

Demo Abstract: MoodMagician - A Pervasive and Unobtrusive Emotion Sensing System using Mobile Phones for Improving Human Mental Health

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Abstract

In this demo, we present *MoodMagician*, a pervasive and unobtrusive mobile phone system for inferring human emotions through the recording, processing, and analysis of the real-time streaming Galvanic Skin Response (GSR) signal from human bodies. Being different from traditional multimodal emotion sensing systems which rely on data from multiple sensing sources and may hence interfere with people's daily life, our proposed system is able to detect various categories of human emotions using single GSR signal, which is captured by compact and wearable mobile sensing devices in an unobtrusive fashion. The proposed system has been evaluated by well-designed practical experiments to recognize human emotions. The recognition accuracy of each emotion can be up to 70% through the development of effective preprocessing algorithms and the extraction of representative features from the GSR signals.

1 Introduction

Modern healthcare systems, which stand as one of the key factors for improving people's quality of life, have been recently facilitated by emerging biomedical sensing technologies. There have been significant efforts to monitor the humans' physiological health on mobile devices using real-time sensing of the biological signals.

On the other hand, mental health of human beings has been generally neglected by most of the current biomedical sensing systems, despite its potential impact leading to various psychological or behavioral problems such as depression and addiction. The few existing schemes aim to monitor the stress levels of human beings by analyzing their biological signals, however, are insufficient for precisely reflecting the

mental health status of human beings due to the following reasons. First, current stress monitoring systems are generally cumbersome and far from convenience or unobtrusiveness. These systems pose undesirable physical burden or activity disturbance onto users, who are in turn reluctant to have these systems deployed in their daily lives. Second, the humans' stress level reported by current monitoring systems only provides coarse-grained information about their mental health status. The lack of detailed information about humans' emotions underlying such stress makes it difficult to apply appropriate remedies for stress relief, and hence reduces the practical merit of stress monitoring.

In this demo, we explore the possibility of inferring various kinds of humans' emotions (e.g., fear, sadness, relax, etc.) from a single type of biological signal - Galvanic Skin Response (GSR) - which can be monitored in a completely unobtrusive manner from human bodies via compact and wearable sensing devices. We develop a demo system on Android smartphone which records GSR signals from human beings, and apply supervised classification techniques to infer human emotions. The fine-grained emotion information obtained from our system would serve as a good source for further analysis of the mental health status of human beings and facilitate intelligent decisions of telemedicine or smart well-being systems.

2 System Design

2.1 GSR Sensing

Our proposed system for emotion sensing is built based on the Shimmer GSR sensors¹. It monitors the skin conductivity between two reusable electrodes being attached to human fingers at a fixed frequency of 10Hz. A Shimmer GSR sensor is also equipped with a 3-D accelerometer, whose sensed data will be used by our system to eliminate the impact of humans' physical movements on their GSR signal. An integrated 450mA battery of a Shimmer GSR sensor ensures continuous monitoring of several days.

2.2 System Components

Figure 1 illustrates the different components of the proposed *MoodMagician* system. After the acquisition of raw

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<http://dx.doi.org/10.1145/2668332.2668371>

¹<http://www.shimmer-research.com/p/products/development-kits/gsr-development-kit>.

signals from the GSR sensors, a preprocessing step is necessary to remove various kinds of noise caused by the testing subject. This is followed by a feature extraction step to more effectively characterize the GSR signal with a feature vector and a classification step that labels the feature vectors with different emotions. The detailed information on these preprocessing steps can be found in our full paper in [1].

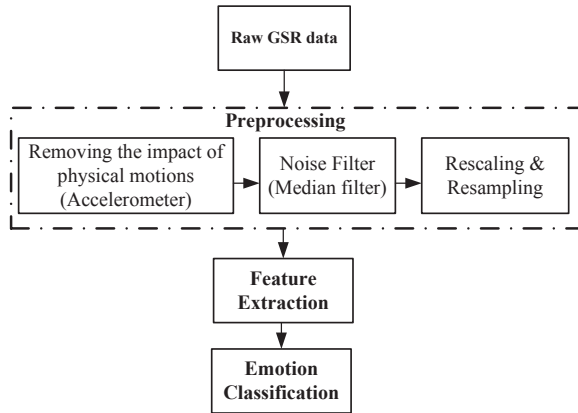


Figure 1. Different components of the proposed *MoodMagician* System.

