The New Technology of Intelligent Medicine Box System Function based on Data Storage and Transmission Function

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Abstract

The smart medicine box is a kind of intelligent medical equipment that mainly solves the problems of the elderly forgetting to take medicine, children taking medicine indiscriminately and drug expiration, and has multiple functions such as multiple reminders, remote monitoring and lock security. At present, there are still many deficiencies in the research on smart medicine box, and this paper mainly focuses on the new technology of smart medicine box system based on data storage and transmission function. The new technology of smart medicine box we have studied mainly focuses on five aspects: telemedicine, medicine box and medicine box combination, intelligent scanning, medication reminder and monitoring system.

Keywords

Smart Medicine Box; Data Storage; Data Transmission; Internet of Things Technology; New Features.

1. Introduction

With the continuous growth of economic level, the rapid development of modern medical care, the increasing expansion of the pharmaceutical industry, and the gradual strengthening of family health care awareness, the smart medicine box is designed to help the elderly solve problems such as difficulty in taking medication. The smart medicine box can reduce other diseases and secondary hospitalizations caused by various drug abuse by serving each group in need of services on time and in accordance with the quantity and accuracy. It can solve the worries of patients' families, and they can understand the patient's medication status in real time through the mobile data network, which can reduce the pressure on work and life. Allow consumers to obtain medical services at critical moments is conducive to promoting communication and care between people, caring for each other's physical condition, jointly building a beautiful and harmonious society, promoting the development of social civilization, and responding to the spirit of reciprocity and mutual assistance called by the country. With the increasing improvement of living standards, the elderly have a higher demand for home care services, but the needs are different for different elderly people, and the demand for smart medicine box functions and services is often great. The elderly often encounter different degrees and different aspects of problems when taking medicines.

The study explores the use of smartphones, big data, Internet of Things (IoT) technologies, telemedicine, and digital healthcare data on an increasingly widespread network to expand the field of healthcare and improve the quality of care. The smart medicine box reduces the potential safety hazards such as mistaken medication, missed medication and drug mildew for the elderly living alone

in the empty nest, assists in solving the serious problem of aging, and keeps up with the pace of development of the times.

At present, the smart medicine boxes on the market in China are mostly portable pill boxes with simple functions. Most of them use the timer of the single-chip microcomputer to interrupt the design software alarm clock, when the set time is reached, the LED light on the box will be on to give a visual prompt or a voice broadcast module is installed, and a voice prompt is issued. Use space division or independent storage to classify drugs. On the basis of the above functions, some smart medicine boxes are also equipped with special mobile phone apps or applets, with functions such as SMS reminders, remote reminders, GPS positioning, medication records, and scanning codes to add medicines. There are also a very small number of smart medicine boxes with perfect functions, not only the functions of the above-mentioned medicine boxes, but also with the function of independent dispensing, but the price is relatively expensive.

Abroad, some developed country governments have also stepped up efforts to promote the development of the Internet of Health IoT, and the British Department of Health has launched a demonstration project to help people manage their health through Internet of Things technology. Japan is very well developed in the field of wireless sensors as a whole, laying a certain foundation for smart medical technology in the world.

Based on the current social status quo of China's aging population, the social background of comprehensively promoting the construction of a healthy China, and the continuous improvement of national living standards and living conditions, China's pension service market demand space is large, and the development prospects of smart medicine boxes in the future are very broad. In the future, the combination of the Internet and medical care must be the trend of market development. The medical industry and AI medical potential has a huge space for development, the shared medicine box gives full play to the advantages of the sharing economy, the public sharing, resource sharing, Internet assistance, efficient matching of supply and demand, will be committed to user-centric, more timely and convenient to meet the needs of users. Internet artificial intelligence sharing economy will enter the medical field, and promote the continuous development of the medical industry.

Developed regions show the most cutting-edge innovations of research institutions in the medical field to all parties in society, so as to promote in-depth discussions and exchanges between each other, so that these cutting-edge technologies can be applied to medical units faster and more widely to serve people.

