International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 03 | Mar 2019 www.irjet.net p-ISSN: 2395-0072

SMART WEARABLE HELMET WITH EEG

DANIEL.M[1], DHANUSH KUMAR.N[2], HARISH.K[3], ABIRAMI.S[4]

[1,2,3]Student, Dept. of ECE Engineering, Valliammai Engineering College, Tamil Nadu, India
[4]Professor, Dept. of ECE Engineering, Valliammai Engineering College, Tamil Nadu, India

---

Abstract – *Modern wearable technologies have enabled continuous recording of important signs, however, for activities like sport, motor-racing or military engagement, a helmet with embedded sensors would supply most convenience and therefore the chance to watch each and every important signs such as EEG .To the current finish, In this project we tend to investigate the practicability of recording the electroencephalogram(EEG), respiration, achieved by embedding multiple electrodes inside a customary helmet. The conductor positions are at the lower part of the jaw, mastoids and forehead to assess the performance. Smart helmet consists of embedded sensors like EEG and Respiration device. All device values monitored sporadically, if any abnormal state of affairs emergency alert message sent by recovery authorities*.

Key Words:* *Arduino microcontroller, GSM module, GPS module, EEG sensor, Respiratory sensor, Emergency switch.

1. INTRODUCTION

An embedded system is thus vital in today's automation because it has been wide employed in all quite industries and automation. Trendy wearable technologies have enabled continuous recording of significant signs, however, for activities like athletics, motor-racing or military engagement, a helmet with embedded sensors would supply most convenience and therefore the chance to observe each the very important signs and the graphical record observation of physiological signals exploitation wearable devices is progressively changing into a necessity for the assessment of the state of body and mind in natural environments. Sensible helmet consists of embedded detectors like EEG and Respiration sensor. All detector values monitored sporadically, if any abnormal scenario emergency alert message sent by recovery authorities. This has been expedited by small-scale analogue and digital microcircuit technology, along with on chip process. A variety of wearable graph devices exist, however, most are used for measure heart activity or calorie consumption in sports and may solely work out an estimate of the center rate. These are so not appropriate for real-world activities wherever it's essential to record and monitor very important signs in unsure or dangerous things. One example are traffic accidents, particularly once the state of body and mind, like somnolence, stress, anxiety and illness, of drivers. Prevents them from concentrating on the road. variety of critical injuries occur in athletics, bike and automotive racing, horse riding, rugby, and cricket. This has driven North American nation to form a 'smart helmet' which might record and monitor each vital sign and neural activity (EEG) of wearers.

A variety of studies propose to live very important signs from head locations, however, most specialize in hardware development solely, while not taking under consideration signal process techniques for the suppression of noise and artefacts in real-world signals. associate example is found wherever during a Formula One car the connection between the car speed and also the pulse rate of the driving force was examined victimisation wired limb-lead graph. This comes with the disadvantage of recorder physically troubling a driver, and a substantial setup time. to the current finish, retiring wearable devices are being investigated, like a military helmet that records the encephalogram (EEG) and graph of troopers sitting at rest, whereby the sensors were positioned on a sweatband and a jaw strap. Although the motivation within the latter was to live the extent of consciousness, somnolence and fatigue in troopers, all recordings were performed at rest and victimisation relatively massive recording devices. the employment of a ball is to electroencephalogram and single-lead graph to watch the regular recurrence from behind the ear was studied in, wherever EEG-devices used to live the waves of the top made by the brain. The results show a correlation between the two measured signals. However, as graph signals at the arm are abundant stronger than on the highest, it is typically assumed that the larger share of the potential changes originated on the left arm. In our own work electroencephalogram was recorded within the meatus with a wearable device referred to as ear-EEG.

2. EXISTING SYSTEM

Physiological signals recorded in real world tend to be notoriously weak and with a Signal to noise ratio (SNR). to the current finish, Associate in Nursing amplifier with a high common mode rejection quantitative relation is needed thanks to the numerous leads and electrodes required, such devices are fitted to clinical environments, wherever patients are usually stationary (except e.g. for viscus stress tests), so the amplitude is comparatively low.

