COMA PATIENT MONITORING USING BRAIN COMPUTER INTERFACE

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ABSTRACT

This work is based on the coma patient movement and monitoring system in which the system that is used to detect movement changes in the coma patient. This paper presents the method of patient movement monitoring system for those patients that are taking medical treatment in both local and foreign hospitals with the help of frames comparison approach. Coma lies on a spectrum with other alterations in consciousness. The level of consciousness required by, for example, someone this passage lies at one extreme end of the spectrum, while complete brain death lies at the other end of the spectrum. Healthcare industry has perpetually been on the forefront in the adoption and utilization of information and communication technologies (ICT) for the efficient healthcare administration and treatment. Recent developments in ICT and the emergence of Internet of Things (IoT) have opened up new avenues for research and exploration in the all fields including medical and health care industry. Hospitals have started using the cell instruments for communication intent and for this intent internet of things (IoT) has been used and fused with wi-fi sensor node reminiscent and small sensor nodes. In this paper novel method to utilize it IoT within the field of scientific and crafty wellness care are presented. The majority of the survey exist about the different health care approaches used in the IoT, similar to, wireless well-being monitoring, U-healthcare, E-healthcare, Age-friendly healthcare techniques.

Keywords: *Brain Computer Interfacing (BCI), Internet of Things (IoT), Information and Communication Technologies (ICT).*

I. INTRODUCTION

The paper provides people world-wide in coma require the assistance of a sensor glove, to provide the sensor based on hand movement of the person's fingers. The aim of incorporating the modern way of sensor glove control it at the same time making it cost effective, so it is affordable to all the masses.A practical approach to prevent the inside attack by using multiple data servers to store patient data.The main contribution is securely distributing the patient data in multiple data servers and employing the cryptosystems to perform statistical analysis on the patient data without compromising the patient's privacy.

In this work, we analyze the brain wave signals. Human brain consists of millions of interconnected neurons. The pattern of interaction between these neurons is represented as thoughts and emotional states.

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According to the human thoughts, this pattern will be changing which in turn produce different electrical waves. A muscle contraction will also generate a unique electrical signal. All these electrical waves will be sensed by the brain wave sensor and it will convert the data into packets and transmit through Bluetooth medium. Level Analyzer Unit (LAU) will receive the brain wave raw data and it will extract and process the signal using MATLAB platform. Then the control commands will be transmitted to the robot module to process. With this entire system, we can move a robot according to the human thoughts and it can be turned by blink muscle contraction. Coma or unconsciousness is a state of a person where an individual cannot respond to the internal and external stimulus.

Coma is a deep state of unconsciousness. Such cases require a serious attention and continuous monitoring to save the patients' lives. Nowadays, having someone to watch critically ill person is very expensive and takes a lot of manpower. Besides, such a continuous supervision by a paramedical assistant are error prone and may lead to difficulties due to human error. In case of critically ill patients it requires to measure the vital parameters at least for every 15 seconds until the patient's condition stabilizes.

Furthermore, state that monitoring of coma patients is different from monitoring the normal patients. It is very tough job for the paramedical staff to continuously monitor each patient's 24 hours since the proportion of staff to patient is very low. A practical approach to prevent the inside attack by using multiple data servers to store patient data. The main contribution is securely distributing the patient data in multiple data servers and employing the cryptosystems to perform statistical analysis on the patient data without compromising the patients' privacy.

As seen everywhere the quantum of the accident happens very high, if there is an accident, the patients are admitted in Intensive Care Unit (ICU). In such condition, the patient may go in a coma state. Coma is a state of consciousness in which a person cannot be awakened; fails to respond normally to painful stimuli, light or sound; lacks a normal wake-sleep cycle, and does not initiate voluntary actions. Coma may occur for various reasons, such as intoxication, a disease or infection that affects the Central Nervous System (CNS), a serious injury and hypoxia, or oxygen deprivation.

II. BRAIN COMPUTER INTERFACING

The first step toward a BCI is recording the activity of the living brain. This can be done invasively by surgically implanting electrodes in the brain, or non-invasively. In this section we will review various brain imaging technologies. Biologists can measure the potential at different parts of a single neuron in a culture. Recording neuron activity in a living brain is possible using surgically implanted micro-electrodes arrays, although it is no longer a single neuron recording but the activity of groups of neurons. Monkeys with brain implants have been reported to brain-control the displacement of a cursor on a screen or to control the motion of a robotic arm.

