Research on Wireless Charging Intelligent Car Based On Super Capacitor

Jian Huang* and Zichen Bai
XiJing University, Xi’An, 710123

*Email:565200245@qq.com

Abstract. A wireless charging intelligent car is designed and manufactured. It includes a set of wireless charging device. The car chassis is equipped with a wireless charging receiving device. The super capacitor is used as the energy storage device to receive the electric energy from the transmitting device. The fine wire is used as the guide track, and the capacitance sensor is used to detect the trace of the fine wire. The test results show that the car can charge and drive automatically.

Keywords: Wireless Charging, Intelligent Car, PID Algorithm

Introduction
In recent years, the State advocates green energy and vigorously develops electric vehicles. After a period of development, autonomous vehicles have played an important role in economic development. In addition, there are intelligent car problems in the subject competition of college students. Such problems are ornamental, interesting and challenging, which are deeply loved by teachers and students. The intelligent car covers electronics, computer, sensor, automation and other disciplines. Many teachers and students have conducted in-depth research on this, developed the black-and-white line tracking technology based on photoelectric sensors, and realized the automatic reverse storage, driving and other functions using image processing technology [1-3].

Most of the above intelligent cars are powered by power or battery, which can't realize automatic charging and has certain limitations. It is easy to be affected by the intensity of light. With image processing technology, the performance of the processor is required to be high and the algorithm complexity is high. In order to overcome these shortcomings, this paper designs a wireless charging intelligent car, using super capacitor as energy storage device; taking thin wire as runway, using ldc1614 as capacitance sensor to realize the function of trace inspection. Compared with photoelectric sensor, it has higher reliability and is not easy to be affected by light. PID algorithm is used to control the smooth running of the car.

1. System Design
The system design block diagram is shown in Figure 1. With embedded microprocessor stm32f103zet6 as the main control, the whole car is powered by super capacitor.
First of all, the wireless charging circuit uses the coil to transmit the electric energy to the receiving circuit to realize the charging of the super capacitor. At the same time, the A / D acquisition pin of stm32f103zet6 is used to detect the super capacitor voltage. When it is full, the buzzer alarms and the LED indicator lights up. Then, tb6612 is used to drive DC motor, ldc1614 is used to guide the trolley along the wire track. The important information is displayed on the OLED display. When the super capacitor voltage drops to a certain value, the car will return to the charging position and continue charging [4-5].

2. Hardware Circuit Design

2.1. LDC1614
The circuit diagram of ldc1614 is shown in Figure 2. Ldc1614 is a four channel capacitance sensor. Four channels IN0 ~ in3 can be connected to the inductance coil shown in Figure 3. Based on the principle of eddy current, it can sense fine wire

![Figure 2. ldc1614 circuit diagram](image)
Figure 3. Inductance coil

Figure 3 is a self-made coil drawn in Altium design and then processed.

\[ f = \frac{1}{2\pi\sqrt{LC}} \] (1)

When there is a metal object outside, mutual inductance will be generated, and the inductance value of formula (1) will be changed. Ldc1614 can sense this change and convert it to 28 bit binary output, and send it to stm32f103zet6 through IIC interface. In order to realize the trace inspection of fine wire [6-10].

2.2 DC Motor Drive

Tb6612 is a DC motor driver produced by Toshiba formula. Its performance is better than L298. It can drive two DC motors at the same time. The maximum current can reach 1.5A, and the connection diagram of tb6612 and STM32 is shown in Figure 4.

Figure 4. Connection diagram of tb6612 and stm32

In Figure 4, ain1, ain2 and pwma control one motor respectively, and the corresponding motor connection end is AO1 and AO2; Bin1, BIN2 and pwmb control one motor respectively, and the corresponding motor connection end is Bo1 and Bo2; ain1, ain2 and pwma can be connected to the IO port of the corresponding STM32, and the pwma pin generates the corresponding PWM waveform for motor speed regulation [11-15].

