

Design and Implementation of Voiceprint Recognition Access Control System

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Abstract

Voiceprint recognition technology is one of the methods of biological authentication at present, that is, a technical method of identifying the speaker's identity by recognizing speech. The entrance guard system based on voiceprint recognition has the advantages of high safety factor and convenient use. At present, voiceprint recognition technology is in a promising era and is one of the hot acoustic application technologies currently studied. In this paper, an access control system that can use voiceprint to identify people is designed. The core processor of the access control system adopts Sunplus 16-bit MCU SPCE061A, which has been improved and perfected on the basis of voice analysis technology, so as to achieve accurate voiceprint recognition function, and can accurately determine whether it is the user's own effect, so as to complete the recognition of specific people's voices. The measured data show that the system meets the design requirements, can accurately identify and judge the user's identity, and has a good market prospect.

Keywords

Voiceprint; Access Control System; SPCE061A Singlechip.

1. System Design

1.1 Principle of Voiceprint Recognition

The principle of voiceprint recognition and speech recognition is different, mainly because the two rely on the command issuer. Voiceprint recognition technology mainly includes two levels, namely the training recording level of undocumented voiceprint information and the recognition and comparison level of received speech information. In the training recording stage, the microcontroller analyzes and records the received voice sound wave spectrum, and obtains its unique voiceprint information through analysis and calculation in the time domain and frequency domain [1]. The voiceprint features extracted when the speaker makes a sound are used as the voice identification of the command issuer, and the voiceprint feature models are built by distinguishing the voiceprint features of others from each other. This feature model calculates a set of feature values in the frequency domain using equations (1).

$$F(\omega) = \int_{-\infty}^{+\infty} x(t)e^{-i\omega t} dt \quad (1)$$

In the formula:

$F(\omega)$ --Signal spectrum.

$x(t)$ --Measured voice signal.

1.2 System Solution Design

In this design, first of all, the analog signal is converted to a digital signal through analog-to-digital conversion technology, which collects and converts the voice signal received by the voice collector in the microcontroller hardware circuit into a regular electrical signal in a specific way. After that, the regular electrical signal is converted into a digital signal that can be recognized and processed by a microcontroller through the conversion circuit. The processing of the digital signal will be processed by the control core microcontroller of the voiceprint recognition access control system designed in this paper, and the processing process will be carried out by the algorithm set in advance in the microcontroller. The algorithm analyzes the sound wave spectrum of the speech information received by the speech receiver through a certain calculation method, and extracts the unique sound characteristic values, and then compares the extracted feature values with the feature values stored in the microcontroller that have been trained and recorded. Finally, whether it conforms to the characteristics of the biometric information stored in the microcontroller is given, and if it is, the biometric information that is consistent is output to complete the voiceprint recognition work. If not, the system does not perform any action.

It is mainly carried out in two steps: voice acquisition and voice identification. In the first step, the user records the system, and the sound is converted into a unique feature model through the microphone and microcontroller, and then entered into the system as a reference model [2]. In the second step, the collected sound signal is transformed into a specific value by the same algorithm, which is compared with the feature model of the previous input system, and if the two are highly matched, it is manifested as unlocking or closing the lock (the light is on or off), and the difference is realized as no action (the lamp does not change). The flowchart of the training identification stage is shown in Figure 1.

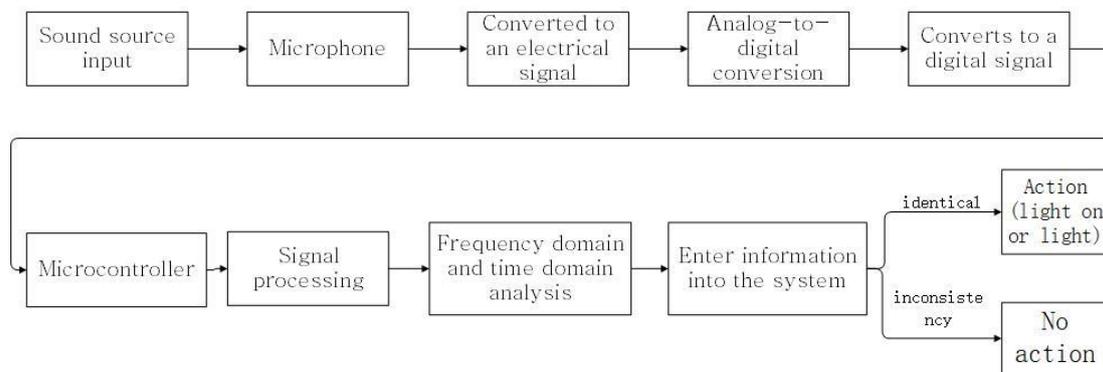


Figure 1. Identification phase flowchart

1.3 Hardware Design

The control core used in voiceprint recognition access control is the SPCE061A 16-bit microcontroller produced by Taiwan Lingyang Technology Company. The CPU operating voltage of the chip is 2.4V dc to 3.6V, the input and output voltage is 2.4V to 5.5V, and the CPU clock is operating at 0.32MHz to 49.152MHz.

