A Control System for Suspension Movement

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Abstract

The dominant control of the hang moving control system of which driving parts is controlled by the step-by-step electrical machinery is a single-board-computer AT89C52, and use LCD for demonstration. The system can locate accurately within the scope of the provided, and be controlled by keyboard to draw a straight line from the current point to the prescribed point and a diameter as 50cm circle at the specified position

Keywords

MCU; Control; Position

1. Introduction

Control part of the micro controller and CPLD as the core of the control system, CPLD is more suitable for complex control logic and a high-speed system, and the hardware of the system is not complicated, control process more emphasis is the realization of control algorithm, so the micro controller unit (MCU) is more appropriate. We adopt AT89C52 microcontroller as the core, combined with LCM1602 liquid crystal display module and keyboard module, data acquisition module, and the step motor control module together to achieve suspension of the programmable intelligent control system [1]. The system can complete the corresponding functions according to the control of the keyboard, and the LCD can display the trajectory coordinate and the system state in real time.

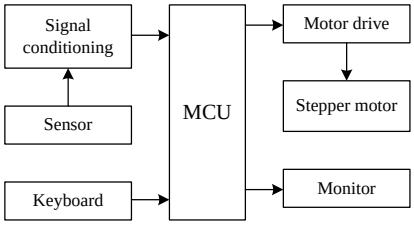

Figure 1 System constitution diagram

2. Scheme comparison, design and demonstration

2.1 Motor selection

Using stepper motor to achieve the precise positioning and direction control. Stepper motor is a pulse control motor, it is a kind of the pulse signal can be converted to the angular displacement of the digital analog converter, can be widely used for no feedback control but requires a precise location of the occasion. With rotary encoder to control the DC motor, the motor running smoothly, the accuracy can be guaranteed. But its drive circuit is complex, and it is difficult to realize [2] in a short time. In this case due to control brush drawing accuracy and circuit complexity, intends to choose choose plan a, and the control of high performance stepper motor to control the movement of objects.

2.2 Implementation of control object motion algorithm

Linear interpolation method. Linear interpolation method is a kind of point by point comparison algorithm commonly used in drawing system. Its principle is: every step of the implementation of the organization, and the coordinates of the given trajectory on a comparison, to see the relationship between the current position and the trajectory, so as to determine the next step in the direction of the feed. If the current position is below the given trajectory, the next step is to go above the given trajectory, whereas the opposite is the case. If in a given trajectory to the current location outside the given trajectory next steps, and vice versa. This step by step, decided to go to the next step, the formation of "point to point", make the line approximation to a given trajectory.

A simple linear algorithm. This algorithm is according to the straight line in the computer graphics display method change, the basic principle is "point to point", the executing agency according to the relationship between the current position and track location to determine the next step in the direction of feed, but data processing. In the linear interpolation method, a cycle can only determine a direction (X or Y), and in the linear simple algorithm, a cycle can take two steps, which can greatly improve the efficiency of. At the same time, the linear interpolation method to consider the problem of the calculation formula of quadrant, different quadrants, and simple linear algorithm to bypass the quadrant of the problem, you can save a lot of code. The above comparison easy and hard to combine software programming, quasi selection scheme two.

2.3 The black line detection module design

Detection by infrared reflection type, that is, the use of modulated infrared vertical shoot to the plate surface, the reflection after conversion into electrical signal into the microcontroller processing, this is a very common application, although it has some shortcomings: (1) due to the short distance reflecting, infrared reflection power is small, if the board paper uneven or blank surface debris, the microcontroller misjudgment. (2) due to the surface of the black line may be ink or adhesive tape, two though all black, but the practical application found the reflective level are different, can also cause some interference of the infrared sensor.

Photoelectric detector composed of multi channel array type photosensitive resistance. Because the photosensitive resistor to detect black line, black line above the resistance value change, through the voltage comparator will signal sent to MCU processing, so as to control the object do the corresponding action. Photosensitive resistance of light environment recognition is required to consider the influence of environment light, the test may in indoor or outdoor, in order to eliminate the external light according to the intensity of interference, beside each photosensitive resistance with a high brightness light-emitting diode, so that each photosensitive resistance a kind, even under dark conditions can also work [3]. Test results show that using this method can eliminate the interference of external light. Based on the above discussion, the selection of anti interference ability of the program two.

3. Software design of the system

3.1 General block diagram of program design

The total block diagram of the system [4] is shown in figure 2.

