Internet Plus-based Anorectal Medical Patient Follow-up Platform

Chaoyang Li, Junhao Gao, Kegang Cui, Pengtao Jia

Abstract—**With changes in dietary structures and lifestyle habits, the prevalence of anorectal diseases has been on the rise. Limited medical resources contribute to difficulties in patient access to healthcare and hinder effective doctor-patient communication. In response, we leveraged an internet platform to establish an anorectal disease medical follow-up platform, seamlessly integrating the internet with traditional Chinese medicine theories. This platform offers comprehensive management throughout the entire cycle of anorectal disease for patients, addressing issues such as insufficient patient knowledge, communication barriers between doctors and patients, and challenges in scheduling follow-up appointments. The platform encompasses WeChat Mini Program, official account, and data management backend, enabling functionalities such as patient services, doctor-patient interaction, popular science education, and healthcare training. Through the research conducted on this platform, we have strengthened communication between doctors and patients, facilitating the early recovery of patients.**

Index Terms—**About Anorectal diseases, Internet Plus healthcare, Microservices architecture, Remote consultation, Medical services.**

I. INTRODUCTION

With the continuous improvement of the people's living standards, corresponding changes have occurred in dietary structure and lifestyle habits. People's diets are characterized by refined grains, high protein, and high-fat content, coupled with a lack of physical activity and frequent late-night activities. These changes have significantly contributed to the increased incidence of anorectal diseases. A study was conducted on 3250 healthy individuals from March 2020 to January 2022, revealing a 67% incidence rate of anorectal diseases. Among them, hemorrhoids accounted for 70.2% of all cases, followed by conditions such as anal papillary hypertrophy and rectal polyps[1].Due to its high incidence and low cure rate, anorectal diseases seriously affect people's quality of life[2].

Xi'an Traditional Chinese Medicine Hospital's Department of Anorectal Diseases has been providing long-term services to patients. During the course of our service, we have identified the following issues:

（1）We have accumulated a substantial amount of clinical diagnosis and treatment data but lack further exploration and analysis of the data.

（2）Patients experiencing sudden anorectal diseases not only require hospital treatment but also necessitate crucial post-discharge care and maintenance. However, patients often lack knowledge about care and healthcare practices,and frequent hospital visits pose various inconveniences[3]. Existing hospital management information systems also do not support remote consultations and rehabilitation follow-ups.

（3）The training tasks for medical staff in the Anorectal Hospital are challenging to effectively supervise and implement.

Therefore, it is an urgent issue to explore the organic integration of modern scientific technology with the inheritance and development of traditional Chinese medicine theories. Summarizing classical Chinese medicine, inheriting and promoting the academic thoughts of renowned Chinese medicine practitioners, strengthening doctor-patient communication, leveraging the distinctive advantages of traditional Chinese medicine in treating anorectal diseases, and promoting the early recovery of patients are crucial aspects that need to be addressed.

The practice of internet healthcare in China has a history of around 20 years, evolving from early stages of singular online health information dissemination and virtual consultations to the 'Internet Plus Healthcare' model. Numerous Healthcare Information Management Systems (HIS) have been developed and widely adopted. However, on one hand, traditional HIS systems primarily focus on the process of patients seeking medical care in clinics, often falling short in fully integrating health education resources. This limitation results in patients having a restricted understanding of physical well-being and disease prevention[4].Moreover, the large number of on-site patients has led to prolonged registration and waiting times, affecting the efficiency and quality of healthcare services[5].On the other hand, traditional HIS systems have also fallen short in effectively tracking patients' recovery progress and medication outcomes. This makes it challenging for doctors to access detailed post-discharge medical records and treatment histories, preventing a comprehensive understanding of the patients' recovery status.This has impacted the formulation of personalized treatment plans for patients by doctors and has increased the likelihood of patients seeking medical attention again. Physicians also face challenges such as high diagnostic pressure and cumbersome electronic medical record documentation, adding to their workload.Doctors are required to invest a significant amount of time in entering and retrieving information in the system, rather than focusing on clinical diagnosis and treatment planning for patients.

Therefore, leveraging an internet platform and taking

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anorectal diseases as an example, we have established a medical follow-up platform to provide comprehensive management throughout the entire cycle of anorectal diseases. This initiative addresses various issues present in traditional HIS systems.

