Design and Implementation of Intelligent Vehicle Based on CMOS Sensor for Automatic Road Recognition

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Abstract. In order to achieve automatic driving of the vehicle, it is necessary to identify the road by means of a CMOS sensor. The focus of this study is to acquire images by CMOS sensors and identify them to control the motion of the vehicle. The device achieves an accurate identification of the road and allows the trolley to move stably on the road. The detailed design details of the hardware and software are given in the paper. In order to improve the overall function of the system, we conducted various tests. The conclusion from the test is that our smart car system may become the direction of future smart car development.

1. Introduction

With the development of science and technology, especially the rapid advancement of computer technology, information technology, artificial intelligence, and electronic technology, intelligent vehicle technology has achieved the technical foundation. At present, smart vehicle technology is mainly used in collision warning systems, intelligent speed adaptation, automatic operation, etc. in cars and heavy vehicles, and its military application is more extensive and important.

2. Hardware system design

2.1. The structure of the smart car

The smart car includes parts such as a car model, a motor, an encoder, a circuit board, a camera, a wheel, a battery, and the like. In order to improve the stability of the smart car, the motor and encoder are placed at the bottom of the car model. The board is placed over the motor and encoder. In order to increase the acceleration of the smart car, the battery is placed in front of the car model and as close as possible to the car model, so that the center of gravity can be concentrated and slightly forward. In order to enable the vehicle to recognize the road ahead in advance and accurately, the CMOS sensor is placed at the top of the vehicle model using a triangular support rod and adjusted to prevent the sensor from seeing the vehicle body to identify the road.
2.2. Main controller circuit design
Based on the requirements of low power consumption and performance, choose MK60FN1M0VLQ15 as the master controller [1]. In the stability consideration, the capacitor is connected to the power supply pin of the chip for filtering, and the digital ground and the analog ground are connected by a 0 ohm resistor to prevent the analog circuit and the digital circuit from interfering with each other.

2.3. Motor drive circuit design
As show in Fig. 2, the motor drive circuit is driven by an H-bridge, the driver chip uses an IR2104S chip, and the H-bridge uses an IRLR7843 FET [2]. When the motor needs to rotate in the forward direction, Q1 and Q4 open, and the current flows from top to bottom; when the motor needs to rotate in the reverse direction, Q2 and Q3 open, and the current flows from bottom to top. We control the speed and steering of the motor by controlling the pulse and pulse width of the input motor drive chip.
2.4. Communication circuit design

The communication module uses HC-05. The HC-05 Bluetooth module is designed for smart wireless data transmission. It uses the British CSR BlueCore4-Ext chip and follows the V2.0+EDR Bluetooth specification. This module supports UART, USB, SPI, PCM, SPDIF and other interfaces, and supports SPP Bluetooth serial port protocol [3]. It has the advantages of low cost, small size, low power consumption, high sensitivity of sending and receiving, etc. It can be realized with only a few peripheral components. Powerful features. This module is mainly used in the field of short-distance data wireless transmission. It can be easily connected to the Bluetooth device of the PC, or the data between the two modules can be intercommunicated. Avoid cumbersome cable connections and directly replace the serial cable.

Figure 3. Motor drive circuit
2.5. **Power circuit design**

The power supply is powered by a 7.2V battery, so a voltage regulator chip is required to generate a variety of different voltages. Here we use the AMS1117 chip for voltage regulation [4]. The AMS1117 is a forward low dropout regulator suitable for high efficiency linear regulators that publish switching power supply regulator battery chargers active small computer system interface terminal notebooks for power management battery powered instruments. Two of the AMS1117 chips are connected to a 7.2V supply to regulate the voltage to 5V, and then two AMS117s are regulated to 3.3V. The advantage of this is that the heat of the voltage regulator chip can be reduced. If the voltage of 7.2V is directly reduced to 3.3V, the heat generated by the voltage regulator chip will be very large, and even if it is serious, the voltage regulator chip will be burnt.

2.6. **Attitude sensor circuit design**

The attitude sensor uses the MPU6050. The MPU-6050 is the world's first integrated 6-axis motion processing component. Compared with the multi-component solution, it eliminates the problem of the difference between the combined gyroscope and the accelerometer time axis, reducing the amount of packaging space [5]. The MPU6050 integrates a three-axis gyroscope and three-axis accelerometer sensor, as well as an expandable digital motion processor DMP (Digital Motion Processor). We added a power indicator to the MPU6050's power supply to ensure the sensor's operating state, while using a
small capacitor near the power circuit for filtering to improve sensor stability. It must be calibrated before using the sensor by resting the sensor on a horizontal table, reading the data from the six axes and averaging them to obtain the error value of the sensor. In the latter control algorithm, we need to remove the error value to ensure the stable operation of the car.

Figure 6. Attitude sensor circuit

3. Conclusion
In this paper, a road recognition algorithm for intelligent vehicle based on two-wheeled vertical automatic road recognition is proposed, and the hardware circuit design and mechanical design of the intelligent vehicle are described. We use Freescale's K60 series Microcontroller Unit, get the road image through CMOS sensor, and get the road information after image analysis, then calculate the appropriate motor control quantity through PID algorithm so that the intelligent vehicle can drive steadily on the current road. The results of the intelligent vehicle are satisfactory, and the algorithm is suitable for the driving condition with high visibility. The operating condition with low visibility needs to be studied.

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