



Intelligent Wheelchair Based on Medical Health Examination

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Abstract. The acceleration of the population ageing and the frequent accidents have caused the rapid growth of the number of the elderly and the disabled in our country. The Traditional Electric Wheelchair can no longer meet the diversified needs of the elderly and the disabled in the new era, therefore, it is necessary to research and develop the intelligent wheelchair according to this demand. In this paper, an intelligent wheelchair based on medical health detection is designed. The system is mainly divided into three parts: lower computer, Web end and mobile end. It is mainly composed of STM32 main control chip, 4g communication module, GPS module, sensor module, alarm module and motor driving module, with the function of detecting human health indicators, after experimental testing, the system can effectively remind obstacle avoidance and detect health indexes such as blood pressure, heart rate, body temperature, PM2.5, temperature and humidity.

Keywords: Health index · Intelligent wheelchair · Blood pressure and heart rate · STM32 · GPS

1 Introduction

With the continuous improvement of modern people's living standards and the gradual acceleration of the aging process of our country's population, how to solve the daily life of the elderly is an important contemporary issue. Due to the influence of the childbirth policy of the last century, most contemporary families are single-child families. One family often needs to support multiple elderly people. It is difficult for children to take care of the elderly on both sides while working [1], so the elderly need to have a certain degree of self. Survival skills. Among them, the elderly and some disadvantaged groups with leg disabilities have severely reduced physical functions or loss of motor functions and require the assistance of external media to carry out their daily lives. Therefore, it is very important to design a smart wheelchair to meet the above needs.

In the daily life of the elderly or the disabled, traditional wheelchairs or crutches are usually used to assist travel. Traditional wheelchairs are mainly controlled manually, and there are many problems. For example, manual assistance is still required when using them, and traditional wheelchairs are only a means of transportation for users, and

cannot understand the user's physical condition in time. In order to be able to understand the physical condition of wheelchair users at any time, this article adds some functions to the original basis of traditional wheelchairs, such as adding sensors that can detect human blood pressure, heart rate, body temperature and ambient temperature, humidity, and pm2.5 in modern traditional wheelchairs. Real-time collection of environment and human body information, and can generate the user's path map. Install a 4G module on a traditional wheelchair to act as a client, upload it to the designated cloud server via TCP/IP, and the upper computer receives the information collected by the sensor to analyze the user's environment and physical health, and provide corresponding diagnostic solutions. When these data reach the upper limit set in advance, the manager can be pushed by a short message or forced to occupy the front desk (similar to an alarm clock) to remind the manager, and the device can also be located by calling the Baidu map API. It is helpful for managers to understand the user's location in real time, and to check the information, which effectively protects the personal safety of users. Compared with the current traditional wheelchairs, our products have great advantages, for example, it can detect health indicators (blood pressure, heart rate, body temperature) and the temperature, humidity, pm2.5, etc. of the environment in which it is located, so This is a smart wheelchair that can meet the needs of contemporary people, and can bring great convenience to mankind.

2 Related Work

Intelligent unmanned wheelchair technology is to extend the wide application of electric robot intelligent technology to electric unmanned wheelchairs, integrating technical research in a variety of key areas, including electric robot intelligent vision, robot intelligent navigation and automatic positioning, pattern recognition, multi-function sensors and A variety of user interaction interfaces, etc., the key technical fields involved include electromechanical, control, sensors, artificial intelligence, etc., which can also be called artificial intelligence unmanned wheelchair mobile robots.

Intelligent driving wheelchairs may usually be added a tablet computer and some temperature sensors on the basis of the functions of the electric driving wheelchair, or may be added a power seat system on the basis of the functions of a mobile robot to carry out technological research and development. In 1986, British workers began to use computer vision technology to automatically carry out wheelchair navigation, and developed the first electric wheelchair, which was later called *ibm. TJwatsonresearchcenter's chconnell and ooviola* can set the mobile seat on a mobile robot working platform. Thus, it is possible to use electric joysticks, ultrasonic laser sensors and various infrared laser sensors to directly realize the three-dimensional walking and mobile obstacle avoidance functions of the mobile robot. After more than 20 years of research and development, many countries have invested more funds to develop smart wheelchairs [3]. At present, the United States [4], Germany, Japan, France, Canada, Spain, China and other countries have begun to conduct in-depth research on various types of smart electric wheelchair technologies, so that smart electric wheelchairs can have the following functions: Assisted map, automatic assisted obstacle avoidance [5], automatic assisted walking, interaction with other users, etc. In 2009, Ulm University in Germany re-developed a wheelchair navigation robot *namaid* on the basis of a commercial

