

Design and Application of Intelligent Sickbed based on Internet of Things Technology

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Abstract

Artificial intelligence represented by Internet of things technology has a profound impact on our life. Intelligent home is not only the demand of life, but also the social trend. By analyzing the current situation of the market demand for intelligent hospital beds at home and abroad, this paper believes that the intellectualization of hospital beds has important social value and significance. Based on the defects of current hospital general hospital beds, the team studied and designed an intelligent hospital bed model and framework based on Internet of things technology, which can meet the needs of new generation hospital beds and has good application prospects.

Keywords

Internet of Things; Intelligent Hospital Bed; Artificial Intelligence; Model.

1. Research background

With the development of science and technology, more and more scientific and technological products have not only played their role in the high-end field, but also entered thousands of households. The emergence and development of artificial intelligence affect human development to a great extent. However, focusing on the current development of hospital beds, the degree of intelligence is far from being satisfied with people who pursue a higher quality of life.

1.1. Development and demand analysis of international and domestic intelligent sickbed Market

In China, the design and research of intelligent hospital bed is still in its infancy. It belongs to semi intelligent hospital bed, which can only initially assist the movement of patients, and it is not very convenient. For example, the hospital bed of Luoyang Peony maternity hospital can manually lift the shelves on both sides of the legs, so that the hospital bed can be transformed into a delivery bed in a very short time, and the lifting can also be adjusted, but the patients can not move freely and do not have the monitoring function. In contrast, our intelligent sickbed function is more sound and humanized.

Looking abroad, Germany and Japan are the most advanced technologies. The beds used in medical institutions in developed countries are basically intelligent controlled, and the beds used in family nursing beds and community hospitals are also multi-functional manual beds and multi-functional electric beds. The adamekor project in Germany has a fund of 1.8 million euros. It is planned to use the robot arm in patient transfer. However, if the patient's limbs cannot be changed significantly, the use of the robot arm will be limited, and the finished product of the project has not been developed yet.

A New Zealand medical device company has developed a multi-purpose intelligent hospital bed compass, which can be urgently changed into medical appliances such as operating table and diagnostic table. Doctors only need to take away the mattress and thoroughly disinfect the steel

plate bed surface with disinfectant, and the height can be adjusted. However, we believe that while taking away the mattress and disinfecting it, we also need to move the patient, which is almost as time-consuming as transferring the patient to the operating table. Moreover, we do not consider that the patient cannot move, so the practicability is not high. Early sense, an Israeli digital health company, has developed a non-contact sensor system that can be embedded in the hospital bed to monitor the patient's heartbeat, respiratory rate and activity at any time. But their products are expensive and complex to operate. In comparison, our smart hospital bed is more economical, the use function is not inferior to them, and it is feasible and cost-effective.

1.2. Analysis of China's social situation

From January to October 2017, the number of people diagnosed and treated in public hospitals in China was 2.399 billion, a year-on-year increase of 4.09%; From January to October 2017, the number of hospitalizations in public hospitals in China was 126.2434 million, a year-on-year increase of 6.25%. By 2019, the number of nurses in China was 4.45 million, and the proportion of nurses to patients was lower than the world average. In addition, according to the latest statistics of the national office on aging, by the end of 2017, the national population over the age of 60 had reached 240 million, accounting for 17.3% of the total population, with an average of nearly four labor forces supporting one elderly.

According to the analysis of the code for architectural design of general hospitals, the number of operating rooms should be set according to the total number of 50 beds or the number of surgical beds every 25-30 beds. At the same time, with reference to the planning requirements of the national medical and health service system (2015-2020), by 2020, the number of hospital beds per 1000 permanent residents will increase to 4.8. If calculated according to the population of 1.4 billion, The number of hospital beds in 2020 will be 6.72 million, while the data at the end of 2015 will be 5.33 million (health and Family Planning Commission), that is, 1.39 million beds need to be added, corresponding to 27800 operating rooms, with an average annual new market scale of 13.9 billion. One of the purposes of the emergence of sensor intelligent sickbed is to solve the real-time sharing of detection data indicators between patients, doctors and other medical staff, so as to ensure that doctors can better treat patients; There is also the need to solve the problems of home-based care, nursing home care and community care for the elderly, so that the elderly's families can know their health status in real time and solve their children's worries.

