Human Basic Emotion Recognition from EEG Signals using IOT

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***Abstract*—Emotion is an important aspect in the interaction between humans. It is fundamental to human experience and rational decision-making. There is a great interest for detecting emotions automatically. A number of techniques have been employed for this purpose using channels such as voice and facial expressions. However, these channels are not very accurate and can be faked. In this thesis, we are trying to use EEG signals as a new channel for emotion detection. The first part of the thesis is to infer four different emotions, happiness, Sad, Excited, Normal from EEG signals. This will require using sophisticatedfeature selection techniques which will generate large set of features. The generation of large number of features will require using feature reduction techniques. we will explore the accuracy of detecting four different emotions against the number of channels.**

Keyword— EEG.

I. INTRODUCTION

Emotion is an natural instinctive state of mind which is derived from ones circumstances mood or relationship with others. It is an important aspect in the inter-connection between humans. It accompany everyone in the daily life by playing a key role in non-verbal communication. An emotion is a mental and physiological state related with a wide variety of feelings, thought, and behaviour. An emotion is an individual occurrence which makes studying emotions one of the most disordered and still open fields of research in psychology. It is a broad concept and includes any communication between the brain and the machine in both direction and also we have selected EEG as a measurement method are based on ease of applications, portability and excellent time resolution. The reason why studying emotions is important is the fact that emotion is basic to human incident, influencing cognition, cognizance, and everyday tasks such as learning, communication, and even rational decision-making. since emotion plays an important role in the daily life of human , the need and importance of automatic emotion recognition has grown with increasing role of human computer interface applications. It is fundamental to human experience and rational decision-making. There is a great interest for detecting emotions automatically. It is a technology currently being developed with the aim of improving the quality of human computer interface. A number of techniques have been taken on for this motive using channels such as voice and facial expressions. However, these channels are not very precise and can be faked. In this thesis, we are trying to use EEG signals as a new channel for emotion detection. EEG is more effective since it provides convenient, non-intrusive and more accurate way of capturing brain signals. The first part of the thesis is to infer four different emotions, happiness, Sad, Excited, and Normal from EEG signals. This will require using sophisticated feature selection techniques which will generate large set of features. Whenever we are happy or sad our body temperature, heart rate changes with all these emotions we have considered all these to detect emotions. The generation of large number of features will require using feature reduction techniques. We will explore the accuracy of detecting four different emotions against the number of channels. Emotion recognition is the process of identifying human emotion. It is a method of determining emotions in humans which is still relatively unexplored using EEG. It plays an important role because it provides instant response to every state of change in human brain. Emotion can be conveyed either verbally through emotional vocabulary or by expressing non-verbal sign such as facial expressions and gesture. The objectives of our project are

1. To provide technological support to make health care system easier and faster.
2. To establish the extent to which people will naturally express emotion when they know they are interacting with an emotion detecting computer.
3. Emotion accompany everyone in the daily life, playing a key role in non-verbal communication, and they are essential to the understanding of human behavior.

The scope of our project is to use in medical field in order to determine patients with disabilities who cannot directly communicate. It determines patient's feelings and comfort level about the treatment. It can also be implemented in old age homes where the counseling and determining client's medical state.

II. LITERATURESURVEY

[1]S. Valenzi, T. Islam, P. Jurica and A. Cichocki, "INDIVIDUAL CLASSIFICATIONS OF EMOTIONS USING EEG," Journal of Biomedical Science and Engineering, vol. 7, pp. 604, 2014.

Emotion analysis can be treated as a grouping problem since the goal of the system is to find the correct label of emotion. It is thus often a superintend task since labels are already assigned to the data by humans, although grouping methods have also been utilized. An important part of the studying emotion via machine learning involves the choice of features. Researchers have made use of a variety of features.

[2]R. Jenke, A. Peer and M. Buss, "FEATURE EXTRACTION AND SELECTION FOR EMOTION RECOGNITION FROM EEG," Affective Computing, IEEE Transactions On, vol. 5, pp. 327-339, 2014.
Jenke surveyed feature choice and extraction across a variety of studies and classified these as a time-domain, frequency-domain, time frequency domain and multi-electrode features. Time-domain feature includes event related potentials, signal statistics, Hjorth features, nonstationary index, fractal dimension and higher-order crossings; frequency-domain features include band power and higher order spectra; time-frequency domain features include the Hilbert-Huang spectrum and discrete wavelet transforms; multi-electrode features include magnitude squared coherence estimate and differential and rational asymmetries. Frequency domain features are prevalent and appear in the majority of the studies surveyed in the paper, in spectral power, but it was found by the authors to have a lower performance scores compared to other features. Another study using a different kind of visual stimuli, namely images of natural scenes, tag positive and negative, was used by Zhang et al.