wheelchair. According to the different regional environment of the machine navigation, he subdivided the operation mode of the wheelchair machine into: nan (small Regional deep navigation) and nawan (wide regional deep navigation), which greatly effectively improves the accuracy of machine navigation [6]. Together with two researchers from the Hokkaido Institute of Industrial Design, we have jointly developed an intelligent voice-controlled electric wheelchair that can be operated mechanically without requiring any manual labor. The researcher uses a ut as a voice chip that senses the voice of the system. It is installed in a wheelchair. After a user speaks his request aloud to the phone microphone, the sensor voice system has the opportunity to follow his request. Directly start the mobile phone to operate the wheelchair. In addition to the wheelchair being able to walk upwards, forwards, backwards, left and right, and moving speed, the back of the chair is also designed to tilt backward or forward, which makes it more convenient for the user to rest. In the technological development of new smart electric wheelchairs, although my country has developed later than other developed countries [7], at present, Chinese wheelchair developers have already developed and produced many products based on their own advanced technology research and development advantages and application characteristics. Featured new intelligent electric wheelchair [8]. Researchers at home and abroad have also achieved good research results after more than 20 years of in-depth research. In 1998, Fan Xiaochun's paper proposed a new automatic control system method for electric driving wheelchairs, that is, the automatic driving direction and movement rate of this wheelchair are automatically controlled through the wheelchair joystick, and the system temperature is manually adjusted to achieve a certain movement. Stability [9]. In 2011, Sun Dongyuan proposed a smart wheelchair controller with a FREESCALE 8-bit microprocessor as the core, thus realizing the high performance and low cost of the smart wheelchair. The multi-modal interactive smart wheelchair and embedded smart wheelchair of the Institute of Automation of the Chinese Academy of Sciences, the multi-functional smart wheelchair of Shanghai Jiaotong University, and the smart wheelchair based on head movements of the Shenzhen Institute of Advanced Technology of the Chinese Academy of Sciences [10]. The Electrical Engineering Department of Chung Cheng University in Taiwan uses an industrial-grade PC as the control center, which drives the amplifier through the motor control, and uses the joystick to control the operation of the electric wheelchair, etc. [11].

In terms of the structure and design form of the machine tool automatic control system, in fact, most large-scale machine tools currently adopt a master-slave automatic control operating system design method. To control the electric driving mode, the smart electric vehicle generally can use three modes to control the electric mode on the wheelchair, namely, all the three modes of automatic mode, semi-automatic mode, and manual intelligent control. Each model will be formulated for different groups of people. According to the different interface modes of the automobile rolling control system, its interfaces can be divided into two types: the setting human-machine interface and the natural human-machine interface. Among them, the stable human-machine interface that is naturally used on the device is mainly used for patients. Physically disabled medical people who have physical disability or have a low degree of illness and death but have relatively high requirements for their own physical disability movement control ability and have a strong sense of self-protection, including the use of car rolling joystick button

scrolling control, button button scrolling control, Steering wheel button scroll control, touch screen button scroll control, menu button scroll control, etc. [12]. The wide-spread use of natural human-machine interfaces is mainly aimed at special groups of people who have a high degree of physical disability and low physical mobility, including the use of voice operation control, breathing operation control, head operation control, gesture operation control, and biological control. Information signal processing control and other operation methods.

3 Overview of Smart Wheelchair Control System

This research project will be used to design a smart medical wheelchair for medical health detection based on stm32 single-chip microcomputer to realize the four major functions of manual autonomous driving navigation, automatic safe obstacle avoidance, fast automatic human-computer interaction, and multi-functional health services, Can greatly improve the quality of healthy daily life and health work management of urban elderly and severely disabled people, so that they can greatly strengthen their daily life self-care ability and fully integrate into a healthy society. The system is mainly divided into three parts: the lower computer, the Web terminal, and the mobile terminal. With four stm32 as the core of the automatic control system, it is mainly composed of four stm32 master control chips, 4gps communication control module, gps communication module, sensor control module, alarm control module, motor circuit drive control module and other parts.