2. Processing Technology of Intelligent Medicine Box Data

2.1 Data Storage

The emergence of smart medical devices such as smart medicine boxes has made it easier to collect medical data, and has also promoted the development of data storage and management technology. The data storage technology in the smart medicine box can convert the collected medical information into a digital format and store it in electronic devices, and then further analyze and manage it, which can help the relevant subjects better understand the user's medication status and health status. The significance of data storage technology is to improve the management efficiency of medical data, enhance the mastery of user data and the ability to warn of diseases, and also promote the development of multidisciplinary cooperation and Internet telemedicine.

(1) Since most of the smart medicine boxes are used in the home environment, a large number of text data, images, videos and other users' privacy will be generated and stored in the process of use. Therefore, we will use the RSA encryption algorithm to solve the above problems. RSA encryption is an asymmetric encryption algorithm, which is encrypted and decrypted by a pair of keys, that is, the public key and the private key, which can ensure the security of the information, avoid the risk of being cracked caused by direct transmission of the key, and use this method to better protect the user's privacy.
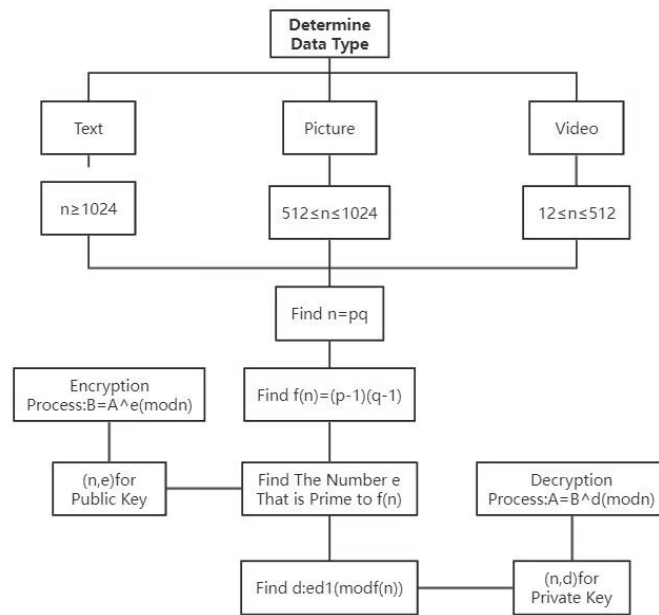
Figure 1. RAS encryption algorithm flow

The RSA encryption algorithm process is to first determine the type of data that needs to be encrypted, control the range of the key length according to the selected type, so as to determine the range of two randomly selected large prime numbers p and q, and calculate the product n of p and q. The length of n is the key length. The RSA algorithm improves the encryption algorithm by adjusting the key length, which can not only ensure the storage security of various types of data, but also take into account the high security of text-based data and the fast encryption of large-capacity data, which reduces the storage burden of intelligent terminals and accelerates the operation speed of terminals.

(2) The smart medicine box needs to have a series of functions that can monitor the type and quantity of drugs stored in the medicine box, the shelf life, whether the user takes the medicine, can set the medication time and remind the user to take the medicine, so as to effectively avoid the occurrence of mistaken drugs, wrong doses, missed doses, etc., and ensure the physical safety of users. Therefore, we will adopt an Arduino-based intelligent medicine box, which has the function of drug information storage and can realize the intelligent management of drugs.

The upper surface of the smart medicine box is embedded with a touch screen, the user can edit the name of the stored drug, the production date, the shelf life, the main efficacy and other relevant information through the touch screen, the system will give the storage location suggestions according to the drug information for the user to choose, after the confirmation, the corresponding medicine box layer will automatically pop up when taking the medicine. Through the drug information storage system, users can view the name, storage location, expiration time and other information of the drugs stored in the medicine box, and remind the user to replace them in time through the display screen before the drug expires, so as to prevent accidents caused by taking expired drugs.

