

Study on Arduino-based Smart Cane for the Blind

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Abstract. Under the trends of intelligent automation, more and more intelligent products into our lives, these products are changing our life now in the background. Therefore, we designed a smart cane device the device adopts the embedded system, using the Arduino microcontroller design a set of portable intelligent auxiliary tools, which can provide the blind with corresponding voice prompts such as obstacle avoidance, and monitor the blind's travel location through GPS and GSM modules. At the same time, the device is equipped with one-button emergency communication function, enabling the blind to travel safely and conveniently.

Keywords: Arduino; blind person; safety; convenience.

1. Background

According to statistics from the state authorities, China has the most blind people in the world, with about 5 million, accounting for 18% of the world's blind population. In addition, there are about 450,000 new blind people and 1.35 million people with low vision in China every year, that is, there will be one blind person and three patients with low vision every minute. However, their own vision problems limit the activity space and scope of the blind, and have a huge impact on the quality of life of the blind. As a result, assistive tools for the blind have become an essential part of their lives. Aiming at the walking stick which is used as a guide device to help the blind to walk, it will be transformed into the eyes of the blind with visual impairment to escort their daily life. Therefore, the research on smart walking sticks to assist the blind to travel is of great importance in today's society.

2. Introduction to Arduino Single Chip Microcomputer

Arduino is a convenient, flexible and easy-to-use open source electronic prototype platform. Developed by a European development team in the winter of 2005. It is built on the open source simple I/O interface and has a Processing/Wiring development environment similar to Java and C. It mainly consists of two parts: the hardware part is the Arduino circuit board which can be used for circuit connection; The other is the Arduino IDE, the programming environment on your computer. You just write code in the IDE, upload it to the Arduino circuit board, and the program tells the Arduino circuit board what to do. Arduino senses the environment through a variety of sensors, and influences the environment by controlling lights, motors, and other devices. The microcontroller on the board can be programmed in Arduino's programming language, compiled into binaries, and burned into the microcontroller. Programming Arduino is through the Arduino programming language (based on Wiring) and the Arduino development environment (based on Processing). An arduino-based project can either contain only Arduino, or it can contain Arduino and some other software running on a PC that communicates with each other.

3. The Structure of the Smart Cane

This device is based on Arduino single chip microcomputer control, with ultrasonic ranging module, GPS positioning module, GSM communication module. This design USES the single chip microcomputer processing information control information function. When the user walks on a section of road, the multi-channel ultrasonic ranging module is used to collect data, identify obstacles in different directions, feedback the information to Arduino MCU, and issue obstacle avoidance prompt sound through the voice module (TTS).

In addition, combined with the GPS module, the user's location information is collected in real time and connected to the cloud through the GSM module (SIM800C) to transmit real-time data to the cloud. When the user encounters an emergency situation, it realizes the one-button emergency call function (SMS function to send a message for help, TTS at the same time to the surrounding alarm voice).

The shape of the device is based on crutches, and is divided into handle, rod and chassis. The pole is used to place the host box, which contains single chip microcomputer, battery box, TTS speech module and GSM module. The side wall of the main case is provided with sound hole, which is convenient for voice module to scatter sound. Square chassis with two rollers to facilitate the movement of the whole cane; The front left and right sides of the chassis are provided with ultrasonic ranging module. The chassis can be moved at 180 from the front to the rear, and the rod and the chassis are connected by a telescopic rod, which can change different angles to make the device more user-friendly.

4. Main Function

1. Avoid obstacles with voice prompts. When the user walks on a section of road, the multi-channel ultrasonic ranging module is used to identify obstacles in different directions by comparing the data collected by the ultrasonic module, and the information is fed back to the single-chip microcomputer. After the operation and processing of relevant programs, the appropriate response is obtained and the TTS is adopted to guide the user to avoid obstacles.

2. GPS positioning. Combined with GPS module, real-time user location information is collected, and data is uploaded to the cloud through GSM module. Can be in mobile phone terminal or PC terminal real-time query user location information.

3. One-button emergency call function. This device is equipped with SOS button. In case of emergency, the user can use SMS function of GSM module to realize one-key emergency call function to send a message for help or make a call for help, and TTS voice module can send an alarm and call for help to the surrounding area at the same time.

