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Research Paper

Engineering

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Voice Based Security System Using Matlab & Embedded System

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ABSTRACT

VBSS is developed for the users to open lock with very high security through voice commands. The authorized and authenticated users can access the system. If the user is unauthorized, the system will not respond. When the system recognizes the authorized user voice, it will open the lock .The microcontroller sends signal to the driver section (servo motor) to open the door. A feedback system using GSM model is also attached to monitor who entered the home/office via message. The GSM model will also give message if any intruder breaks the lock and gets inside the home/office. The voice detection code will be in MATLAB. The Microcontroller program will be in Embedded C. The microcontroller to be used is AT89C51.

Introduction

We are living in a world where self security & for surrounding is utmost important. Conventional security systems like password, finger-print, thumb-print, palm scanning, Iris scanning could be breached easily. By knowing one's password we can access system, and by force or by keeping one in unconscious state we can breach the remaining security system. So, the proposed security system allows us to address the protection of our document and offices/home with quality solution.

The selection of voice as pass code is the best among all the techniques used for security. The reason is everyone has a unique voice. So this makes it exclusive in self.

As the technology is exponentially reaching to the peak, so the urgency for security is also crucial subject of concern.

Description of the proposed project

This project is intended to be installed at home/office where a group of people are authorized to access the place. An extension of this project is also possible. We can secure any software document/file using VBSS.

VBSS can only be accessed only and only by the users' conscious state. And if the user is in unusual state (horrified, worried etc.) the features of voice will be automatically varied which will not match to the stored voice sample. This will lead to no permission granted to access the system. The proposed project provides a scheme in which the main owner of the system will be informed about the action performed with it. The scheme is that a message will be sent to the owner using GSM model. It will be in two cases: a) when the authorized person is allowed to access the system b) when the intruder tries to break the door lock.

A survey is carried on following paper based on voice recognition system.

Literature Survey

Voice recognition Security System

The endeavor to unlock upon a specific voice input is described in this paper. To analyze the information, software filters as well as hardware filters are used. In this project, ATMEGA 168 microcontroller is used. The resemblance was based on correlation and Euclidean distance.

The architecture for the project consists of following parts.

Microphone circuit
Fingerprint/Voiceprint analysis
Filters (digital filter)
Function written in code

a. Microphone circuit

This circuit will take the input and produce output of few mV. So in order to process further the output should be amplified.

This amplification is done using three steps of op-amp. Low pass and high pass filters are also implemented in support of op-amp setup.

b. Digital filters

MATLAB 6.5 is used to design the digital filters. The bandwidth of filter is adopted as parameters to determine the coefficient of respective filters. Chebyshev fourth order High Pass filter is used in MATLAB which was compased by two second order High Pass filter.

c. Fingerprint/Voiceprint analysis

The voiceprint/fingerprint will be the response of summation of output of digital filters.

It is a known fact that the voiceprint for even two similar words will bring about two distinct spectrum of speech. Even though a single person saying a word twice as accurately and similar as possible, it will create a different spectrum.

So in this project, the difference is fed to the microcontroller to check whether it can detect the change in both the voice samples. The summation of square of the difference of phrase/word is defined as Euclidean distance.

$$Euclidean\ distance = \sum_{i} (dic[i] - word(i))^2$$

d. Function written in code

Timer0 of microcontroller is programmed for sampling function. The samples will pass through analog to digital conversion and the digital response will be fed to digital filter.

Now the analysis function will from a voiceprint/fingerprint for each sampled word. The comparator function will compare the voiceprint of the real time or test time sample with the already stored voice sample.

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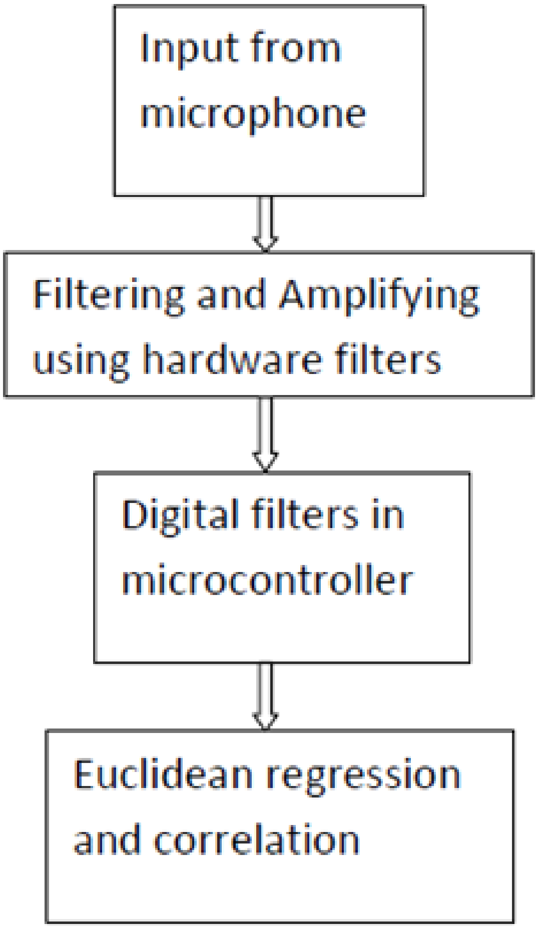

