Design and Application Technology of ARM Embedded System

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Abstract: In today's highly developed information society, how to quickly and accurately identify a person's identity and protect information security is a key social problem that must be solved in the information age. Identity recognition technology based on biometrics, with its advantages of convenience, rapidity, security and reliability, will become the best choice to replace traditional identification technologies such as keys, passwords, smart cards and so on in the future. In this paper, from the anti-counterfeiting point of view, meeting the application requirements of easy acquisition and acceptance, the human-computer interaction interface of embedded system based on ARM was studied and designed from two kinds of single-mode identification technologies, speech recognition and face recognition.

1. Introduction

With the development of social economy and the improvement of science and technology, people's life rhythm is also accelerating, which makes people gradually enter the era of information and network. Accordingly, payment platforms such as electronic payment, e-commerce, e-government and Internet banking are becoming more and more popular. How to make sure that their own information will not leak and confirm their identity has become an urgent problem to be solved. The accuracy, reliability, and convenience of the identity authentication system are essential in some institutions which have strict security requirements, such as banks, the army, the state or some confidential units. The traditional way of identity authentication using password or certificate is far from meeting people's needs. Therefore, a biometrics-based identification technology is proposed. In traditional speech recognition and face recognition, computer is the platform, and some problems arise, such as huge size, difficult to carry, complex system and high cost. Because of its portability, mobility and low cost, embedded electronic products can be used in various occasions, and gradually become an indispensable part of daily life. In order to improve the security and accuracy of identity authentication, the method of applying speech recognition and face recognition technology to biometric identity recognition based on ARM embedded system is proposed in this paper. This method can be more accurate and effective for identification. With the increasing proportion of embedded devices in applications, the development of human-computer interaction interface has become the decisive link in the process of embedded development. Human-computer interaction (HCI) has experienced more than 20 years of development in which innovative technologies continue to flow. Especially with the popularization of communication technology and computing technology, the research of HCI is imminent. The essential function of human-computer interaction is the research and exploration of the interaction technology between human and computer. The main function of interface is the medium and dialogue interface for information transmission and exchange between human and computer. It is an indispensable part of computer system. The research of human-computer interaction technology in China started relatively late.

2. Overview of Embedded System

According to the definition put forward by the Institute of Electrical and Electronics Engineers (IEEE), embedded systems are devices used to control, monitor and assist the operation of machines

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or devices. The definition proposed by the Chinese Computer Society is that embedded computer system is for embedded applications [1]. Therefore, it has formed a knowledge integration system which covers intensive technology, centralized capital, high decentralization and needs continuous innovation. In China, it is generally defined as a special computer system based on computer technology, with application as the center, and with reasonable software and hardware tailoring according to actual needs, which can meet various practical requirements, such as performance, high reliability, low cost, small size and low power consumption. From the above analysis, some important features of embedded system can be seen: small system core; system simplification; strong specificity [2]. The same platform of the same architecture must constantly modify the system at any time with the changes of hardware and tasks of the system. One of the most basic requirements of embedded system software is to have a high real-time system software. In order to improve the speed of operation, the system software can be stored in solid state, and the high quality and reliability of the software code is also one of its prerequisites. In order to use system resources and functions quickly and conveniently, as well as access professional library function interface, multi-task scheduling, users need to choose a RTOS development platform independently to ensure the real-time and reliability of the program in the process of execution, reduce the time spent in development, and then ensure the quality of the software [3]. Some users have completed the design of the system, but because the selected embedded system itself can not be well developed independently, so that users can not usually modify some of the programs and functions. In the process of development, there are two parts: host machine and target machine. Program development, compilation and debugging are carried out on the host computer, and the target machine acts as the final target executor. In the process of development, they alternately combine organically.

3. System Overall Design

3.1. Principles of system design

Human-computer interaction interface provides a good platform for human-machine interaction. The system design should be simple and intuitive, highly consistent, providing feedback, easy to use, with suitable color and typesetting specifications [4]. The design of human-computer interaction interface must be intuitive and functional, so that users can use the software flexibly through a simple and intuitive interface. The language, layout and design of the interface need to be consistent, which allows users to have a better understanding of how to operate, thereby improving efficiency. Real-time feedback from the interface to maintain interaction with users [5]. The design should conform to the user's general usage habits and realize the principles of simple operation for the target function and the shortest mouse movement distance. The proper color matching of the interface makes the head of the household feel less visual fatigue after using the system for a long time, and the interface layout is more standardized. Different functional modules should be placed in fixed positions as far as possible, which is convenient for users to operate and use. The typesetting should not be too intensive, otherwise it may cause visual fatigue.