2. Study on the importance and necessity of hospital bed intelligence

2.1. Large domestic and international demand

At present, China's medical industry is mainly faced with two problems. First, the population base is huge and the distribution of medical resources is uneven; Second, the existing hospital bed function in China can not meet the growing needs of the people. Here I have to talk about the view of the motherland: Although many enterprises in China are producing medical devices, China's grass-roots medical equipment is still worrying. Indeed, at present, there is a lack of medical devices in communities and rural areas, and the overall level is not high. Even in the suburbs of big cities, a considerable number of township health centers have unsatisfactory medical devices and instruments. From this point of view, the development of China's medical industry has a long way to go, and the problems such as insufficient hospital beds and insufficient hospital bed functions still need to be solved. The proposal and popularization of the concept of "intelligent hospital bed" can solve the problem of medical devices we face to a certain extent. Generally speaking, intelligent hospital bed is an intelligent hospital bed built for patients' own conditions. From Li Shuwei's point of view, the intelligent hospital bed is required

to be timely, accurate, reliable, simple and feasible, which is conducive to promotion. Its performance is directly related to the safety of patients. It should help patients request doctors or nurses for diagnosis or nursing at any time during hospitalization, and also facilitate doctors or nurses to understand the patient's condition in time.

2.2. The intelligent degree of hospital bed is far from meeting the current needs

After having a certain understanding of the "smart hospital bed", we further observe the market development to plan our own development steps. Through Wang Yongfei's data analysis, China has great potential in the medical equipment market. According to the comparison of data at home and abroad, the scale of China's medical device market accounts for only 14% of the total pharmaceutical market, while the corresponding proportion in the world is as high as 42%. Therefore, China's intelligent hospital bed has a lot of room for development. With the development of society, more advanced and advanced rehabilitation beds are meeting the needs of hospitals and people. However, China has insufficient development in intelligent beds, which also means that there is a large market space for intelligent beds. In the next five years, stainless steel hospital beds will gradually withdraw from the medical market, and the medical hospital beds with powder spraying process on the surface of cold rolled steel materials will be the mainstream. Two and three Shakers replace single shaker and flat bed. In the next 5-10 years, the electric hospital bed will replace the existing two and three shakers. With the continuous expansion of domestic market capacity and the need for high-quality nursing, the prospect of high-end intelligent nursing bed is very considerable. However, most products at home and abroad are expensive in price and complex in operation, which is not suitable for public patients. A humanized intelligent sickbed that meets the market demand, is reasonable in price and innovative needs to be developed and put into application.

3. Application industry and market prospect of intelligent sickbed

3.1. Market problem description and cause analysis

3.1.1. The existence of "data island" makes data resources closed and difficult to share

"Data island" greatly limits the development of pathological artificial intelligence. The development of artificial intelligence needs a lot of data as support. Most domestic medical data are stored in hospitals and third-party testing institutions. The phenomenon of "data island" makes the pathological sections and pathological data for artificial intelligence diagnosis less. The phenomenon of "data island" in hospitals is more serious. On the one hand, China's hospital system is relatively closed, unable to realize resource sharing, and there is a phenomenon of "data island"; On the other hand, the management of medical records in medical institutions is implemented according to the provisions of the health administrative department, and the pathological data are generally closed in the Department. Third party inspection institutions lack communication and cooperation mechanisms. There is a lack of communication and cooperation mechanism among third-party inspection institutions. Although they have a good accumulation of data resources, different inspection institutions have different degrees of data standardization due to the differences of relevant equipment and software, and often develop algorithms based on their own data resources.

3.1.2. Business model lacking multi industry links

According to industry statistics, there are less than 50000 employees in China's artificial intelligence industry. Although Tsinghua University, Peking University, Fudan University and other universities in China have set up relevant majors, and less than 5000 technicians are trained every year, it is still difficult to meet the needs of the developing field of pathological artificial intelligence. Fourth, the industry has not yet established a sustainable

commercialization model. At present, some enterprises master pathological artificial intelligence technology, but due to the particularity of pathological artificial intelligence medical products, no pathological artificial intelligence products have obtained medical device registration certificate in China. This means that pathological artificial intelligence medical technology can not be widely used in clinic. Consumers are still in the market cultivation period and have not accepted the mode of paid software at this stage. The current method can only make hospitals pay in the form of software through artificial intelligence medical technology. How to realize the realization of technical products has become the key to establish a sustainable commercialization model.

