

Intelligent Medical System of Unmanned Pharmacy Based on Internet Plus

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Abstract—With the rapid development of Internet technology, 5G communication, artificial intelligence, and big data technology, how to meet the development and combine the above hot technologies with people's livelihood medical care is the top priority to realize future development. In this regard, we need to build an intelligent brain of unmanned medicine cabinet by using advanced technologies such as artificial intelligence and construct an auxiliary diagnosis intelligent medical system based on artificial intelligence and remote connection man-machine auxiliary service, which can realize intelligent management in production and integrated closed-loop services such as intelligent medical treatment in terminal services. The cloud database of unmanned medicine cabinets can realize fine management, resource allocation, and scheduling, epidemic prediction, etc. through data analysis. Therefore, it can solve the social problems of low basic medical level, being difficult to see a doctor and to buy medicine in remote mountainous areas. Finally, a closed loop of health management is realized, to construct a healthy and reasonable Intelligent Medical ecology and promote the deep integration of the artificial intelligence pharmaceutical industry.

Keywords—Internet plus, Unmanned pharmacy, Intelligent Medical system

I. INTRODUCTION

Intelligent Medical is a new spark created by the collision of rapidly developing Internet technology with traditional healthcare services that are lagging in capability and awareness. At its core, it aims to reduce the highly uneven distribution of healthcare resources and improve the doctor-patient relationship and the patient's healthcare experience by improving basic healthcare information and management. As such, it has great potential to provide citizen-centered quality healthcare services. Currently, with advanced technology and ample investment capital, Intelligent Medical, while spectacular at first, still cannot avoid being shocking. After several years of exploration, the vast majority of companies are still unable to make a profit, or even a profit point and their business models are not clear enough to create blood for sustainable development through the profitability of their own main business.

Based on the above problems, this paper will build an intelligent brain of unmanned medicine cabinet by using advanced technologies such as artificial intelligence and construct an auxiliary diagnosis intelligent medical system based on artificial intelligence and remote connection man-machine auxiliary service, which can realize intelligent management in production and integrated closed-loop services such as intelligent medical treatment in terminal services. The cloud database of unmanned medicine cabinets

can realize fine management, resource allocation, and scheduling, epidemic prediction, etc. through data analysis. Therefore, it can solve the social problems of low basic medical level, being hard to see a doctor and to buy medicine in remote mountainous areas. Finally, a closed loop of health management is realized, to construct a healthy and reasonably intelligent medical ecology and promote the deep integration of the artificial intelligence pharmaceutical industry.[1]

II. OVERVIEW OF UNMANNED MEDICINE CABINET

A. Technical Background of Unmanned Medicine Cabinet

The technical background of the telemedicine inquiry module in the unmanned medicine cabinet can be dated back to 1985 when medical aid was first reported as civil telemedicine during Mexico City Earthquake[2]. In 2001, the second generation mobile communication technology was applied to civil telemedicine for the first time, transmitting the ECG information of a patient [3]. The first remote surgery in the world was completed by a medical team in the United States in 2001 [4]. The medical team used the Zeus robot system to complete a laparoscopic cholecystectomy, which opened the precedent of remote surgery. However, during the operation, the surgeon can feel the delay between the operation and the image. In 2014, shenai et al. [5] introduced virtual reality technology into remote surgery, which enables surgeons in different angles to share the three-dimensional vision. Although it did not solve the problem of network delay, it brought a new model to remote surgery. Affected by factors such as low information network propagation speed, the telemedicine assumption with high requirements for network propagation speed and network delay did not show its advantages before the application of 5G technology. The communication network with high speed and low latency will bring new development to telesurgery.

B. Existing Problems of Unmanned Medicine Cabinet

There are more than 400000 pharmacies in China, but only about 10% of pharmacies provide 24-hour drug sales service, and consumers' demand for drugs at night is still not met. The core of the problem lies in the disproportionate business costs and output of night sales. However, unmanned medicine cabinets can make up for the lack of 24-hour pharmacy. It can also access a variety of better services such as remote consultation and online drug delivery, to meet the consumption needs of young and middle-aged consumers.

The small and complete unmanned medicine cabinet, integrating many functions, such as connecting to Internet hospitals, supporting drug inquiries, infrared temperature

testing, etc., can not only realize pharmacy "7*24" hours of drug sales services but also support a variety of transaction scenarios. What's more, it can realize and simplify the existing medical online and offline retail model.

The community-based services of unmanned pharmacies based on telemedicine and the construction of supportive infrastructure for remote mountainous areas can alleviate the social problems of unreasonable allocation of modern medical resources, the concentration of high-quality resources and low level of grassroots medical care, difficulty in seeing a doctor and difficulty in buying medicine. At the same time, the use of artificial intelligence and other technologies can replace manual repetitive mechanized labor and thus reduce the labor costs of pharmacy operations. In addition, it can also enable remote diagnosis and treatment of common diseases and relieve the pressure of large hospitals.

