A PID Tracking Car Based on STM32

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Abstract

Intelligent car is a high-order intelligent product integrating intelligent integrated control, visual terminal, automatic control output and cognitive computing. This paper introduces an innovative intelligent tracking car based on STM32 embedded chip. The vehicle adopts fuzzy PID algorithm to control the vehicle operation, and adopts the innovative grayscale card designed by the team hardware designer. This car fully caters to the global environmental protection trend, the new concept of green development. On the premise of low cost and low power consumption, it also ensures the smooth, smooth and high precision operation of the vehicle.

Keywords: Intelligent integrated control, Visual terminal, STM32 embedded chip, Innovative gray card, Green, Preciseness.

1. Introduction

The intelligent tracking car can detect the surrounding situation autonomously. Using image acquisition and processing technology and gray sensing technology to help themselves to identify the various road conditions in front of the feedback to the control center for judgment and processing and then automatic output instructions. A high degree of automatic control and intelligent.

The knowledge involved includes: the use principle of single chip microcomputer, digital circuit, analog electronic technology, innovative design and construction of hardware, digital signal, image acquisition and processing and artificial intelligence applications. This paper will be detailed in the following three aspects: 1) Parts and circuit design; 2) Body material and manufacturing; 3) Detailed algorithm explanation.

2. Components and Circuit Design

The parts are assembled by combining traditional parts with new parts. The traditional parts used are: STM32f103c8t6 microcontroller, L298n drive module, step-down module with digital tube, bread board, 18650 lithium battery, bull eye wheel and N20 motor. The new parts include self-designed grayscale card (shown in Fig.1).

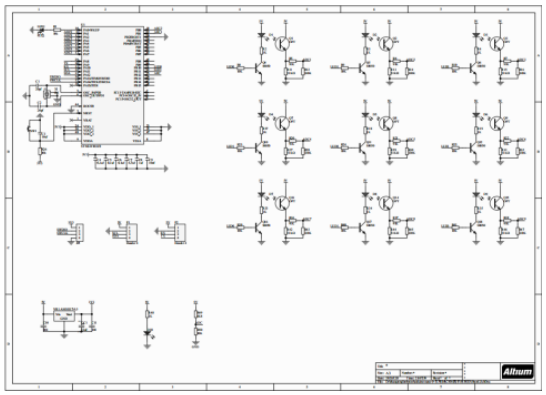

Fig.1. Gray card schematic diagram

This gray card uses 5V power supply, 5V is connected to the positive pole of power supply, GND is connected to the negative pole of power supply. Compared with the traditional gray scale measurement module, its advantages are stable, sensitive, not easy to be interfered by external stray light, easy to use, not easy to damage. As shown below, the two pictures are PCB with grayscale card (shown in Fig. 2 and Fig. 3).

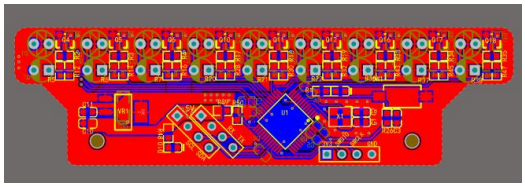

Fig. 2.Gray card PCB

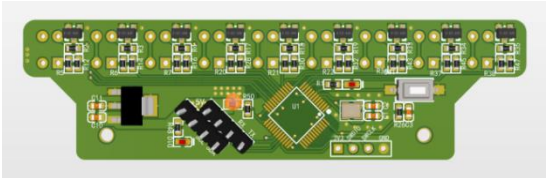

Fig. 3.Gray card PCB (3D)

In terms of circuit design, the car keeps the circuit connection as simple as possible and the power utilization is maximized. It gives full play to its own advantages and suits its actual situation.

The advantages of the STM32f103c8t6 microcontroller are: small package size, low price compared with other microcontroller chips, better performance than 8-bit microcontroller, if the STM32 series of chips will be used, it can be used as an alternative, high cost performance.

The five signal ports A0, A1, A2, A3 and A4 of STM32f103c8t6 are respectively connected to the five signal output ports of the gray card, and the signal output ports of B6, B7, B8 and B9 are connected to the signal receiving port of L298n.

The information recognized by the grayscale sensor[2] is converted into signal and transmitted to STM32f103c8t6 MCU, which is fed back to L298n after processing to realize motor speed regulation.

The power supply outputs two voltages, one of which supplies L298n, one of which reduces the voltage of the transformer module to 3V3 and then inputs it to the gray sensor, thus ensuring the safety of the infrared module and greatly prolonging the service life of the gray card.

