An Embedded Covert Audio Surveillance Shoe Using Application Specific Integrated Circuit (ASICs)

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Abstract: Our society today is plagued with insecurity and terrorism. The impulse to listen in on other people's conversations is becoming more powerful as the days go by. Surveillance has changed the way we interact with one another and protect ourselves. Audio surveillance recording technology is one of the closest descendants of human spying and eavesdropping. In this paper an innovative covert audio surveillance and file keeping device implanted in a shoe is described. The recorded conversation can be retrieved by plugging the covert device in the shoe to a PC and downloading the recorded file from it through a USB cable.

Keywords: Surveillance system, Covert, Audio, USB, Integrated Circuit, Embedded

1. Introduction

Audio information for surveillance and security purpose is not very popular. It is not popular in the society and in our work places but it is the most secure way of gathering information [4]. Audio recording sensors can be placed in both indoor and outdoor environments such home interiors [5], offices [6], banks [7], railway stations [8] and elevators [9]. Most of the interrogation rooms of the Economic and Financial Crime Commission (EFCC), Federal Bureau of Investigation (FBI) etc. have visible recording devices. This usually makes criminals not to open up or confess to their crimes. This paper presents a resolution to this problem by proposing the use of a covert shoe worn by a security operative without the knowledge of the alleged criminals. This covert shoe can also be used by political organizations to get secret information from other political bodies without anyone knowing that all conversations are being recorded. Students can take it to class and record an entire lecture. It is also useful in many other areas of life in the society. There is a great need to invest more resources on audio surveillance systems. A lot of attention needs to be focused audio surveillance system than video surveillance. The visibility of the camera while taking videos is non-negotiable but an audio device can be hidden with very low to non-existent visibility. Automated surveillance system is an interconnection of various types of sensors for the purpose of gathering information particularly for security purposes. The first generation of automated surveillance systems was based on multiple cameras focusing heavily on visual data. There were many considerations such as weather conditions, image quality, sensitivity to light switching, reflections and shadows [2]. Most cameras are almost useless at night due to non-illumination and vehicle flash-light. To override this drawback, there was a need to shift focus to other alternative means of gathering information for security and surveillance purposes. Audio surveillance represents one of the available alternatives [3].

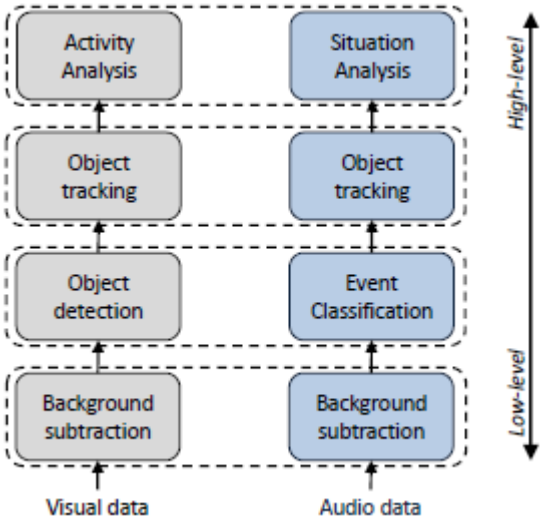

Figure 1: *Parallelism between the Standard Video and Audio Surveillance Workflow [10]*

2. Literature Review

Researchers in [11], presented a method of carrying out audio surveillance through known event order. The proposed method was straightforward and proficient. The utilization of the proposed framework for unknown event detection is likewise recommended and assessed. A particular audio event was identified by utilizing an audio arrangement which causes flags of a particular conduct to be detected. Along these lines it is demonstrated that the framework can be utilized as a part of a few applications. Right now, audio signals are used for advanced surveillance purposes. For instance, microphones have being introduced in areas with high rate of traffic rule violation [12]. The essential favourable attributes and inconveniences of audio surveillance in all utilization are obvious. Audio sensors are very little and can be introduced for all intents and purposes anyplace. Their low power-utilization permits nearby control supply including wireless data transfer. But signals from numerous microphones can't be displayed to one administrator simultaneously. Although it is feasible to live stream video signals from multiple sensors on a mosaic