2.2 Data Transmission

According to a certain procedure, the data is transmitted from the data source to the data terminal through one or more data links, so as to realize the information transmission and exchange between points, so as to improve the real-time and reliability of data transmission.

(1) The data transmission technology of the smart medicine box is usually based on wireless connection technology, which can be transmitted in the NB-IOT network node with the help of the NB-IOT IoT platform, the information collected by the sensors in the smart medicine box and the

physical signs data of various users in the NB-IOT network node. The medication information set up is transmitted to the smart medicine box terminal through the NB-IOT Internet of Things management platform, so that the user's family members and medical personnel can view the user's real-time body data at any time. The technology has the characteristics of low technical power consumption, wide coverage area, large number of connections, etc., and supports the access of multiple smart medicine boxes in the same community, and can also be connected with multiple terminal devices such as family mobile phones and doctors, which greatly reduces the cost of data transmission and improves efficiency.

NB-IOT is a narrowband IoT technology, built with cellular networks, which supports cellular data connectivity of low-power devices in the WAN, and can also provide very comprehensive indoor cellular data connection coverage. When applied to the smart medicine box, the temperature, humidity and drug quality data of the medicine box are collected through the medicine box sensor, and these data will be directly reported to the background IOT management platform in real time through the NB-IOT module, and the user can remotely view the data after the IOT management platform analyzes and processes the data, and the time and quantity of medication can also be set through the management platform.
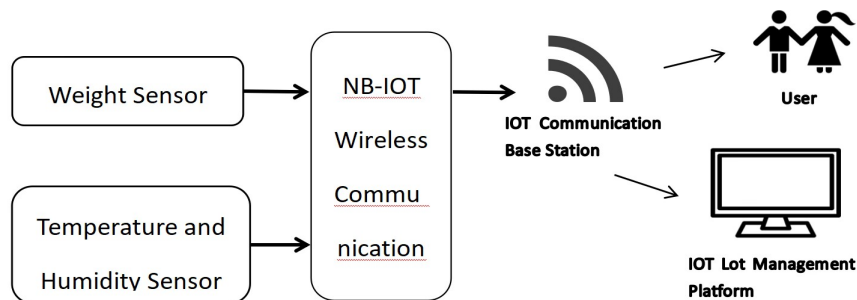
Figure 2. Structure of intelligent medicine box system based on NB-IOT

(2) The APP software of the smart medicine box adopts Java as the main programming language. In terms of the interface design of the APP, part of it is the doctor's side, which is used to issue and adjust prescriptions to doctors, provide an operable and visual interface, and can make appointments for patient inquiries and check the user's real-time sign data. The other part is the patient side, which is used for the patient to upload real-time sign information and complete the interaction with the main information of the medicine box.
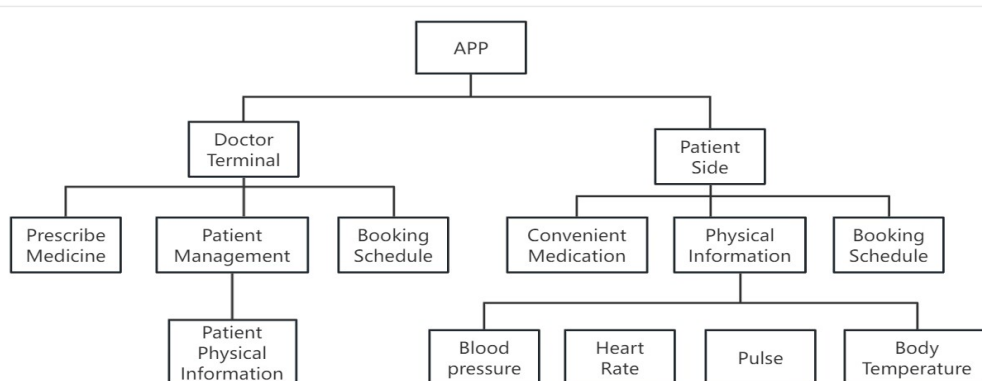
Figure 3. Diagram of APP function module

