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Whistle Blower Identification for Security Doors

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Abstract - *Whistle blower identification for security doors uses sound recognition which is a process of identifying the identity of an unknown whistle on the basis of individual information that contain in the sound signal. Sound recognition is one of the biometric technologies used by the security system to reduce cases of fraud and traits. It is used in variety of applications such as security control for secret information areas, remote access to computer, database access service, security system in cars. In this paper we intend to build a biometric security system using the sound recognition process. We include database of human whistle that contains parameters such as the frequency, timbre and pitch of vocal in MATLAB. By using MATLAB software for coding the sound recognition, the administrator whistle can be authenticated.*

Key Words: **Biometric voice recognition, MFCC, zero cross, roll off, brightness, roughness, irregularity.**

1. INTRODUCTION

To make a generalized yet robust and simple system, we aim at keeping the scope of this research to feature extractors namely Timbre which include following properties like zero cross, roll off, brightness, mfcc, roughness, irregularity. Timbre properties described by each audio samples is extracted. The extraction of audio samples features from audio database, including routines for statistical analysis, segmentation and clustering by using MIR (music information retrival) [5]. MIR toolbox integrates a user-friendly syntax that enables to easily combine low and high-level operators into complex flowcharts. The timbre toolset contains scalar audio features namely Zero Crossing Rate (ZCR), Roll off, Brightness, Roughness and Irregularity, while MFCC as vector.

1.1 Overview

The proposed system architecture requires that the Whistle samples are to be preprocessed with respect to noise and are to be normalized by amplitudes. Following, fig 1.1 explains the proposed system architecture of whistle classification system. As shown in fig 1.1 Whistle blower input containing microphone recording is preprocessed and normalized. A database is generated containing various samples per whistle class. The feature extraction unit extracts the Whistle attributes of the sound in terms of whistle descriptors. These whistle descriptors together give training vector. The whistle classifier has training and testing phases that makes use of Vector Quantization to generate codebook. This codebook contains feature sample per Whistle class which is tested during the testing phase. The final output of the testing phase is the class id number which is declared that represents one of the system [9]. The feature extraction unit, if MFCC is selected, extracts the coefficients of MFCC and these features are used for training and testing both the phases. For non MFCC feature vector only 10 Whistle descriptor values are selected for training and testing per Whistle sample. While, for combined use of MFCC and Timbre Whistle descriptors total 7 feature values are generated that are to be used for training and 3 for testing. The features extracted through all of these descriptors are then classified using classifiers namely K-means and Multi Support Vector Machine (MSVM).

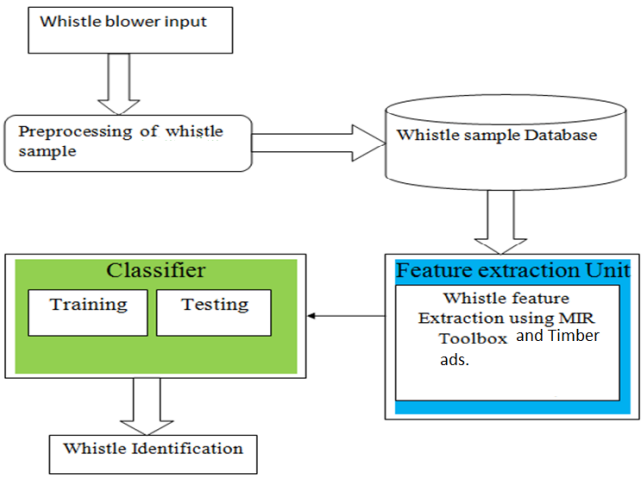

Fig -1.1: System Architecture

1.2 Brief Description

Whistle blower identification for security doors uses sound recognition which is a process of identifying the identity of an unknown whistle on the basis of individual information that contain in the sound signal. Sound recognition is one of the biometric technologies used by the security system to reduce cases of fraud and traits [6]. It is used in variety of applications such as security control for secret information areas, remote access to computer, database access service, security system in cars. In this paper we intend to build a biometric security system using the sound recognition process. We include database of human whistle that contains parameters such as the frequency, timbre and pitch of vocal

in MATLAB. By using MATLAB software for coding the sound recognition, the administrator whistle can be authenticated.

