Design of Intelligent Vehicle for Automatic Obstacle Avoidance Path Optimization of Preset Target

Jie Dong [a], Tao Yang [b]

College of Mechanical and Electronic Engineering, Shandong University of Science and Technology, Qingdao, 266590, China.

[a]1374623537@qq.com, [b]734981537@qq.com

Abstract

Intelligent vehicle is a kind of miniaturized robot that can accomplish specific tasks through programming. It has the advantages of low production cost, simple circuit structure, convenient program debugging and so on, and it is also very interesting. Through the presetting of the smart car's target position, the car can use its own obstacle avoidance system to perform real-time automatic obstacle avoidance processing on the obstacles in advance, and reach the preset target position from the optimal path. This is of great significance to the study of some realistic problems.

Keywords

Coordinate positioning; automatic obstacle avoidance; preset target; path optimization.

1. Introduction

This paper mainly introduces the design and manufacture of intelligent car with the function of automatic obstacle avoidance with preset target and path optimization. The design idea, path optimization, function and working principle of software and hardware are analyzed and discussed in detail. Through practical acceptance tests, the smart car has a simple circuit structure, convenient debugging, quick and flexible system response, correct and feasible design scheme, stable and reliable indicators.

2. Design of Automatic Obstacle Avoidance System

The smart car uses one front wheel and two rear wheels to drive. The front wheel is a universal wheel which is used to control the rotation of the following two wheels to achieve forward and backward and steering. Uses AT89C51 one-chip computer as the control core of the car. [1]In order to realize the processing of the signal, the system is mainly composed of several parts such as the one-chip computer control circuit, ultrasonic launching and receiving circuit, motor drive, power supply circuit. [2]The microcontroller AT89C51 is the core component of the entire system and coordinates the work of each part of the circuit. The one-chip computer starts timing at the same time when the ultrasonic signal is emitted. The signal propagates in the air after meeting the obstacle to produce the reflection. After the echo signal is processed, it is input to the INT0 end of the single chip to generate an interrupt, and the counter stops counting. The number of pulses measured by the counter can obtain the time required for the ultrasonic signal to go back and forth, so as to achieve the purpose of distance measurement. It is not only required that the sensor collect data quickly and accurately, but also that the microcontroller should shield all unnecessary redundant instructions and process the data directly. [3] The system design of the automatic obstacle avoidance vehicle is shown in figure 1.

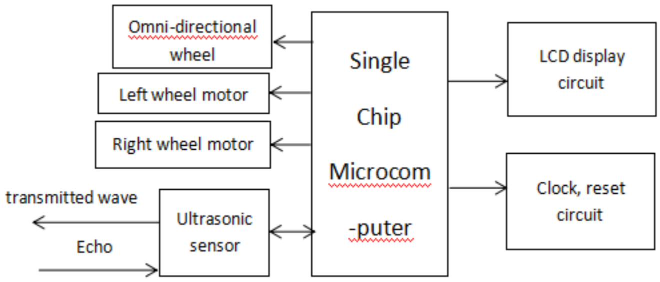

Figure 1. System design

Ultrasonic obstacle avoidance sensors and servo motors are used to perform obstacle detection and running parameter acquisition, and the target coordinates are entered through the keyboard for path analysis. The current coordinate information that is close to the target can be observed on the LCD screen in real time. The signal from the servo motor and the ultrasonic sensor signal will be analyzed at the control end in order to control the rotation speed and direction of the motor. [4] The various automated processes of the car during the running process are programmed by software. When an obstacle is encountered, the first step is to judge and process the information. At the same time, the robotic microcontroller automatically judged and analyzes the obstacle avoidance in order to find the proper route for the operation to continue go ahead.

3. Path Optimization Design

The middle point of the two wheels behind the smart car is set as the origin of the car. When the car is placed in a space, press the positioning button, and the single chip computer begins to count. At this time, two counters are selected to count the coordinates of the X axis and the Y axis respectively. [5]The head direction of the car is set to the Y-axis direction, and the forward direction is Y-axis positive direction. The right and left ends of the car are set to the X-axis direction, and the right side of the car is set to the positive direction of the X-axis. In the process of the vehicle's advance, In addition to the analysis of the route of the car and the target position at the beginning of the car's advancement, the optimal direction selection in obstacle avoidance is also required.

The default front direction of the smart car is the Y axis at the initial time. At this time, manually input the coordinates of the target position, and then the calculation is performed and converted into an angle. After the car universal wheel rotates the corresponding angle, the car starts to move forward. When the car is steered, the initial position and direction of the target are analyzed. At this moment, the trolley drive is stopped, the universal wheel turns the angle α toward the target direction, and then the revolver drive starts, and the circular motion is performed with the right wheel as the center. Go to the car positioning point and the target point at the same angle when the drive stops, the left wheel turns back to the original position (turn right). The coordinate calculation method of the cart at this time is $X=Xo+d/2+(1-\cos\alpha)$, $Y=Yo+d/2\sin\alpha$. When the cart has been diagonally advancing, the coordinates and coordinates of the target point are calculated as $X=Xo+1/2\pi r\cos\alpha$, $Y=Yo+1/2\pi r\sin\alpha$. [6]The car steering diagram is shown in figure 2.

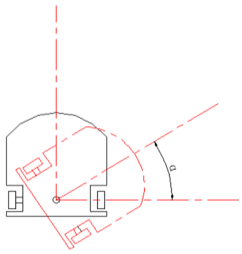

Figure 2. Car steering diagram

In the process of obstacle avoidance, due to the change of the front direction of the vehicle, it is not able to continuously carry out the continuous linear motion of the vehicle's front pointing to the target object, so it is necessary to put forward different path optimization methods for different situations. When the car starts to avoid obstacles, the front of the car no longer points to the target object, so the default direction of obstacle avoidance of the car needs to be set. If the angle between the target object and the initial position of the car and the positive direction of the X-axis is an acute angle, the right side is the default direction. When the car moves in the default direction of the right and encounters an obstacle that cannot be passed in front, the car returns to its original position and takes the left as the default direction to avoid the obstacle again. After avoiding obstacles, the trolley still has to be close to the original route judged by the initial trolley. The situation of the smart car avoiding obstacles is shown in Figure 3.

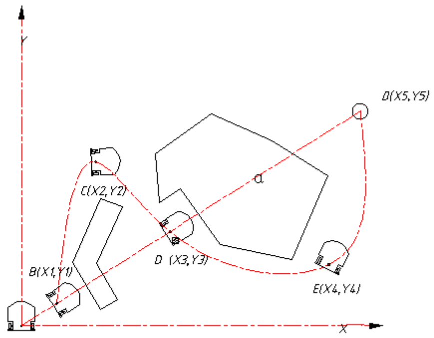

Figure 3. Diagram of obstacle avoidance

4. Summary

This paper presents an economical and practical design method of smart car, which analyzes the closest distance of the car through the coordinates of the target position and the initial position coordinates. In the process of advancing, if the obstacle is encountered, the car can automatically avoid obstacle operation. After the obstacle avoidance is completed, the car can gradually approach the optimal route determined by the original car, and can make corresponding route planning according to different road conditions. The significant advantages of this design are that the circuit is simple, strong reliability and low cost, and it is very easy to further improve and expand the function. The car can be further optimized, such as multi-point input, so that the car can plan the shortest line distance, and can bypass large-scale obstacles, which can achieve the shortest distance optimization in multiple obstacles.

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