[3] Q. Zhang and M. Lee, "EMOTION RECOGNITION IN NATURAL SCENE **IMAGES BASED ON BRAIN ACTIVITY AND GIST"** in Neural Networks, 2008.IJCNN 2008 (IEEE World Congress on Computational Intelligence). IEEE International Joint Conference On, 2008, pp. 3050-3057:
EEG as well as fMRI data was collected from 20 people. EEG signals were recorded from the frontal electrodes. The authors noted that prefrontal asymmetry was one of the bestknown correlates of emotionality with EEG activity. Classification was done using SVM and the highest accuracy achieved was 76.32% for the electrode. In summary, a considerable amount of research has been done for the detection of emotion information from EEG signals. However, different datasets were calculated in different situations and the results were not consistent from one another.

[4] A. S. AlMejrad, "HUMAN EMOTION DETECTION USING BRAIN WAVE SIGNAL: A Challenging", European Journal of ScientificResearch, vol.44, pp. 640-659, 2010.
Emotion play evaluative roles in rational and intelligent deportment. When people are happy, their perception is biased at selecting happy events, similarly for negative emotion. While making decision, users are often determined by their affective states. The human emotion using brain wave signals are categorized into three types that is motivational, basic and self-conscious. The basic types are happy, sad, fear, disgust, anger and surprise.

[5] S. Tokuno, G. Tsumatori, S. Shono, E. Takei, and G. Suzuki, "USAGE OF EMOTION RECOGNITION IN MILITARY HEALTH CARE", 2011 Defense Science Research Conference and Expo (DSR), Aug 2011.
Inquiry of emotion from voice data collected fromthe personnel of military medical corps participating in a special stressful mission. They used delicacy technology for emotion voice analysis system which is capable of finding emotional elements including anger, joy, sorrow, calmness and excitement. The result explained that the implementation of proper techniques of emotion recognition can help in screening of mental status in military.

[6] Mandeepsingh, Mooninder singh, surabhiGangwar The literature survey tells out two highly divided opinions.one group of researchers obtained less accuracy of emotion classification using EEG signal and another group is to view that EEG signal alone is sufficient for emotion classification with a little low accuracy. These signals can be used to classify emotions using neural network and to improve the accuracy of classification.

III. III PROPOSEDWORKS

The proposed system aims at first we place an electrode in a specific area of the head. Electrodes are placed in the subject's brain as a system. The system which frequently used to place silver-chloride electrodes for monitoring the clinical EEG is the International Federation system..

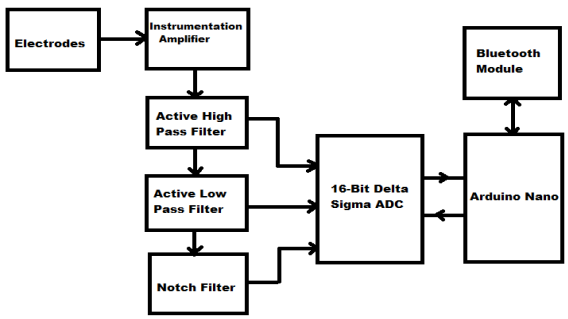

Figure 1: Block diagram of transmitter

The system is not about how many number of electrodes to be put on the scalp but preferably a calculation of percentage of 10 or 20% on a certain anatomical landmarks to improve the placement of electrodes. The Ag-AgCl electrodes are used in the EEG signal acquisition system because of having low impedance, low offset voltage and low noise with high stability. The application gel is needed for making the skin before placing electrodes to the skin in order to lower input impedance and help for systematic transmission of the current through electrode – electrolyte interface. Although an EEG system is generally equipped with more than eight electrodes, but we have used three electrodes for this system.