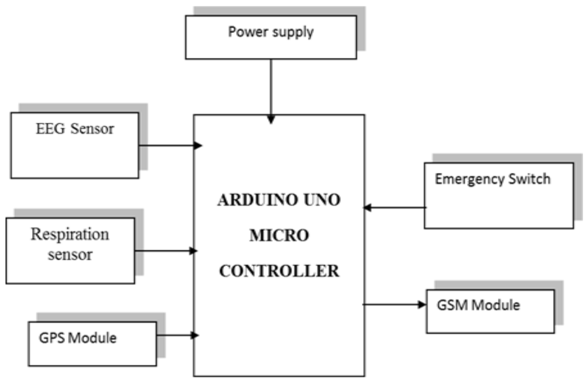
3. PROPOSED SYSTEM

We planned the conception of feasibleness for electroencephalogram and cardiogram recordings from inside a helmet, and seek advice from this device because the good helmet. All the sensing element values watching and compare to human customary tolerance level through

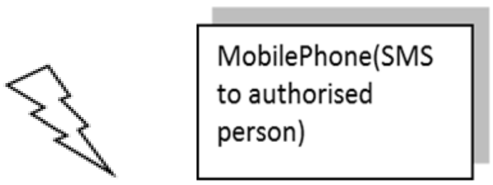
ARDUINO UNO microcontroller. If any accidents or abnormal sensing element values, current GPS location and emergency alert message sent recovery team. Driver can push the emergency button whereas emergency state of affairs message sent caretaker.

4. BLOCK DIAGRAM

Transmitter side:



Receiver side



5. HARDWARE REQUIREMENTS

- GPS Module
- GSM Module
- Emergency Switch
- EEG Sensor
- Respiratory Sensor
- Power Supply

6. SOFTWARE REQUIREMENTS

- Arduino UNO
- Embedded C

A. ELECTROENCEPHALOGRAM

The ability of the planned helmet to record electrical signals from the brain was assessed supported normal neural responses, like the brainwave in encephalogram (7:5 cps to 12:5 Hz) that's distinguished once someone is within the state of wakeful relaxation with eyes closed. With a rise within the person's activity the ability of the brainwave decreases. in addition, 2 elicited response potentials (ERPs)were examined: (i) sensory system steady state response (ASSR)and (ii) steady-state visual potential drop (SSVEP).

The ASSR is AN sensory system potential drop, induced in response to modulated tones compete into the ear of the subject; the evoked encephalogram corresponds to the frequency of the envelope of the sound stimulation. A high-frequency sinusoid or racket is amplitude modulated with a sinusoid of frequencies unremarkably around nineteen cps, forty cps or eighty Hz and compete to the topic. This created AN encephalogram response comparable to the modulating frequency within the temporal region of the brain (auditory cortex) and in the brain-stem.

Note that the frequency spectrum of the amplitude modulated signal doesn't have a peak at the modulating frequency, which the brain demodulates the signal. The SSVEP response is analogous to ASSR in this it's the response of the brain to external stimulation – during this case visual. The brain space that exhibits the strongest response is that the os region, however the SSVEP may also be recorded from different regions, e.g. frontal and temporal. the quality stimulation is AN LED blinking at a frequency between 3:5cps and 70 Hz, which ends up in AN SSVEP response at precisely the same frequency.

B. ARDUINO

Arduino ATMEGA-328 microcontroller contains fourteen input analog, output analog, input digital and output digital pins (from this half-dozen pins are thought-about to be the PWM pins), within which half-dozen are analog inputs and remaining digital inputs. Power jack cable helps to attach arduino board with the pc. outwardly battery is connected with the arduino microcontroller for the facility provide. Arduino is associate degree open supply microcontroller that doesn't have feedback within the microcontroller. This arduino board consists of I2C bus that may be able to transfer the info from arduino board to the output devices. These arduino boards are programmed over RS232 serial interface connections with ATMEGA arduino microcontroller. The operational V ranges upto 5v. The input voltage suggested for arduino microcontroller is from 7v to 12v. The DC input current given to the arduino board are within the vary of 40mA.

