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EMBEDDED LINUX AND MACHINE LEARNING BASED SPEAKER RECOGNITION AND AUTHENTICATION

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ABSTRACT;

Speaker recognition is the process of automatically recognizing who is speaking on the basis of individual information included in speech waves. This technique makes it possible to use the speaker's voice to verify their identity and control access to services such as voice dialing, banking by telephone, telephone shopping, database access services, information services, voice mail, security control for confidential information areas, and remote access to computers. Such a speaker recognition system has potential in many security applications. For example, users have to say a PIN (Personal Identification Number) in order to gain access to their office doors. The main aim of the project is to build a embedded, machine learning based speaker recognition and authentication system using raspberry.

Keywords:

Raspberrypi3, microphone, LCD display, machine learning, Linux os.

1. INTRODUCTION:

There are several techniques that can be used for home automation. Out of these techniques the proposed system will be using speaker recognition. The system checks if the audio input provided by a speaker matches a registered sample of the system's database and will then allow or deny access. The proposed system finds use where the other biometric scans like facial recognition, iris or fingerprint identification is not possible. For real time recognition the system is implemented on Raspberry Pi platform[2], a compact and affordable single board computer developed by Raspberry Pi Foundation. We are using the Raspberry Pi 3 B model which is faster and more powerful than its predecessors. The Raspberry Pi uses Raspbian which is a Linux kernelbased operating system. Python is an open source programming language which is used to implement the algorithm of the system[5]

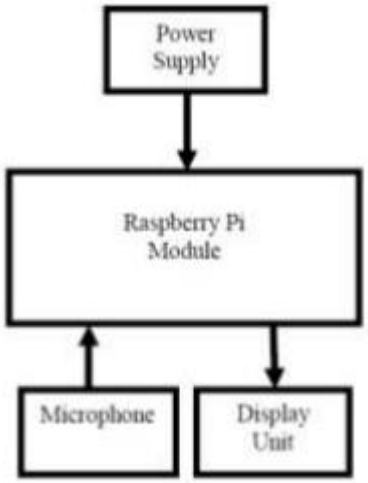
There are two major techniques of speaker recognition namely: speaker verification or authentication and speaker identification.

Verification is done when the speaker claims to be of a certain identity and the speaker's voice is used to verify this claim. On the other hand, identification is used to determine an unknown speaker's identity. Our system will be using speaker verification. Speaker recognition systems have two phases training and testing. Training phase includes extracting a template with the help of feature extraction from a recorded speaker's voice. Testing phase consists of a comparison of an utterance with the existing voice templates in the system's database.

2. LITERATURE SURVEY:

In the work (Sanchez, 2010), a speaker recognition tool for handheld computers was developed. The tool is written in C++ and it requires a single word to be used for the training phase and the same word for the recognition phase. It used the Euclidean distance to find the best match. (CMUSphinx, 2014) is a solution originally for speech recognition, but its modular design allows for extension in order to perform voice biometrics. Other solutions in Python such as voiceid (Google, 2011) and Speaker Recognition (SPEAR) (Python, 2012) also exist. Given the fact that the task of voice biometrics consists of computationally expensive operations, such as feature extraction and creation of models, systems that utilize a server-based approach have been proposed. (Chowdhury, 2010) describes a distributed system for speaker recognition is which uses Gaussian Mixture Model Universal Background Model (GMM-UBM) models. {Brunet et al, 2013 }proposed a method that performs the entire speaker recognition process on an Android mobile device by extracting the MFCC features, and storing them as a distance vector. For the pattern-matching step, during the testing phase, they compare the test samples and extract their Euclidean distance. They used samples both from a publicly accessible and a private database, achieving promising accuracy results.

3. IMPLEMENTATION:



3.1 Block diagram

The microphone provides audio input to the system. The on-chip computer implements the machine learning algorithm. The SD card acts as the data and instruction storage of the system. The output section consisting of a LCD displays if the access to the user is allowed or denied.

4. RELATED WORK:

The brief introduction of different modules used in this project is discussed below:

4.1 Raspberry pi3 processor:

Fig: 4.1 Raspberry pi3

The Raspberry Pi 3 Model B is the latest single-board computer from the Raspberry Pi Foundation. In this version, they've upgraded to a 1.2 GHz 64-bit quad-core ARM processor and added 802.11n Wireless LAN, Bluetooth 4.1 and Bluetooth Low Energy. If you're looking to incorporate the Pi into your next embedded design, the 0.1" spaced 40-pin GPIO header gives you access to 27 GPIO, UART, I2C, SPI as well as both 3.3V and 5V power sources. Raspberry Pi processor is programmed using embedded 'Linux'. Linux is the best-known and most-used open source operating system.

4. 2 LCD Display:

Fig: 4.1.5 LCD display

One of the most common devices attached to a micro controller is an LCD display. This project presents a 16*2 LCD it means 16 characters per line by 2 lines respectively. The status of the project will display on LCD module.

4.3 Microphone:

Fig: microphone

The microphone provides audio input to the system which is connecte at the jack point of raspberry.

5. CONCLUSION:

Speaker recognition for access control has been successfully implemented on the Raspberry Pi Single Board Computer. This system can be further industrialized and made to work in companies as their means of entrance to only authorized places in the firm. Furthermore, it can be used to securely log the data of the persons that have had an access to a particular place. From the tests and the results carried out, it can be deduced that the speaker recognition module performs best when the speakers' voice is loud and when there is silence in the place where the module is performing computation. The response time of this module is relatively fast.

6. ACKNOWLEDGEMENT

We would like to thank all the authors of different research papers referred during writing this paper. It was very knowledge gaining and helpful for the further research to be done in future.

7. RESULTS:

A prototype of the proposed system was developed. Experiments were performed to test the proposed system and to measure the accuracy of the system.

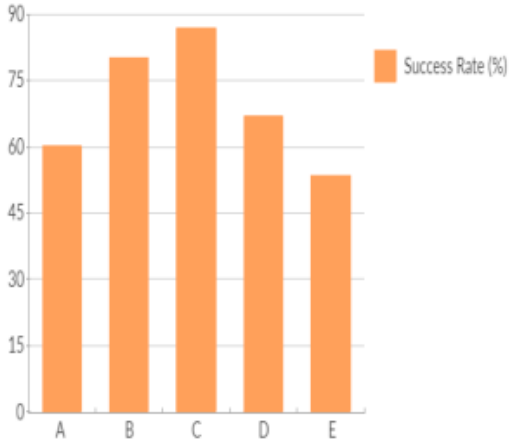


Fig: source rate of speaker recognition module

A = Recognition in a crowded place with a lot of background noise

B = Recognition in a silent place with little or no background noise

C = Recognition when the speaker's voice is not loud

D = Recognition when the speaker's voice is loud

E = Recognition when the speaker's voice has slight variations due to cold

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