Design of Intelligent Control Medical Nursing Bed

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Abstract. This article introduces an intelligent control medical nursing bed under the control of a single chip microcomputer. It can realize remote monitoring and complete any angle turning. Thus, it will not only be beneficial to recover the patients' condition and prevent the decubitus ulcer, but also ease off the pressure of the family members to take care of the patients.

Introduction

With the acceleration of the aging process of the world population, a large number of elderly and handicapped people need nurse. The traditional nursing beds can only be manually rocked, which make the intensity of care is very large. The emergence of intelligent control medical nursing bed can reduce the labor intensity of family members and nursing staff. The continuous development of domestic intelligent control technology has laid a very good technical foundation for improving the intelligent control of medical nursing beds. The current medical infrastructure is a serious issue. High-end medical devices are the future development trend. Therefore, smart medical devices will have a vast market and bringing considerable economy benefits and social effects.

The Whole Frame

The working principle of the intelligent control medical nursing bed: After the MCU programming, the push rod motor is controlled to complete the automatic folding of the medical bed, and the manual switching can be actualized through the keys. Through the WIFI connection, real-time video transmission or online viewing can be brought out through the camera. The guardian directly uses the computer to control the left and right sideways of the nursing bed and other related operations. Such remote control will greatly reduce the labor intensity of family members and nursing staff and solve the problem that the guardian must be required to appear in person. Multi-functional intelligent control medical nursing beds, compared with similar products in most medical institutions, not only realize automatic control, but also add some practical functions which provide many conveniences in nursing work such as lying down, kneeling, and turning.

The bed is designed for paralyzed patients or people who are unable to take care of themselves. It can realize the folding of various angles of the bed, reduce the labor intensity of the guardian, and realize the guardian's state monitoring of the patient. The bed consists of a bed structure, a control system module, a monitoring module, and a web page. Taking advantage of the k60 single-chip control system, the guardian, according to patients’ actual situation, can make the bed full-automatic or semi-automatic program to achieve the control requirements. What’s more, it realizes remote monitoring and products page production. The system architecture of intelligent control medical care beds is shown in Figure 1.
Hardware Design

Circuit Board Design

According to the functions required to intelligently control the medical nursing bed, the k60 single-chip microcomputer is selected in the hardware circuit board. First of all, we use Altium Designer software to draw the schematic diagram that can realize the corresponding functions. The functions include the key function, which can realize the automatic and manual switching of the control; the warning function, through LED lamp and buzzer, which realizes the emergency alarm; and the motor module, which realizes the rise and fall of the motor, etc. Then, after confirming that the schematic is compiled successfully, the components are exported through the package library. Finally, plot the PCB graph to achieve the best performance. Figure 2 shows the schematic and PCB diagram as follows.

Medical Bed Structure Design

The intelligent control medical nursing bed includes a bed frame, a bed body and several linkage mechanisms. The bed body includes some rectangular bedplates and hinges; the bedplate is laid on the bed frame, and two adjacent bedplates are respectively fixed at two ends of each hinge. Each link mechanism includes an electric push rod and a pulley block; the electric push rod is fixed on the side of the support column provided on the bed frame; the bottom end of the pulley block is mounted on the electric push rod and the top end is under the bedplate. Among them, the electric push rod pushes the pulley group up or down, and the pulley group pushes the bed board up or down, thereby changing the bending degree of the bed body.

The intelligent control medical nursing bed folds the bed body by providing a connecting rod mechanism, so that the patient lying on the bed body can turn over and get up, so that the nursing staff can operate conveniently.

Software Design

Program Control Process

After the hardware design is completed, the software needs to be designed for code writing. The
design software program flow is shown in Figure 3. After entering the main program, determining whether the system is automatically adjusted comes to first. If it is automatically adjusted, then it calls the full-automatically adjusted subroutine, otherwise it will call the semi-automatically adjusted subroutine. As soon as you enter the auto-adjustment subroutine, the system is set to alternately flip and lift up and down every half hour or so. If the full-automatic adjustment is turned off and the semi-automatic adjustment is performed, the intelligent control medical nursing bed can execute the left side turning or the up or down lying operation according to the keys. Meanwhile, it can also perform a manual call alert operation.

![Program flow chart.](image)

**Web Design and Display**

In addition to the full-automatic and semi-automatic implementation of bed rollover to help the patient recover the condition, this design also compiles a dedicated intelligent control medical care bed webpage. Family or medical staff can see all the relevant information about the medical bed and the status video of the patient on the web page. The code and web interface for writing a website is shown in Figure 4. below.

![Website section screenshot.](image)

**System Debugging**

**Physical Structure**

Firstly, this design uses solidworks to model the bed, and then it is imported into the cad software to modify it. Finally, the kinematics and dynamics analysis of the mechanical hardware are used to analyze the bed movement. The mechanical structure of the bed was eventually built according to the model.

Combined with the actual situation of the nursing industry and the needs of the patients, the design of the bed can help the patient to sit up, bend his knees, and turn over and other functions. It is a key technology that needs to be solved to help patients adjust to a comfortable posture according to the
requirements of ergonomics. Due to the needs of completing the turning function, the bed has a relatively large number of variability parts. Therefore, there are high requirements for mechanical design in order to perform a reasonable transformation of the desired angle under ergonomic conditions and have a good stability and load-bearing capacity after transforming different shapes. It puts a high demand on the mechanical structure. The real-time video surveillance system is implemented by a WIFI camera. The camera and the client are connected in the same local area network, which make the real-time video transmission be realized. The medical bed model as shown in Figure 5.

![Physical picture.](image)

**Push Rod Motor Debugging**

The push rod motor is an important element to realize the mechanical movement. Its core is the controller. In this project, the K60 single chip microcomputer is used as the controller, and the movement of the push rod motor is realized by controlling the turning on and off of the relay. Moreover, the relay has the ability to realize the interaction between the control system and the controlled system. Usually it is applied in the automatic control circuit. The relay can realize the control of the small current to the large current. Under the circumstances, the relay is considered as a switch. The following is the process of pushing rod motor debugging. First, start the push rod motor, set the full-automatic adjustment, and observe the movement of the nursing bed. Then set the system to semi-automatic adjustment, press the corresponding up or down button to observe the machine whether execute the corresponding instruction. At the same time, the observation of whether the flip angle is a suitable angle and whether the angular velocity is appropriate is needed. After several adjustments, the best parameters are set.

**Conclusion**

This project is based on the current concept of “Internet Plus” and “Smart City”. This product is mainly composed of physical mechanical bed structure, k60 single chip, push rod motor and other parts. The product uses the single-chip microcomputer program to realize the automatic control of the medical bed and realize the real-time monitoring of the video. We have designed an intelligent control medical nursing bed that is suitable for patients during two years, based on the objective basis of China's pharmaceutical industry and medical and health care. The high-performance medical device that serves a new type of product that is safe, practical, convenient, and reliable for the user.

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**References**