C. GPS

The Global Positioning System (GPS) is international navigation satellite system based on US model . It provides reliable positioning, navigation, and temporal arrangement services to worldwide users on a nonstop basis altogether weather, day and night, anyplace on or close to the planet. GPS is formed from 3 parts: between 24 and 32 satellites orbiting the planet, four management and observation stations on Earth, and therefore the GPS receivers closely-held by users. GPS satellite broadcast signals from house that are utilized by GPS receivers to supply three-dimensional location (latitude, longitude, and altitude) and the time.

D. GSM

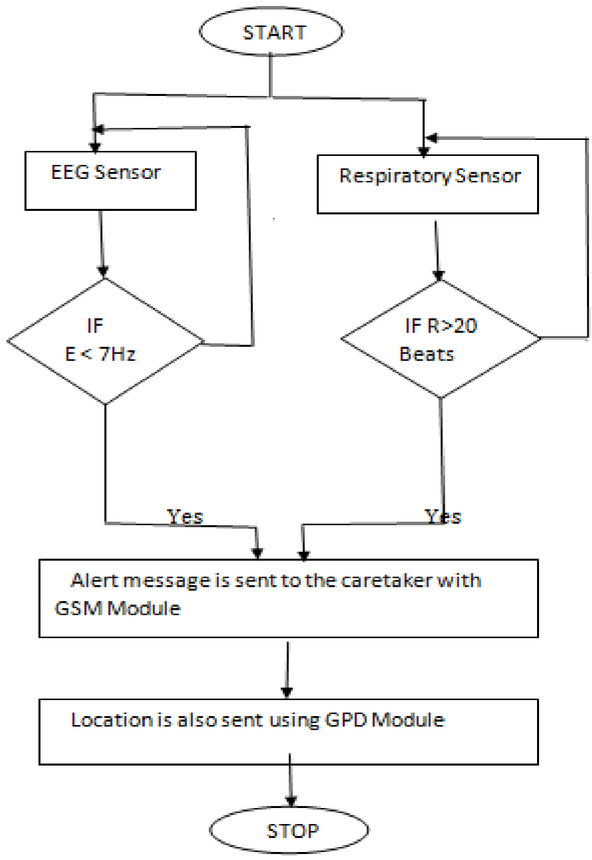
GSM can be expanded as Global System for Mobile communication(GSM) can be said as mobile communication modem developed in 1970 at bell laboratories. It is widely used mobile communication system in the world. GSM is an open and digital cellular technology used for transmitting mobile voice and data services operates at the 850MHz, 900MHz, 1800MHz and 1900MHz frequency bands. GSM system was developed as a digital system using time division multiple access (TDMA) technique for communication purpose. A GSM digitizes and reduces the data, then sends it down through a channel with two different streams of client data, each in its own particular time slot. The digital system has an ability to carry 64 kbps to 120 Mbps of data rates.

E. RESPIRATORY SENSOR

The Respiration device is employed to watch abdominal or thoracical respiratory, in training program applications like stress management and relaxation coaching. Besides respiratory frequency, this device conjointly provides you a sign of the relative depth of respiratory

The Respiration device are worn over clothing but for best results we've a bent to advise that there alone be one or a combine of layers of damage between the device and conjointly the skin. The Respiration device is usually placed inside the abdominal house, with the central an element of the device merely on prime of the navel. The device must be placed tight enough to prevent loss of tension.

DESIGN FLOW



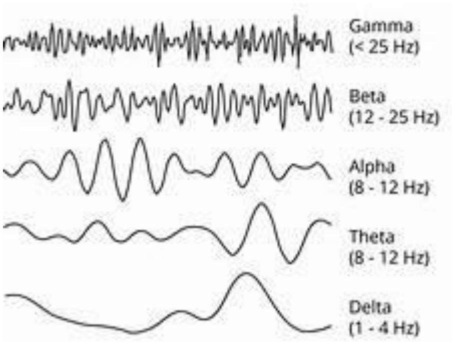
E = EEG wave	R= Respiratory rate

The flow chart is the diagrammatic or graphical representation of the working of the smart helmet with the use of EEG sensor and respiratory sensor. The EEG sensor and respiratory sensor continuously monitor the person's respiratory rate and EEG values. This process happens during normal health condition. But if the respiratory rate goes above 85 beats per minute it is considered abnormal. Similarly the EEG values from the brain are repeatedly monitored and a value of less than 7Hz is considered abnormal.

