# Emotion estimation of physiological signals by using low power embedded system

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**Abstract**

Emotions are an essential and productive aspect of human thought or action and human thought is inherently emotional. Emotions are factors which vary as mood varies. When person experience different emotions then there is also change in physiological signals in human body and with this variation comes in different parameters like skin conductance(GSR), heart rate(HRV), brain waves (EEG), muscle tension, blood volume pulse(BVP), temperature and respiration. Emotional coefficients are sensed by these parameters. By using EI (Emotional Intelligence) we can experience ability to identify, access and can control emotion of our self or others. This factor is high in magnitude. In some magnitude when person experiencing emotion they face different factors. As some gets completely concealed, some gets diverted and some don't express themselves by hiding their emotion in real world. The main objective of this paper is to design and develop a system through which we can measure the tension level of a person perceived by portable and cost effecting embedded system using MSP430F2013.Focusing parameters are GSR, BVP, EEG and Temperature. Their variations are discovered to conclude the emotional state of the subject (person) by low power device

*Keywords*: Arousal, Blood Volume pulse (BVP), Emotional Intelligence, Emotional experience, Galvanic Skin Resistance (GSR), Heart Rate**.**

## 1. Introduction

There are my reasons and factors which can tell health issues of a human. My work focus on galvanic skin response with inbuilt temperature sensor in controller. An experiment was conducted by using Galvanic skin response measuring self-developed device. That device helped to measure readings of different persons in different environmental room. Those rooms were having different musical sessions which were supporting both audio and video sessions. Some sessions were having fast music and some were having slow. Autonomous nervous system of human varies when the person get into condition like excited, sad, fear etc.[7] Due to variation in emotions sweat gland produce sweat which brings change in resistance of our body. Therefore, different changes were expected at different state of emotion in GSR and production of different emotional expressions was reflected whenever

there is change in autonomic activity. Following are various
Activities:

- when anger will increase then with skin conductivity GSR will decreases
- When fear will decreased then with skin conductivity GSR will increases
- When happiness will be there then no change in skin conductivity

## 2. Block Diagram with architecture

The architecture of GSR measurement system includes different input and output to the device which is shown in figure given below (fig.1), which includes the process of measurement with physical parameters.[8] New model is solution to various problems. In Model will be having microcontroller MSP 430 which will be helping in low power consumptions. MSP 430 is also having

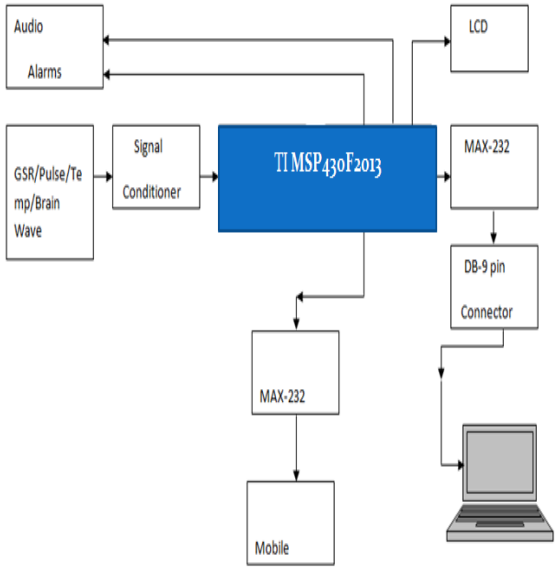



Fig. 1. . Emotion estimation system

inbuilt A/D converter. It will work as a control system for various parameters like GSR, Pulse rate etc.
Obtained normalization of GSR [16] is a value that has to be done, so the person dependency is neglected. Following equation is used to equate normalized GSR:

$$\text{normalized\_GSR} = \frac{(\text{original\_GSR} - \text{relax\_GSR})}{\text{relax\_GSR}} \quad (1)$$

A two dimensional model with four different quadrant that can measure high to low arousal and negative to positive valence. As figure shown below for the reference:

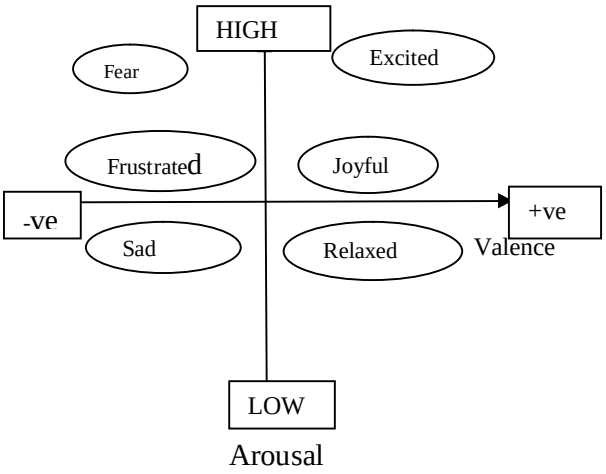



Fig. 2. Two dimensional emotion model

Values at different emotion levels are mentioned following after experiment done on different persons and values were as expected given in table below.