Since the emotion recognition is done on a resource-limited smartphone, which requires that the classification algorithms to be light-weight. The *MoodMagician* system is based on a decision tree classifier, which is implemented using the Weka Library².

3 Demonstration Proposal

3.1 General View

In the on-site demonstration, conference audience will be able to first observe an operation tutorial on the *MoodMagician* system and Shimmer GSR sensor, then they will be able to operate the GSR sensor by themselves for emotion sensing on Android smartphone. We will provide five Google Nexus S smartphones which have the *MoodMagician* system installed and two sets of Shimmer GSR sensors. This will allow two users at once to test out the system.

3.2 Demonstration Setup

We adopt event-elicited methodology in our experiments, so as to ensure recording of subject-elicited emotions. We choose to use video clips from Youtube as stimulus to arouse conference audiences’ emotions. During the demo, the GSR signals of experiment participants are recorded when they are watching video clips (usually lasts 4 to 5 minutes) with different emotional themes, and are then fed to supervised classifiers (on the smartphone) for emotion identification using the known labels of video clips as the ground truth.

We implement *MoodMagician* on a smartphone running the Android Jelly Bean system. The smartphone is connected with the Shimmer GSR sensor through Bluetooth protocol with a sampling rate of 10Hz. When the GSR data along with the accelerometer data are fed into the smartphone, they

will be first stored into separate data arrays on the smartphone’s memory. When the length of the data array reaches a threshold (i.e., 1000) the preprocessing will be triggered on the smartphone for GSR data pruning. When the number of preprocessed data samples reaches a predefined amount (i.e., 2000 in our experiments), the feature extraction process will be triggered. Also, the raw data samples will be stored on the smartphone’s SD card. After the feature extraction process, the extracted features will be used for emotion classification. Figure 2(a) shows the GUI of the system on Android. Figure 2(b) shows a sample classification result displayed on the smartphone.

3.3 Expected Experience

We test the *MoodMagician* and provide some preliminary results on the emotion classification rates over 4 subjects. Each emotion is averaged over 100 trials, the results are shown in Table 1.

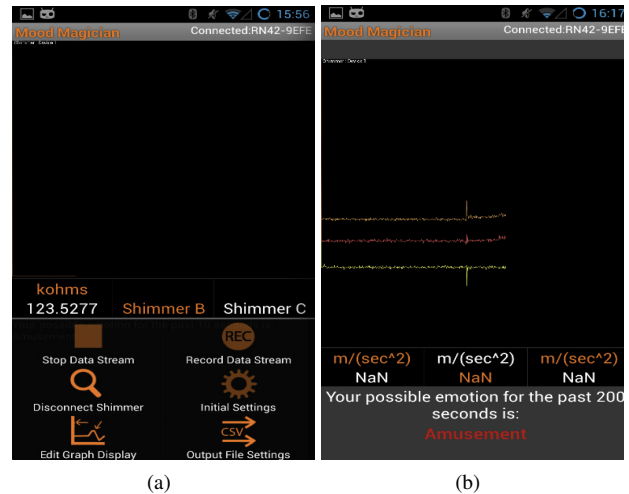


Figure 2. The proposed *MoodMagician* system. (a) GUI components for sensor connection, recording, and configuration. (b) Classification result.

Table 1. Results for emotion classification.

Subject	Decision Tree			
	Amusement	Fear	Relax	Sadness
1	52.9%	41.2%	58.8%	47.1%
2	41.2%	47.1%	64.7%	52.9%
3	64.7%	47.1%	70.6%	52.9%
4	58.8%	64.7%	59.4%	41.2%

4 References

- [1] R. Guo, S. Li, L. He, W. Gao, H. Qi, and G. Owens. Pervasive and unobtrusive emotion sensing for human mental health. In *7th Intl. Conf. on Pervasive Computing Technologies for Healthcare*, pages 436–439, 2013.

²<http://www.cs.waikato.ac.nz/ml/weka/>