

# Design and Implementation of Robot Remote-Control System Based on Embedded Platform

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**Keywords:** Remote-control system, Robot, Embedded platform

**Abstract.** In order to solve the problem of high cost and poor expansibility, this paper presents the design and implementation of the robot based on embedded platform. This paper introduces the design of the printed circuit board backplane, interface, information acquisition and information interaction module of the robot remote-control system based unimpeded platform. We have verified the usability of the system through experiment to provide some references for the relative researchers.

## Concept and Features of Embedded Platform

Common definition of embedded system is application centric based on computer technology, hardware and software which can be cut, for the application of the system, a special computer system to function, reliability, cost, volume, power consumption. The computer system includes two branches: general computer system and embedded computer system. The general computer system generally adopts standard design, including the general architecture of storage devices and large capacity, can carry out high speed and mass data processing; and the embedded computer system is a computer system for data storage capacity and computing ability of resource constrained. Its function, cost, shape, size, reliability, power consumption and so on are limited according to the design requirements of the application object, so there is no standardized design. The biggest advantage of embedded systems is that, according to the actual needs can be tailored to different systems. It is composed of four parts: embedded microprocessor, peripheral hardware, embedded operating system and user's application program, which can be used to control, monitor and manage other devices. Embedded system is an integrated platform of software and hardware. The processing ability of the integrated platform is much higher than that of the previous. System kernel. Embedded systems are usually used for small electronic products, the system resources are relatively small, so the kernel is much smaller than the traditional operating system. The software and hardware of the embedded system are very close. The system is based on different hardware, even the same series of products for the same task should be modified according to the change of the hardware.

## Hardware Design of Robot Remote Control System Based on Embedded Platform

**Design of Printed Circuit Board.** If the user uses the interactive layout system can automatically detect the current state of the layout, display the current layout in violation of rules error or warning, which greatly reduce the error caused by the layout for the work. In order to get a satisfactory component layout, the user must set the printed circuit board component layout rules. Printed circuit board routing rule number routing is based on various specifications, such as safe spacing, wire width and so on, which is a constraint on automatic wiring. The wiring rules are also one of the key printed circuit board design, need some practical experience, the wiring rules cannot be too high nor too low, if the constraint conditions are set too high, will bring about the difficulty of wiring, the wiring of low success rate, the constraint conditions are set too low, not only the quality will be affected, but also bring risks to the actual product, even unable to meet the actual requirements. For more stringent requirements of the wiring line, the input and output lines should be avoided as far as possible to the adjacent parallel, in order to prevent the occurrence of reflection interference. When necessary, the ground wire should be isolated, and the wiring of the two adjacent layers should be perpendicular to each other, which can easily produce parasitic coupling. Firstly, the power line and the ground wire

are wired to ensure the electrical performance of the circuit board. In the scope of the allowable conditions, should try to broaden the power line, the width of the ground wire, preferably the line than the power supply line width. If the wiring density is high, the hole size can be reduced, but not too small. The printed circuit board of the digital circuit can be used to form a circuit which is composed of a wide ground wire. In order to enhance the network connection of the printed circuit board and improve the reliability of the welding components, it is sometimes necessary to make the printed circuit board.

**Design of Backplane.** The image and display of information output, input by input mixing handle keys and touch screen; wired and wireless network to Ethernet network controller and the wireless LAN network controller; power module directly affects the accuracy and performance of the system, to guarantee the output of high quality, good stabilizing effect and strong reliability in order to expand the capacity of the system; convenient, increasing redundancy design, leaving expansion interface, later need to simply connect the corresponding capacity of the Flash chip can, before the design of the development platform has not yet been achieved, development and transplantation procedures are carried out in the experimental hardware platform, so choose a core and the design of the development platform of the same device experimental platform. By contrast, the HHARM2410 development platform in the experiment, it is a high-performance platform for S3C2410 chip, suitable for the development of high performance portable intelligent terminal equipment and product design, rapid expansion on the basis of this platform. The experimental platform server of wheeled robot can be divided into several parts, such as video acquisition, processing thread, sensor data acquisition thread and data transceiver thread. All the sub thread and data acquisition package unified package in the main thread, send to computer through the data sending thread, and data reception thread can receive and parse the computer command, used to control the motor when the computer client server closes the connection exit, and data acquisition in the monitoring state.

