

Intelligent Suitcase based on Arduino Microcontroller

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Abstract: Arduino is an open source, portable, flexible and easy to use open source electronic platform. This intelligent suitcase uses Arduino as a single chip microcomputer and HC-SR04 ultrasonic ranging module to realize intelligent following person's track. The handheld device is made of an Arduino Nano board and connected to the HC-SR04 ultrasonic module for receiving and transmitting ultrasonic signals. Both sides of the suitcase are also ultrasonic modules. Intelligent tracking is realized by detecting the time difference between the signal launched by the hand-held ultrasonic module and the ultrasonic module on the two sides of the suitcase, which reflects the relationship between the running direction of the suitcase and the direction of the person. In addition, the suitcase can also be equipped with smart locks, removable battery and can be switched to mobile phone remote control and automatic follow mode. The suitcase can also be switched to a hand-pulled mode when the battery is run out. This paper proves the feasibility of intelligent luggage following by using ultrasonic module through theory.

1. Introduction

Nowadays, most people can't travel without suitcases. And the heavy and forgettable luggage can bring a lot of inconvenience when we are traveling. This paper theoretically discusses the feasibility of Bluetooth luggage with ultrasonic module for intelligent tracking. This suitcase connects HC-SR04 ultrasonic module and Bluetooth module to Arduino microcontroller. Through the ultrasonic obstacle avoidance algorithm, the incoming ultrasonic signal is processed to control the operation of the suitcase, so as to realize the luggage to follow the movement of people. The Bluetooth module is used to interact with the phone to obtain information such as the status of the luggage. Today, designing such a smart suitcase plays a very important role in relieving people's travel pressure and improving their travel experience. Such a smart luggage can also promote the development of embedded artificial intelligence field.

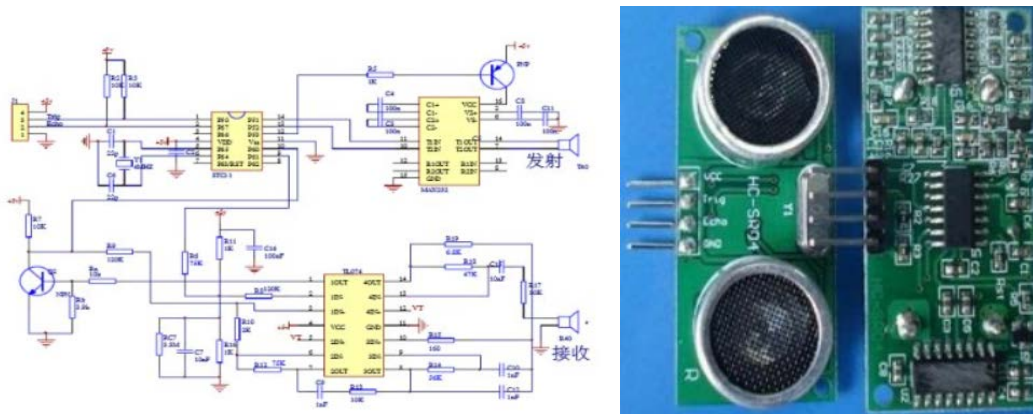


Fig. 1 Schematic diagram of ultrasonic obstacle avoidance module

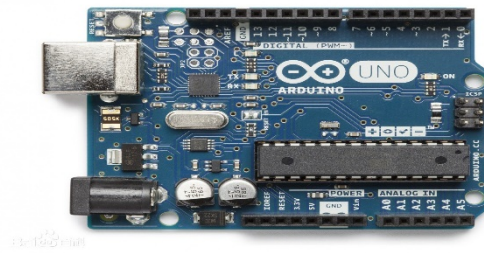


Fig. 2 Arduino UNO Board

2. An Introduction to the Arduino Uno Board and the HC-SR04 Ultrasonic Module

2.1 Arduino Uno Board

2.1.1 The Use of Arduino Uno Board

Arduino is an open source electronic prototype platform that is convenient, flexible and easy to use. It contains hardware (Arduino boards of various models) and software (Arduino IDE). It is built on the open source simple I/O interface and it owns Processing/Wiring development environment like Java and C. The hardware part is Arduino circuit board which can be used for circuit connection. The software part is the Arduino IDE, the programming environment on your computer.

Arduino senses the environment through a variety of sensors. By controlling lights, motors and other devices to feedback and influence the environment. Microcontrollers can be programmed with an Arduino programming language, compiled into binaries, and burned into microcontrollers. Programming for Arduino is implemented with the Arduino programming language (based on Wiring) and the Arduino development environment (based on Processing). Arduino USES existing electronic components such as switches or sensors or other control devices, leds, stepper motors, or other output devices. Therefore, the Arduino board is widely used in the hardware development field.

2.1.2 Arduino SCM Structure and Parameters

Digital I/O digital input/output ports: 0 -- 13.

Analog I/O Analog input/output port: 0-5.

Support ISP download function.

Input voltage: connect to USB without external power supply or external 5V~9V dc voltage input.

Output voltage: 5V dc voltage output and 3.3v dc voltage output and external power input.

Atmel Atmega328P microcontroller was used. due to its large number of supporters, many companies have developed 32-bit MCU platforms to support Arduino.

Arduino size: 70mm wide X 54mm high.

