A Design of Micromouse Control System

Hucheng Wang
Tianjin University of Science and Technology, China
E-mail: 1776315920@qq.com

Abstract

This paper designs micromouse. The micromouse collects external information through six groups of infrared sensors. The STM32 single chip microcomputer adjusts the posture of the micromouse according to the environmental signal detected by the sensor, adjusts the PWM signal of the driving circuit, searches the unknown maze according to the software search algorithm, finds the shortest path in the strange environment, and on the premise of ensuring stability, Sprint from the starting position to the end of the maze at the fastest speed.

Keywords:micromouse,STM32,path search, sensor

1. Introduction

With the continuous development of science and technology in China, it has become a social development trend that intelligent robots replace human labor. Intelligent robots are widely used in many frontier innovation fields, such as smart home system, aerospace system, biomedicine and so on.

As one of the intelligent robots, maze walking computer mouse has the basic functions of detecting strange environment, automatically controlling movement, completing path search and planning.

Since the concept of micromouse was put forward in the 1970s, the design and manufacture of micromouse have been continuously optimized and improved. However, so far, the micromouse still has some disadvantages, such as heavy weight, inflexible steering, slow path search and so on. We optimized these existing problems and redesigned its mechanical structure. Creatively use the new infrared sensor layout to enable the computer mouse to collect external information more sensitively and quickly. Combined with the potential value search algorithm, the micro mouse can complete the sprint task in the maze more efficiently and quickly.

2. Mechanical Structure

2.1 Chassis design

The chassis should be as light as possible to reduce the impact of turning inertia caused by excessive weight on the smooth operation of the computer mouse, and have the strength to withstand the welding of components on its surface. Considering such problems, the printed circuit board is selected as the chassis of the micromouse.

2.2 Mobile mechanism design

The computer mouse moving mechanism is composed of a driving wheel and a driving wheel. The driving wheel is driven by a motor, and the driven wheel has no power. In order to prevent slipping in motion, it is required that there should be a certain friction between the tire and the ground. In order to make the computer mouse have high flexibility in sprint and turning, this design uses a low-cost plastic wheel hub with a diameter of 30 cm as the driving wheel of the computer mouse.

2.3 Transmission part design

This design adopts belt indirect transmission. The driving force output by this transmission mode is more appropriate, and it is relatively simple and convenient in actual installation, and the noise generated during operation is relatively small. The mechanical design drawing is shown in Fig.1.

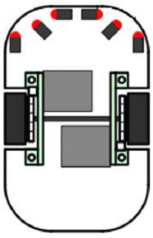

Fig.1. The mechanical design drawing

3. Hardware Design

3.1 Minimum system board circuit

1. Power supply circuit

The main power supply of maze computer mouse adopts 7.4v Mini lithium battery. Since the reference voltage of this design is 3.3V, ams1117 is adopted_ 3.3 the chip is used as a step-down module. The schematic diagram of power supply module is shown in Fig.2.

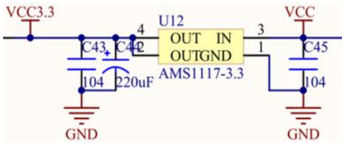

Fig.2. The schematic diagram of power supply module

2. System download and debugging circuit

The system adopts JTAG interface, also known as joint action working group, which is used to complete the burning, debugging, online debugging and other operations of the program [1]. The schematic diagram of JTAG download circuit is shown in Fig.3.

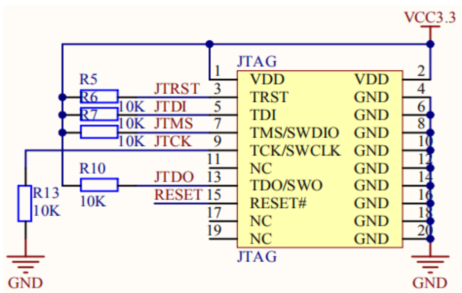

Fig.3. The schematic diagram of JTAG download circuit

3.System clock circuit

The frequency of low-speed clock source in this design is 32.768KHz (as shown in Fig.4), and the frequency of high-speed clock source is 8MHz (as shown in Fig.5).

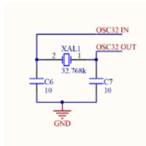

Fig 4.Low speed clock source

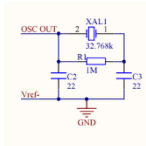

Fig.5.High speed clock source

4.Reset circuit

The function is to avoid accidental contact. The reset circuit diagram is shown in Fig.6.

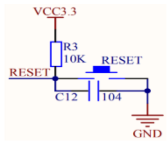

Fig.6. The reset circuit diagram

3.2 Sensor module

In general, the micromouse is composed of five groups of sensors in the front, left, right and left 45 degree oblique direction [2]. A forward sensor is added in this design to prevent the computer mouse from tilting during its travel.

3.3 Motor and encoder circuit

This design adopts a DC motor with encoder which is easy to control and low power consumption. The encoder acts as a speed measurement feedback device. The purpose is to make the microcontroller perceive the walking distance of the micromouse and the accurate steering angle of the micromouse calculated according to the pulse. This design adopts photoelectric weight device, and the schematic diagram of encoder is shown in Figure 7.

