An Implementation of Snoring Detection in Real-time by Time Analysis

Xinjiang Shao, Xiang Huo, Yanzi Jin and Yiting Li
Department of Computer Science
University of Illinois at Chicago
Chicago, Illinois 60612
Email: xshao3@uic.edu, @uic.edu, @uic.edu, @uic.edu

***Abstract*—Snoring is not only health problem for snorers but also great thread for partners life. In this project, we suggest a method by analyzing real-time audio data from a smart phones microphone which could successfully identify the snoring sound and take actions such as vibration, alarm etc. to notify the snorer to adjust himself/herself. Two features from sound data which are energy and zero-crossing rate applied to detect snoring. By experimenting with sound data from freesound.org, were able to set thresholds for figuring out regular snoring patterns.**

I. Introduction

Normal people spend one third of their life in sleep, and it is estimated that approximately 30% to 50% of the US population snore at one time or another, some significantly. Snoring causes a few problems including marital discord, sleep disturbances and waking episodes which is caused by one's own snoring [1]. In some serious condition, apnea which is a potentially life-threatening disease developed from simple snoring. Thus, we're looking for a method to use cell phones to do real-time analysis at night and give proper responses to the snorer in order to alert the person. In this way, we could train the user to stop snoring.

In this paper, an android app is built for this purpose. The app contains three main components which are sound capturing module, analysis module and action module. In sound capturing module, we used raw data from microphone input. After microphone collected large enough data, they were sent analysis module. The analysis module extracted two key features which are energy and zero crossing rate in order to identify the snoring. After snoring sound was confirmed, action module responded with pre-recorded alarm.

II. Related Work

A. Snoring Detection Methods

Numerous researchers are interested in snoring signal features and detection. Back in 1996, Fiz tried to figure out the difference in snoring sound among simple snoring patients and obstructive sleep apnea patients [2]. Their research demonstrated significant difference in sound power spectrum of snoring sound between subjects with simple snoring and obstructive sleep apnoea which means that it should be possible to identify different snoring patterns. In 2006, Duckitt [3] suggested using Hidden Markov Models(HMMs) as basic elements to model different type of sound. In [3], the authors made overnight audio recordings for six subjects, and analyze the data afterwards. This approach is not perfect since feedback can not be provided when the subject is snoring. Cheng [4] implemented a portable device to detect sleep apnea syndrome. The device is made up of recorder, LCD screen, microphone etc. which all can be found in a normal cell phone. [5] also introduced a method to detect snoring by time and frequency analysis. The method is used in our project, but adjustments need to be made since snoring sound is normally in low frequency area [6] [7]. Thus, we'd analyze frequency lower than 500 HZ instead of 0-7500 HZ range.

B. Awakening Methods

What is the proper way to wake a person up? Thomas's research shows that voice alarm was quite effective for younger age groups but not for older adults [8].The paper [8] also mentioned the mother's message including the child's name several times is quite effective when waking the kid's up. It lays the foundation for us to use human voice, especial a snorer's name as alarm. In Bruck's experiment, it shows male's voice is more effective than a female's voice [9]. For short arousal while sleeping, people will have short term memory lost, so it is hard to people to notice how many times they woke up [10]. This helps us to let the app alert with certain duration.

III. Architecture

A. System Design

Figure 1 demonstrates the overview of the project app.

B. Sound Analysis

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IV. Result

V. Conclusion

The conclusion goes here.

Acknowledgment

The authors would like to thank...

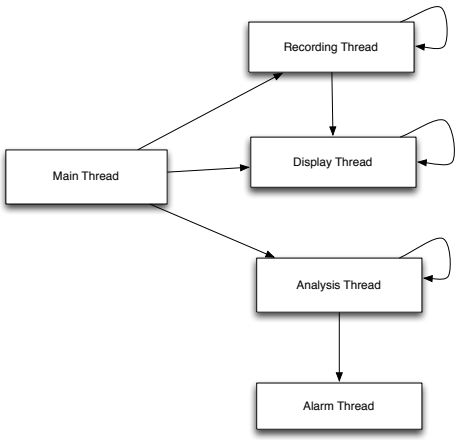

Fig. 1. Overview of the App

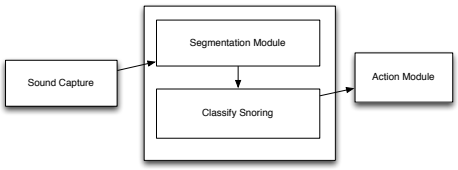

Fig. 2. Overview of Modules

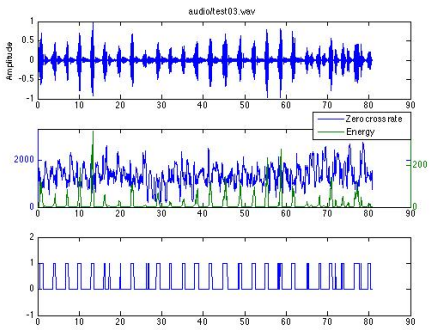

Fig. 3. Simple Snoring Results

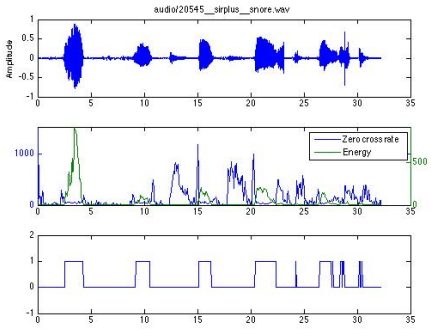

Fig. 4. Snoring with Breath Results

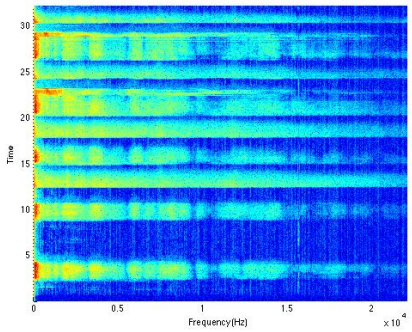

Fig. 5. Spectrogram

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