2. Plan of Project Execution

1) Feature Extraction

The purpose of feature extraction is to compress the audio signal into a form that characterizes the important sound event information. A good feature should be able to discriminate easily between different classes of sounds, while keeping the variation within a given sound class small. It should also be insensitive to external influences, such as noise or the environment [10].

a) Zero crossing rate(ZCR)
b) Roll off
c) Brightness
d) MFCC(Mel Frequency Cepstrum Coefficient)
e) Roughness
f) Irregularity

2) Classification

The materials ability to absorb sound is generally presented with absorption coefficients measured in different frequencies. This means in practice that one material has a number of different absorption coefficients based on frequencies [10].

a) K-means

Clustering is a technique of classification of similar objects in one cluster and dissimilar objects in another cluster. It is basically partitioning technique so that same dataset share common traits. K-means clustering is one of the clustering technique in which approximate method is used to simplify and accelerate convergence. Here, the goal is to find K means vector which would be K cluster centroids. This partitioning method is applied to analyze the data and treats. Observations of the data as objects based on locations and distance between various input data points. The partitioning of objects in clusters is done in such a way that objects in same cluster remain close to each other and in different cluster are far away from each other. The distances in clustering do not represent spatial distances most of the time. The only solution to this problem of global minimum is exhaustive choice of starting points. Use of several replicates with random starting points also leads to solution .i.e. a global solution. In a dataset, we take desired number of clusters K and a set of k initial starting points, the K-Means clustering algorithm finds the desired number of distinct clusters and their centroids. The centroid is obtained by means of computing the average of each of coordinates of points of sample assigned to cluster. Finally, the aim of algorithm is to minimize an objective function, in this case a squared error function.

Algorithm:

The algorithm for k-means clustering is as follows:
Step 1: Set k, select k whistle inputs randomly
Step 2: Initialization- Each whistle input data represents an initial cluster center.
Step 3: Classification to examine each point in dataset and assign it to cluster whose centroid is nearest to it.
Step 4: Centroid calculation- When each point in dataset is assigned to cluster, we need to recalculate the new k centroids.

b) Multi support vector machine (MSVM)

In speech recognition system the sample of speech signal is preprocessed by applying pre-emphasis, then framing and windowing. From short time wavelet signals fundamental frequency, Energy, Zero crossing rate, and Mel frequency cepstral coefficient are investigated [8]. In feature normalization statistical features are calculated for each and every window of a specified number of frames by using statistical method. By combining these features a different training model is developed. Then Support Vector Machine is used for classification of whistle inputs. Support vector machine is an supervised effective approach for pattern recognition. The concept used in MSVM technique is presented here. In MSVM approach, the basic aim is to determine hyperplane or decision boundary. The objective of hyperplane is to separate two classes of input data points. This Hyperplane is shown in given fig 2.1 below. Here the margin M is distance from the Hyperplane to the nearest point for both classes of data points. The data points are seperated by two types linearly seperable and non-linearly seperable. In MSVM classifier the decision boundary is placed by using maximal margin among all possible hyper planes. The feature MFCC is extracted from the whistle blower. Classifier classify different whistle inputs based on age, gender from database in which various whistle inputs are present [1].

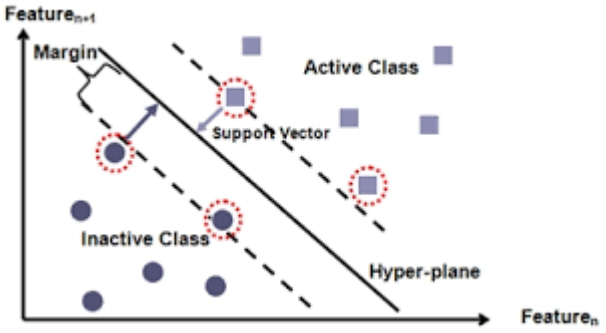

Fig -2.1: MSVM Architecture

This function removes out the limitation of MATLAB MSVM function of two classes and uses more classes. This function can classify more than two classes which is limited in MATLAB MSVM. This is primary work and does not include plotting function for MSVM.

c) Identification

The identification module is concerned with finding the start and end points of each sound event, and segmenting it from the continuous audio stream. In general, approaches can be assigned as belonging to one of two categories: detection and classification, or detection by classification, where the latter

combines detection and classification into a single pattern recognition problem.