II. OVERALL SYSTEM FRAMEWORK

The anorectal disease medical follow-up platform comprises three main components: WeChat Mini Program, official account, and data management backend. It facilitates functions such as patient services, doctor-patient interaction, popular science education, and healthcare training. The platform adopts a three-tier B/S architecture design, including the presentation layer, application layer, and data layer, as illustrated in Fig.1 in the overall system architecture diagram.
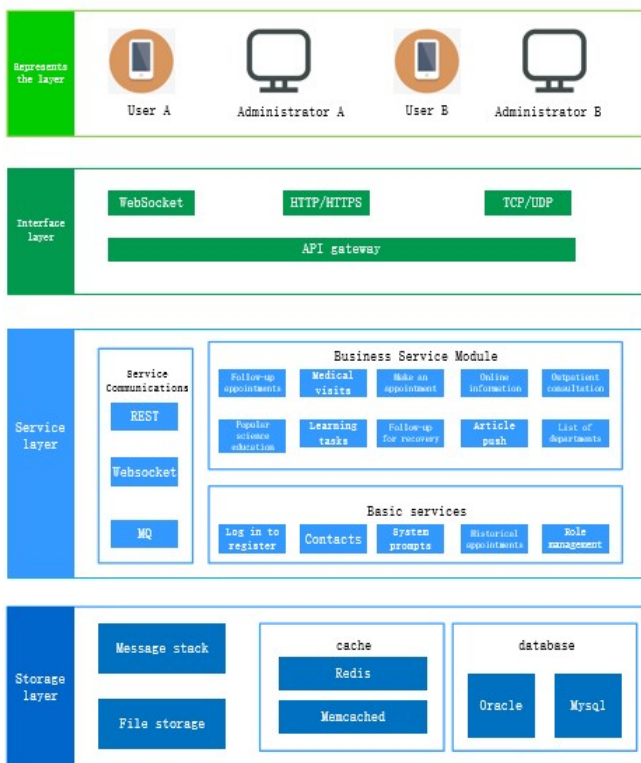

Figure 1 Overall Architectural Design of the Platform

A. Presentation Layer

The presentation layer is responsible for the design and implementation of the user interface, functioning as the human-computer interaction layer. It receives user input and presents medical data, diagnostic results, patient recovery information, and more to the healthcare professionals. This assists doctors in better analyzing user conditions, making timely follow-up arrangements, and providing rehabilitation guidance to patients.

B. Application Layer

The application layer, situated at the core, encompasses the design of business logic and workflows, including patient management, medical record management, diagnosis, and plan formulation. Additionally, it is responsible for interacting with the data layer, supporting real-time communication between healthcare professionals and patients. This involves functionalities such as online consultations and electronic prescriptions.

C. Data Layer

The data layer is primarily responsible for data storage, data management, and data integration. It stores medical device data, including patient basic information and medical records. It manages the addition, deletion, modification, and retrieval of medical data, ensuring data consistency, integrity, and security. Additionally, it integrates data from different healthcare systems and devices, enabling comprehensive management of patient health information.

III. SOFTWARE ARCHITECTURE

The Colorectal Disease Doctor-Patient Follow-up Platform is mainly divided into three functional components: the management backend, WeChat Mini Program, and WeChat Official Service Account. The system's functional structure diagram is illustrated in Fig.2.

A. WeChat Mini Program

Given the widespread usage of WeChat, the frontend application for the Colorectal Disease Research Service Platform is developed as a WeChat Mini Program. The WeChat Mini Program consists of nine main modules, namely User Information Module, Nursing Module, Online Clinic Appointment Module, Follow-up Appointment Module, Message Module, Online Consultation Module, Health Education Module, Learning Tasks Module, and Rehabilitation Follow-up Module. Through the implementation of these modules, the Mini Program can achieve all the intended functionalities. The homepage interface is depicted in Fig.3, which includes essential business functions such as online clinic appointments, follow-up reservations, and health education. Each module is described in detail below:

（1）User Information Module: This module primarily handles user registration and login, user type differentiation, user information entry, user information modification, and user information request functions. When users utilize the Mini Program, this module is invoked to record and request relevant information. After validating the user's identity and obtaining their user type, further use of subsequent functionalities becomes possible.

