

# A Review on Various Emotion Elicitation Methods

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**Abstract**— Emotions are an incredibly important aspect of human life and basic research on emotions has produced several discoveries that have led to important real world applications. Picard, founder and director of the Affective Computing Research Group at the Massachusetts Institute of Technology states that Emotions play an essential role in rational decision-making, perception, learning, and a variety of functions. A psychologist can diagnose the disease easily with the knowledge of the patient's emotional state. Applications can be extended to missions involving very aged people, new born, patients with Autism etc., who will not be able to express their emotions explicitly. Hence we need to design experiments and institute methodologies that successfully induce emotions in a laboratory setting wherein we can record and collect psychological data. The objective is to elicit different emotions in normal and emotionally impaired (Autistic Spectrum Disorder) patients using different elicitation methods. That is to devise different emotion elicitation methods and classify these emotions based on efficient algorithms, compare the performance and accuracy of different elicitation strategies depending on the emotion identified.

**Keywords**—*ecg, autismspectrumdisorder, heartratevariability*

## I. INTRODUCTION

Everyday people in this world interact with each other in one way or the other, that is either directly (for e.g. face to face) or indirectly (for e.g. phone calls). The people interacting with each other should be aware of the current emotions of the person he/she is interacting which will result in social as well as professional benefits. That is by knowing the emotional state, on-going conversation or interaction can be carried out in an effective manner without creating any mess. Firstly, we can see what emotions are. Emotions are complex processes comprised of numerous components, including feelings, cognitive reactions, bodily changes, behaviour and thoughts. It is a mental state that arises spontaneously (i.e an involuntary action) rather than through conscious effort and is often accompanied by physiological changes and these physiological changes are recognized from outer world. The physiological changes can be variations in the physiological signals (ECG, PPG, GSR, EEG etc., facial expressions, eye movement, variations in speech etc.

Emotions play a major role in our choices and decisions. The basic six emotions include

- Happiness
- Anger
- Fear
- Sadness
- Disgust
- Surprise

Earlier emotion recognition methods include facial expressions, gestures, affective sounds etc. But these expressions can be masked and hence recognition accuracy will be less. Hence new methods using physiological signals is being used. The different signals that can be used are ECG (Electrocardiogram), EEG (Electroencephalogram), GSR (Galvanic skin response), PPG (Photoplethysmography) etc. Hence here we use an effective emotion recognition method using ECG signals. One of the benefits of detecting emotions using physiological signals (ECG signal) is that the involuntary reactions of the body are very difficult to mask.

One widely used and accepted method for induction of emotional states that does not involve deception and that can be easily standardized is the use of pictures. The International Affective Picture System provides such a set of standardized photographs. International Affective Digitized Sound system (IADS) provides a set of audio clips. Hence identifying an effective method to elicit truthful emotion is an important task.

## II. RELATED WORK

Eun-Hye Jang et al proposed that Audio visual film clips with appropriateness and effectiveness are selected as stimulus. Using these stimuli different emotions like boredom, pain, and surprise are elicited. The signals used are EDA, ECG, PPG, and SKT. The experiment was conducted for 200

college students. 23 different features are extracted from physiological signals. The different classifiers that are used here are LDA, CART, SOM and SVM. The result showed that an accuracy of emotion classification by SVM was highest [4].

Pravina P. Ladde et al, proposes a system that allows recognizing a person's emotional state with the help of recording audio signals. This system is able to recognize four emotions (anger, happiness, sadness and neutral). This emotion recognition technique is mainly composed of two subsystems as - 1) gender recognition (GR) and 2) emotion recognition (ER). It has been proved experimentally that the performance of emotion recognition increases because of the apriori knowledge about gender of the speaker. Pitch of the specific speaker, accent of the speaker, speaking styles, speaking rates, cultural effect on the slang of utterance, duration taken for making particular utterance, energy used to make the utterance are the features considered here. Traditional approach shows that selection of proper and unique features of speech signals reduces the unnecessary calculation complexity. Recently use of combination of two or more different classifiers is emerging trend in the classification field. As HMM is the best training algorithm and SVM is the best classification algorithm, proposed technique makes use of hybrid of HMM and SVM classifiers to get best results [5].