3. New Feature Design

The smart medicine box for the elderly needs to solve multiple problems such as Figure 5, and the smart medicine box is divided into the following five technologies: telemedicine, combination of medicine box and medicine box, intelligent scanning, medication reminder and monitoring system. Telemedicine can conduct health checks on users and connect with doctors in real time. The combination of the medicine box and the medicine box can make it more convenient for users to go out and take medication. Smart scanning reduces the barrier of users not being able to enter their own medications. Medication reminders can remind patients of medication from multiple angles such as voice broadcast and SMS notification to ensure the timeliness of patients' medication. The monitoring system can detect the patient's medication status. It can also be connected to other monitoring systems at home, and then through the mobile phone APP, the real-time situation of the elderly at home can be fed back to the children in a timely manner.

3.1 Telemedicine

3.1.1. Daily Health Monitoring

Nowadays, it is very common for middle-aged and elderly people to suffer from hypertension, hyperglycemia and other diseases, in order to be able to detect the physical health status of the elderly at any time, the wisdom medicine box provides daily blood pressure and blood sugar heart rate health monitoring for the elderly group. The technology is based on the medicine box itself is equipped with blood pressure and blood sugar instruments, built-in intelligent algorithms and cloud analysis platforms and its big data artificial intelligence system. The system will remind and give corresponding suggestions, and ask the elderly whether they need to go to the hospital for consultation. If necessary, the system will automatically search for nearby medical consultation locations, and after each test, its data will be synchronized and stored in the cloud in time, so that it is convenient for children to view and follow up the basic status query. This technology allows the elderly to grasp the basic information of their own health more comprehensively to a great extent.

3.1.2. Convenient Consultation

The progress of modern science and technology has made many elderly people unable to keep up with the pace of the times. The core function of our telemedicine is that it can be convenient for consultation, which can well solve the problem that many elderly people do not use smart products and cannot cope with the complex process of going to the hospital. This function is mainly based on remote communication, data transmission and Internet computer technology. When the elderly feel unwell, but it is inconvenient to seek medical treatment, then they only need to read telemedicine to the medicine box, and then select their own discomfort point on the mannequin given by the system. The system will automatically conduct remote consultation for the doctor who is responsible for treating this aspect connected to the line. If the situation is urgent, you can skip it directly, and the system will automatically match the online general practitioner consultation. With the rapid development of the cloud and the Internet, the more comprehensive the patient information that doctors can grasp through the cloud, the more complete the treatment plan will be.

3.1.3. Convenient Delivery of Medicines and Medical Treatment

Relying on Internet multi-platform collaboration, data transmission technology and modern logistics technology, the medicine box cooperates with takeaway platforms such as Meituan, online platforms of major hospitals, and transportation platforms such as Didi Chuxing. If it is an incurable disease, the system will automatically search for a nearby hospital that can provide treatment for the elderly, and will automatically make an appointment with a doctor for treatment, and at the same time, the guardian will be notified in the form of a text message. Similarly, if a user needs to add medication to their kit, they can order it directly from the kit, have it delivered to their home, and even diagnose and prescribe it remotely. This function reduces the burden on children, provides a more private and safe environment for drug purchase and medical treatment, and effectively avoids the risk of cross-infection of infectious diseases.