3.2. Objectives of system design

Some units, such as banks, the army, the state and some units requiring special confidentiality, have high requirements for information security, while traditional passwords or certificate authentication are prone to password leakage, forgery and other unsafe hidden dangers. Therefore, a user interface for speech recognition and face recognition is designed and implemented on the basis of ARM embedded system. In this interface, not only the information collection of voice and face can be realized, but also the recognition results of voice and face can be realized, thus achieving information security protection [6]. Firstly, it acquires multiple voice information and face images for training and storage in the template library. Then, it selects the person to be recognized to record or take photos to collect voice and face information, and matches the collected information with the template library through feature extraction to realize the recognition of voice and face.

3.3. System overall design

The hardware part of a system plays a crucial role in the realization of the function of the whole system. In order to make the system more scalable and versatile, Flying OK6410-A and Samsung's S3C6410 processors are adopted in this paper. The hardware part adopts the modular design idea, that is to add the functional modules used in the design on the basis of the original system, so that the whole system can be optimized and used flexibly and conveniently [7]. This design system mainly includes audio interface module, camera module, power module, system clock module, storage module, serial module and so on. Fig. 1 is the hardware schematic diagram of this design.

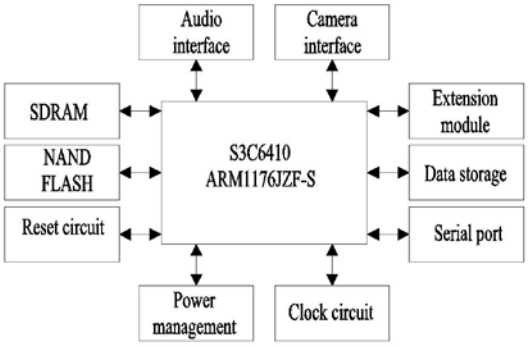

Fig.1. Processor module and its peripheral interface

This system chooses embedded Linux operating system as the basic software platform and the hierarchical structure of Linux system. Software design can be divided into embedded Linux system, device driver and user application program according to function. According to the functional requirements of the system, the development environment of embedded Linux is constructed [8]. The U-Boot, root file system and Linux kernel are transplanted. The minimization of the embedded operating system is realized. At the same time, the design and development of the subsequent embedded Linux system are greatly facilitated.

4. System Software Testing

4.1. Testing of speech recognition interactive interface

This system tested the voice interface in the laboratory environment. The training data are obtained from the voice of 10 people (5 males and 5 females) in quiet environment. The sampling rate is 8 kHz and the quantization is 16 bits. The voice is 10 digits (0-9). Each digital recording is about 1s for 10s. Twenty voices are recorded as training data. Through endpoint detection, speech signal is segmented into training templates for each number, that is, each person has 10 templates corresponding to different numbers. Recognition test data are recorded 5-8 digits on the spot according to the prompt for speech recognition test. The test steps are as follows:

Establish voice template library: record according to the interface. After recording is completed, FWBCC+VQ method is selected to train the template to generate the voice template library, which is stored in the development board/dev/dsp/shengyin directory. The voice input to be tested: the speaker read eight digits in Putonghua according to the content of the text prompt box, and extracted the voice data through FWBCC+VQ method [9]. Recognition results: the Euclidean distance is used to calculate the errors between the test template and all the templates in the template library, and the template with the least error is displayed on the interface as the recognition result. The test results show that the speech recognition design system in this design can accomplish the recognition of speech feature identity.

4.2. Face recognition interactive interface testing

Face recognition process is also tested in the laboratory environment. Face images of 10 people are collected when the illumination conditions are appropriate. Each person collected eight pictures of 320*240 in size and created a small face database. The test steps are as follows:

Establishing a face template database: the image captured by the camera is first detected (whether there is a face) and the collected face image is preprocessed. The generated face images are saved in XML format in the development board/dev/vcs/video directory. Face acquisition under test: the person under test is detected to obtain the face image, and the image is preprocessed to extract features. Recognition results: the features of the detected face image and the image features in the template database are classified and recognized by the nearest neighbor to determine whether the face in the image is in the face database and display the recognition results [10]. The results show that the face recognition design system in this design can complete the recognition of face feature identity.

5. Conclusion

With the development of modern society and economy and the progress of computer technology, the requirement of identity authentication in human life is becoming higher and higher. Embedded system is widely used in production, life and various system design, which has the characteristics of convenience, simplicity and applicability. The design of human-machine interface system based on ARM embedded system is taken as the research object. After determining the design principles and objectives of the system, the interactive interface of speech recognition and face recognition is realized in this paper. Finally, through the test, it can be seen that both functions can be successfully realized, and the recognition of face and voice features can be completed comprehensively. This research has a positive effect on the research of ARM embedded system, but the system design is relatively simple.

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