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Design of Table Tennis Ball Picking Robot Based on LPC1752

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Abstract: In view of the disadvantages of the traditional manual picking up table tennis with large amount and low efficiency, the method of using RF wireless communication technology to carry out the remote control of table tennis ball picking robot is proposed, and the hardware platform of system is built with Cortex M3 –LPC1752 development board, NRF905 wireless data transceiver module, LCD12864 screens. Using infrared sensor to detect the environment of the robot to achieve obstacle avoidance, using TCS230 color sensor to realize autonomous recognition of table tennis, using the three - Page roller driven by the motor as the executing agency to carry out the table tennis. The system software is written in C and VC++ programming language. The system is debugged and achieves the preconcert function of the robot. The communication distance of wireless remote control can reach to 50 meters, and the communication is stable and reliable.

Keywords: Ball picking robot; LPC1752; Color recognition; PWM; RF

INTRODUCTION

Table tennis as a fashion movement has come into everyone's lives, now we have more and more table tennis hall, also has a growing number of people like the table tennis sport. In particular want their technology to get better to improve the way people often used practice, practice really works. However, after the pick-up ping pong ball exercise is most of us are not happy, because the ball will cost us a lot of energy and effort. If there is an alternative we ball machines that much better? Ping pong ball picking robot was born. Ping pong ball picking robot is a kind of service robots, service robots is a semi-autonomous mobile robots or automatic, mainly engaged in non-production activities; it can help people save time and effort to complete the work [Xu et al., 2008].

This design of the table tennis ball robot, Sphere uses color recognition sensors to recognize for table tennis, after seeing the ball, robot forward followed up with motor-driven three-page roller picked up the ball, using reflected infrared sensor in cars during avoidance.

THE OVERALL DESIGN OF THE TABLE TENNIS BALL PICKING ROBOT

The design of LPC1752 Control chip, mainly by 4 Components: namely control, picking up the ball, driver, display.

Control section: LPC1752 Development boards to control; DC motor, main control is the reflected infrared sensor, a color module [Zhou, 2007]. When a car is detected by infrared sensors for obstructions in front, if obstacles are on the left, the right wheel of the car is suspended and delayed for some time, until the car turning right around the obstruction if obstruction is on the right, the revolver of the car is suspended and delayed for some time, until the car turn left around the obstruction. When the color module TCS230 identified in table tennis, the car will keep going until picked up the ball inside the car [Zhang et al., 2004].

Ball module: geared motor-driven roller collecting the ball into three pages inside the car is to be achieved.

Driver module: L298N Driver robot car left and right wheels, combined with infrared sensors around the car steering control [Li et al., 2012].

Display module: LCD12864 Display robot current state and detected by the number collected through the color of table tennis and table tennis.

Structure diagram of a table tennis ball robot As shown in figure 1.

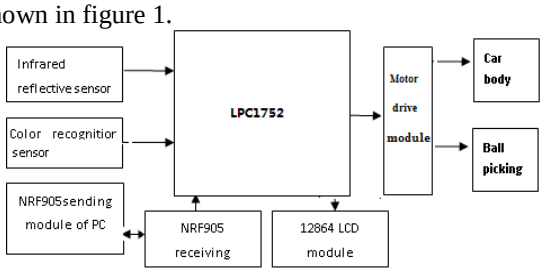

Figure1 Ball picking robot structure

Considering experimental table tennis ball picking up the strength and stability of spherical robot, body using 5mm thick acryl glass plate on a milling machine milling all kinds of parts assembled and body driving selection of M30 type metal copper gear

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dc gear motor, ball picking module using friction of silicon rubber made three pages of drum shape.

BALL PICKING ROBOT WIRELESS REMOTE CONTROL SYSTEM HARDWARE CIRCUIT

Core Controller and System Power Supply

The controller is the LPC1752 development board. LPC1752 is a micro controller based on Cortex-M3 kernel, which is suitable for embedded applications requiring high integration and low power consumption. LPC1752CPU operating frequency is up to 100MHz. Lpc1752 peripheral component includes up to 64KB flash memory, 16kb data memory, USB device interface, 8 channel universal DMA controller, UART, 1 can channels, two SSP controller, a SPI interface, two I2C interface, 6 of 12 bit ADC, motor control PWM, quadrature encoder interface, 4 general purpose timer, 6 outputs universal PWM, with separate battery supply of ultra-low power RTC and up to 52 universal I/O pins.[4]. In order to ensure the endurance capacity, power system part by ACE 30C 3500mah 7.4v lithium battery, through the module of voltage regulator lm7805 and as1117 respectively to the steering gear and a main control chip power supply [Li et al., 2014].