C. Current Application of Unmanned Medicine Cabinet

Sale and lease are the two ways of cooperation between the unmanned medicine cabinet and the drugstore. The sale is a one-time buyout, and the drugstore bears the cost and operates the machine of the store independently. For leasing, the service provider and the pharmacy share the machine cost and the profits. When the service provider owns a large number of machines to tread in the market and form the scale effect, it can participate in business activities with the upstream enterprise. In this way, the profits they share with pharmacies will also gradually increase.

In terms of equipped varieties, there are more than 190 OTC drugs, mainly cold, fever, and digestive drugs, as well as emergency products such as family planning products, which are greatly accepted by consumers.

III. OVERVIEW OF INTELLIGENT MEDICINE

A. Definition of Intelligent Medicine

The term "Intelligent Medicine" was put forward by IBM in the report on the development strategy of smart earth in 2008. This report shows IBM's ambition to become a global smart, and specifically, it points out that smart medical care is the core element of the smart earth strategy. Its core view is to build a "patient-centered" medical service system, relying on the medical service system to establish electronic medical records, and the Internet (now the Internet of Things), and other technologies to collect real-time clinical data, and ultimately form a complete electronic health record.

B. Successful Cases of Intelligent Medicine

Over the past 10 years, many Intelligent Medicine enterprises with large capital and strong technical strength have sprung up one after another, which has greatly promoted the development of the industry and market prospects.

(1) Ping An Good Doctor: now has been renamed Ping An Health, a subsidiary of Ping An Group of China, was officially logged into major APP malls in April 2015, with the core objectives of health management, health mall, and Internet health consulting mobile software. With the strong own network traffic of Ping An Group, Ping An Good Doctor has been registered more than 100 million users in 2016, becoming the O2O health management APP with the highest coverage rate in China.

(2) Flatironhealth: since its establishment in 2012, FlatironHealth, a health big data analytics company, has relied on big data analytics to accomplish complementary precision medicine for cancer since its founding in 2012. The company has reportedly raised \$175 million in Series C funding, making it the most promising unicorn in U.S. healthcare big data.

(3) Proteus Digital Health: established in 2001, Proteus Digital Health, a digestible IC chip sensor company, has always been devoted to the research and development of Intelligent Medical hardware products. Its core purpose is to customize health management tools for users by collecting various behavioral parameters, physiological data, treatment information and other human indicators, including continuous medication, heart rate, sleep quality Pressure, and other data. The company obtained from A to G Rounds of equity investment and debt financing in 2001 and 2017 respectively, totaling USD 382 million.

It can be seen that the Intelligent Medicine industry is very "young" and full of vitality, which is very favored by capital. The penguin doctor studied in this paper is also a potential Intelligent Medicine company.

IV. DESIGN OF INTELLIGENT MEDICAL SYSTEM FOR UNMANNED MEDICINE CABINET

Based on the related technologies of Single-Chip Microcomputers, combined with Voice Recognition module, telemedicine, and intelligent database system, this project realizes intelligent video diagnosis and drug sales based on the existing unmanned medicine cabinet, to meet the daily medical needs of citizens. Its main functions are shown in Figure 1.

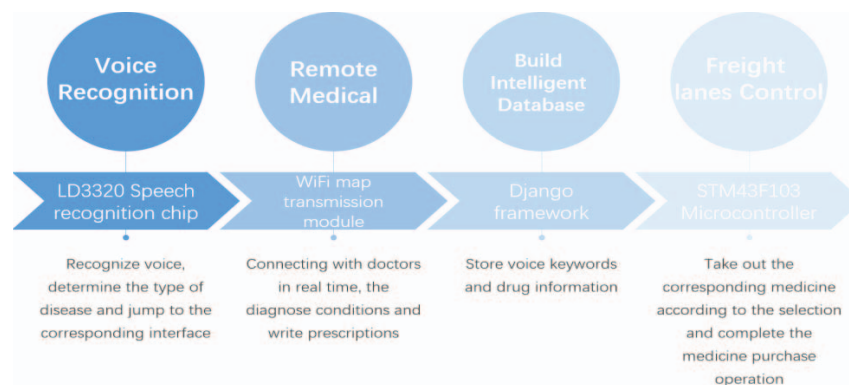


Fig. 1 Main research contents and process

A. Voice Recognition

The Voice Recognition system is the most basic part of the system. The Voice Recognition module of the unmanned medicine cabinet mainly depends on the LD3320 Voice Recognition chip. First, the voice information is entered and recognized to analyze its category and determine the

corresponding disease type, while the microcontroller sends a pulse signal to the corresponding L9110 chip according to the recognition information and sends a signal through the output interface, followed by jumping to the common medicine page of the corresponding symptom for subsequent operations such as medicine shopping, respectively. As shown in Figure 2