2.2 A Brief Introduction to the HC-SR04 Ultrasonic Module

HC-SR04 ultrasonic module has the advantages of stable performance, accurate measurement distance, high precision and small blind area. This ultrasonic module is widely used in many fields such as ultrasonic ranging, robot control and parking lot detection. Moreover, the ultrasonic ranging module is cheap, small and portable, which can reduce the weight and bring many functions in intelligent robot.

Here is the performance parameter:

- 1: voltage: DC-- 5V
- 2: static current: less than 2mA
- 3: level output: high 5V
- 4: level output: bottom 0V
- 5: induction Angle: no more than 15 degrees
- 6: detection range: 2cm-450cm
- 7: high precision up to 0.2cm

The basic working principle of the HC-SR04 ultrasonic module:

(1) IO port TRIG trigger ranging is adopted to give at least 10us high level signal;

(2) the module automatically sends 840khz square waves and automatically detects whether there is any signal to return;

(3) a signal is returned, and a high level is output by IO port ECHO. The duration of the high level is the time from the emission of ultrasonic wave to the return. The formula for calculating the distance is as follows:

$$\text{Test distance} = (\text{high level time} * \text{sound velocity (340M/S)})/2; \quad (1)$$

This module USES method is simple, the mouth sends a high level of more than ten us, you can receive the mouth for high level output. To be able to open the timer timing, an output when the mouth into a low electricity at ordinary times the value of the timer can be read, this is for the distance of time, can calculate the distance. So constantly cycle test, which can reach your mobile measuring values

3. The Ultrasonic Obstacle Avoidance Algorithm

3.1 Distance Calculation Algorithm

In the above paper, we introduce the formula of HC-SR04 ultrasonic obstacle avoidance module to detect the distance of obstacles. The principle is sound velocity times divided by two. In intelligent following, we can turn the ultrasonic signals reflected by obstacles into hand-held ultrasonic transmitters. The left and right ultrasonic modules on the suitcase emit ultrasonic signals respectively. At this time, the handheld ultrasonic module will immediately transmit the ultrasonic signal to the suitcase after receiving the ultrasonic signal. Due to the distance difference between the left and right ultrasonic module and the handheld ultrasonic module of the two suitcases, there is a time difference between the signals sent by the handheld devices received by the two ultrasonic modules at this time. By subtracting the processing time of the whole single-chip microcomputer system, the time of ultrasonic wave propagation in the air is obtained. By dividing the propagation time by the speed of sound by two, the distance between the ultrasonic modules on the left and right sides of the suitcase can be obtained. By comparing the distance difference between the ultrasonic module on the left and right sides and the handheld ultrasonic module (the handheld module is the human body), the motor is controlled to adjust the running direction of the suitcase.

This algorithm can get the accurate distance and posture information of luggage and human body, which has a strong flexibility. However, the ultrasonic waves reflected from other places after being emitted by the ultrasonic transmitter may cause slight disturbance to the luggage movement. This is also the shortcoming of this algorithm.

3.2 Simplified Version of Obstacle Avoidance Algorithm

If the distance transfer process is simplified, the effect of reflected ultrasonic waves can be avoided. In the handheld ultrasonic module, add a switch button. After pressing the switch, the ultrasonic module starts to emit ultrasonic signals. Ultrasonic signals are emitted at regular intervals. After receiving the ultrasonic signal on the left and right sides of the suitcase, the distance between the left and right sides from the handheld ultrasonic signal transmitter is different, so the received ultrasonic signal also has a time difference according to the time difference can adjust the attitude of the suitcase. If the distance to the left is greater than the distance to the right, the suitcase should rotate to the right. If the distance to the right is greater than the distance to the left, the suitcase should rotate to the left. The user can control whether to transmit or stop the signal by pressing down or back to the handheld device according to the distance of the suitcase. The suitcase moves when ultrasonic signals are received and remains stationary when no ultrasonic signals are received.

3.3 Error Correction Method

In the obstacle avoidance algorithm of this suitcase, the main error source is the delay of the single-chip microcomputer processing. However, if the ultrasonic module on the left and right side

of the suitcase produces the same delay, it will have no impact on the work of the suitcase. However, ultrasonic modules have slight differences in processing time due to various problems. In order to avoid this error, we can adopt experimental method to adjust. Handheld ultrasonic transmitter can monitor the time of ultrasonic signal received by the left and right ultrasonic module on the suitcase after the signal is transmitted in front of the suitcase. If the time detected is different at this time, it is necessary to adjust the time difference between the left and right sides.

4. Summary

Nowadays, intelligent products continue to enter our life, and artificial intelligence gradually makes our life more colorful. Intelligent home is also an important part of intelligent development. The era of 5G is coming, and the uncertainty of the development of artificial intelligence also casts a veil over the future.

In China, almost all suitcases are hand-pulled. With the development of The Times, exquisite suitcases with complete functions are gradually appearing in the Chinese market. But high-tech luggage is still rare. This paper theoretically discusses the realization idea of intelligent suitcase, which provides a theoretical support for the development of intelligent suitcase. The suitcase designed according to this idea is indeed feasible and can realize the function of intelligent obstacle avoidance. Moreover, hc-sr04 ultrasonic module is very cheap, and MCU is also relatively cheap, so it is very important for manufacturers to reduce the cost. The cost of this kind of luggage produced by the manufacturer will not be higher than that of ordinary luggage, which is more conducive to the better popularity of smart luggage. Therefore, intelligent luggage plays a very important role in the development of artificial intelligence and the improvement of living standards.

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