Table 2. **Normal GSR values and emotions**

| | Sad | Bliss | Joy | Fear |
|---|---|---|---|---|
| **GSR** | 938.35 | 706.33 | 643.2 | 612.45 |

## 2. Hardware Requirements

Components used are given below:

- Electrodes (silver)
- MSP430F2013
- Display system can be LCD of 16 Character x 2 Line) /Personal Computer

Fig. 3 Electrodes

## 3. Procedure for Experimentation and Methodology

Every experiment needs some prerequisites so following are few to get started:

- Creating an environment that will make person comfortable and also set audio/video music sessions for different age groups. Placing of screen and music system as proper arranged.
- Designing: designing of circuit should be in such a way that it must calculate GSR range i.e. between 5 kilo-ohms to around 45Kohms.
- As device will attach to person, then that person would be advice to get rid of different other activities or work and should listen to the songs when played.
- All different kind of music would be played and make the person listen whether person is enjoying or not.
- Position of person should be relaxed while experiment is performed, can make then sit on chair or can lay down on bed.

### 3.1. *Experiment*

Language like Hindi/ English Songs were played in both audio and video form while conducting the experimental sessions.by this stimuli of person got triggered and emotion got activated .Different person were asked to listen songs and asked to give verbal feedback of song to put interruption in there listing. With this various reading can be captured as variation occur in emotions. As the sensors used were silver electrodes and were easy to use by person under experiment. They were asked to keep finger on each electrode to give input to system. With reference to figure 1 output value were displayed on LCD.

Initially every person were make them to listen to their favorite song and to the kind of song which they don't like. With this exercise different range of value were triggered and emotions were changing. GSR value was also changing with emotions. Result was reflecting and supporting all four different quadrants shown in figure 2.

Total time taken to stimuli human emotion was 4-5 min as songs starts with gap of 1 minute so that person can get ready for next song or to make person comfortable for next sessions. They were also allowed to have a sip of water, munch on a biscuit etc.

## 4. Experiment Results

**Table 2. GSR values of different persons**

| Person | GSR VALUE |
|---|---|
| Person1 | 25kohms(normal) |
| person2 | 35kohms (fit ) |
| Person 3 | 29kohms(normal) |
| Person 4 | 26kohms(normal) |
| Person 5 | 24kohms(normal) |
| Person 6 | 29kohms(normal) |
| Person 7 | 22kohms(normal) |
| Person 8 | 13kohms(critical) |
| Person 9 | 22kohms(normal) |
| Person 10 | 23kohms(normal) |
| Person 11 | 23kohms(normal) |
| Person 12 | 22kohms(normal) |
| Person 13 | 36kohms (fit ) |
| Person 14 | 24kohms(normal) |
| Person 15 | 27kohms(normal) |

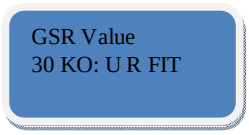
As GSR value is >25KOHMS this will indicate low arousal that means brain is in clam state and if < 5 K OHMS then this will indicates high level .these experiment and value were obtained from those person who's mental condition is normal in all senses.

Emotion result produced when changes occurred in different activities are:

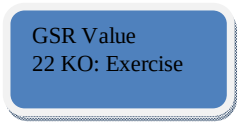
- Anger: increase skin conductivity when GSR decrease
- Happiness: no change in skin conductivity
- Anxiety: increase skin conductivity when GSR decrease
- Sad: increase skin conductivity when GSR decrease
- Fear: decrease skin conductivity when GSR increase

GSR Value
25 KO: Normal

RANGE:-25 to 29 (K ohms) NORMAL




RANGE: 30 to 40 (K ohms) FIT




RANGE: 22 to 24 (K ohms) EXERCISE

Fig. 5 Different GSR range

## 5. Conclusion

Research talks about different emotions like anger gives high arousal emotions and reduce resistance of our body due to which GSR got reduced and if emotion like relaxed will enhance the resistance as resultant GSR value get increase. In this emotions are acting as input to GSR system and output is shown in any of output component like LCD. The processing part of this is done by latest MSP430 which help to make system low power as it need just 1.8 V power supply. Future working is also being done parallel by adding more input parameters to the same.

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