3.2 Combination of Medicine Box and Pill Box

3.2.1. Multi-class Drug Storage

The medicine box is divided into a plurality of small pill boxes, which are used to store multiple types of drugs, which are not easy to mix, and family members can input and fill in the dosage and time of the drug according to the doctor's instructions or scan the drug instructions to place the drugs. Each small pillbox in the pillbox starts with 1, 2, 3... For numbering, each time a drug is entered, the medicine box will automatically eject the empty medicine box for the device, and the medicine box will be recorded in the medicine box after the device. When it is time to take medicine, the medicine box will sound a bell and use voice broadcast to prompt the dosage, and then pop up the corresponding medicine box. After popping up, the medicine box will judge whether the elderly take the medicine according to whether the weight of the medicine in the medicine box is reduced, if not, the guardian will be notified (as shown in Figure 4).
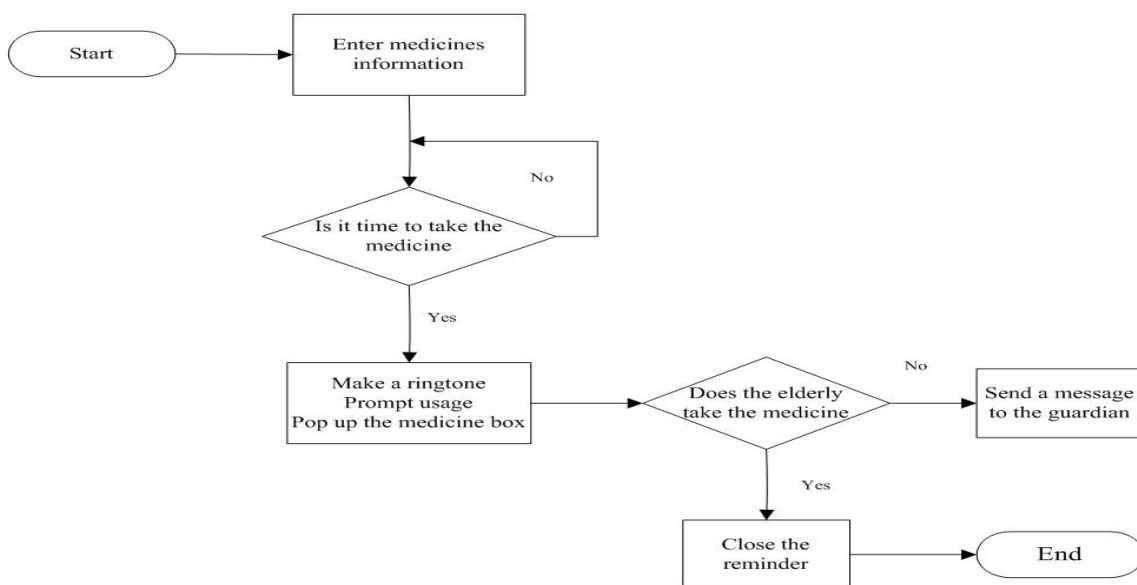

Figure 4. Multi-class drug storage

3.2.2. Drug Isolation and Storage

Because it is placed in an independent small medicine box, first of all, the drugs are independent of each other and clearly separated, which is not easy to cause the elderly to take it by mistake and mix and cause life danger. Secondly, in long-term storage, the drug will be affected by changes in the external environment. If the two drugs are mixed together for a long time, there will be a physical or even chemical reaction, resulting in the weakening or even disappearance of the drug's efficacy. In addition, some drugs are conventional medicines, while others are first-aid medicines, and if they are mixed, they will not be able to be found and taken out in time when needed. There will be situations that cannot be distinguished, and eventually cause irreversible consequences. Not only the medicine box, but also the portable medicine box that can be carried out is also stored in isolation for medicines, so it is not easy to have the problems mentioned above.

3.2.3. Convenient Pill Box

With the development of the times, the life of the elderly is becoming richer and richer, so the problem of medication when going out can be solved by using a small pill box. The medicine box can hold 2-3 days of medicine, there is a small grid inside to store the drug and is the same medicine box corresponding to the number, the old people only need to take the medicine to be packed into the corresponding grid. Because the medicine box and the medicine box are bound, so the dosage and time will be transmitted to the medicine box through the cloud, to the time the medicine box will vibrate and the indicator light flashes and will prompt the dosage. If it is not closed, the guardian will be notified, the main usage is consistent with Figure 1. Since the pill box will be lost if you carry it

with you, you can fill in the contact information on the pill box to prevent it from being lost. If you lose the pill box and can't find it, the pill box is equipped with multiple pill boxes, and after the loss, you can also go to the vending platform to purchase a separate out-of-the-box pill box.

