Design of a multi-functional intelligent guide stick

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Abstract: The living problems of visually impaired people have increasingly attracted people's attention. This article designs an intelligent guide cane based on STM32, aimed at helping visually impaired people move more conveniently.This system includes HC-SR04 ultrasonic ranging module, YF017 voice module, small vibration motor, GPS positioning module, and GSM communication module. It can detect surrounding obstacles in real time and provide voice and vibration prompts, making it easier for users to avoid obstacles. At the same time, users can actively send help messages to friends and family, providing better protection for the safety of visually impaired people.This design is practical, simple, and cost-effective, and has certain guiding significance for future research on intelligent guide canes.

Keywords: Multi functional ; Singlechip; Guide cane

Introduction

China has the largest number of blind people in the world, and the number of blind people is increasing at an average rate of 450,000 per year, and many of them are caused by congenital genetic eye diseases, including many children under the age of 14. Cataract is the main reason why many people over the age of 60 become blind or have low vision. There are a large number of visually impaired people, and how to walk safely is the biggest problem in the life of the blind. Although the traditional walking stick can help the visually impaired to avoid obstacles, its function is limited. The training cycle of guide dogs is too long and the price is expensive, which is not conducive to popularization. As an auxiliary tool combining advanced technology and humanized design, intelligent guide stick aims to help visually impaired people guide and move more easily. In order to improve the safety of travel for the visually impaired and reduce the probability of getting lost, this guide stick is designed.

1. Overall design

The system uses STM32 as the main control, and the external modules mainly include ultrasonic module, YF017 voice module, vibration module, GPS positioning module and GSM communication module. This design takes the STM32 minimum system as the core control unit, the HC-SR04 ultrasonic module is used to detect whether there is an obstacle in front of the visually impaired, the YF017 module and the vibration module remind the visually impaired in front of the obstacle situation in two different ways, the positioning module and the communication module are combined to send the positioning information to friends and relatives by short message. The schematic diagram of the overall design circuit is shown in Figure 1.

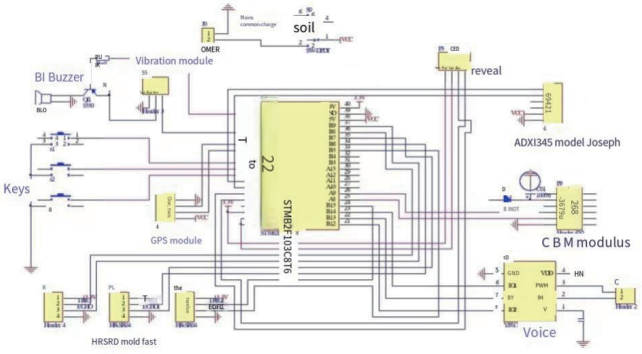

Figure 1 Schematic diagram of the overall design circuit

2. Overall structure of the system

2.1 STM32 minimum system

The main control adopts STM32 chip, which has the advantages of low power consumption, energy saving, suitable price and strong stability, fast processing speed and so on. STM32 is used to drive each external module, the received and sent signals are processed, the sending and receiving process is repeated, and then the various parts of the components are connected to integrate the function.

2.2 Ultrasonic ranging module

Ultrasonic wave is a frequency of more than 20 kHz sound wave, with the ability of linear propagation, the higher the frequency of diffraction ability is weaker, but the reflection ability is stronger, its directivity is strong, energy consumption is slow, and the distance of propagation is far.

Ultrasonic module is a commonly used sensor, its frequency is generally 40KHZ. The module is mainly composed of ultrasonic transmitter, receiver and control circuit.

2.3 Voice module

By using its speech synthesis function, it can convert text messages into speech signals for playback.

2.4 Vibration Module

Vibration motor motor module is usually composed of motor, vibration device and drive circuit and other parts. Control the vibration motor, when the input is high, the motor will vibrate.

2.5 Positioning Module

In order to obtain the location of the visually impaired, it is necessary to design a GPS module. The positioning information of the satellite data is obtained through the GPS positioning module, and then the latitude and longitude information read is obtained.