2.3 TFT Display Unit

TFT display unit adopts 1.44 inch SPI interface true color screen, and the display circuit design is shown in Figure 5.
Figure 5. Schematic diagram of TFT display circuit design

In order to improve the screen swiping speed of 1.44-inch TFT true color screen, the hardware SPI1 interface of STM32F103zet6 is used to connect with 1.44-inch TFT true color screen.

3. Software Design

3.1. Software Design Flow Chart
The software design flow chart is shown in Figure 6.

Figure 6. Software flow chart

4 Test
During the test, in order to increase the difficulty, a bend is set at the corner. The length of the runway is in meters. The starting position of the trolley is placed in the center of the 2m straight road, which passes through 6 bends, and the radius of the arc of the bends is 20cm. Finally, go back to the starting point and drive clockwise for a circle.

5 Summary
Adding appropriate software filtering algorithm can make data processing more stable and reliable. This design adds a new idea and method for the tracking of intelligent car, overcomes the disadvantage that photoelectric sensor is greatly affected by strong light, and can be applied in the harsh environment such as dust, dirt, oil and humidity, which has a certain practical value.

Reference
[1] Yu Chiye, song Yue, Lei Ruting. Intelligent tracking car based on STC12C5A60S2 [J].
Laboratory research and exploration, 2014, 33 (11):46-49.

[2] Yin Jie, Yang zongshuai, Nie Hai, et al. Design of intelligent tracking remote control car system based on infrared reflection [ J ] . Electronic design engineering, 2013 (23):178-184.

[3] Jin Li, Jia Cunliang, Wang Mei, Liu empeng. Design of intelligent tracking car based on PIC microcontroller [J]. Industrial and mining automation, 2010, (8): 129-132.

[4] Zhao Zhengyi, Li Shuhui, Geng Yaoqiang, Yang Yang. Capacity allocation and control strategy of urban rail super capacitor energy storage [J]. Energy storage science and technology, 2020,1:1-7

[5] Wang Zhiyu, Wang Bin, Wang Zhaohui. Parameter identification of supercapacitor equivalent circuit model using nonlinear least square method [ J ] . Journal of Xi'an Jiaotong University 2020, 54 (4), 2-8

[6] Zhang Youpeng, Yang Hongwei, Zhao shanpeng. Application and control of super capacitor in regenerative braking energy storage of high-speed railway [ J ] . Energy storage science and technology, 2019, 8 (6): 1145-1150

[7] Qiao Zhijun, Yu Xuewen, Yuan Jun, Zheng Chao, Ruan Dianbo. Failure mode analysis and design improvement of supercapacitor [J]. Power technology, 2019,43 (10): 1688-1690.

[8] Wu Weide, Miao Changsheng, Chen Shunfei, Gao Pan, Xiang Jingrui, long Hailian. Research on the new application of intelligent electric energy meter based on super capacitance [J]. Electric measurement and instrument, 2019,56 (24): 138-144

[9] He Guifang. Design of a new intelligent metal detector [J]. Instrument technology and sensor, 2016,1:13-15

[10] Shi Shuheng, Zhao Bin, Guo Pengyan, Zou Dong. Design of intelligent tracking car based on mk60n512 [J]. Machine tool and hydraulic, 2014, 42 (2): 91-96

[11] Wang RuRu, song kaihong, Ming Jun, pan Yutian, Wu Zhenfei. Characteristic analysis of metal detector sensor based on open coil system [J]. Journal of Hefei University of Technology (NATURAL SCIENCE EDITION), 2015,38 (3): 354-357

[12] Song Yongxian, Ma juanli, he naibao, Zhang Xianjin. Design of intelligent tracking car control system based on TMS320F2812 [J]. Computer measurement and control, 2011,19 (9): 2128-2130

[13] Huang Jian, LV Lintao and fan Hui. Development of tracking car based on ldc1614 [J]. Sensors and Microsystems, 2018, 37 (8): 88-93

[14] Huang Jian. Development of DC motor speed control system based on PI control [J]. Astrometric technology, 2017, 37 (6): 75-78

[15] Huang Jian, Dong Sanfeng, Wang Liping. Based on the design of ldc1000 automatic tracking intelligent car [J]. Micromotor, 2017, 45 (6): 62-65