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Design of Cross-Country Robot Control System Based on Wireless Communication Module

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Abstract. This paper describes the design of the cross-country robot's control system. It mainly includes two parts, one is the software and hardware system for the lower computer, the other is the man-machine interface for the upper computer. The core of the hardware system is MCU; it controls double relays to drive the motor's positive and negative rotations, and accordingly carries out the cross-country robot's forward, backward and other functions. On the other hand, the upper computer uses VB to program and it uses a component named MScomm to communicate with the lower MCU via wireless COM. The double relays' controlling motor is this paper's innovation point.

Introduction

In modern measurement and control system, as PC has large ability in data processing and excellent interface for our users, MCU has good anti-jamming and well cost performance, so it is well applied using PC as upper monitor and MCU as lower computer in data acquisition and system control. This paper uses MScomm[1] and wireless COM to realize the data exchange between PC and MCU. The data is transferred to AT89C51 through RS232 COM, and to control cross-country robot to go forward, go backward, etc. Furthermore, the AT89C51 sends sensor's data to PC to display.

Overall Design of the System

The system flow chart is shown in Fig.1.

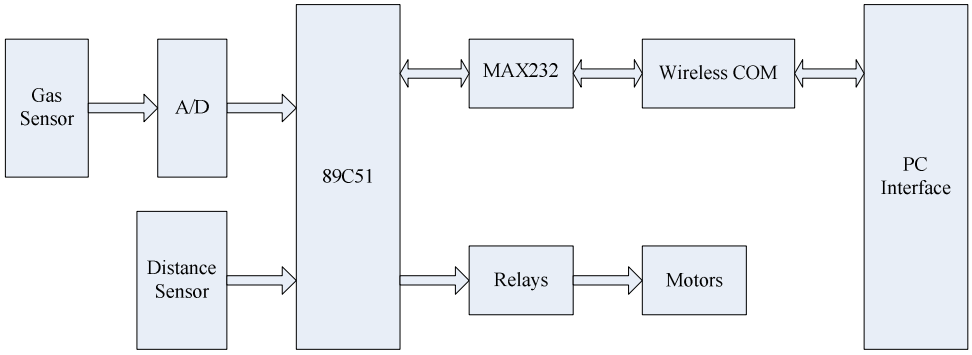

Fig. 1. Overall design

This system realizes two functions. First, we can use PC to control the robot's forward, backward, left rotation, right rotation and other functions; second, we can see the sensor data sent from lower MCU via wireless COM to PC, and determinant how to control the robot further. The core of control system is AT89C51.

The system can be divided into two parts, upper PC and lower MCU. The function of PC is to send orders to the robot and to check sensor's data. MCU has two functions; one is to collect sensor data to send to PC, the other is to control robot's motors according to received commands. Data exchange is realized by wireless COM.

Hardware Design

The hardware part is based MCU. It adopts 12MHz crystal, the reset circuit is power-on-rest and key-rest. The main parts are introduced as below.

The Power Part. As the dc motors' supply voltage is 12V, and MCU needs 5V, so we need voltage switch and voltage stabilization. We adopt the 3-terminal 1A positive voltage regular LM7805. It has three footprints, one is input(12V), one is output for MCU 5V, the other is GND. It's application circuit is shown in Fig.2.

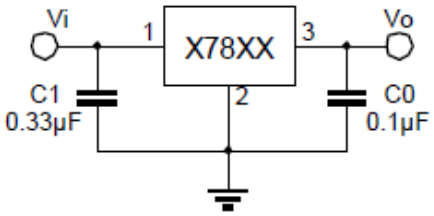

Fig. 2. LM7805

The Motors' Part. The circuit for motor's driving is by two relays. It accepts the MCU's commands to control the motors' positive and negative rotations. The relays output is 12V. Fig.3 shows how to control motor's rotation by the relays. In this figure, the transistor's base is connected to MCU's I/O, and the I/Os' "01", "10" control the relays and then control the motor.