3.2 Motion localization algorithm

When the motor traction load is moving in the coordinate system, the position is the key of the whole system. The whole system is located in Figure 3. When the P traction point coordinates (X, Y), a ACP and a BDP length of the hypotenuse determines the position of [5] point P. When the traction point P is located, the relative displacement is about traction motor:

L_{left} = L- PA; L_{right} =L-PB; where L is the length of the BE or AF

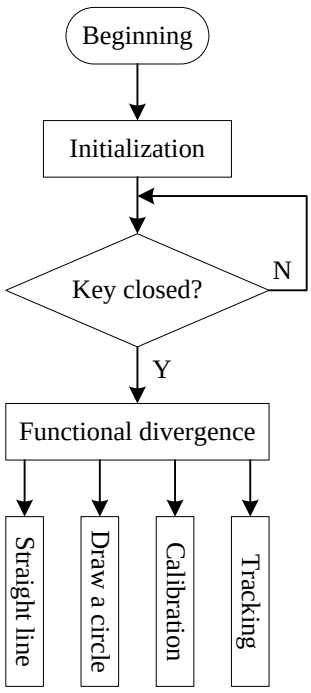

Figure 2 Programming assembly drawing

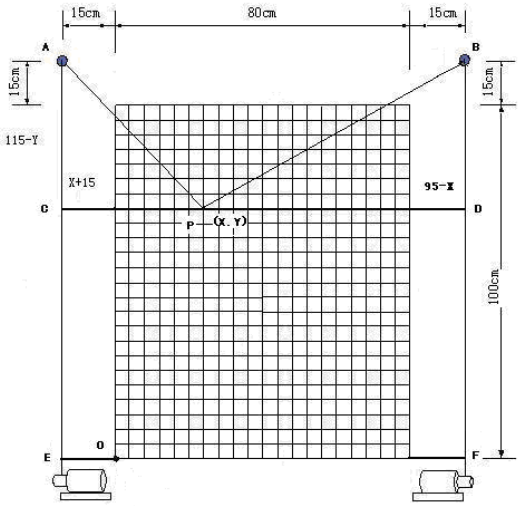

Figure3 Algorithmic analysis diagram

In the right triangle ΔACP:

$$AP = \sqrt{AC^2 + CP^2} \tag{1}$$

In the right triangle ΔBDP:

$$BP = \sqrt{BD^2 + DP^2} \tag{2}$$

Among them: AC=BD=115-Y; CP=X+15; DP=95-X;Then the relationship between AP and BP and (X, Y) is:

$$AP = \sqrt{(115 - Y)^2 + (X + 15)^2} \tag{3}$$

$$BP = \sqrt{(115 - Y)^2 + (95 - X)^2} \tag{4}$$

When the coordinates of P (X, Y) points are determined, the relative displacement of the left and right motor is:

$$L_{\text{left}} = \text{L- PA} = L - \sqrt{(115 - Y)^2 + (X + 15)^2} \tag{5}$$

$$L_{\text{right}} = \text{L- PB} = L - \sqrt{(115-Y)^2 + (95-X)^2} \tag{6}$$

3.3 The realization of drawing straight line algorithm

Draw a straight line that is the motor traction load in the specified motion area to do linear motion, because the motor traction displacement and load displacement of the nonlinear, we must establish a linear equation of the load running track. Because the load movement specified in the starting point (X1, Y1) and the end of the coordinates (X2, Y2), so you can set up a linear equation:

$$Y = \frac{Y_2 - Y_1}{X_2 - X_1} X + \frac{Y_1 X_2 - X_1 Y_2}{X_2 - X_1} \text{ (The slope is less than } 45^0\text{)} \tag{7}$$

$$X = \frac{X_2 - X_1}{Y_2 - Y_1} Y - \frac{Y_1 X_2 - X_1 Y_2}{Y_2 - Y_1} \text{ (The slope is greater than } 45^0\text{)} \tag{8}$$

3.4 Realization of drawing circle algorithm

Set point coordinates of the circle is (X1, Y1), radius R (50cm). It is the center coordinates (X1, Y1+R), the equation of circle is:

$$(X - X_1)^2 + (Y - Y_1 - R)^2 = R^2 \tag{9}$$

Draw a circle with Y as the independent variable, the circle is divided into two semicircles, draw the left semicircle draw right semicircle. Its equation is

$$X = X_1 - \sqrt{R^2 - (Y - Y_1 - R)^2} \text{ (leftsemi-circle)} \tag{10}$$

$$X = X_1 + \sqrt{R^2 - (Y - Y_1 - R)^2} \text{ (right semi-circle)} \tag{11}$$

4. Conclusion

This work uses 89C52 microcontroller as the control center of the moving object, 89C52 microcontroller, SCM has more stronger function. The main control circuit of power supply and motor power photoelectric isolation, reduce the interference for the main motor control circuit. The polygon circle and optimization algorithm for automatic control approach to realize the accurate positioning.

Reference

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