The main research of this project is a smart wheelchair that can effectively remind obstacle avoidance and detect blood pressure, heart rate, body temperature, PM2.5, temperature and humidity and other health indicators through STM32 single-chip microcomputer, and display the data on the host computer and analyze the results. On the basis of the smart wheelchair, the function of health detection is added, and the user can detect the three health indicators of body temperature, blood pressure, and heart rate anytime and anywhere, which brings great convenience to the user. The design of the entire frame structure is shown in Fig. 1:

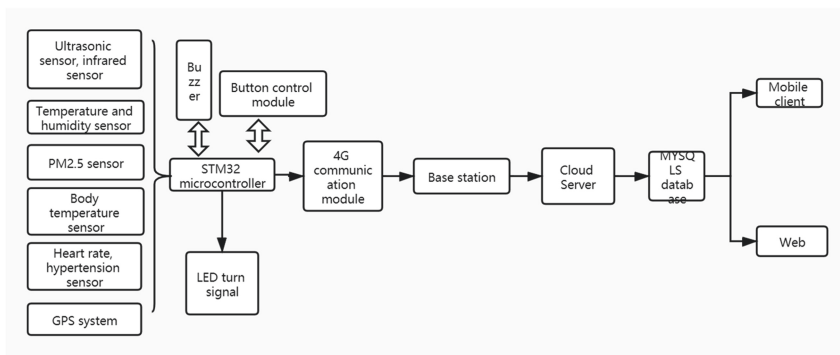


Fig. 1. The design of the entire frame structure

3.1 Introduction to the Lower Computer

The lower computer is composed of stm32 single-chip microcomputer, 4gps communication control module, gps communication module, temperature and humidity change sensor, heart rate graph and hypertension temperature sensor, body temperature and humidity sensor, ultrasonic laser sensor, infrared laser sensor, pm2.5 sensor, noise buzzer and The alarm module is composed. The stm32 microcontroller first reads the data randomly collected by each signal sensor and then processes the collected data. After the data processing is generated, it is sent to the 4g mobile phone communication control module through the serial port, and then the 4g mobile phone communication control module sends the collected data to two Mobile phone communication client and web. In order to better protect the safety of users in the wheelchair, we control the obstacle avoidance module through the STM32 single-chip microcomputer. When encountering obstacles, the signal of the obstacle in front is quickly sent to the STM32 single-chip microcomputer through the ultrasonic sensor and the infrared sensor. After the signal is transmitted to the buzzer, an alarm will be issued quickly to remind the user that there is an obstacle in front. The specific functions are shown in Fig. 2:

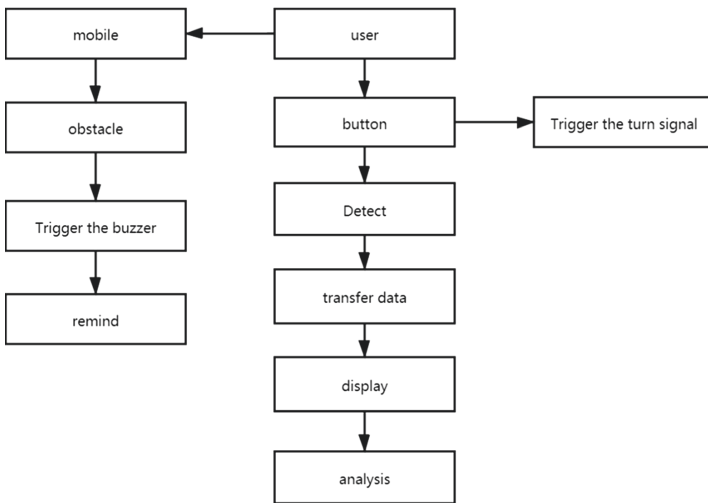


Fig. 2. The specific functions

3.2 Introduction to Android

The mobile development client will be developed based on the mobile development platform with androids, using the new androidstudio mobile development tool, and implemented in the java application language. In addition to being able to view the detected data, the mobile client can perform intelligent analysis on the data. It can draw a line chart by referring to the Android chart view library MP Android Chart and display it in a discounted manner. When the data is abnormal, the guardian will be reminded by means of pop-up windows. Due to the user-oriented particularity, the mobile client interface

will strive to be concise, intuitive, and easy to use, making it convenient for users to view data. Guardians or users can log in to the mobile client and can view the operation of the device in real time. Its overall function is shown in Fig. 3:

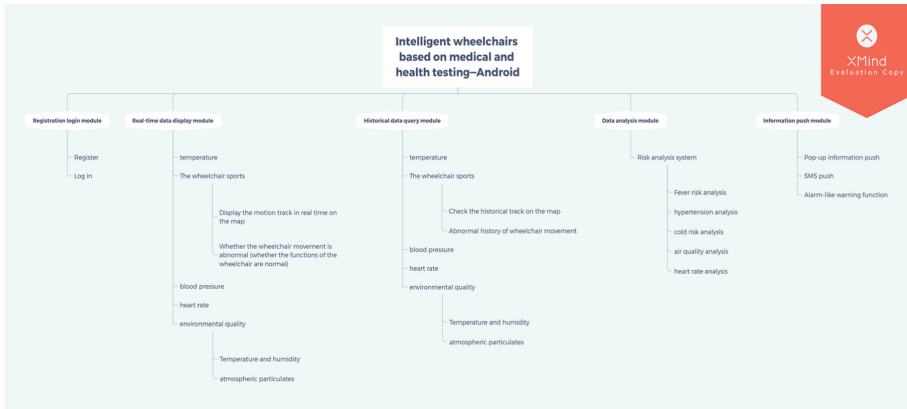


Fig. 3. Its overall function

3.3 Introduction to the Web

Web end uses eclipse software to write JavaScript language, and uses B/S architecture mode. The interface is a tree-like connection structure. The Web terminal realizes the connection operation of the database through the HTTP interface. The HTTP interface obtains the JSON data, and then transfers these data to the interface control, and then the interface control can display the corresponding data. We use graphs to display data. The realization of the line chart uses the Echarts chart method in the Vue project, and draws the chart in the Vue function. Strive to be consistent with the mobile interface, and the page is simple, which can realize data viewing, device location positioning, data analysis, and historical records. The web function is shown in Fig. 4:

4 System Hardware Design

4.1 Positioning and Communication Module

The 4g network module network is an important communication carrier between mobile connected things and one of the core components of the integrated access network of mobile terminal equipment and the Internet of Things. The positioning and wireless communication engine module selects a multifunctional wireless communication module that integrates four high-performance frequency gns communication engines and four same-band frequency gsm/gprs communication engines. gmc20 [2]. Connect MC20's UART serial port transmitter TXD with MCU's UART1 receiver RXD (PA10), MC20 UART serial port receiver TXD with MCU's UART1 transmitter RXD (PA9), then GPS data can be sent to the MCU, STM32F103 will The data is transferred to the MYSQLS database and then transferred to the Android mobile platform.