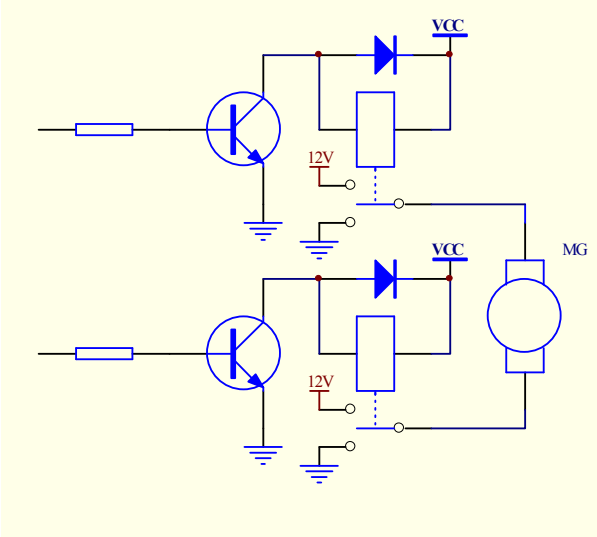

Fig. 3. Motor circuit by relays

232 Circuit. MCU and PC's data exchange is carried out by COM, it needs a 5V-12V switch circuit, 232 circuit. We adopt MAX232 to establish the circuit, as shown in Fig.4.

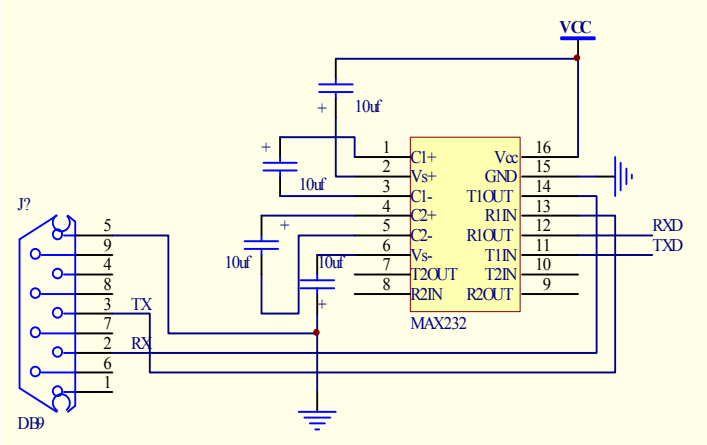

Fig. 4. MAX232 circuit

Sensor Circuit. A System's input is sensor's data. The gas sensor can detect fog and methane gas. We adopt analog sensor, its data is converted by ADC0831 to digital data before sending to MCU, and can be read on PC via wireless COM. The circuit is shown in Fig.5.

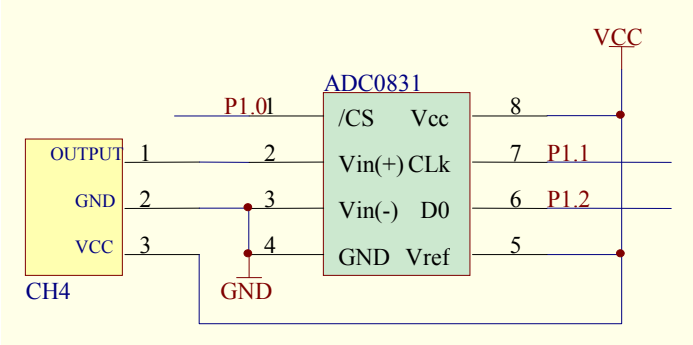

Fig. 5. Methane gas sensor circuit

Wireless COM Part. This part is realized by wireless COM module XT02-232AP1, with frequency band 430 KHz, 300 meters' transmission distance, baud rate 4800bps and data format "8N1". This module's send part is connected with PC, and it's receive part is connected with MCU.

Software Design

The software design includes two parts, one is the lower MCU program, the other is the PC's VB program.

Lower Computer Program. The function of the lower computer's program mainly is to accept the commands from upper monitor, for example, to drive the motors or to pick up sensor's data to PC. The program is written in interrupt mode with C language, its flow is shown in Fig.6.