3. Body Material and Manufacture

In order to follow the new concept of global green, cater to the global environmental trend. The car adopts green environmental protection material, the whole car material pollution-free. Lightweight and environmentally friendly materials and streamlined design make it even more portable.

Traditional car bodies generally use acrylic panels and other materials. The protective paper should not be broken during transportation, and it may be toxic in some special cases. The car body material using epoxy resin, full environmental protection, reliable.

When manufacturing the body, 3D printing technology is used to empty the reserved position to achieve the body and module tightness. Another point, the body manufacturing light, greatly reduce the vehicle load.

4. Detailed Dlgorithm Explanation

In order to realize the intelligent vehicle tracking highly automatic, high precision, the vehicle adopts fuzzy PID automatic control algorithm. Compared with the traditional PID algorithm, this algorithm has better performance. Fig 4 is the flow chart of traditional PID:

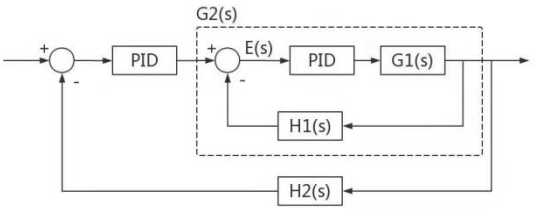

Fig.4.Flow chart of traditional PID

Traditional PID is a classical mathematical model whose principle can be given by mathematical formula[1], as shown below:

$$\mu(t) = K_P e(t) + K_I \int_0^t e(t)dt + K_D \frac{de(t)}{dt} \quad (1)$$

Where KP stands for proportional gain, KI stands for integral gain, and KP stands for differential gain.

But fuzzy control does not need to determine the exact mathematical model of the system, it is an automatic control principle to adapt to rules. She combines control strategy, application variables, fuzzy set theory and integrated algorithm theory. It has three main uses:

●Fuzzification: Transform the exact quantity into the fuzzy quantity (change E into EC).

● Fuzzy judgment: According to the existing linguistic basis (fuzzy control rule table, shown in Table 1), fuzzy judgment is made on the fuzzy quantity obtained [3].

Table 1. The fuzzy rule list

		e						
u		NB	NM	NS	ZE	PS	PM	PB
de	PB	ZE	PS	PS	PM	PM	PB	PB
	PM	NS	ZE	PS	PS	PM	PM	PB
	PS	NS	NS	ZE	PS	PS	PM	PM
	Z	NM	NS	NS	ZE	PS	PS	PM
	NS	NM	NM	NS	NS	ZE	PS	PS
	NM	NB	NM	NM	NS	NS	ZE	PS
	NB	NB	NB	NM	NM	NS	NS	ZE

●Fuzzy decision: The fuzzy quantity of fuzzy decision is converted into the actual precision quantity for output [4].

These three points will make the fuzzy PID run smoothly. The flow chart of fuzzy PID is as follows (shown in Fig. 5).

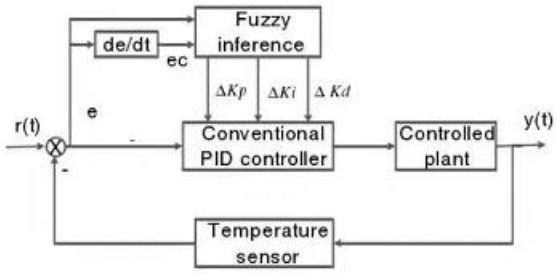

Fig.5 Fuzzy rule list

Compared with the traditional PID algorithm, fuzzy PID algorithm is the embodiment of high precision operation. Aided by visual terminals and cognitive computing, the car as a whole can be elevated to a new level.

5. Conclusion

Intelligent car is a product of high degree of self-control, combining software and hardware cleverly, and widely using a variety of knowledge and material principles.

At present, the car has achieved high precision automatic control, in the future, the car will use cloud data comprehensive computing, using the advanced processing of big data to make the intelligent car running more smooth and concise.

Based on the original knowledge, the vehicle has been successfully tested and achieved good experimental results. Next, we will add intelligent autonomous learning mode, using the advantages of intelligent autonomous learning mode can modify parameters independently, comprehensive improvement and optimization.

In order to ensure high precision operation, the power consumption is reduced as much as possible, so as to achieve power persistence. It is committed to bringing intelligent vehicle tracking to a new height in the field of intelligent vehicle tracking.

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