Color Recognition Sensor and Control Method

TCS230 is the TAOS Company introduced the programmable color light to the frequency of the converter. The configuration of the silicon photodiode and current frequency converter integrated on a single CMOS circuit. At the same time in a single chip integrated red, green and blue (RGB) three filters; it is the industry's first digital compatible interface of RGB color sensor. The output signal of the TCS230 is the digital quantity, can drive the standard TTL or CMOS logic input, so it can be directly connected with the microprocessor or other logic circuit. Because the output is digital, and can achieve the conversion accuracy of each color channel 10 or more, and thus no longer need the A/D conversion circuit, so that the circuit becomes more simple. Its pin and function block diagram is shown in Figure2 [Zhou et al., 2005]. Its circuit pin wiring diagram is shown in Figure 3.

Design principle is: set the timer for a fixed time (such as 10 ms), then the strobe three color filter, calculated in this period of time of the TCS230 output pulses, a scaling factor is calculated, through the scale factor can be the pulse number 255. In the actual test, the use of the same time count, the measured pulse number multiplied by the ratio of factor, and then you can get the corresponding value of R, G and B. At the baud rate of 9600bps through the serial port connected to the computer, you can see the output value of RGB. Here we can only detect two kinds of colors of the ball. Yellow ball corresponds to the RGB: G:112 B:42 R:223, the white ball corresponds to the RGB: G:235 B:200 R:255.

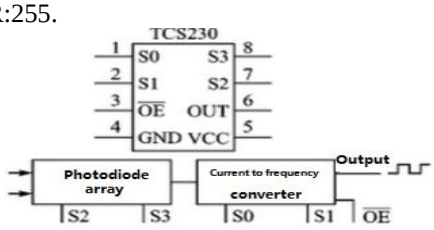

Figure 2 TCS230 pin and functional block diagram

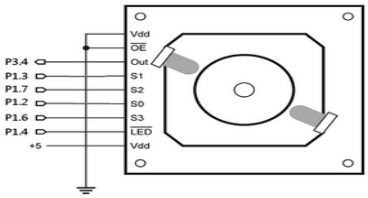

Figure 3 TCS230 circuit pin connection diagram

RF Wireless Control Method

The wireless control of the system is achieved through the wireless transceiver module NRF905.

NRF905 is a monolithic RF transmitter chip of Norway Nordic company, working voltage is 1.9-3.6V, 32 pin QFN package, working on the 433/868/915MHz3 ISM channel (the field of science and medicine belong to industry). NRF905 single chip wireless transceivers work consists of a fully integrated frequency modulator, a demodulator receiver, a power amplifier, a crystal oscillator and a regulator [Hu, 2010]. The communication interface between the module and LPC1752 is as follows:

1) mode control interface: mode control interface by the PWR and TRX CE, TX en composition control composed of nRF905 tuner of four working modes: power down and SPI programming model; standby and SPI programming mode; transmission mode; receiving mode.
2) SPI interface: SPI interface by CSN, SCK, MOSI and MISO to form.
3) State output interface: to provide carrier detection output CD, address matching the output AM and data ready output DR.

NRF905 pin wiring diagram is shown in Figure 4.

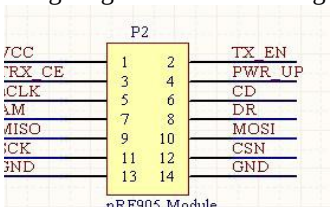

Figure 4 nRF905 pin wiring diagram

Through the nRF905 wireless transmission module, the host computer sends commands to the nRF905 wireless receiving module fixed on the ball picking

robot, The module then converts the received corresponding instructions to the CMOS level data transfer to the master control module LPC1752, Finally, the PWM (pulse width modulation) signal generated by the LPC1752 to drive the robot body motor, through different control timing, so that the robot to complete the corresponding action.