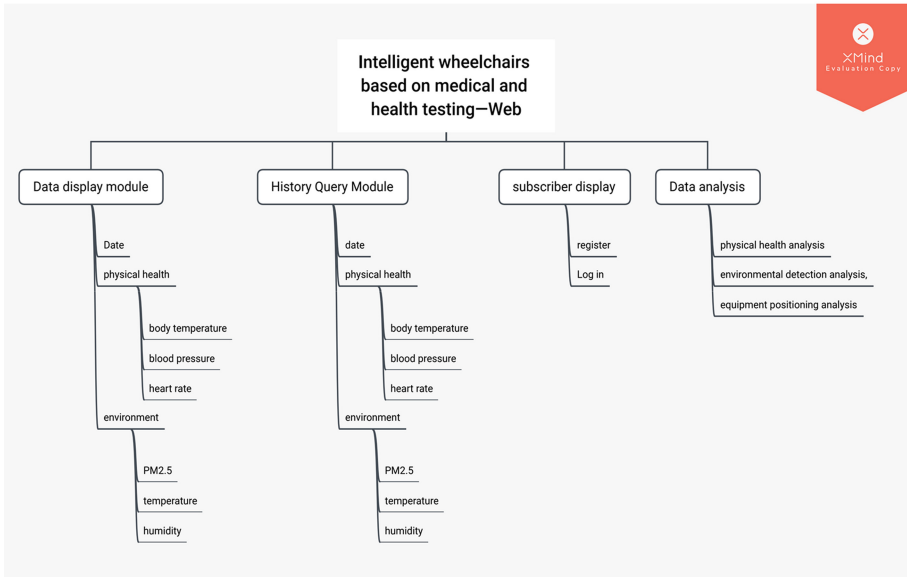


Fig. 4. The web function

4.2 Sensor Module

The main products of the temperature sensor laser module of this technical project include human body temperature and humidity laser sensor, heart rate graph and hypertension temperature sensor, body temperature and humidity sensor, ultrasonic laser sensor, infrared laser sensor, pm2.5 sensor.

The temperature and humidity sensor uses the DHT11 model. The sensor includes a resistive humidity sensing element and an NTC temperature measurement element, and is connected to a high-performance 8-bit single-chip microcomputer. The product has the advantages of excellent quality, ultra-fast response, strong anti-interference ability, and high cost performance. The DHT11 sensor is calibrated in an extremely accurate humidity calibration room. The calibration coefficients are stored in the OTP memory in the form of a program, and these calibration coefficients are called during the processing of the detection signal inside the sensor. The single-wire serial interface makes system integration easier and faster. Ultra-small size and low power consumption, the signal transmission distance can reach more than 20 m, so DHT11 is a better choice. The schematic diagram is shown in Fig. 5:

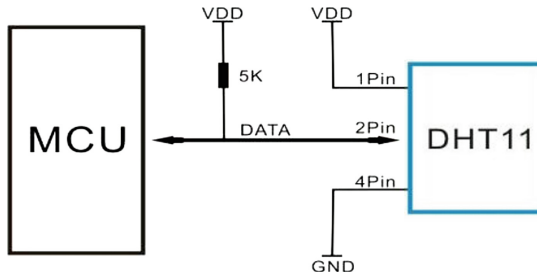


Fig. 5. The schematic diagram

Heart rate, aorta, pulse, flow and blood pressure automatic monitoring blood oxygen sensor is mainly designed and selected a new model mxa30102, max30102 is an active heart rate pulse blood flow high pressure monitoring oximeter based on the integration of man-machine and a passive heart rate, pulse, blood pressure automatic monitoring instrument and it. It is an integrated application module of a biological pulse and blood pressure monitoring sensor. As long as the user only needs to put two round fingers close to a pulse data sensor, he already has the ability to monitor the average blood oxygen concentration and thermal saturation in the pulse data in real time through calculation and output (spo2). And can monitor the pulse in real time. Small neutral red blood cells that carry a large amount of other oxygen can usually only absorb a certain amount or more of long-distance infrared light (850–1000 nm) at the same time, and large neutral red blood cells that are not breathing or carry a small amount of other oxygen at the same time usually also It also can only absorb more ultraviolet light and red light (600–750 nm) at the same time, so the design of pupupulseoximeter is a mini design for analyzing the refraction of blood oxygen fluorescence, so that we can make full use of two red blood cells with different types of fluorescence. The different refraction principles of the blood oxygen refraction spectrum absorbed at the same time are used to accurately analyze the refraction saturation of different types of blood oxygen light. In other words, it can directly detect the average exercise heart rate of the human body in the world and the blood pressure of normal people. Therefore, we use max30102 blood oxygen sensor not only to directly detect the user's heart rate and blood pressure, but the host computer receives the information collected by the sensor to detect whether the user can reach the health indicators. When the data reaches the upper limit set in advance, it can be managed The user carries out a short message push or forced occupation of the front desk (similar to an alarm clock) to remind, and also analyzes the user's environment and physical health, and provides the corresponding diagnosis plan and sends it to the mobile phone [13], for this reason This project has increased the detection of health indicators, which brings great convenience. The measurement standards of nitric oxide and unsaturated chemical factor gas concentrations in blood oxygen are defined as follows:

$$SaO_2 = \frac{C_{HbO_2}}{C_{HbO_2} + C_{Hb}} \times 100\%$$

4.3 Obstacle Avoidance Module

Ultrasonic sensors use ultrasonic waves to detect object distances, and infrared sensors use photosensitive objects to measure object distances [14]. The combination of the two can better avoid obstacles. In order to better protect the safety of users in wheelchairs, we use STM32 single-chip microcomputer to connect ultrasonic sensors and infrared sensors to control the obstacle avoidance module. When an obstacle is encountered, the signal of the obstacle in the front is quickly sent to the STM32 MCU through the ultrasonic sensor and the infrared sensor, and then the signal is transmitted to the buzzer alarm, and then an alarm is quickly issued to remind the user that there is an obstacle in front, and then By driving the L298N motor to control the straight stop, left and right rotation and other actions. The design logic of obstacle avoidance program is shown in Fig. 6:

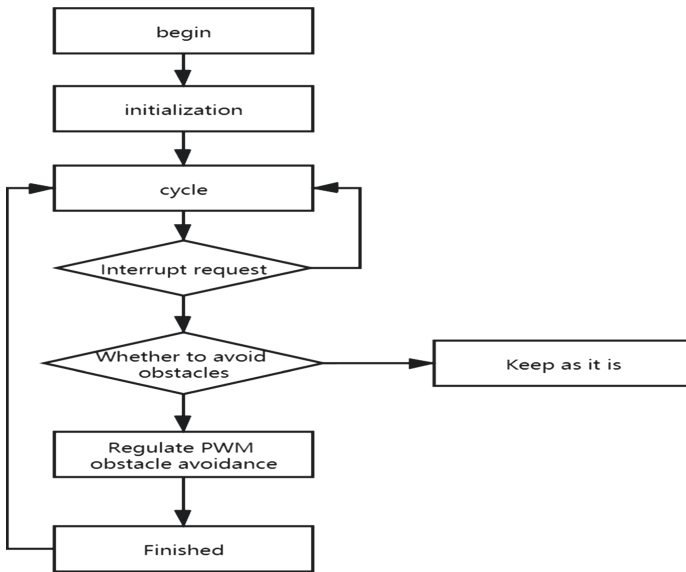


Fig. 6. The design logic of obstacle avoidance program

5 Results

This project is based on electric wheelchair equipment. A turn signal controlled by STM32 is added to an ordinary electric wheelchair. When the user reaches a dangerous distance from an obstacle, a buzzer will be used to remind the user. Here the user can press the button to detect body temperature, blood pressure, heart rate, temperature, humidity, pm2.5, and the data collected by the sensor is sent to the cloud server through the 4G module, and finally to the host computer. The administrator can view the data through the Web terminal, locate the user’s real-time location, and provide related services for the monitor or user. The mobile client can not only view and locate the data, but also

analyze the data in the background and push the medical rehabilitation plan suitable for the user. When the health factor is higher than a critical point, you can directly push the text message or occupy the phone interface to warn, so as to remind the user and make the user aware of their own health problems.

6 Summary

With the rapid development of the Internet of Things, embedded technology and sensor technology, people's daily life has been greatly improved [8]. Our project "Smart wheelchair based on medical health detection" cleverly combines the development of smart wheelchairs with remote monitoring. In combination, a smart wheelchair suitable for patients with inconvenient legs and the elderly is designed.

This system integrates all modules on the wheelchair, which is easy to operate and has strong practicability. The real-time detection of sensors can observe the status of the wheelchair and map the status of the occupants, which not only effectively improves the safety and convenience, And also give the passengers' families peace of mind. Therefore, the main innovations of the smart wheelchair we studied are as follows:

- (1) Equipped with a control system and voice interaction [7], which can not only increase the way users communicate with the network and the outside world, but also control the functional status of the wheelchair at any time;
- (2) When encountering obstacles such as pits and rocks ahead, the voice module will broadcast a sound and tell the user the next walking trajectory to avoid the obstacles in front.
- (3) The wheelchair is equipped with a GPS positioning module. While the occupant is using the wheelchair, the family can check the location information of the occupant at any time, and can also find the specific location of the occupant at any time, so that the family can feel more at ease.
- (4) The biggest design point of this wheelchair is to add the function of health detection on the basis of its smart wheelchair, mainly for measuring body temperature, heart rate, and blood pressure. Its function can detect these three health indicators anytime and anywhere, reducing the trouble of going to the hospital and making it convenient for users.

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