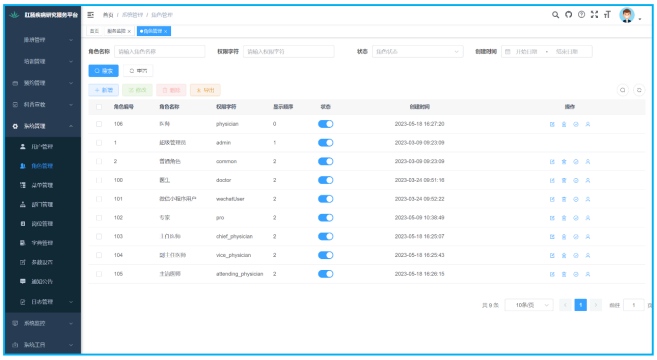

Figure 3 User Role Management Interface

(2) User Role Data Management Module: The role data management primarily involves managing the roles of different logged-in users. Currently, there are predefined roles such as administrator, department administrator, chief physician, and physician, each with distinct permission levels. Administrators can manage each user account's information in the database through the user management feature and assign or revoke roles via the role management feature. The operation permissions in the management backend are directly related to the user's role. When an administrator successfully logs in and accesses the role data management, the interface shown in Figure 3 will be displayed. Administrator users can manage user roles through the user role management interface. This paper does not detail other data platform interfaces; Figure 3's sidebar displays each module.

(3) Learning Task Data Management Module: This module primarily manages training task lists for medical professionals. Training tasks include learning articles and videos, which can be managed by administrators or authorized medical professionals. Additionally, authorized medical professionals can add new training tasks, which are then synchronized directly into the learning task lists of doctors within their respective departments. The module features functions such as adding, deleting, and modifying learning tasks.

(4) Health Education Data Management Module: The health education module encompasses informative articles and educational videos. It primarily manages the dissemination of educational articles, video lists, and content. Functions include adding, deleting, and modifying content. To ensure system security and effective management, this module incorporates permission control. Only users with specific permissions can publish, edit, and delete health education articles and videos, thereby ensuring the legality and accuracy of the content.

(5) Medical Consultation Data Management Module: This module primarily handles the unified management of all consultation data on the platform. Each consultation record includes information such as the sender, recipient, sending time, and message content. The module features functionalities such as deleting chat messages, adding system messages, searching message records, and searching sender information.

(6) Appointment Data Management Module: This module primarily manages appointment data, doctor scheduling lists, and follow-up data. Administrators or authorized physician users can quickly import scheduling plans through the doctor scheduling feature. They can also manage existing appointment data using the appointment data management feature and manage existing follow-up data using the follow-up data management feature.

(7) Follow-up Data Management Module: This module primarily handles the unified management of comments on educational materials and learning videos. It includes functionalities such as deleting comments, adding comment messages, searching comment records, and searching for commenters. Each follow-up data entry includes information such as the commenter, comment time, and comment content.

(8) Operational Data Monitoring and Management Module: This module primarily monitors the current operational status of the platform. Through this functionality, users can monitor current registration data, service data, and cache data. It also allows for setting scheduled system tasks and execution counts. Administrators can use this feature to view the registered user list, system scheduled tasks, service consumption by staff, and service cache usage in real time.

(9) Other Data Management Module: The other data management module mainly includes menu management, department management, position management, and keyword management. Administrator users can manage the menu list of the management backend through the menu management function, manage existing department departments through the department management function, and manage existing doctor positions through the position management function. These management functions are used to achieve the specialization of medical service characteristics in the management backend.

IV. SUMMARY

The medical follow-up data management platform overcomes the limitations of traditional medical systems and offers several advantages compared to traditional HIS systems. First, the platform comprehensively stores and manages patients' diagnosis and treatment data, providing a reliable data foundation for subsequent data queries, analysis, and processing. Analysis of recovery patient treatment plans can assist doctors in formulating more personalized and effective treatment plans. Second, the platform enhances medical system services through the storage of important information such as electronic medical records. Doctors can conveniently access comprehensive patient medical records via the platform, including diagnosis and treatment history, thereby improving the efficiency and quality of medical services. This convenience not only enhances the efficiency of doctor-patient communication but also provides more reliable data support for diagnosis and treatment, thereby enhancing the level of medical services and user satisfaction. Additionally, the platform adopts the Spring Cloud framework to achieve efficient data

management and processing. Through the collaborative efforts of various system layers, the platform's stability and reliability are ensured. These advantages make the data management platform a crucial support for medical services, enhancing communication efficiency between doctors and patients, promoting the improvement of medical service quality, and advancing the development of health medical big data.

V. FUNDING

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