3.3 Smart Scan

Because the popularity of intelligent technology is wider nowadays, its use is more difficult for the elderly, so the medicine box provides the technology of intelligent scanning. The method is mainly through the machine learning algorithm to automatically identify and classify the document, and then extract the key information therein, convenient for the elderly group to add medicine independently, the elderly only need to place the drug instructions in the scanning port when they get the drug. The system will automatically recognize the text, capture the key words of the time and dosage, automatically pop up the empty medicine box for drug placement and enter it. If the child is not with you and the elderly will not use it, the child can enter the instructions for the use of the drug from the cloud or take a picture of the drug instruction manual for uploading, and the system will automatically scan and identify it. The intelligent scanning of the medicine box takes into account the multi-faceted problems, which is suitable for the elderly to use at home, even if the children are not around, the elderly can also have a certain protection for their own health. At the same time, the smart medicine box will classify and match the drug information, and judge whether the scanned drugs are consistent with the information in the database by comparing and verifying with the existing drug information. If it is consistent, the drug is added to the box in which it was originally stored. In addition, the scanned drug information can be stored in the database of the smart medicine box, which is convenient for users to find and manage in the future use process, and will also record the drug history and view it at any time.

The intelligent scanning system of smart medicine box makes use of modern imaging technology and image processing algorithms, which can greatly improve the accuracy and efficiency of drug information identification and management. At the same time, the recognition algorithm of the smart medicine box will continue to learn and optimize according to the scanned data, improve the intelligence level of the system, and bring users a better service experience.

3.4 Reminder Medication

3.4.1. Voice Announcement Reminder

The voice reminder function of the smart medicine box is based on the built-in voice chip. This function plays an important role in reminding you to take your medication, setting a scheduled reminder, identifying your medication and how to use it. First of all, the voice chip of the smart medicine box can remind you to take medicine in time. Nowadays, there is a lot of competition in society, and many things are cumbersome, and many people will ignore the small thing of taking medicine, and the voice chip of the smart medicine box helps people overcome this problem. Secondly, the voice chip of the smart medicine box not only has the function of timing reminder, but also can repeatedly set multiple sets of timing. In this way, the user only needs to set it once, and a reminder will be sent at the set time every day, which is very convenient. In addition, it is also very helpful for people with vision impairments or elderly and infirm people to identify drugs and their usage through the voice chip of the smart medicine box. This greatly reduces the risk of medication due to their inability to read the drug instructions or read the drug label.

3.4.2. Send SMS Reminder

The SMS reminder function of the smart medicine box is realized by connecting the user's mobile phone or smart watch and other devices. When the set time for taking medicine is reached, the smart medicine box will automatically send a text message to remind the user. To realize this function, first of all, it is necessary to set the time and drug information of taking medicine in the smart medicine box, and enter the user's mobile phone number or Bluetooth connection information of the smart watch into the system. When it's time to take medicine, the smart medicine box will automatically send a text message to send a reminder. This feature is very practical for people who often forget to

take their medications or need to take multiple medications on time. It ensures that users don't miss a single dose of medication and can avoid potential health problems caused by forgetting to take their medication. In addition, the SMS reminder function of the smart medicine box can also provide personalized suggestions and guidance based on factors such as the user's physical condition and drug interactions, helping users better manage their health.

3.4.3. APP Notification Reminder

The medication notification function of the APP is mainly achieved through mobile applications. Through technologies such as the Internet of Things, smart medicine boxes are combined with mobile apps, allowing patients' children to timely understand the patient's medication time and frequency. Medication reminder is the foundation of the APP's medication notification function. Patient children can set medication time, dosage, frequency, etc. in the application. When the set time is about to arrive, the smart medicine box detects that the patient has not taken medication on time, and the app will notify the child to urge the patient to take medication. In addition, the application can also provide additional reminder functions, such as reminding when forgetting to take medication, warning when drug interactions occur, etc.