BALL PICKING ROBOT WIRELESS REMOTE CONTROL SYSTEM SOFTWARE DESIGN

The system program mainly uses C language, each function module of the program by the main program and a number of sub routines, the main program include the definition of the GPIO port initialization and NRF905 configuration program. The system program is mainly composed of wireless communication subroutine, ball picking robot motion control subroutine and TCS230 algorithm subroutine. The main program flow chart of the slave computer is shown in figure 5[Kim et al., 1998].

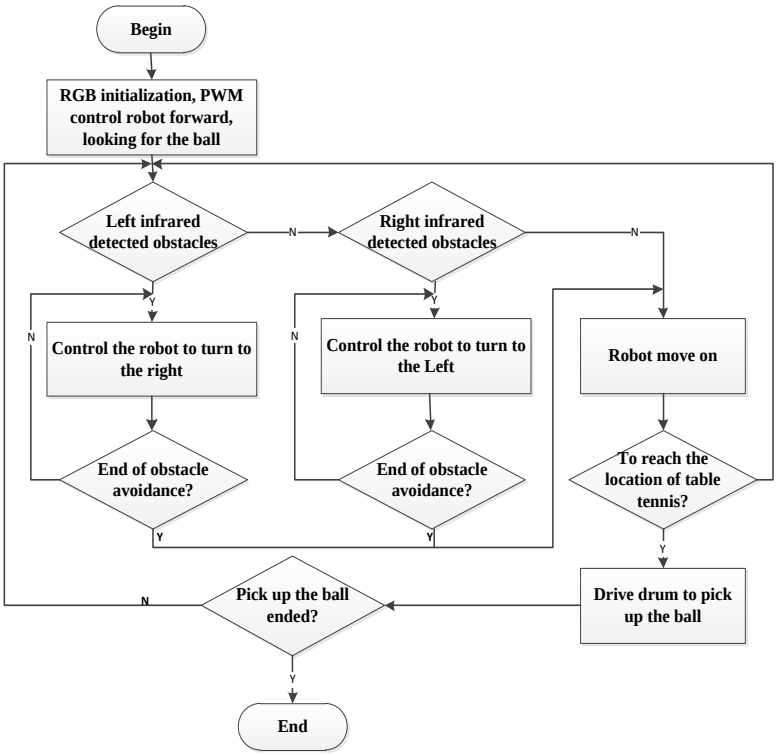

Figure 5 main program flow chart of the slave machine

The software compiled correctly downloaded to the supporting hardware, achieve the expected function.

The actual objects of table tennis ball picking robot is shown in Figure 6.

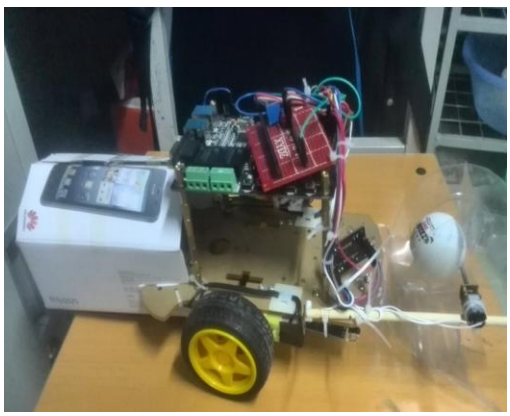

Figure 6 the actual objects of table tennis ball picking robot

CONCLUSION

It mainly completes the design and manufacture of the table tennis ball picking robot body and the wireless remote control system. The hardware part of the system mainly completed the ball picking robot's ball picking part design, power module, motor drive module, table tennis recognition module, infrared obstacle avoidance module and the design and manufacture of wireless radio frequency communication module. The software part of the system is designed to realize the function of the system. It adopts the modular structure design. This system realizes the expected planning function robot are able to avoid the obstacle to good at picking the ball up to and through the host machine of the wireless control, wireless control distance can reach 50 meters, and is stable and reliable. The ball picking robot motion control algorithm is simple, low cost,

simple and convenient speed adjustment, stable operation of the system, with good performance.

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