（2）Nursing Module: Upon entering the nursing interface as depicted in Fig.4, the Nursing Module primarily presents basic postoperative or post-illness care knowledge. Patients can engage in self-care by learning from the provided nursing knowledge.
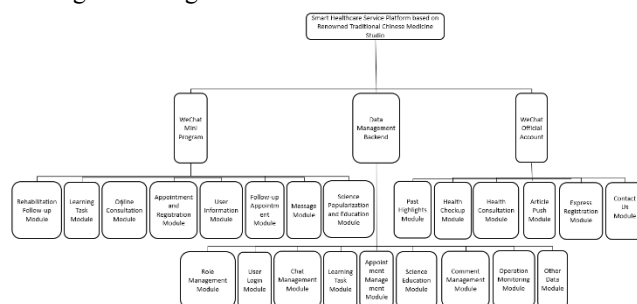

Figure 2 System Functional Structure Diagram

（3） Online Clinic Appointment: This module encompasses functions such as department selection, doctor selection, time slot selection, appointment confirmation,

and viewing appointment history. When patients use the online clinic appointment feature, they can choose the desired department, select a specific doctor, and allocate a preferred time slot for the appointment. For patients with existing appointment data, the appointment history feature allows them to review past appointment records. The details of the Online Clinic Appointment Module are illustrated in Fig.5.

（4）Follow-up Appointment Module: This module includes functions for follow-up appointments and follow-up plans. Medical professionals can use this feature to schedule follow-up appointments for specific patients. Follow-up appointments are independent of the online clinic appointment module and are not constrained by the availability of time slots. The implementation of this functionality contributes to improving the overall follow-up rate for patients. Details of the Follow-up Appointment Module are presented in Fig.6.

（5）Message Module: This module primarily caters to chat messages and system notifications, featuring functions such as sending and receiving messages, follow-up reminders, medical reports, My Physicians, appointment reminders, and contact list. Users can exchange real-time messages by adding each other to their contact lists. The system can also use this module to push information such as appointment reminders and medical reports to different users at specified times. The message list interface is depicted in Fig.7.

（6）Online Consultation Module: This module primarily facilitates remote consultations and medical consultations based on traditional Chinese medicine's concept of a 'Cloud Ward.' Patients can engage in online consultations by selecting the Online Clinic, choosing a specific department, and consulting with a designated doctor. Medical professionals can utilize the Online Consultation feature to collaborate on comprehensive diagnosis and treatment plans for remote patients. If users encounter issues or have feedback during the use of the Mini Program, they can directly contact customer service for assistance through online consultation.

（7）Health Education Module: This module encompasses informative articles, educational videos, and homepage recommendations. Users can access medical knowledge, stay informed about recent healthcare developments, and provide comments on articles or videos of interest. The three latest health education articles will be featured on the homepage for user recommendations. The Health Education interface is depicted in Fig.8.

（8）Learning Tasks Module: This module is primarily designed for medical professionals. Physicians in different departments may have distinct learning tasks, which are typically assigned and published by the chief physician of the department or the system administrator through the data management backend. Doctors can access the task interface by selecting the third tab in the Health Education section and initiate their learning by clicking on the respective column

（9）Rehabilitation Follow-up Module: This module is primarily operated by medical professionals. After patients complete offline consultations, within a specified

observation period, doctors can use this functionality to send health questionnaires to the relevant patients. Once the patients complete the form, it is automatically returned to the doctors, allowing them to assess the patient's recovery status.

B. Data Management Backend

Number The Data Management Backend serves administrators and is primarily composed of the following modules: User Login, User Role Data Management, Chat Data Management, Learning Task Data Management, Appointment Data Management, Health Education Data Management, Comment Data Management, Runtime Data Monitoring, and Other Data Management.

（1）User Login Module: This module primarily implements the functionality of the user login interface, allowing individuals with different permissions to access distinct features.

（2）User Role Data Management Module: Administrators can manage each user account information in the database through the user management function. Additionally, they can appoint or revoke roles for each user account through the role management function.

（3）Chat Data Management Module: Administrators can manipulate existing chat data through this functionality.

（4）Learning Task Data Management Module: This module oversees the management of training tasks, which include learning articles and videos. Administrators or authorized medical professionals can manage existing training data. Additionally, authorized medical professionals can create new training tasks, and once added, these tasks are directly synchronized with the learning task lists of doctors in their respective departments.