2.1 Functional Magnetic Resonance Imaging (fMRI)

Functional Magnetic Resonance Imaging (fMRI) is a relatively recent imaging technique that aims to determine the neuro-biological correlate of behavior by identifying the brain regions that become "active" during the performance of specific tasks in vivo. The technique is based upon the different magnetic susceptibilities of the iron in oxygenated and deoxygenated hemoglobin. Blood Oxygenation Level Dependent (BOLD) measurements measure local variation in the relaxation time caused by variations in the local concentration of deoxygenated blood.

2.2 Functional Near-Infrared Imaging (fNIR)

Functional Near-Infrared Imaging (fNIR) is a relatively novel technology based upon the notion that the optical properties of tissue (including absorption and scattering) change when the tissue is active. Two types of signals can be recorded: fast scattering signals, presumably due to neuronal activity and slow absorption signals, related to changes in the concentration of oxy- and deoxy-hemoglobin.

2.3 Magnetoencephalography (MEG)

Magnetoencephalography (MEG) is an imaging technique used to measure the magnetic fields produced by electrical activity in the brain. Because of the low strength of these signals and the high level of interference in the atmosphere, MEG has traditionally been performed inside rooms designed to shield against all electrical signals and magnetic field fluctuations.

2.4 Electroencephalography (EEG)

Electroencephalography (EEG) is the recording of electrical activity along the scalp produced by the firing of neurons within the brain. The recording is obtained by placing electrodes on the scalp with a conductive gel or paste. The number of electrodes depends on the application, from a few to 128, and they can be mounted on a cap for convenience of use The electric signal recorded is of the order of few microvolt, hence must be amplified and filtered before acquisition by a computer.

2.5 P300 Signal Detection

The P300 signal cannot be seen with the naked eye in the EEG. Traditionally, ERPs are synchronously averaged to enhance the evoked signal and suppress the background brain activity. This way uncorrelated noise is canceled out and the P300 signal appears more clearly as can be seen on bottom panel once the signal to noise ratio has been enhanced, the P300 signal can be detected. For instance, Farwell and Donchin used Step-Wise Discriminant Analysis (SWDA) followed by peak picking and evaluation of the covariance. The P300 signal in EEG waveform is shown in Figure 1.

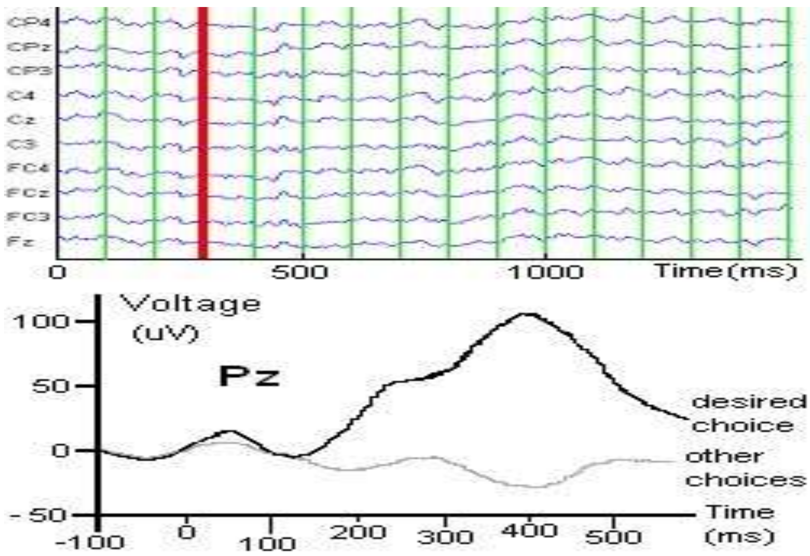

Figure 1. P300 Signal in EEG Waveform

2.6 Steady-States Visually Evoked Potentials (SSVEP)

Steady-States Visually Evoked Potentials (SSVEP) corresponds to the response of the visual cortex to stimulation of the retina by a blinking light source. Three peaks at 7 Hz, 14 Hz, and 21 Hz can be found clearly. Panel (a) shows the single trial amplitude spectrum, while panel (b) shows the mean amplitude spectrum averaged over 40 trials. Vertical lines give standard deviation.2D control of a cursor using a μβ-BCI by 4 disabled people from Wolpaw et al. The subjects were instructed to move the cursor to one of eight targets: the figures show cursor’s trajectories and times to target.In a typical SSVEP-based BCI setup, an array of LEDs (or buttons on a computer screen), blinking at different frequencies and associated with commands, are disposed in the visual field of the subject. To select a command the user simply has to focus his attention to the desired button. The signal for EEG spectrum is shown in Figure 2.