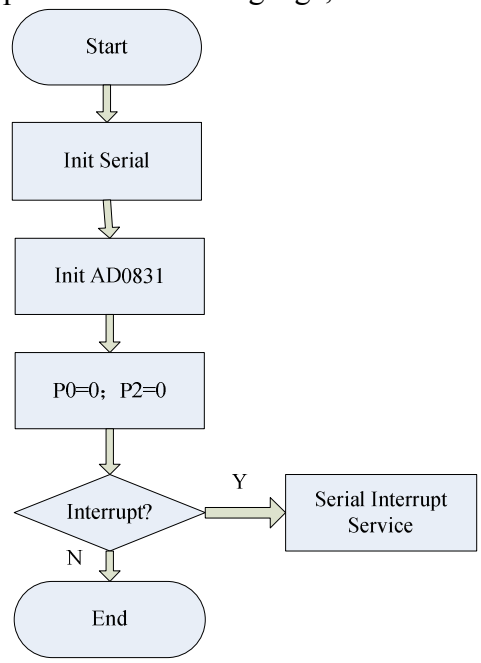

Fig. 6. Lower computer program flow

In the COM interrupt service program, MCU reads the commands form PC and makes use of switch codes to determine concrete order and then to control the relays or send sensor data to PC.

Upper Monitor Program. Upper monitor program is developed in VB[4], it is mainly a man-computer interface. Users can input control commands for robot or check the state of gas sensor and distance sensor. In a word, through the interface, user can control robot and check the work field.

As we use wireless COM to communicate, the VB program uses MScomm component[5]. We only need set the component's properties and program its events to carry out COM communications. We use the component's output property to send commands to lower computer, and use its input property to receive sensor data. The baud rate is 4800bps.

The interface is shown in Fig.7. In this figure, the "start", "stop", "exit" and two sensors button are in response to mouse, other buttons are in response to keyboard via form_keypress events. From this figure we can see that it is very convenience to control, and the robot has 12 functions. Because of the robot is carried away for other uses before writing this paper, I am very sorry that there are no data in the interface's textbox, but I am sure the 12 functions are realized.

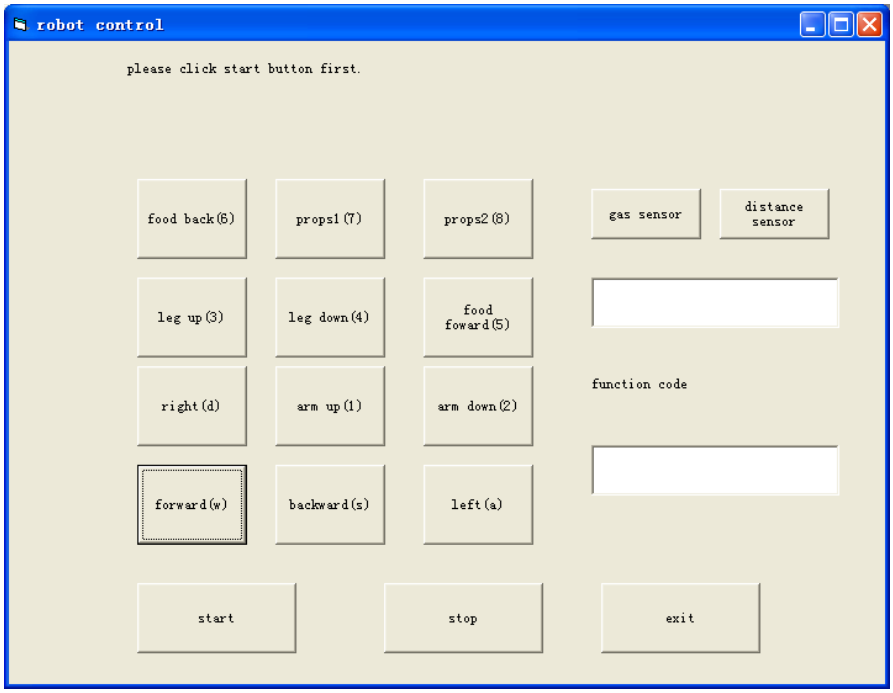

Fig. 7. Upper monitor interface

Summary

This paper gives the hardware and software design for the cross-country robot control system based on AT89C51, and the upper monitor control software based on MScomm. The hardware and software system are both verified by experiments. Through the experiments test, we can easily control the robot's multi functions and check work field's gas and distance states by sensors with the upper monitor's interface. The wireless COM module's use is one of this paper's bright points.

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