**Design of Interface.** Between the remote-control system and the miniature mobile robot interface includes data input interface and output interface data input, data interface to external data input to the remote-control system, remote control system will output the processed data output. The input data of the remote-control system mainly includes two aspects: analog video information and speed angle measurement and control information. For these two kinds of data, the remote-control system is as follows. First of all, through the information processing system into 320 x 240 gray digital image, after compression can reach about 10KB, and then use the wireless network to the remote terminal display. In the case of indoor network 30m network conditions are good, the transmission rate of up to 15 frames/s. The data transmitting station of the information processing system is transmitted to the remote-control terminal directly after receiving, and the speed and the angle information are stored in the floating-point type. The output data of the remote-control system is the control command issued by the robot. The control instruction first through the wireless network to the information processing system, information processing in the system after analysis, determine the type of the command and different sign, finally sent by radio to the miniature mobile robot. Remote control system has two very important parts, 3G wireless internet module and USB camera module. These two parts are connected through the USB interface and the system, so the remote-control system needs to stimulate the two USB interface. Here, the use of USB Hub can easily through a USB interface to extend the 4 or more USB interface, thus solving the need for multi interface. If you no longer need time for a piece of equipment, also can at any time, and can insert a new equipment in the port, of course, this new equipment also can immediately be confirmed and began to work immediately, so the USB interface has attracted more and more manufacturers and users. The system also uses USB interface.

## **Software Design of Robot Remote Control System Based on Embedded Platform**

**Design of Information Acquisition Module.** In the touch screen pen to click to send control commands to electrical stimulation for experimental staff efficiency is not high, a touch screen is affected by the reaction time limit is two; if the experimenter pen placement allowed or touch screen positioning of the contact is not easy to cause the disoperation. The experiment staff needs long time watching PDA fatigue. Therefore, a remote-control module is developed to facilitate the operation of

the experimenter. As long as the laboratory technician by remote control button on the control of the PDA send corresponding commands. Compared to the experimental stimulus in one hand PDA, a holding pen, a single hand can control the more remote control cabinet is the electrical stimulation experiments better choice. We have 4 development board buttons the original together with the next pull-up resistor removed, correspondingly connected to the output line remote control receiver, each output line with a corresponding button remote control transmitter module. When a button of the transmitting module is pressed, the level of the output line of the receiving module can be changed, and the 53C2410 can detect the change. The image acquisition card does not occupy the system resources when the image is collected, and the application can use all the resources of the CPU. Using parameters to set the number of image buffers in memory. When the program starts running, when the first frame image acquisition is completed, to the memory of second frames of image acquisition, image data and image processing program can handle the first frame, when the second frame image acquisition is completed, to the memory of the first frame image acquisition, image processing procedures can be handled in the second frame of image data, so repeatedly. When the PAL image data processing time is less than 1/25 second, you can achieve the real-time image processing. When the program is implemented, the image processing program is placed in the callback function, so that the image will be processed immediately after the successful acquisition.

