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Techniques to Identify Audio Recording Location

Kiran P Kamble[1], Manik K Chavan[2]

Student, Computer Science and Engineering, Walchand College of Engineering Sangli, Maharashtra, India[1]

Assistant Professor, Computer Science and Engineering, Walchand College of Engineering Sangli, Maharashtra, India[2]

Abstract: Audio recording location authentication is needed when we want to prove an any evidence as recording of an event, audio recording depends on the various factors like geometry,composition of the audio recording and also a recording device. To authenticate the recording we need to consider many features of event happened. Methods are Electrical network frequency is machine learning based a system find grid environment. Sabin & Erying approach usefull for acoustic environment design. Time domain analysis effective for editing and compression attack.Sttatistical pattern recognization with help of classification and validation gives more accurate result. This paper is a survey of various approaches and techniques used to authenticate recorded audio.

Keywords: Audio Recording, Sabin & Erying, Time domain.

INTRODUCTION

THE environments of audio recording, identification useful for an application as audio recording integrity, authentication of acoustic structure. For instance, consider a scenario where an audio recording presented in the court as evidence claiming that the recording was made in the claimed environment e.g., office, hallway, outdoors, etc. for that authentication of the evidence is required.

In this contest digital media forensics aims to determine the underlying facts about an evidentiary recording and to provide authoritative answers (in the absence of helping data) to various questions such as: Is an evidentiary recording "original" or was it created by splicing a multiple recording, was the evidentiary recording captured using recording device P at location Q, as claimed?
The past few years have perceived significant advances

In text,video, image forensics [1], whereas,techniques for digital audio forensics are comparatively less developed. Research in the field of audio forensics major focus areas of

(i) speech recognition that objects at generating readable text from human speech,
(ii) speaker verification that known voice to an unfamiliar voice to determine the identity of the unfamiliar voice
(iii) speaker location identification based on different parameter while recording that audio.
(iv) Classification of audio on the basis of classical music mode.

The kindness of this paper is acoustic surroundings from evidentiary recording which has application in the area of audio forensics, distant speech recognition, speaker location.

This paper presents a various approaches and techniques used to identify the location of recorded audio. Figure 1. Shows the general flow of the acoustic environment identification system

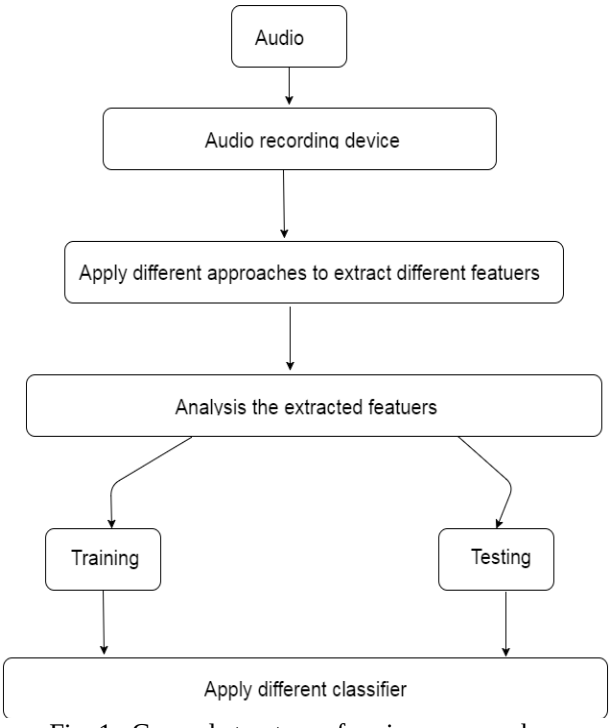

Fig. 1. General structure of various approaches

APPROACHES AND METHODS TO ACOUSTIC FORENSICS

A. Empirical analysis
In 1900 year, Sabin and Erying derive formula based on room acoustic i.e. volume and absorption rate of the acoustic environment.

I. Sabin equation.
Empirical fashion Sabin derives [2] an equation based on room volume and power of absorption coefficient rate of the different acoustic surface area. Reverberation time of acoustic environment effects with different parameter as intensity of audio and absorption rate and volume of the

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acoustic environment. Reverberation can very effectively measure if the intensity of sound nearly 60db. On the bases of this parameter Sabin equation. [5]

$$RT_{60} = \frac{0.161\ V}{A}$$

V=Volume of acoustic environment.
A=Effective surface area

$$A = \sum_{i=0}^{n} \alpha_i A_i = \alpha_1 A_1 + \alpha_2 A_2 + \alpha_3 A_3 + \alpha_4 A_4 + \cdots$$

II. Erying equation.
Erying with the same assumption derive equation [3] with change in the absorption coefficient value calculation. [5]

$$RT_{60} = \frac{0.161\ V}{A}$$

$$A = \sum_{i=0}^{n} \alpha_i A_i = \alpha_1 A_1 + \sum_{i=i-1}^{n} \alpha_i A_i + \cdots$$

Table 1: Sabin and Erying approach comparison

Sr. No.	Sabin approach	Erying approach
Assumptions	One after another	Successive simultaneous impacts
Absorption coefficient	One after another coefficient for summation.	Simultaneous im pact of absorption coefficients

B. Electrical network frequency
Electrical network frequency is machine learning based a system [1] that can identify the grid of origin of an ENF signal.