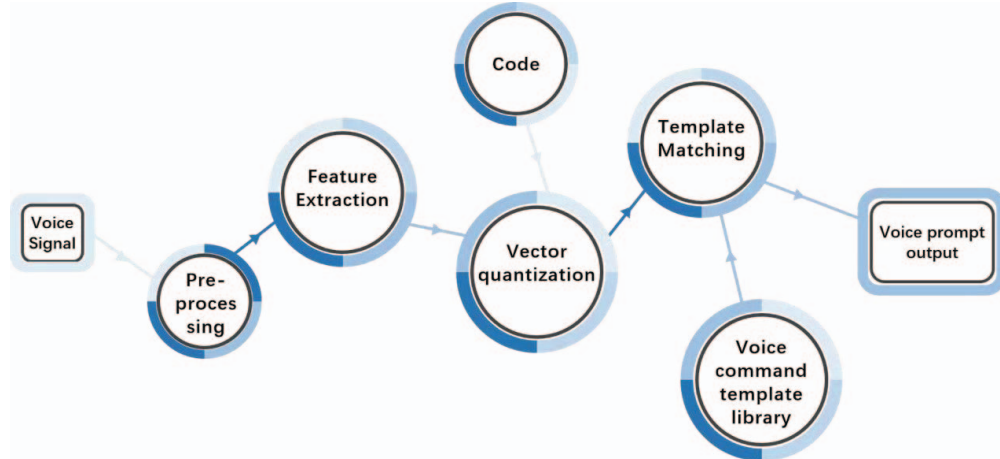


Fig. 2 Implementation flow of speech recognition

B. Telemedicine

Telemedicine is a major challenge in the "unmanned medicine cabinet" project, which combines the concepts of "unmanned" and "remote" in the 21st century, making "Unmanned medicine sales" upgraded to "unmanned diagnosis". The common audio and video remote transmission methods for medical imaging equipment are to be adopted. Firstly, the HDMI video signal from the image output of the medical device is connected to the WIFI module through the video signal cable, and after the video capture, the H.264 Image Compression technology is used to generate

a high compression ratio data stream, which is sent to the decoder through the WIFI antenna. The tablet PC receives the data stream through the built-in WIFI receiver module and then decodes and reduces it into high-definition video displayed in the corresponding window of the remote consultation module in the tablet PC, and the video signal is sent to the cloud server by the built-in 4G module or 5G module of the tablet PC, and each application terminal realizes real-time audio and video transmission of medical imaging equipment by accessing the cloud server. As shown in Figure 3.

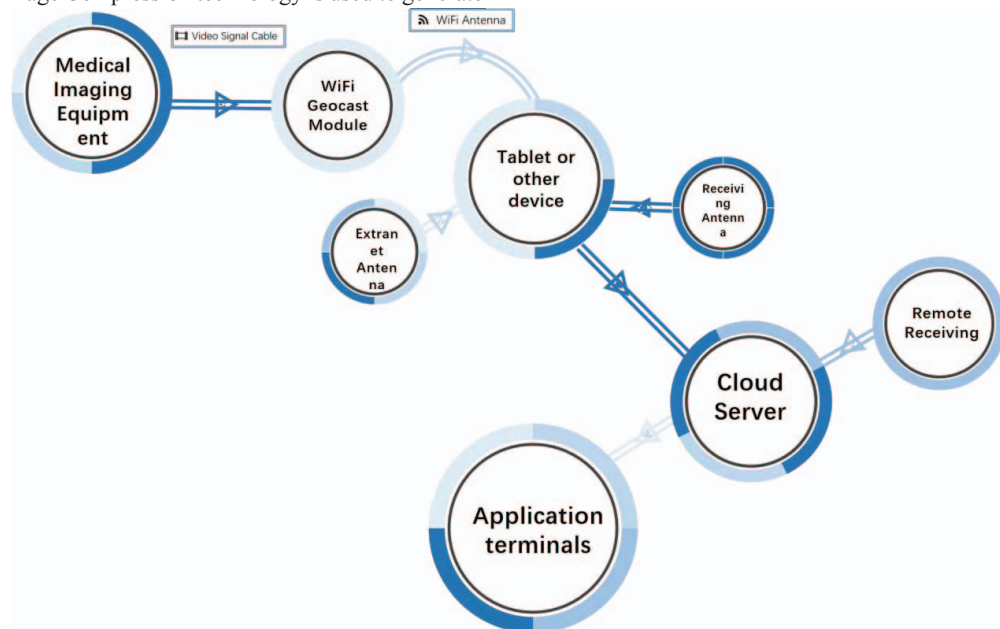


Fig. 3 Video remote connection process

C. Building Intelligent Database

The concept of the "unmanned medicine cabinet" is the same as that of the vending machine, but database technology is introduced to give people a relatively accurate diagnosis. Compared to other traditional vending machines, the "unmanned medicine cabinet" adds the collection and analysis of data, which is presented by a database. In the unmanned medicine cabinet project, the database is used to store some keywords in the common language of people, mainly for patients who do not know what medicine to buy and use these keywords to initially determine what they need. In addition, the database needs to be expanded overtime to compensate for the difference between people's everyday language and their professional language. On the other hand, it can be used to store the daily list of medicines people buy, to determine the number of different medicines in the medicine cabinet, and to predict the occurrence of epidemics soon.