The amplitude of the EEG signal is very less ie (5-500 uV), this makes it difficult to obtain and measure. Hence an amplifier is wanted to build up the signals to a desired or recognizable level. Another problem in this is the DC offset of the signal which occurs electrode-tissue interface. This DC offset is generally about 20-50 mV and EEG signal is about 500 times less than the DC offset. Hence, instrumentation amplifier has a very low noise, high input impedance and high Common Mode Rejection Ratio is being mandatory to amplify EEG signals and reject the DC offset.

Designed system is mainly made up of scalp electrodes, instrumentation amplifier, active high pass filter, active low pass filter and 50 Hz Notch filter, Bluetooth transmission and OLED display.

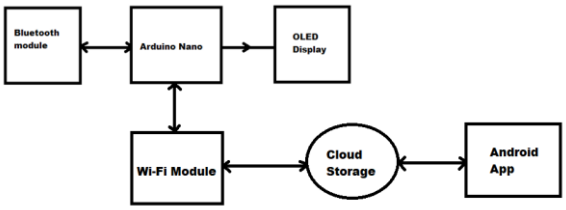

Figure 2: Block diagram of receiver

The process of electric conductivity in the body involves ions as charge carriers. Thus, picking up of bioelectric signals involves interaction with these ionic charge carriers and transducing ionic currents into electric currents required by wires and electronic instrumentation. This transducing function is carried out by electrodes that consist of electrical conductors in contact with the aqueous ionic solutions of the body. The interchange between electrons in the electrodes and ions in the body can greatly influence the performance of these sensors and requires that specific considerations to be made in their application. At the interface between an electrode and an ionic solution redox (oxidation-reduction), reactions need to occur for a charge to be transferred between the electrode and the solution.

Results: The aim of the project is to improve a system accomplished of evaluating human emotions based on the data given by sensors. As explained in the literature survey section emotion plays a very important role in decision making problem solving and communicating. Emotion do not arise independently and are regularly accompanied with physiological changes. Hence it is important to note their changes as they contain information that can help in evaluating human wellbeing.

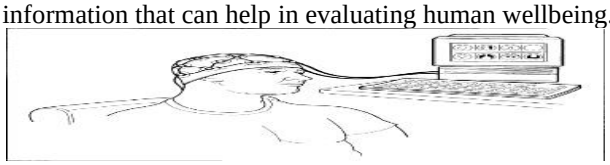

Figure 3 : EEG recording and electrode cap.

In our project we monitor physiological signals using EEG signals. Depending on the output of these signals we determine four basic emotion they are sad, angry,happy, and normal. The sensors were verified step by step for data reliability, accuracy and ease of use, before they were used for emotion assessment

IV.CONCLUSION

- This project is to develop a system capable of evaluating human emotions based on the information provided by the sensors.We monitor physiological signals using EEG signals and the signals can be used to classify human emotions.Based on the output of these signals we evaluated four basic emotions happy ,sad, excited and normal.The result of this study can be used by hospitals and police departments to detect the emotions of patients and offenders.Hence as per this study we confirm that EEG was the most excellent tool to measure the brain signals.The subjects were monitored. Verbal agreement was taken from all the individual people before the data was collected. To start with, the system was connected to the subject and a few trials were conducted, before storing the data The idea of the test was made to make the subject feel contented with the system. It was also guaranteed that the signal was reliable and consistent for each individual. Once the set up was completed to test, the comedy show was turned on and data monitoring was done and temporarily stored. After the show was over the subject was asked to reduce while sitting on a couch The information was monitored and saved during sad emotional sections. To generate angry emotions, fights and debates on religion and politics were initiated. The subject was carefully observed and the data was saved during the most intense state of the quarrel. The last part was to observe the process of coming back to a normal l state after the argument had concluded and the tests are completed.

In the project ,depending on the information provided by the sensors we develop an actual time emotion recognition . The literature review also gives us a good method of selection for the sensors utilization in order to achieve good emotion recognition. From all the sigals we can tell that the Physiological sensors are found to be the best method to recognize emotional changes, as they give information about changes which takes place physiologically and are out of a person’s control. Information and knowledge are also increased by taking other researches helps in giving information about the range of the physiological parameters and are allowed in confirming results obtained from this study.

Acknowledgement:We are grateful to Maharaja Institute of Technology, Mysore for continuous encouragement to continue this research work. We would like to thank our family members, Staffs of department ECE and friends for their continuous support to present the paper.

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