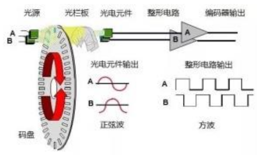

Fig.7.The schematic diagram of encoder

3.4 Voltage detection circuit

This design uses the analog-digital module of STM32 microcontroller to detect the battery voltage. The voltage detection circuit is shown in Fig.8.R9 has a resistance value of 10kΩ, one end is connected to the 3 pin of ams1117, one section is connected to the ADC acquisition pin of microcontroller, and R15 has a resistance value of 5kΩ One section is pulled down to the ground to form a voltage dividing circuit, and the ADC port is connected to the ADC acquisition port of STM32 microcontroller.

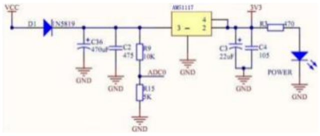

Fig.8. The voltage detection circuit

4. Sotware design

The potential value search algorithm calibrates different potential values into the maze when searching the maze. The closer the cell is to the center of the maze, the smaller the potential value is[3]. Therefore, the potential value of the destination is zero, and the potential value calibration of each unit is shown in Fig.9.

14	13	12	11	10	9	8	7	7	8	9	10	11	12	13	14
13	12	11	10	9	8	7	6	6	7	8	9	10	11	12	13
12	11	10	9	8	7	6	5	5	6	7	8	9	10	11	12
11	10	9	8	7	6	5	4	4	5	6	7	8	9	10	11
10	9	8	7	6	5	4	3	3	4	5	6	7	8	9	10
9	8	7	6	5	4	3	2	2	3	4	5	6	7	8	9
8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8
7	6	5	4	3	2	1	0	0	1	2	3	4	5	6	7
7	6	5	4	3	2	1	0	0	1	2	3	4	5	6	7
8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8
9	8	7	6	5	4	3	2	2	3	4	5	6	7	8	9
10	9	8	7	6	5	4	3	3	4	5	6	7	8	9	10
11	10	9	8	7	6	5	4	4	5	6	7	8	9	10	11
12	11	10	9	8	7	6	5	5	6	7	8	9	10	11	12
13	12	11	10	9	8	7	6	6	7	8	9	10	11	12	13
14	13	12	11	10	9	8	7	7	8	9	10	11	12	13	14

Fig.9. the potential value calibration of each unit

The course coordinates of the micromouse direction in which the micromouse moves in the maze. It is mainly defined by the following four directions, namely West, South, East and North. Other variable algorithms are defined to indicate whether the maze has been searched by the micromouse. False if the maze is not searched, otherwise true. Variables marked as prohibited indicate that the maze here is impassable, that is, the maze here is a dead end or part of a dead end or a closed-loop path. The micromouse also identifies a search times variable to mark the number of times the computer mouse searches here. After the micromouse reaches a maze, the count variable of the maze increases by one. The operation strategy (i.e. the strategy adopted by the micromouse to reach a certain position) is independently selected by the micromouse. Possible situations are: there is no access (dead end) ahead, the front can perform left turn, the front can perform right turn, or a combination of several situations. When the micromouse faces a variety of selection strategies in the maze, it will judge in combination with the cell potential value and the number of searches here, and take different execution strategies independently. The micromouse strategy is shown in Fig.10.

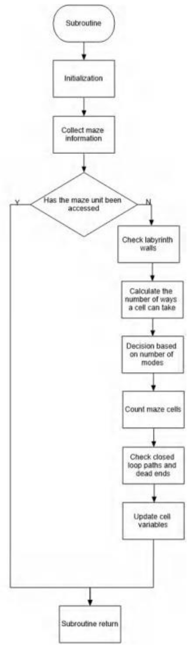

Fig.10. The micromouse strategy

5. Conclusion

When the left and right sides of the micromouse leave 5mm away from the wall (or when it is at an angle of 45 degrees from the horizontal and 20mm away from the wall), the motor can react quickly to prevent the micromouse from accidentally touching the wall during high-speed operation. The distance between the micromouse and the wall is shown in Fig.11.

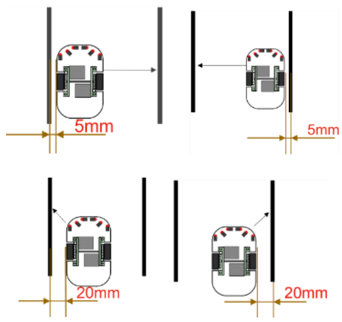

Fig.11. The distance between the micromouse and the wall

When the left and right sensors leave the wall, you can judge whether the micromouse body is inclined according to the two infrared sensors in front. If the micromouse tilts during operation, the data collected by the first two sensors will be larger and smaller. At this time, the main controller of the micromouse will adjust the posture in time, so that the micromouse is always in the center of the maze.

The schematic diagram of intersection detection is shown in Fig.12.

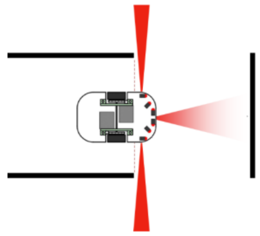

Fig.12. The schematic diagram of intersection detection

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Authors Introduction

Mr. Hucheng Wang

He received his bachelor's degree from the school of Electronic Information and Automation of Tianjin University of science and technology in 2021. He is acquiring for his master's degree at Tianjin University of science and technology.