Figure 1: Voice Recognition Security System [1]

Limitations
Since the code was written in C language in embedded system, it was tough to employ it in Arduino base.

Solution
Assembly language program can be a success for this problem.

Intelligent Voice-Based Door Access Control System Using Adaptive-Network-based Fuzzy Inference Systems (ANFIS) for Building Security
In this paper, the opening of door is controlled by voice of user. If the user is authenticated, then he will be allowed to enter and if not, then if not the system will deny the access. The technique used for the recognition of authorized voice is Adaptive-Network-based Fuzzy Inference Systems.

In this paper, it is described that the features from the voice of authorized person is extracted and using Adaptive-Network-based Fuzzy Inference Systems (ANFIS), a model is developed for that person.

Here the proposed system has a electromagnetic door lock (DC 12v) controlled by the system the voice recognition unit.

Voice-based verification system
Speaker recognition is of two types.

1. Speaker identification - the system checks that this person is who he claims to be.
2. Speaker verification – the system defines who this person is from the group of persons.

This stage is further classified in two categories as text independent and text dependent. In text independent recognition technique, the user can speak any phrase/word. In text dependent recognition technique, the user has a set of phrase/words in option to speak.

The critical stage in project is the verification of voice. So the person is authorized by registration and voice for the same person is recorded. From the recorded sample of voice, the features are extracted. Consequently the model for that person is created. This phase of speaker recognition is called **Training** or **Enrollment phase.**

The next stage in project is when we test the system. In this a person willing to enter the building, has to check using the system installed whether he/she is authorized to access the system. The input voice is processed and verified with the already stored model of authorized person. If the response of check is negative, the electromagnetic door will not be opened. And if response of check is positive, the electromagnetic door will be demagnetized. This phase of speaker recognition is called **Testing** or **Operational phase**

Features which are extracted from the user's (authorized) voice are used to represent the person's voice. For this extraction, the technique used is Perpetual Linear Prediction (PLP). This is favorable for small length of speech spectrum.

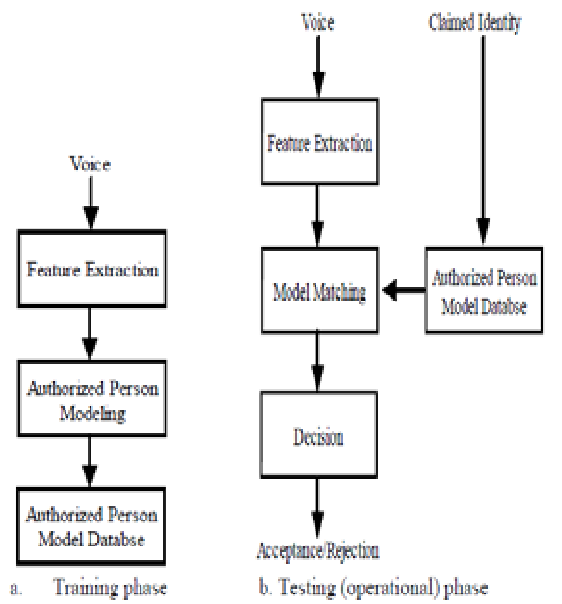

Figure 2: Voice based Verification System [2]

Controlling Of Device Through Voice Recognition Using Matlab.
In this project, devices are controlled by voice recognition. There are three different mode for recognizing a voice: speech to text, voice recognizer & text to speech. In this paper, second mode is used. The operation of voice recognizer is based on predefined commands. Templates are stored in dictionary according to the sampled speech power.

For templates, different parameters of voice are used. Different parameters like pitch, amplitude, intensity etc. are taken into consideration. MATLAB is used for sampling the input voice sample. The criterion to sample the voice signal is Nyquist Sampling Theorem.

Fs=2*Fm
Band pass filter is also used in the setup. As the voice bandwidth is 300-4000Hz, so after sampling of the analog voice signal, the sampled signal is allowed to pass through band pass filter to eliminate the noise.