**Design of Information Interaction Module.** As a remote-control system, communication module is very important. The system uses the Bluetooth module to communicate with the backpack on the animal, and can transmit the collected data to the PC terminal through the wireless local area network. Bluetooth wireless interface to replace the cable connection, has strong portability, and is suitable for various occasions. The technology of low power consumption, strong penetration, stable performance, little harm to a human body, and the application is simple and easy to realize, so easy to popularize. In order to improve the development efficiency and save the development time, the Bluetooth module is selected. Bluetooth embedded module as a cable replacement program, it can be directly connected with the microcontroller or processor, plug and play in a transparent way to achieve wireless data transmission between devices. It is mainly responsible for converting the data received from the serial port to the Bluetooth device which is sent to the other side of the Bluetooth protocol. USB UART module using UART bridge controller. The chip with high integration. The built-in function at full speed controller, USB transceiver, crystal oscillator, EEPROM and asynchronous serial data bus, modem, support full function signal, USB device without any external. It accords with the requirements of the USB2.0 specification, the maximum transmission rate of 12Mb/5. asynchronous serial data bus, it is compatible with all hands and modem interface signal. PDA can be accessed through the USB wireless network card to the wireless local area network, through the wireless network to collect the neuronal activity signal to the wireless network access to the PC terminal. The structure of the information interaction module is shown in the following figure.

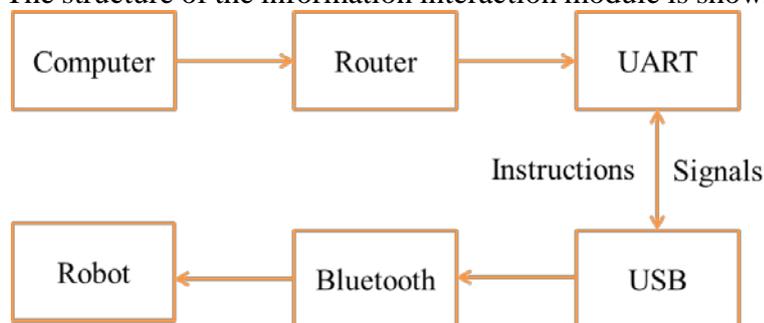


Fig. 1: Structure of the information interaction module

### Implementation of Robot Remote Control System Based on Embedded Platform

The analog signal collected by the camera through the video vehicle wireless transceiver to signal processing system, the remote terminal operation is based on digital image, so image acquisition chip converts analog signals into digital signals. The transmission of measurement data and control command is responsible for the data transmission station. The signal processing system mainly

includes the image processing module and the path key acquisition module. The main task of image processing module is to convert the input analog image into digital image in real time. Key problems. This paper adopts the method to determine the path segment of the horizon, the basic idea is: first set a distance threshold, select a series of path points in the visual range, with the robot at the flat ground plane, the projection of all path points, obtained after projection coordinates of the robot; on the basis of a path towards the first coordinate point forward, when the advance distance reaches a distance threshold, set the time for the robot flat big new horizon, and weed out the key point of the robot has arrived at the same time, the re projection of key points on the left, to correct the coordinates, then the robot in the new high on the horizon and based on revised coordinate point forward. So back and forth until the robot reaches the critical point of the last path, and then select and project the key points of the next path. In the remote-control terminal, the information display module can display the video image transmitted by the robot, and can display the state of the robot and the instructions given by the operator through the data. Through the interactive control module, the operator can use direct remote control or semi-autonomous remote control. The use of wireless local area network communication between remote control terminal and signal processing system to realize the remote transmission of analog signals in the signal processing system. Then the digital image information is acquired by the image acquisition card for the operation of the handheld terminal. The number of radio to achieve safe and efficient transmission control command and control data, remote control system software using the embedded Linux as the software development platform, real-time calculation and graphic display function on the basis. The host computer monitoring software is installed on the PC, the host port is configured, the address of the embedded system, the port and the video port number are monitored and controlled. We realize the robot in the process of getting video, and can avoid obstacles. Robot shape design using humanoid to achieve forward, backward, turn left, turn right of the experiment.

## Conclusion

This paper introduces a design scheme of remote control system based on embedded platform. Experimental results show that the system can be used to control the navigation in the off-road environment by the way of human-computer interaction. The system has good scalability and prospect. The research will continue to strengthen the stability of the system and expand the system function in the later.

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