3.2. Market scale

Firstly, through the comparison of data at home and abroad, the scale of China's medical device market only accounts for 14% of the total pharmaceutical market, while the corresponding proportion in the world is as high as 42%. China's development in intelligent hospital bed is insufficient, which also means that there is a lot of market space for intelligent hospital bed. Moreover, the development of medical devices in China started late. Compared with developed countries, the R & D investment, innovation ability and transformation ability of scientific and technological achievements of the medical device industry are relatively weak. However, with the development of economic level, people's demand for medical treatment has expanded rapidly. At the same time, the process of population aging has accelerated, and the common diseases of the elderly The demand for daily care of chronic diseases and other medical services will be upgraded, and the outbreak of demand will promote the rapid growth of China's medical bed Market in the future. In the next five years, stainless steel hospital beds will gradually withdraw from the medical market, and the medical hospital beds with powder spraying process on the surface of cold rolled steel materials will be the mainstream. Two and three Shakers replace single shaker and flat bed; In the next 5-10 years, the electric hospital bed will replace the existing two and three shakers. With the continuous expansion of domestic market capacity and the need for high-quality nursing, the prospect of high-end intelligent nursing bed is very considerable.

3.3. Intelligent sickbed has broader application and development prospects

Although the market potential is great, we should see ourselves clearly. On the one hand, we should innovate boldly, on the other hand, we should understand the development of relevant projects at home and abroad to learn from each other, so as to make our products stand firm. After summarizing the development at home and abroad, we found that relevant products at home and abroad only realize part of the electric control of bed structural parts, and their functions and performance can not meet the actual needs of health care for empty nest elderly, patients with mobility difficulties, critically ill patients and comatose patients. In addition, they are similar to hospital informatization There is still a big gap in the construction goals of intellectualization, smart community and smart city, which can not meet the practical application needs of big data access in the era of Internet of things. At present, the development at home and abroad is still in a stable state of development, and there is still a big gap with the practical application. To sum up, while summarizing the development law, we should gradually shorten the gap between actual products and theory.

Based on the above market problems, we designed a hospital bed with relatively high intelligence and easier operation. It can detect and monitor the patient, integrate the data into information after monitoring the human body, and send it to the terminal of doctor or nurse station to report and alarm the patient's physical condition; It also has the functions of intelligent information, such as heartbeat and pulse monitoring, temperature and humidity monitoring, sleep monitoring, blood pressure measurement, automatic regulation of oxygen supply and so on. This new type of can meet a variety of needs of patients.

4. New generation intelligent sickbed design model

Based on the Internet of things, the sensor intelligent sickbed realizes the synchronous networking between the patient's detection indicators and the hospital's clinical, realizes the real-time and sharing of data, and enables the patient, doctors and other medical staff to get the latest data indicators of the patient in time. In this way, patients will understand their severity and treatment, and doctors can better treat patients through real-time data indicators.

The intelligent sickbed we designed mainly adopts the latest sensing technology, and uses pressure sensor, temperature and humidity sensor and heartbeat and pulse sensor to monitor the patient's physical condition in real time. The data is transmitted and processed through the transmission layer and application layer, and the terminal displays and alarms.

4.1. Four layer structure of intelligent sickbed function setting

4.1.1. Sensing layer

Set up temperature and humidity sensors on the bottom layer (hospital bed), set up blood pressure monitors, heartbeat and pulse detectors, collect environmental data and transmit it to the upper network. The sensing layer uses sensitive sensors to monitor the patient's physical condition in real time. The application layer monitors the data and archives, screens and alarms, so as to avoid the serious consequences caused by the initial abnormality of the patient's body in the unattended gap, which brings great convenience to medical workers. For example, the doctor can log in to the terminal approved by the hospital every morning to understand the patient's physical condition; When the number of nurses on duty is insufficient, they can solve the problems of dressing change in time; Treatment data archiving provides great convenience for patient medical record sharing.

4.1.2. Transmission layer

ZigBee wireless sensor network ad hoc network with CC2530 as the core chip is adopted to receive the temperature, humidity, blood pressure, heartbeat and pulse data of the bottom layer (hospital bed), summarize and simply process and transmit them.