Building the database in a Python environment, the capacity is large enough to meet daily needs. Django framework is fully functional and comes with database operations. ORM is an important part of its framework. Using ORM can make the database have low requirements for the design of the data model, which in essence will be translated into the corresponding SQL statements according to the docking database engine. If the database is migrated, there is no need to consider statements such as MySQL used at the bottom of the program. You just need to replace Django's database engine. Therefore, under ORM conditions, the design of the data model does not depend on a specific database. The database can be easily replaced by a simple

configuration to meet the needs of a database that needs to be constantly updated.[7]

D. Control of Cargo Road

Traditional vending machines generally use spring delivery. Although this method is simple and easy, it is only suitable for non-fragile goods, and there are strict requirements for the size of goods. Therefore, the intelligent unmanned medicine cabinet adopts the X-Y Cargo Road to ensure the integrity of drugs. In this part, STM32F103 is selected as the main control chip to realize the communication between the host computer and MCU through the CAN bus. After the customer selects the drugs, the upper computer converts the corresponding information into control signals and sends them to the main control chip through the CAN bus. The main control chip controls the cargo lane control motor and the pallet control motor through the PWM signal to drive the X-Y cargo lane and push the drugs to the transportation platform, and then the drugs are transported to the pick-up port by the transportation platform so that the customer can take away the required drugs. In this system, X-axis and Y-axis motors need high-precision positioning. The general motor speed regulation circuit adopts open-loop control, which has low precision and poor ability to suppress interference. PID control is a closed-loop control, which can be quickly regulated when the speed deviates from the target speed. [8]Therefore, it can be considered to realize the incremental PID algorithm with PWM modulation in the Single-chip Microcomputer by software programming, to realize the adjustment of motor speed, reduce power consumption and effectively control motor speed. As shown in Figure 4.

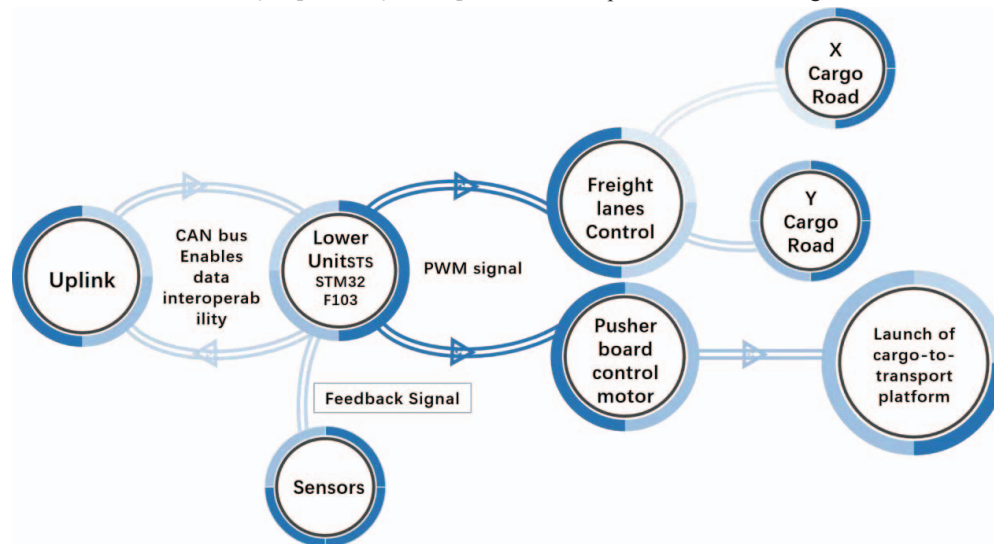


Fig. 4 Cargo Road control structure

V. CONCLUSION

The cloud database of the unmanned medicine cabinet can carry out data analysis and realize fine management, resource allocation, and scheduling, and epidemic prediction. This solves the social problems of low level of grass-roots medical care, being difficult to see a doctor and to buy medicine in remote mountainous areas. Through the cloud database, people can finally realize a closed loop of health management, construct a healthy and reasonable Intelligent

Medical ecology and promote the deep integration of the artificial intelligence pharmaceutical industry.

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