4. The shock absorption. A shock absorber spring is added at the connection between the rod and the chassis of the walking stick to prevent injuries caused by the impact of the walking stick.

5. Embodiment

This device USES Arduino as the control basis and coordinates with various modules to realize various functions of the smart walking stick. The basic implementation scheme is shown in the figure:

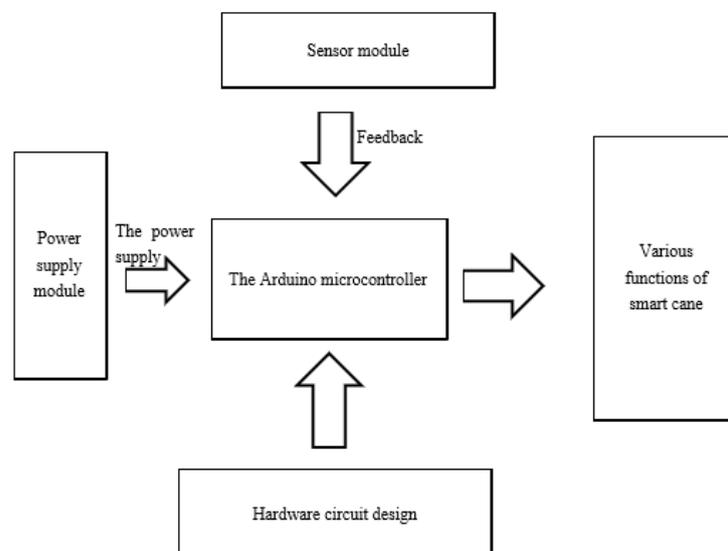


Fig 1. The basic implementation schemes

The basic working principle diagram is as follows:

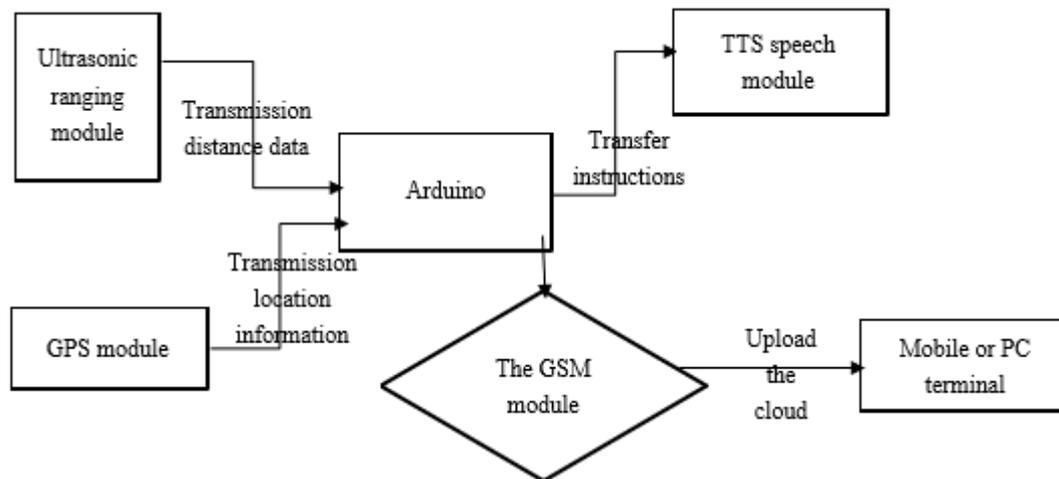


Fig 2. The basic working principle diagram

6. Epilogue

The arduino-based intelligent walking stick for the blind plays an important role in assisting the blind to travel and improving their life. This product can solve the travel problems caused by the visual inconvenience of the blind by providing the blind with a speech prompt to avoid obstacles. In case of emergency, the user and guardian shall be provided with effective help to help the guardian find the user quickly and avoid further accidents. With the development of the society and the improvement of living standards, it is the general trend to care for and improve the quality of life of the blind and other vulnerable groups. This project has a broad application prospect, has a good economic and social significance, and provides some reference for the disability assistance project. It is believed that in the near future, the smart walking stick for the blind will become a beautiful sight in the market of assistive devices and an indispensable intimate partner for the blind.

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