This method mainly based on electromagnetic influences on the place of recording, that change the ENF of an audio signal. Which vary from 60Hz and 50Hz.

The method involves following steps
1. Comparing ENF Signals in Different Grids:
For 60Hz grids: Eastern North America, Western North America.
For 50Hz grids: China, India, Ireland, Lebanon.
2. Feature Extraction
The mean of ENF segment, log (range) of ENF segment, loge variance) of approximation after wavelet analysis (L= 4), loge variance) of four levels of detail signals computed through wavelet analysis (L= 4), AR (2) modeling parameters
3. Classification based SVM classifier

C. Time Domain analysis based method
Time Domain analysis [2] has been proposed to determine the legitimacy of MP3 audio files against editing and compression attacks.
To detect splicing in the audio file. These steps are segments, signature, correlation

1. Segments: Seg_1, Seg_2, Seg_3 consisting of M_1, M_2, M_3 frames, for more accurate analysis the each frame to detect the splicing detection or editing detection.
2. Signature: After the segmenting the audio signal into frame do reverse engineering mean to assign the acoustic environment to each frame as Seg1 as acoustic environment A, Seg2 as acoustic environment B, Seg3 as acoustic environment C.
3. Correlation: Then in third step we compute the cross correlation of each frame by frame i^{th} with $i+1^{th}$ frame
4. Compare: correlation of frame it with an $i+1^{th}$ frame if it gives value near to '1' then we can say that frame nearly equal.

D. Statistical pattern recognition-based
1. Feature Computation: LSB ration, LSB flipping rate, Mean of samples
2. Classification: For classification the data mining tool WEKA with K-means as a clustering.

Figure 2. Shows the Conceptual information flow

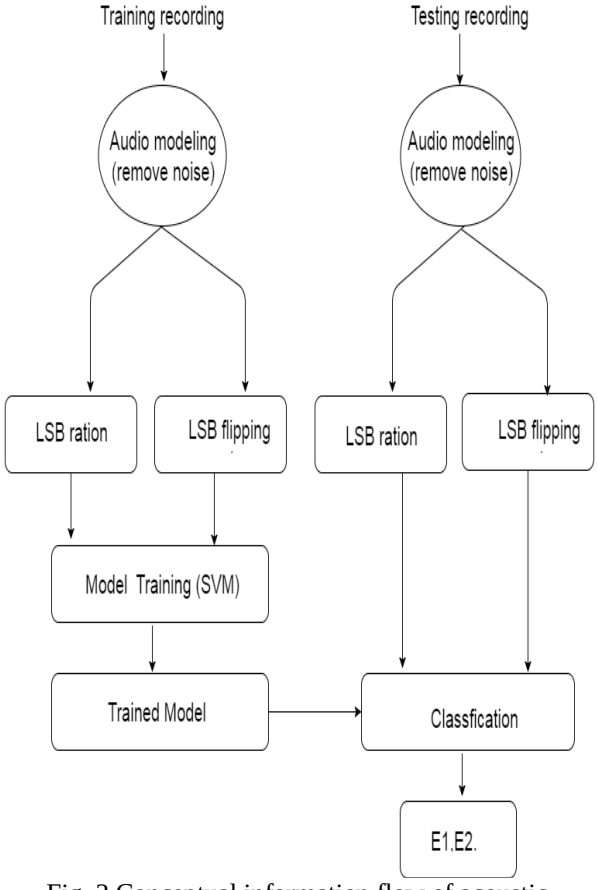

Fig. 2 Conceptual information flow of acoustic environment identification system. [6]

ANALYSIS OF REVIEW

Analysis of overall paper is shown below:

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Table 2:Advantages and Disadvantages of various approaches

Sr. No.	Methodology Used	Advantages	Disadvantages
[1]	Sabin & Erying approach	Result of reverberation time gives more accurate	Only Useful for Acoustic environment design
[2]	Electrical network frequency	Effective against cut and past attack	Depends on audio equipment or battery operate devices used to capture recording
[3]	Time Domain analysis based	Effective to find editing and compression attacks	Low accuracy
[4]	Statistical pattern recognition-based	Classification using various acoustic features	Low accuracy and not able to uniquely map an audio recording to the source

CONCLUSION

In this paper, a method for acoustic environment identification with various feature considerations like background noise, reverberation, ENF signal, Correlation of the frame. With classifier SVM, WEKA with K-means clustering. And compare each method with advantages and disadvantages.

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