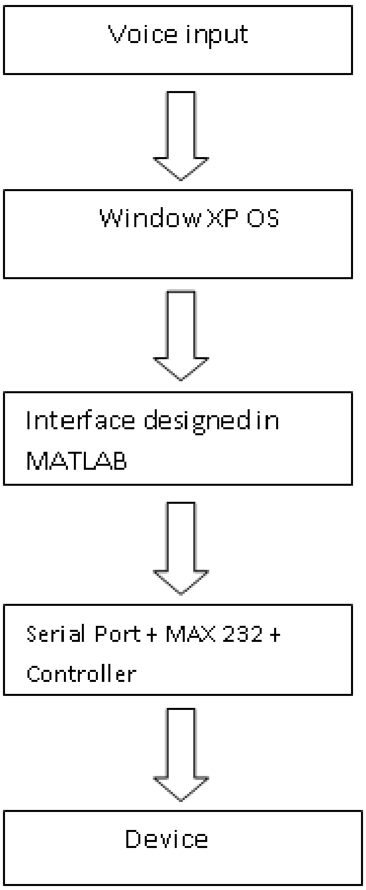

Figure 3: Block diagram of Hardware [3]
Hardware used in this project is
a. AT89S8253 microcontroller
b. MAX232
c. Microphone
d. Computer system.
e. Relay driver (ULN 2803)

Software used in this project is
a. MATLAB
b. Windows OS

Limitation
It can understand only English. Undesired operation can arise due to noise and voice interference.

Solution
It is desired to install the setup at quiet place to avoid unnecessary operations.

Gesture and Speech Based Appliance Control
In this paper, an approach attempted to be a help for elders as the age will not allow them to physically able to control the appliances at home. The system can be accessed by speech as well as by gesture. Here the target is tried to achieve by two methodologies. The processing of speech is accomplished by MFCC approach and the processing of gesture is accomplished by Identification of Characteristics Point Algorithm.

Speech Processing
With the innovation in the technology, the multimedia can be accessed in PDAs as well. MFCC approach is used because MFCC processor has the capability to imitate human ears. Also it is less likely to react with limited variations. Nyquist sampling is used here also. There are 10000 sample vectors are stored as speech signal. But after experimenting, it is observed that the pure uttered speech recognized is 2500 sample vectors. This paper describes two procedure for speech recognition

MFCC Technique
MFCC approach has a silent detection block which is helpful in detecting all the spoken words clearly. After this, the sampled signal is forwarded to MFCC processor where it is separated in time domain using windowing technique. Mel scale is used for frequency wrapping.

Definition of MEL-SCALE
The mel scale is a scale of pitches judged by listeners to be equal in distance one from another. It is linear till 1000Hz.

The output of Mel scale is given to CEPSTRUM which is supported to take Inverse Fourier Transform (IFT) logarithm of the estimated spectrum of a signal.

Drawback of MFCC Technique
By reason of eminence given to energy of signal, it misses the accuracy in recognition of signal with different energies. But this approach is effective for lower energies.

Training and Testing
This procedure is partitioned into two categories: "template matching" followed by "feature analysis".

Training is a category in which we train the system form the template of phrase/word on the basis of average energy of spoken word. For the same, the user is required to repeatedly utter the word or the phrase which is displayed on the screen. So according to the variation in the energy of each utterance, the program will generate statistics and form a template.

Testing is a category in which template matching is done in between the stored/trained template and the real time occurred speech. Now the feature analysis will give the final result and allow the event to happen.

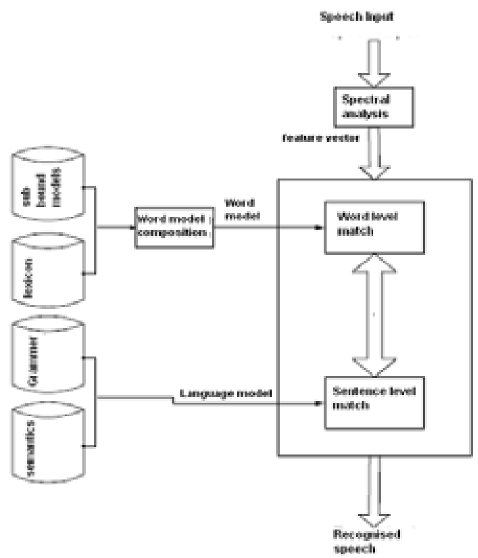

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Figure 4: Speech recognition application [4]

Conclusion

A survey on various papers using different technology for voice based security system. So I conclude that MATLAB should be used for voice recognition unit (VRU) via mike. A microcontroller ATMEGA328 should be the core of project.

The main purpose is to make the proposed model efficient and effective lies with VRU. It is likely to achieve 60-70% of success rate in detecting the exact person's voice.

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