Gaetano Valenza et al, reports on how emotional states elicited by affective sounds can be effectively recognized by means of estimates of Autonomic Nervous System (ANS) dynamics. Specifically, emotional states are modeled as a combination of arousal and valence dimensions according to the well-known circumplex model of affect, whereas the ANS dynamics is estimated through standard and nonlinear analysis of Heart rate variability (HRV) exclusively, which is derived from the electrocardiogram (ECG). In addition, Lagged Poincare Plots of the HRV series were also taken into account. The affective sounds were gathered from the International Affective Digitized Sound System and grouped into four different levels of arousal (intensity) and two levels of valence (unpleasant and pleasant). A group of 27 healthy volunteers were administered with these standardized stimuli while ECG signals were continuously recorded. The different features extracted are HRV (RR mean, RR std, SDNN, RMSSD) etc. Then, those HRV features showing significant changes ( $p < 0.05$  from statistical tests) between the arousal and valence dimensions were used as input of an automatic classification system for the recognition of the four classes of arousal and two classes of valence [6].

Jerritta S et al reports that human emotions can be recognized by several approaches such as gesture, facial images, physiological signals and neuro imaging methods. Most of the researchers have developed user dependent emotion recognition system and achieved maximum classification rate. Very few researchers have tried to develop a user independent system and obtained lower classification rate.

Efficient emotion stimulus method, larger data samples and intelligent signal processing techniques are essential for improving the classification rate of the user independent system. In this paper, a review on emotion recognition using physiological signals is presented. The various theories on emotion, emotion recognition methodology and the current advancements in emotion research are also discussed [7].

Niranjana Krupa et al discusses about children with Autism Spectrum Disorder (ASD). They cannot express their emotions explicitly; this makes it difficult for the parents and caretakers associated with these children to understand the child. Here the method used for emotion elicitation is Musical session and math test. In this paper a wearable wristband for acquiring physiological signals and an algorithm, using a support vector machine (SVM) classifier, that will predict emotional states such as neutral, happy and involvement of children with autism are developed. The psychological reactions are recognized based on the changes in the bodily parameters (physiological basis) such as the galvanic skin response (GSR) and heart rate variability (HRV) etc. For this purpose, vital features like GSR mean, standard deviation, rate of change HRV 1 frequency domain (HFC/LFC), 4 time domain (mean, SD of IBI, mean difference, RMS) are extracted from the recorded physiological signals. SVM classifier is used and provides an accuracy of 90 percent [8].

Human emotion recognition using brain signals is an active research topic in the field of affective computing. Music is considered as a powerful tool for arousing emotions in human beings. This study recognized happy, sad, love and anger emotions in response to audio music tracks from electronic, rap, metal, rock and hiphop genres. Participants were asked to listen to audio music tracks of 1 min for each genre in a noise free environment. The main objectives of this study were to determine the effect of different genres of music on human emotions and indicating age group that is more responsive to music. [9]

Electrocardiogram (ECG) and galvanic skin responses (GSR) of 11 healthy students were collected here while subjects were listening to emotional music clips. Applying three dictionaries, including two wavelet packet dictionaries (Coiflet, and Daubechies) and discrete cosine transform, MP coefficients were extracted from ECG and GSR signals. Next, some statistical indices were calculated from the MP coefficients. Then, three dimensionality reduction methods, including Principal Component Analysis (PCA), Linear Discriminant Analysis, and Kernel PCA were applied. The dimensionality reduced features were fed into the Probabilistic Neural Network in subject-dependent and subject-independent modes. Emotion classes were described by a two-dimensional emotion space, including four quadrants of valence and arousal plane, valence based, and arousal based emotional states. [10]

Khairun Nisa Minhad et al developed a system to monitor the physiological state of a driver. The goal is to determine the most efficient display stimuli to evoke emotions and classify emotions of individuals using electrocardiogram (ECG) signals. 69 subjects were participated in the experiment, ie 36 males and 33 females. ECG signal information lies in 0.5-100 hz frequency range. The signals that is recorded have undergone filtering process and then feature extraction to select meaningful features. The different features selected are root mean square of successive difference and HRV. SVM classifier classifies the emotions to happy and anger with 83.33% accuracy using audio visual stimulus.[11]

## CONCLUSION and future scope

Emotion recognition from ECG signal is more accurate and reliable compared to earlier methods. Hence the first and foremost thing in emotion recognition is the elicitation of truthful emotion without eliciting multiple or two or more emotions. There are different methods to elicit these emotions. These methods include film clips, audio clips, pictures, games etc. These different methods provide different accuracy level and these methods can be compared to evaluate the performance. The method can be used to elicit different emotions in children with ASD so that their emotions can be controlled to certain level.

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