3. METHODOLOGY

I. Zero Crossing Rate(ZCR)

Zero Crossing Rate (ZCR), is simply the rate with which the audio waveform changes its sign. The sound that is periodic in nature with low frequency usually has less number of such sign changes and thus small value for zero crossing rate. On the other hand, if the sound contains noise component, then there are many such sign changes resulting in high value of zero crossing rate. ZCR is one of the measures used to identify the noise component present in the sound.

II. Roll Off

Roll off (spectral) gives an estimation of the amount of high frequency in the input signal. It is found such a way that a certain fraction of the total energy is contained below that frequency. In other words, if the ratio is fixed to 0.85 or .95 then 85% or 95% signal energy is contained below the roll off point. For the audio input of North Indian classical music voice, roll off plays vital role in identifying the high frequency energy contained in the singing part of the input file [2].

III. Brightness

Similar to roll off, in other way, brightness gives a value (range: 0 to 1), indicating the amount of signal energy above a particular given cut off frequency. The cut off value chosen is 1500Hz for a simple reason that, the Whistle blower identification for Security doors, whistle in a frequency usually near to 1 kHz when we consider a bright voice [2].

IV. MFCC

Mel Frequency Cepstral coefficients (MFCC) describe the spectral shape of an audio input. It is a multiprocessing system. First, the frequency bands are logarithmically positioned. This is called as Mel scale. A method that has energy compaction capability called, Discrete cosine transform (DCT) is used, that considers only the real numbers [7].

V. Roughness

Roughness is an estimation of sensory dissension. It represents a rapid sequence of important events occurring in the audio sample. Roughness of a sound depends on the shapes of the events and the frequency of occurrence of those events. Roughness values are higher when short duration events occur for a fixed pulse frequency, while it is smaller when the pulse frequency is higher.

VI. Irregularity

Irregularity is the sum of the square of the difference in amplitudes between neighboring partials. Yet, there is another approach to find the irregularity. It is calculated as sum of the amplitude minus the mean of previous, this and next amplitude. It is the degree of variation of the successive peaks of the spectrum. And these prolonged notes in the spectrum usually, are same throughout the signal for a short duration. Thus, irregularity value shall be less for long notes and shall be higher for short duration notes being sung.

4. SCOPE OF PROJECT

There are several scopes that need to be identified in order to achieve the objective of this paper. In this paper, it requires software implementation. For software implementation, software (MATLAB) is required for writing the source code. Microphone as the hardware and its purpose is to give sound as an input to the software system. In this paper it has more focus to unlock the door by using whistle. In this paper, sound recognition system was implemented by using K-means, MSVM (Multi Support vector machine).

5. ADVANTAGES OF THE SYSTEM

1. Security Control for secret Information Areas.
2. Remote Access to computer.
3. Database Access Service Provided.
4. As a security system in cars.
5. Easy to Understand and Use.
6. Increases Flexibility.

6. DISADVANTAGES OF THE SYSTEM

1. The distinctiveness of the system is low as compare to other biometric systems.
2. The permanence characteristic should be sufficiently invariant (with respect to the matching criterion) over a period of time.
3. The Accuracy of the system is medium.

7. RESULT AND DISCUSSION

Here we analyze the result of timbre which is a feature of sound using feature vector extraction unit and after applying the whistle samples for training and testing phase in classification unit using k-means and MSVM algorithm, we get the percentage accuracy of the system for authenticated user. And result is being displayed in Table-5.1.

Table -5.1: Result Analysis Table

FEATURES	5 USERS(%)	10 USERS(%)
Zerocross	33.33	20
Rolloff	26.33	10
Brightness	40	20
Mfcc	33	60
Roughness	20	20
Irregularity	40	10

3. CONCLUSIONS

In this paper, we have presented the design of system used for whistle blower identification in security doors. The problem of whistle blower identification is solved by using various algorithms and techniques for feature extraction and classification. The features used for extraction are Timbre which include zero cross, roll off, brightness, mfcc, irregularity, and roughness. For feature classification we have used techniques like K-means, MSVM (Multiclass Support Vector Machine). We have used these two techniques for feature classification to get the maximum accuracy of the system. Future work to be done for this system is to increase the accuracy of system and reduce the effect of sound to noise ratio for the system.

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