2.6 Information transmission module

GSM modules usually consist of baseband processor, RF transceiver, SIM card slot, antenna interface, etc. It can be used for SMS transmission and data communication through the GSM network. The GSM module supports multiple frequency bands and can communicate across the globe. Connect to GSM network through SIM card and communicate with other devices through MCU.

3 Software design

3.1 Overall design

The peripheral equipment required by the ultrasonic module, vibration module, voice module, positioning module and communication module are connected with the STM32 microcontroller to realize the functions required by the design.

3.2 Program design of ultrasonic ranging module

First of all, the control circuit will send a control signal to the ultrasonic transmitter to tell it to emit ultrasonic waves, ultrasonic transmitters will produce a certain frequency of ultrasonic signals, and the generated ultrasonic signals are emitted. After the ultrasonic emission, if there is an obstacle, the ultrasonic reflection, the reflected wave will be received by the ultrasonic receiver; If the obstacle is not encountered, the reflected wave can not be received.

The test distance is set as S, the high level time is set as T, and the sound speed is 340 m/s, then S=T*340/2. Then the distance between the obstacle and the ultrasonic sensor is calculated by the formula: distance = time delay × 340/2.

3.3 Programming of speech module and vibration module

STM32 processes the information collected by ultrasonic wave. If the obstacle is detected by ultrasonic wave outside the set range, the voice module and the vibration module do not respond. If the obstacle is detected by the ultrasonic wave within the set range, the voice module broadcasts “there is danger in front”, and the vibration module begins to vibrate, so as to remind the visually impaired people of the obstacles in front.

3.4 Program design of positioning module and communication module

The positioning module starts positioning after the device starts to supply power. After inserting the SIM card, the communication module will read the information stored in the SIM card, and then the mobile phone number corresponding to the SIM card can be used for communication. The module is combined with the key and buzzer to send the positioning information. Long press the button, if you hear the buzzer sound, release the button, the communication module will send the positioning information read by the positioning module to the reserved mobile phone number.

4 System function test

The function test of the ranging module and positioning module will be carried out, and the distance display measured by the ultrasonic wave and the reception of positioning data are shown in Figure 2.

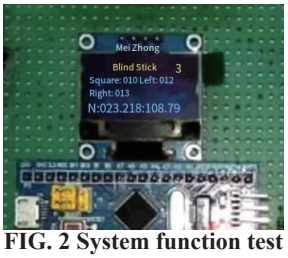

FIG. 2 System function test

4.1 Distance Test

Wait after the power supply is turned on. When the distance of the front obstacle is less than the set distance, the vibration module vibrates and the voice module broadcasts “there is danger in front”. The distances set in this test are 20cm, 40cm, 60cm and 80cm respectively, and then 15 tests are carried out for different distances, and the test results are shown in Table 1:

Table 1 Distance alarm test results

Actual distance	The number of times a voice broadcast (vibration) is made after an obstacle is identified	The number of times a voice broadcast (vibration) was performed after an obstacle was not identified
20cm	15	0
40cm	15	0

60cm	15	0
80cm	15	0

4.2 Positioning test

Wait after the power supply is turned on, wait to receive GPS positioning information, long press the key, wait for the buzzer to sound, and send positioning information to relatives and friends after the buzzer sounds. The received positioning information is shown in Figure 3.

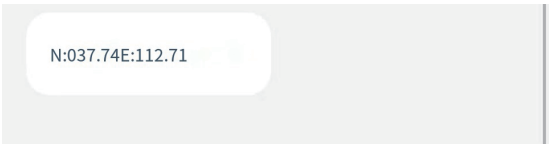

Figure 3 Positioning information

5 Closing remarks

The design can identify the obstacle information and transmit it to the visually impaired through voice broadcast and vibration. Long press the key to wait for the buzzer to sound and release the key. The communication module sends the information obtained by the positioning module to the relatives and friends of the visually impaired. After system testing, it is proved that the system can obtain obstacle information and feedback to the visually impaired, and the visually impaired can also actively send positioning information to relatives and friends by pressing the key, and the effect is good.

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