4.1.3. Application layer

Carry out serial communication with the wireless sensor network module through STM32 and other terminals, and receive the environmental temperature and humidity and other data transmitted from the lower MCU. The PC host computer program is designed and developed, which has the functions of data processing, screening, alarm and so on. The alarm function is realized by setting the threshold in the combining data function and feeding back the alarm signal beyond the threshold. At the same time, the database and graphical interface are set to facilitate the monitoring of data.

4.1.4. Feedback layer

Set effector in the bottom application environment, and set buzzer if alarm is required. It is used to receive and process the alarm signal transmitted by the upper computer software and respond in time.

4.2. Design model

The design model see figure 1 and figure 2.



Figure 1. Main modules of intelligent sickbed

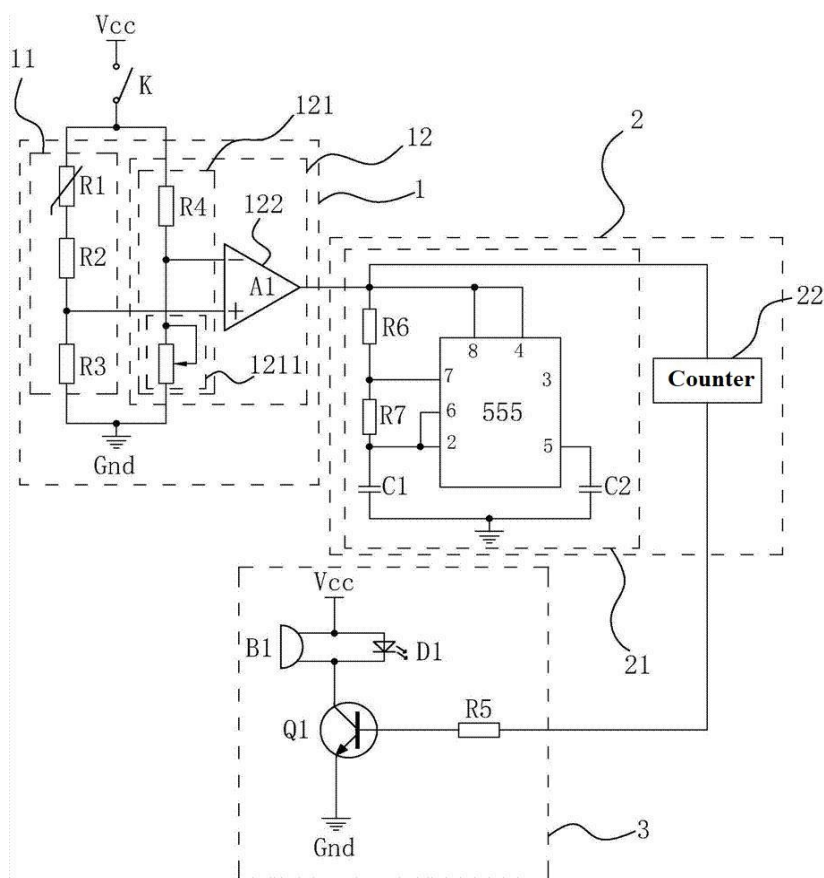


Figure 2. Circuit module design diagram of intelligent sickbed

5. Conclusion

The development of hospital bed industry in China's manufacturing industry is relatively late. However, its innovation speed is no worse than that of other industries. For example, in terms of hospital bed function, the time span from manual hospital bed to electric medical hospital bed is not large, of course, because of market demand. With the development of science and technology and the prediction of the future market, many people of insight in the industry generally believe that there will be a lot of room for the development of smart beds in the future. It is based on the following two aspects. First, the development of science and technology will promote the technological innovation of intelligent hospital bed products. Intelligent chip, artificial intelligence and other technologies are developing with each passing day. These

technologies that are closer to people's daily life will be gradually applied to our medical hospital bed industry, so as to make our hospital bed function more humanized.

The second is market demand. In the future, China will have a huge aging market. The utilization rate of hospital beds for the elderly is very high, and in this case, there will be more requirements for various functions of hospital beds. Especially in the future, there will be a branch of artificial intelligence, nursing. In this case, the requirements for the intelligent function of hospital bed will naturally be. In short, according to professional forecasts, the demand for smart beds has a very good prospect in the future Chinese market, and our design scheme can meet the needs of future customers and will have a certain market application space.

Acknowledgments

This paper is funded by the good helper for doctors and patients: an intelligent hospital bed based on Internet of things technology (No.: s202110599131x) of Guangxi district level college students' innovation and entrepreneurship training program in 2021.

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