（5）Appointment Data Management Module: This module primarily manages appointment data, doctor scheduling lists, and follow-up data. Administrators or authorized medical professionals can efficiently import scheduling plans through the doctor scheduling function. They can also manipulate existing appointment data through the appointment data management functionality and operate on existing follow-up data through the follow-up data management functionality.
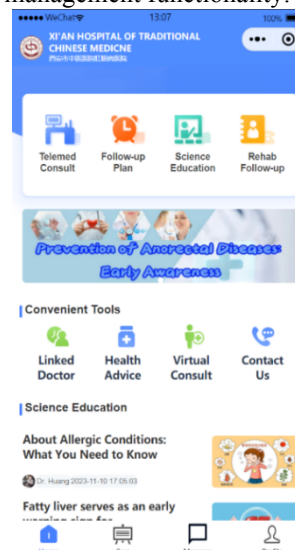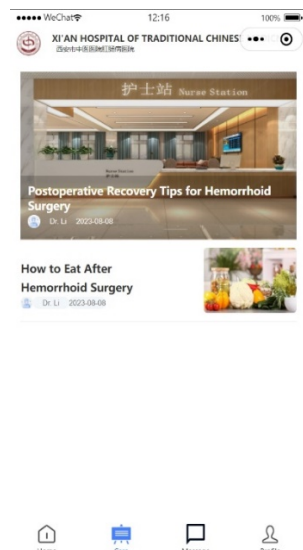

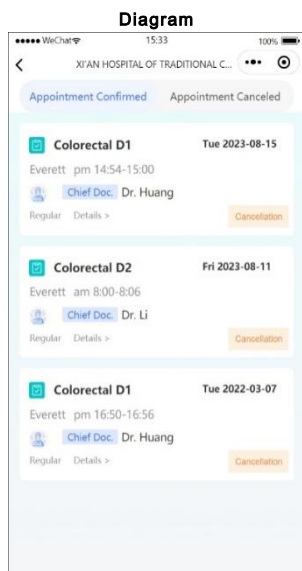Figure 3 Homepage Interface   Figure 4 Nursing Knowledge

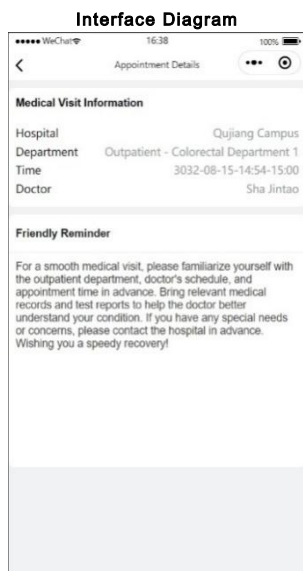**Figure 5 Online Clinic Appointment Interface**

Figure 6 Follow-up Appointment Details Interface Diagram

Figure 7 Chat Message List Interface

Figure 8 Popular Science and Educational Articles List Interface Diagram

（6）Health Education Data Management Module: This module primarily oversees the management of health education materials, which include informative articles and videos. Administrators or authorized users can manage existing health education data. Additionally, authorized users can publish new health education articles or videos, which are then directly synchronized with the corresponding lists in the platform's health education section.

（7）Comment Data Management Module: Administrators can manipulate existing comment data through this functionality. Each comment data entry includes information such as the commenter's name, timestamp, and comment content.

（8）Runtime Data Monitoring Module: This module is primarily responsible for monitoring the operational status of the server hosting the management backend.

（9）Other Data Management Module: This module includes functions for menu management, department management, and position management. Administrator users can manage the menu list of the management backend through the menu management function, oversee existing departmental units through the department management function, and supervise existing medical positions through the position management function.

C. WeChat Official Account

Built on the backdrop of the widespread usage of WeChat, the Official Account leverages an extensive user base. According to Tencent's financial report for the third quarter of 2021, WeChat boasts a monthly active user base of 1.262 billion, with 80% of users engaging in subscription behaviors for Official Accounts. Furthermore, over half of the encountered users spend an average of half an hour daily browsing information through Official Accounts[6]. In practical use, the Official Account of this platform is primarily responsible for the direct dissemination of informative articles and the utilization of quick functionalities. Patients can benefit from the Official Account for supplementary medical consultations, while medical professionals can stay updated on relevant information in a timely manner.

IV. CONCLUSION

The Colorectal Disease Doctor-Patient Follow-up Platform addresses shortcomings in traditional healthcare models, including the lack of post-discharge rehabilitation knowledge, difficulty in follow-up appointment scheduling, and challenges in effectively supervising and implementing training tasks for healthcare professionals. This platform offers a comprehensive management solution for the entire cycle of traditional Chinese medicine (TCM) diagnosis and treatment for patients. It achieves intelligent services such as interactive communication, Q&A support, health education, and post-discharge follow-up reminders. For healthcare professionals, the platform facilitates online delivery of TCM classic teachings, ward rounds via video, uploading and browsing of teaching materials, and remote consultations through the TCM 'Cloud Ward.' The application of this platform promotes real-time communication between healthcare professionals and patients, effectively enhances diagnostic and therapeutic outcomes, and stimulates innovation and development in healthcare practices.

V. FUNDING

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