screen. If there are an abundance of audio sensors, automatic audio surveillance has to be designed in such a way that attention is called to conceivably intriguing parts of a flag or to specifically examine the flag and trigger a suitable activity. The system, by and large, points out portions of the audio signal which are unique in relation to a common foundation. It is possible, for instance, by sound-related consideration levels, [13] to catch sudden and startling changes of audio signals and present it to the administrator. If the audio surveillance system is designed to take specific actions, for instance, when a gun is fired [14], the system might automatically call the police. All of these actions are dependent on a close examination of the flags. Audio flags that are caught in public zones may be grouped for easy analysis. A backlog of several audio recordings may be used to accurately classify audio flags and create a framework for detecting audio outliers when they show up [15]. The present research manages audio events detection in noisy environments for multimedia surveillance applications. In surveillance, the vast majority of the frameworks expecting to naturally distinguish strange circumstances are just in light of visual signs. In a few circumstances, it might be less demanding to recognize a given occasion by utilizing audio information. This is specifically the case for the class of sounds considered as danger sounds such as the sounds created by weapon shots [16]. The programmed shot detection framework introduced depends on an oddity detection approach which offers an answer for distinguishing variations from the norm (anomalous audio events) in persistent audio chronicles of open spots. Attention centres on the rigour of detecting flag variables, unfriendly conditions and the minimization of false flags which is especially vital in surveillance applications. Specifically, potential similitudes between the acoustic marks of distinctive kinds of weapons are explored by building a various levelled arrangement framework [17]

3. Methodology

An Application Specific Integrated Circuit (ASIC) was used in the design of the covert audio surveillance shoe project with appropriate modifications to suit the purpose and objective of the work. A flash drive, the ASIC and its accompanying circuitry were carefully placed inside the sole of a shoe. The usable end of the flash was positioned in a way that a USB cable can be connected to it in order to pull out information recorded when needed. This can be seen in figure 2. The size of the flash drive determines the quantity of information that can be saved. The recording size is directly proportional to the flash size. In this prototype, a five (5) gigabyte flash drive was used. The flash size is adjustable. Figure 1 shows the circuit diagram of the ASIC used in the construction of the prototype.

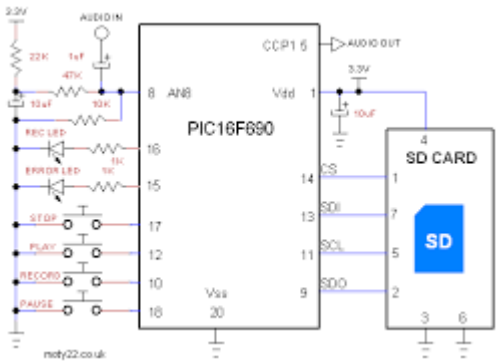

Figure 2: *The Application Specific Integrated Circuit for the Covert Audio System*

Figure 2 shows the USB flash drive that serves as a storage device for the covert surveillance system. It makes the storage of personal strategic/secret information for future replay possible. The OFF and ON key is placed in a way that once slight touched, the record will be activated with no indicator or sound, the purpose of this silence is to reduce the chances of being suspected of any secretive activity. Figure 3 shows the completed covert audio surveillance shoe. Figure 4 depicts the manner in which information stored in the flash drive of the covert system can be recovered.

4. Results

If you are using Word, use either the Microsoft Equation Editor or the MathType add-on (http://www.mathtype.com) for equations in your paper (Insert | Object | Create New | Microsoft Equation or MathType Equation). "Float over text" should not be selected. Number equations consecutively with equation numbers in parentheses flush with the right margin, as in (1). First use the equation editor to create the equation. Then select the "Equation" markup style. Press the tab key and write the equation number in parentheses.

Figure 3: *Testing data- load current (amperes)*

Figure 4: *Top View of the Covert Audio Shoe Prototype*

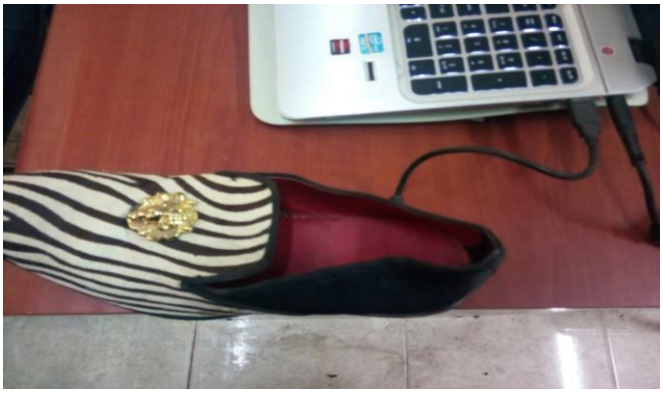

Figure 5: *Information Extraction form the Prototype*

5. Conclusion

In this work, a covert audio surveillance shoe that has the capability to work anywhere and at any time for secret audio recording was designed and implemented. It can also be used as a document storage system for extremely important files as the case may be. It was observed that the quality of the audio recording was directly proportional to the distance between the person wearing the shoe and the source of the information recorded.

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