3.5 Monitoring System

3.5.1. Drug Monitoring

A drug monitoring system is a system that can remotely monitor the use of drugs inside the medicine box. The system can record the type, quantity, time of use and other information of drugs, and transmit this information to doctors or pharmacists through the Internet, so that they can keep abreast of the patient's medication and provide patients with better treatment options. The drug monitoring system is usually composed of the following parts: the smart medicine box is the core part of the monitoring system, which can automatically record the type, quantity, use time and other information of the drug, and transmit this information to the doctor or pharmacist through the Internet. The smart medicine box can also be set up with a timer reminder function to remind patients to take their medication in time. The server side is another important component of the smart medicine box monitoring system. It is responsible for receiving the data sent by the smart medicine box and storing it in the database. Doctors or pharmacists can access the server to view the patient's medication status and diagnose and treat the patient remotely as needed. Mobile applications are another component of the smart medicine box monitoring system. Patients can check their medication status through the mobile app and receive doctor's recommendations and treatment options. At the same time, doctors can also remotely monitor patients' medication status through mobile phone applications and provide patients with better treatment options.

3.5.2. Home Environment Monitoring

The smart medicine box monitoring system can be combined with other monitoring equipment at home to ensure the safety of the elderly at home and the safety of taking medicine. First of all, the smart medicine box monitoring system can be combined with the smart camera. Smart cameras can monitor the activity area of the elderly and record the activities of the elderly. If the elderly do not take their medicine on time, the smart medicine box monitoring system can remind the elderly in time, and the smart camera can record the activities of the elderly so that children or other guardians can check it. Secondly, the smart medicine box monitoring system can also be combined with the smart door lock. The smart door lock can record the time and number of times the elderly enter and exit the room. If the elderly do not take their medicine on time, the smart medicine box monitoring system can remind the elderly in time, and the smart door lock can record the entry and exit of the elderly so that children or other guardians can view.

Acknowledgments

References

[1] Chen Fei , Li Shaoxuan . Application of Improved RSA Encryption Algorithm in Data Storage of Intelligent Medicine Cabinet [J]. Network Security Technology and Application , 2017(04):62-63+72.

[2] Zhang Li Gong , Jiang Yi Bi , Zou Linhong et al . Household Intelligent Medicine Cabinet Based on Arduino [J]. Science and Technology and Innovation, 2021(20):5152+57.

[3] Li Chengwei, Rong Xianzhao, Zhang Shang. Design of Intelligent Medicine Box Based on NB_IOT [J]. Information and Communication,2019(07):92-94.

[4] Sun Naxin, Cheng Hui. Development of a New Type of Intelligent Medicine Box Based on Java and PLC Technology [J]. Medical and Health Equipment, 2017, 38(03):6-10.

[5] Zhang Xiaoqiang, Dong Jie, Wang Guodong, etc. Family multifunctional smart medicine box design [J]. Mechanical Engineering & Automation,2023(02):69-70.

[6] Zhang Tao, Liu Chaohua, Xia Weixi. Design of household smart medicine box application system based on Internet of Things [J].Software,2016,37(02):39-41+53.

[7] Qiu Mengmeng, Liu Rui, Zhang Kaixuan, etc. Design and implementation of STM32 multifunctional smart medicine box [J]. Journal of Hubei Normal University (Natural Science Edition),2023,43(02):87-94.

[8] Ge Jie, Li Zezheng, Zhong Yiqi, etc.Smart medicine box on GSM wireless communication technology [J]. Electronic Production,2020(14):9-10+16.

[9] Huang Yuheng. Design and implementation of household smart medicine box [J]. China Equipment Engineering, 2018(24):128-129.

[10] Shi Yuanwu, Chang Xinxin. Equipment Manufacturing Technology, 2022(02):127-131.

[11] Lin Runtao, Zhao Liquan. Research on the design of smart medicine box for elderly household fun based on design psychology [J]. Design,2023, 36(09):76-80.

[12] Xie Danting, Zhao Pei, Du Sheng. Design of intelligent medicine box for the elderly based on single-chip microcomputer control [J]. Mechanical Design and Manufacturing Engineering, 2021, 50(07):40-42.