Research on alarm control system based on voice lock

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Abstract. In order to realize the intelligent control and remote control of the safe and improve the efficiency of unlocking, a voiceprint unlocking system is proposed. The research uses voiceprint to control the switch of electronic lock. The core technology of voiceprint lock is speech recognition. Speech recognition technology is to convert speech signal to machine language, so that the machine can recognize the voiceprint. Because of the uniqueness of the voiceprint, compared with other unlocking methods, it has the advantages of high precision, high life, high efficiency, etc. Besides, because the voiceprint does not use the mechanical key to unlock, the efficiency of unlocking is greatly improved. The application of voiceprint recognition technology to the voiceprint lock is a high stability unlocking method, which can greatly improve the safety of the safe. Through mobile app and direct voiceprint input, the remote control of the safe is realized. The recognition rate is over 98%, which greatly improves the unlocking efficiency of the safe.

1. Introduction
The safe box appeared in the 18th century and has a history of more than 300 years. The structure of the original safe box is very simple and the shape is very single. After nearly 300 years of development, its shape and unlocking method have changed a lot, but its most fundamental anti theft function has not changed. People have higher and higher requirements for information security, so the long history of safe will continue[1]. At present, mechanical lock and electronic lock are mainly used in safe at home and abroad. When mechanical lock is opened, it is troublesome to turn around. Once the key is lost, it will cause great trouble for users. Electronic lock has short service life and easy to lose password. At present, there are few research on the application of voiceprint technology in voiceprint lock at home and abroad[2]. Compared with mechanical lock and electronic lock, voiceprint unlock has the advantages of high stability, high efficiency, high precision, etc. it will not have the disadvantages of password leakage, key loss, etc. This system uses the voiceprint to unlock, because the stability and uniqueness of the voiceprint greatly improve the safety of the safe. The image of school enterprise alliance of Internet of things in China regards speech recognition ratio as "machine recognition system"[3].
2. overall design

The main working principle of the system is to convert the user specific voiceprint or the specific voiceprint signal sent by the mobile app into a specific current, and use the electromagnetic induction to open the lock.

2.1. voiceprint recognition system:

A voiceprint recognition consists of two processes: voiceprint training and voiceprint recognition. The diagram of voiceprint recognition is as follows:

![Flow chart of voiceprint recognition system](image)

**B denoising:**

The input voiceprint signal is denoised, the voiceprint is quantized and sampled, processed into digital voice signal, then the low-frequency interference is removed (using pre weighting technology), and the noisy voice signal is processed to reduce the noise to get clean and clear voice signal.

**C endpoint detection**

The short-time zero crossing rate and short-time energy are applied to the endpoint detection of the system's voice signal. The data of each frame of the voice signal is 20ms, the sampling frequency is 8kHz, and the total number of sampling points is 160. The short-time energy and short-time zero crossing rate are recorded every 20ms. It can use the detected short-time energy and short-time zero crossing rate to remove white noise and voiceless frame, and keep the voiced signal. The voiced signal is very useful to get the characteristic parameters such as gene LPCC [4].

**D voiceprint recognition -- feature extraction**

The speech signal is transformed into DCT by adding window, calculating spectrum and Mel. The extraction process is as follows:
Figure 2. Process chart of feature extraction

E voiceprint recognition -- building acoustic model
VQ vector quantization, which classifies all vectors (set to \( m \)), is called vector quantization, assuming that the vector
The quantization error of the nearest vector center is 0. Then the average quantization error of \( T \) vectors is.

By using LBJ clustering algorithm, we can find the vector center set which can make \( d \) to be the minimum. A set of codes is composed of this set. This set of codes is the embodiment of the best distribution of \( T \) vectors in \( n \) spaces, that is, acoustic model.

F voiceprint recognition -- pattern matching
On the basis of obtaining the speaker's personality parameters, we match the parameter model and template waiting for recognition with the template or model base after training, get the similarity distance measurement between feature patterns and select the appropriate distance measurement as the threshold value, then judge the best result of recognition. The VQ clustering method LBJ was used.

2.2. schematic diagram of voiceprint unlocking
The specific voice signal from the mobile app or the voice print from the user will be converted into a certain current through the single chip microcomputer. When the input is correct, the current will generate magnetic force through the winding coil, and the lock will be opened by the principle of mutual attraction of different magnetic poles.

