Design of Home Service Robot based on Single Chip Microcomputer

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Abstract. In modern society, with the development of material civilization, people begin to pursue a more convenient and happy family life. According to our verification, the current home service robot has not really out of the laboratory, into the people's homes. Therefore, we made a single-chip microcomputer-based home service robot, which has good flexibility and adaptability. Three omnidirectional wheels are adopted in the structure, which can enhance its flexibility, including remote control, voice dialogue, intelligent obstacle avoidance, path memory, and good adaptability to the complex environment of the family.

Keywords: Home Service Robot; Family Meals; Wireless Remote Control; Real-time Control; Path Memory; Intelligent Obstacle Avoidance.

1. Introduction

With the development of the society and the continuous improvement of people's living standard, the requirements for the daily life of the family are also higher and higher. On the one hand, the rapid development of information and the quickening pace of life and work require people to get rid of the complicated family labor. On the other hand, as China's aging population is more and more serious, more and more old people need care, social security and service demand is more urgent, but after years of family planning policy, China has already formed the inverted pyramid structure, population aging family structure will inevitably make more young family pressure increases, and the accelerating rhythm of life and work pressure, has also made young people don't have more time with their children, then making will be the home service robot, born of the market, such as family care robot, toys, entertainment robots, robot cleaning robot will be most needed [1]. The home service robot we designed and made is based on three omnidirectional wheels, which integrates food delivery, dust removal and entertainment voice dialogue. It has great flexibility and intelligence. It will walk into the homes of ordinary people in the near future when it walks out of our laboratory.

2. Working Principle of Home Service Robot

2.1 Overall Design

The home service robot includes chassis, dust removal device, sensor part, storage device, remote control of upper computer and control system, etc.

(1) chassis: it is the basic component of the whole system, consisting of three omnidirectional wheels and other connecting devices, used for fixing and installing other parts. For example, for carrying storage device, ultrasonic sensor, camera and voice playback device;

(2) dust removal device: two built-in vacuum cleaners can automatically clean the house and clean the room by avoiding obstacles.

(3) sensor parts: in the robot body side of ultrasound and sonar sensors installed in it at the top of the camera, through the ultrasonic ranging principle to detect obstacles around them near and far, when indoor sport in order to prevent the robot will not collision, so as to realize the obstacle avoidance function, camera can real-time scanning the status of the surrounding environment, displayed in the upper machine [2];

(4) storage device: the storage cabinet is a cylindrical cabinet, which is used for family services, such as food delivery, goods handling, etc.;

(5) remote control and control system of the upper computer: the remote control is in the form of touch screen. It can control the movement of the intelligent storage cabinet by drawing a route on the screen, or walk by drawing a path with the mouse on the simulation screen of the upper computer. The host computer displays the data from the camera in real time on the computer screen. The main control is stm32 chip, through the wireless transmitter NRF24L01 to the lower avr MCU to send control signals, to achieve various obstacle avoidance and path memory functions.

2.2 Module Part of Home Service Robot

2.2.1 Touch Screen or Real-Time Computer Control

1. The touch screen remote control is composed of STM32 microprocessor and TFT color touch screen

2. Control the trajectory of the robot by sliding the touch screen.

3. Use Visual Basic to write the upper computer program, and drag the mouse to control the trajectory of the robot.

2.2.2 Speech Processing

In order to show more humanization and intelligence, the home service robot can also carry out speech recognition, that is, we can have some simple conversations with it and control its actions through some simple voice commands. Speech recognition is realized by speech recognition chip, single chip microcomputer, audio and so on.

2.2.3 Path Memory

One of the main features of this robot's intelligence is its path memory function, that is, he will remember this command after the master has set the route, and next time he needs to do the same thing, he will do it automatically and completely leave the master's control. For example, if we want him to deliver food to us from the kitchen, as long as the first time we remote control it, let him finish the meal, the second time into the delivery mode, he will run to the kitchen himself to deliver food, drink, this is his memory function. Memory function block is through an external memory EEPROM, delivery time, for the first time in the path parameter written to memory, when the second time for meals, he will query the data in the memory card, so as to realize the function of memory, the content of the magnetic memory he no lose when power supply drop, which can be a robot can perform a path to memory.

2.2.4 Clean and Remove Dust

The home service robot can clean and remove dust. It has a vacuum cleaner installed in its underground, which can clear the dirt and rubbish on the ground anytime and anywhere. The function of cleaning and dusting is realized by a built-in high-power vacuum cleaner, and the control of vacuum cleaner's switch and dusting function is realized by an amplifying circuit composed of optocoupler, audion and relay.

He uses traversal vacuuming and intelligent obstacle avoidance, uses ultrasonic module to detect obstacles, and triggers traversal function with keys.

2.2.5 Obstacle Avoidance Part

Obstacle avoidance is realized by an ultrasonic sensor installed in front of the robot. Ultrasonic wave can detect the distance of the object in front, so it can judge whether there is an obstacle in front according to the distance.

3. Control of Home Service Robot

3.1 Control Strategy

Robot's video feedback, manual control, intelligent integrated memory obstacle avoidance strategy, can use wireless real time control of the robot's actions, truly realized the man-machine operation

concept, and can be run automatically through the memory model, adopt the ultrasonic sensors for obstacle avoidance strategy, such as to avoid the accident that occurs in the runtime automatically.