1.4 Software Design

The software design of the voiceprint recognition access control system mainly relies on the voiceprint recognition workflow, first of all, the training recognition recording process of the voice of the command issuer, the second is the recognition process of the speech received by the speech receiver and the comparison process with the recorded voiceprint information, and finally the more humanized recognition result of the sound design. Fig. 2 is a flowchart of voiceprint recognition.

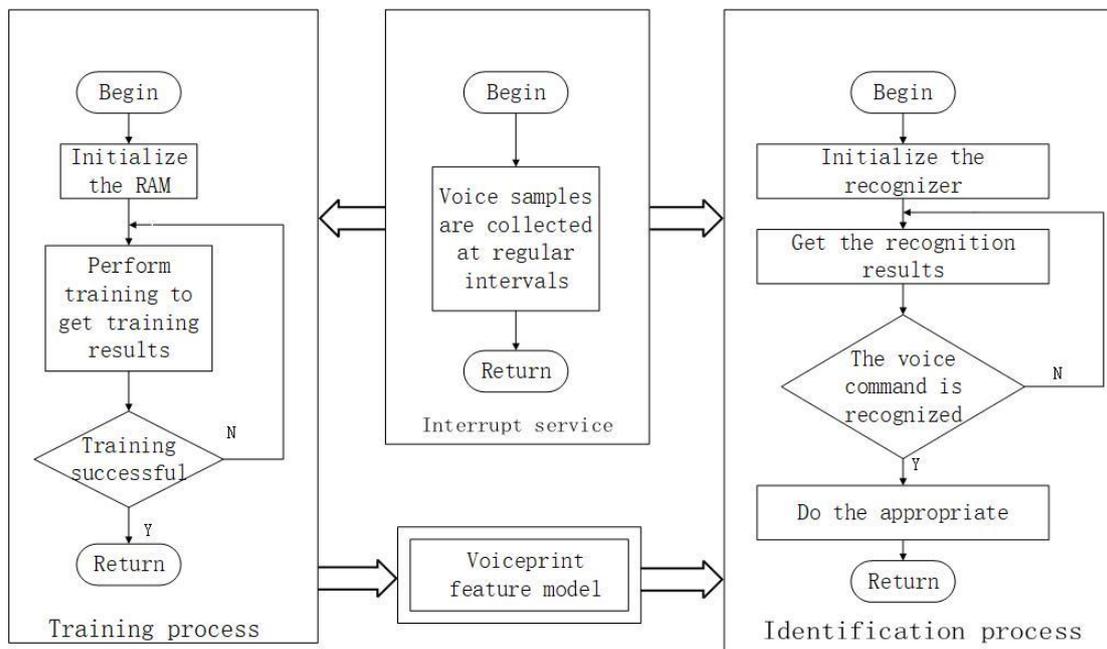


Figure 2. Voiceprint recognition flowchart

2. Hardware and Software Debugging

2.1 Software Debugging

Whether it is the traditional assembly language or the popular C language, you can design programs in the development environment provided by this software, and the two languages can also be mixed for programming, compared to other compilation environments, this program is easier to operate and more developer-friendly.

2.2 System Testing

First of all, follow the prompts of the voice to complete the training of two voices, each of which must be trained twice. Each voice must be trained before recognition can begin.

Finally, according to the prompt tone, start speech recognition and test system performance.

According to the characteristics of the voiceprint, I decided to test the system from the aspects of gender and voice length, and the test results are shown in Table 1 and Table 2.

Table 1. Gender test results

Gender	Number of tests	Number of recognitions
Man	50	42
Women	50	39

Table 2. Voice length test results

Voice length	Number of tests	Number of recognitions
Shorter	50	26
Longer	50	43

The analysis of the system is the most sensitive to the length of the speech, if the speech is shorter to extract fewer features, it is easy to misidentify or not recognize. Gender has less influence on test results.

3. Epilogue

The control core of the voiceprint recognition access control system adopts The Lingyang SPCE061A chip, the system is smaller than the fingerprint recognition and face recognition system, the price is low, the information processing is convenient and the accuracy rate is high, and the speech recognition method also makes the system complete the contactless recognition mode, which is more secure and reliable, isolating the source of harm that may occur due to contact in the special period, and has broad market prospects, especially in the current era of the epidemic, the practical significance is very significant.

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