So during abnormal sensor values the alert message is sent to the caretaker informing them about the situation with the use of GSM module. Similarly the location of the person is also sent to the caretaker for immediate rescue.

METHODOLOGIES

Electroencephalography (EEG) is an electrophysiological monitoring method to record electrical activity of the brain. It is typically noninvasive, with the electrodes placed along the scalp, although invasive electrodes are sometimes used. EEG measures voltage fluctuations resulting from ionic current within the neurons of the brain. Clinically, EEG refers to the recording of the brain's spontaneous electrical activity over a period of time, as recorded from multiple electrodes placed on the scalp.



The respiratory rate in humans is measured when a person is at rest and involves counting the number of breaths for one minute by counting how many times the chest rises. A respiratory rate sensor can be used for monitoring patients during abnormal situation. For humans, the typical respiratory rate for a healthy adult at rest is 12-18 breaths per minute.

The Smart Helmet primarily consist of respiratory sensor and EEG sensor connected to the ARDUINO UNO microcontroller(atmega328p). The EEG values and respiratory values of the person are continuously monitored using both sensors under normal condition.

But during abnormal situation such as accidents, the human body produces abnormal EEG values and respiratory rate values. The Sensor is capable of sensing the values and it can identify the emergency situation with Arduino microcontroller.

Then the message is sent to the caretaker with the help of GSM Module. Similarly the location of the person is also sent to the caretaker using the GPS module. The emergency switch is also provided which can be used by person to send the message manually.

7. ADVANTAGES

1. High precision measuring
2. SMS is send to the authorized person during emergency along with location using GPS.
3. Reduced wiring and size.

8. CONCLUSIONS

The proposed recording setup has been shown to be very convenient, as it requires only the application of a saline solution to the soft electrodes embedded into the helmet lining.

To deal with noisy real-world scenarios, we have developed a signal processing approach based on matched-filtering and an adaptive weighting function for R-peak prediction across multiple channels.

This has resulted in values for the sensitivity and positive predictivity parameters close to 100% at rest and over 90% during movement.

The proposed approach developed signal processing algorithms do not require a priori knowledge of any parameters (for instance an approximate heart rate or a subject-specific threshold amplitude for R-waves), thus reinforcing the real-world nature of the proposed smart helmet recording.

9. REFERENCES

1. G. Webster, "Reducing motion artifacts and interference in biopotential recording," IEEE Transactions on Biomedical Engineering, vol. BME-31, no. 12, pp. 823–826, 2013
2. P. Mithun, P. C. Pandey, T. Sebastian, P. Mishra, and V. K. Pandey, "A wavelet based technique for suppression of EMG noise and motion artifact in ambulatory ECG," in Proceedings of the IEEE Conference on Engineering in Medicine and Biology Society (EMBC), 2011, pp. 7087–7090.
3. B.-S. Lin, W. Chou, H.-Y. Wang, Y.-J. Huang, and J.-S. Pan, "Development of novel Non-Contact electrodes for mobile electrocardiogram monitoring system," IEEE Journal of Translational Engineering in Health and Medicine, vol. 1, pp. 1–8, 2013

4. D. Bronzino, Biomedical Engineering Handbook Second Edition, vol. 1, CRC Press, 2nd edition, 2017.

5. Sampsa Vanhatalo, Juha Voipio, and Kai Kaila, “Full-band EEG (FbEEG): an emerging standard in electrence phalography”,Clinical Neurophysiology, vol. 116, no. 1, pp. 1–8, 2005.

6. T. Chanwimalueang, W. von Rosenberg, and D. P. Mandic, “Enabling R-peak detection in wearable ECG: Combining matched filtering and Hilbert transform,” in Proceedings of the IEEE International Conference on Digital Signal Processing (DSP), 2015, pp. 134–138.