3.2 Selection of Control Chip

Remote control need to use a touch screen control, so choose the STM32 processor as the controller, the core of robot control are three pieces of single chip microcomputer, is one of the host, it is Mega128, AVR series from the other two machines, one is Mega128, wave sensor is used to control the motor and super god, another is 51 single chip microcomputer on STC company, it is used for counting pulse, can realize closed loop control of motor [3].
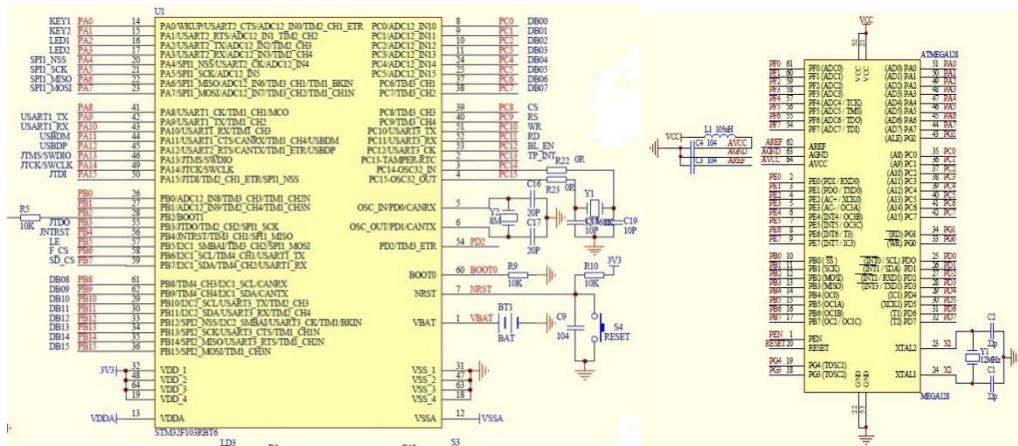

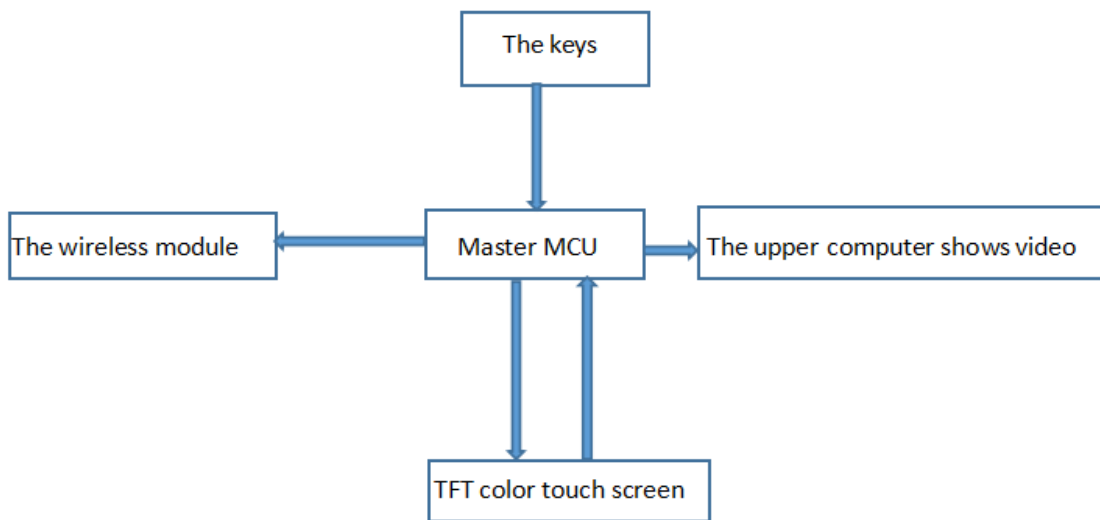Figure 1. Circuit diagram of main control board of remote control and circuit diagram of main control board

Figure 2. Circuit structure of remote control

4. Analysis of Main Innovation Points, Prospects and Economic Feasibility of the Work

4.1 Innovation Analysis of the Robot

1. Combined with wheeled chassis, the robot can be used for both storage and delivery. The total power of the motor is up to 80w, which can be used to transport heavy liquid drinks or meals.

2. Memory path. Eeprom is used to save path data, which can be erased more than 10000 times without power loss.

3. The chassis structure of three omni-directional wheels adopts vector closed-loop control with high stability.

4. Color touch screen control, in line with the current trend of large screen mobile phone era, reliable control, easy to operate.

5. Voice conversations. The addition of voice control chips to the lockers reflects the future development of science and technology and the people-oriented concept of future people's requirements for intelligent machines.

6. Automatic photo saving function for visitors can be used for anti-theft.

4.2 Economic Analysis of the Robot

1. Insulation board material is selected as the basic material of the vehicle body by the robot. Compared with metal material, it has low price and high cost performance.

2. The robot remote control USES NRF24L01 wireless module, which is low in price and high in cost performance. The remote control USES resistive touch screen, which simplifies remote control and low in price.

3. Adopt ultrasonic sensor for obstacle avoidance, high cost performance and convenient use.

5. Summary

Family service robot is a new research field. With the development of the society and the continuous improvement of people's living standard, it has higher and higher requirements for the daily life of the family. The home service robot designed by the author of this paper with STM32 single chip microcomputer as the controller integrates meal delivery, dust removal and entertainment voice dialogue. It has great flexibility and intelligence. In addition, it has realized the required function with low cost, convenient operation and use in the process of experimental testing, and has great value in use and promotion.

References

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