In this study, proteus simulation system is used [5]. The wireless signal or voiceprint signal of mobile phone is preprocessed by windowing, pre weighting, quantization and so on, and then enters ADS1216 analog-to-digital converter for conversion. The converted signal enters SPCE061A single-chip microcomputer and enters the display system after being processed by the single-chip microcomputer [6]. When the master sends a voice print or sends a specific signal through the mobile phone app, the LED displays on and the LED is green. At the same time, the current enters the unlocking system and finally opens the lock. When the signal input other than the master, the LED shows off and the LED is red. There is no current passing through the unlocking system and the lock is not opened at last. The schematic diagram is as follows:
Figure 3. Schematic diagram of voiceprint unlocking simulation circuit

The input voiceprint enters the storage area for temporary storage, and then enters the model library for model matching. When the matching result fails, the recognition process will be interrupted back to the voiceprint input stage. When the matching result is successful, it will enter the electromagnetic trigger stage, and finally the lock will be opened. The flow chart of voiceprint unlocking is as follows:

2.3. Hardware design

The hardware circuit of this design consists of ADS1216 analog-to-digital conversion chip, mobile wireless receiver, SPCE061A single chip, LED display, sir-33st3 led, data acquisition, data processing, identification circuit and some driving circuits. SPCE061A was launched with 61 boards, and the resources of SPCE061A were comprehensively utilized. A safe box with speech recognition function is designed by using single chip microcomputer instead of traditional mechanical unlocking [7].

The ice interface of the online simulation circuit is embedded in the SPCE061A single chip microcomputer, which can process the complex signals quickly [8]. The wireless receiver of the mobile phone can receive the wireless signals sent by the mobile phone. The wireless signals enter the SPCE061A single chip microcomputer for temporary storage. The wireless signals or voiceprint signals of the mobile phone enter the ADS1216 analog-to-digital converter for conversion after pre-processing such as windowing, pre weighting and quantification. The converted signal enters SPCE061A single chip microcomputer, and finally converts into a stable 3.3V voltage signal.

The display part is led display screen, which adopts two-color screen and three position display. The display time is three seconds, so that the visual retention time is kept at three seconds, which will make people's eyes feel more comfortable [9]. When the signal is not sent out by the user, the recognition circuit cannot process the voiceprint signal into a 3.30v voltage signal. The display screen shows off and the ir-33st3 light-emitting diode emits red light. The current will not enter the circuit after the diode. If the input is the user's voiceprint, the display screen will show on and the ir-33st3 light-emitting diode emits green. The safety lock is made of magnet, which is closed when there is no current passing through. When there is current passing through the drive circuit, the current passing through the multi turn coil can produce a larger magnetic force, which makes the lock open under the mutual attraction of magnets. When the current disappears, the magnets attract each other, making the lock closed. The hardware structure is as follows:
2.4. System analysis
The experimental results show that when the input user's voice print, the test voltage is 3.30v, the LED is green, and the electromagnetic lock is turned on. When other people's voice print is input, the test voltage is not 3.30v, the LED is red, and the electromagnetic lock is not opened. The same result can be obtained by using the signal from the mobile app to unlock the lock. The master receives the voiceprint signal from the mobile app through the wireless receiver, which is converted into 3.30v electrical signal by the analog-to-digital converter and the single-chip microcomputer. The LED is green, and the electromagnetic lock is opened at the same time. The voice print signal of other mobile phones received by the wireless receiver is not converted into 3.30v electrical signal, the LED is red, and the electromagnetic lock is not opened. It can be seen from the results that only the user's voiceprint can be converted into 3.30v electrical signal whether it is direct or indirect voiceprint input. Other people's voiceprint signal will not be converted into the required electrical signal, and then the lock will not be opened. The experimental analysis is as follows:

| test      | noise(DB) | distance | output voltage | led display | warning lamp | if open |
|-----------|-----------|----------|----------------|-------------|--------------|---------|
| Master voiceprint | 40        | 1m       | 3.3V           | ON          | green        | open    |
|           | 80        | 3m       | 3.3V           | ON          | green        | open    |
| A voiceprint | 40        | 1m       | 3.7V           | OFF         | red          | no      |
|           | 80        | 3m       | 3.7V           | OFF         | red          | no      |
| B voiceprint | 40        | 1m       | 2.7V           | OFF         | red          | no      |
|           | 80        | 3m       | 2.7V           | OFF         | red          | no      |
| C voiceprint | 40        | 1m       | 3.6V           | OFF         | red          | no      |
|           | 80        | 3m       | 3.6V           | OFF         | red          | no      |

3. summary
Voiceprint recognition can be applied to many fields. With the help of the uniqueness of human voiceprint, voiceprint lock can ensure the safety of property. It is a leading new type of security product at home and abroad, which encrypts the safe system and protects the safe. With advanced voiceprint recognition technology, the voiceprint lock can immediately identify the user's identity by the user's voiceprint. There is no digital password in the voiceprint lock, so the user can not remember a large number of passwords, let alone worry about the loss of passwords and the loss of property. Therefore, high efficiency, high precision and long life represents a major trend in the safety lock.
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