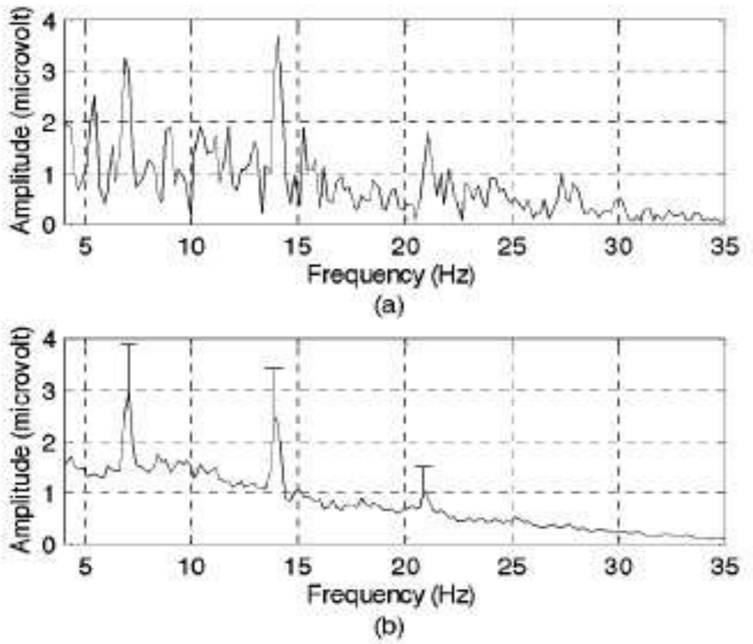

Figure 2. EEG Spectrum

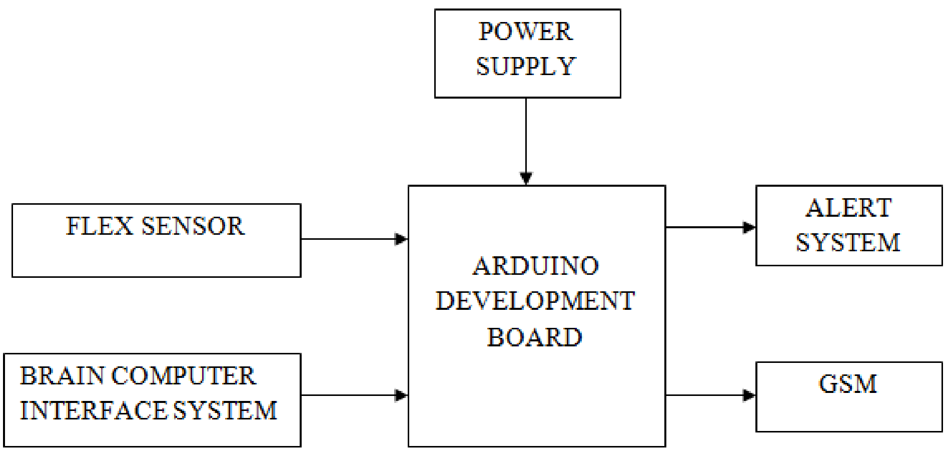

Figure 3. Block Diagram of Proposed System

The block diagram of the work is shown in Figure 3.The block diagram of the proposed system consists of flex sensor, brain computer interface, power supply, arduino development board, alert system and GSM.

III. BRAIN WAVE SENSOR

The communication between neurons within our brains. Brainwaves are produced by synchronised electrical pulses from masses of neurons communicating with each other.Brainwaves are detected using sensors placed on the scalp. They are divided into bandwidths to describe their functions (below), but are best thought of as a continuous spectrum of consciousness; from slow, loud and functional - to fast, subtle, and complex.It is a handy analogy to think of brainwaves as musical notes - the low frequency waves are like a deeply penetrating drum beat, while the higher frequency brainwaves are more like a subtle high pitched flute. Like a symphony, the higher and lower frequencies link and cohere with each other through harmonics.

Our brainwaves change according to what we're doing and feeling. When slower brainwaves are dominant we can feel tired, slow, sluggish, or dreamy. The higher frequencies are dominant when we feel wired, or hyper-alert.The descriptions that follow are only broad descriptions - in practice things are far more complex, and brainwaves reflect different aspects when they occur in different locations in the brain. Brainwave speed is measured in Hertz (cycles per second) and they are divided into bands delineating slow, moderate, and fast waves.

Figure 4. Brain Wave Sensor

3.1 BRAIN COMPUTER INTERFACE

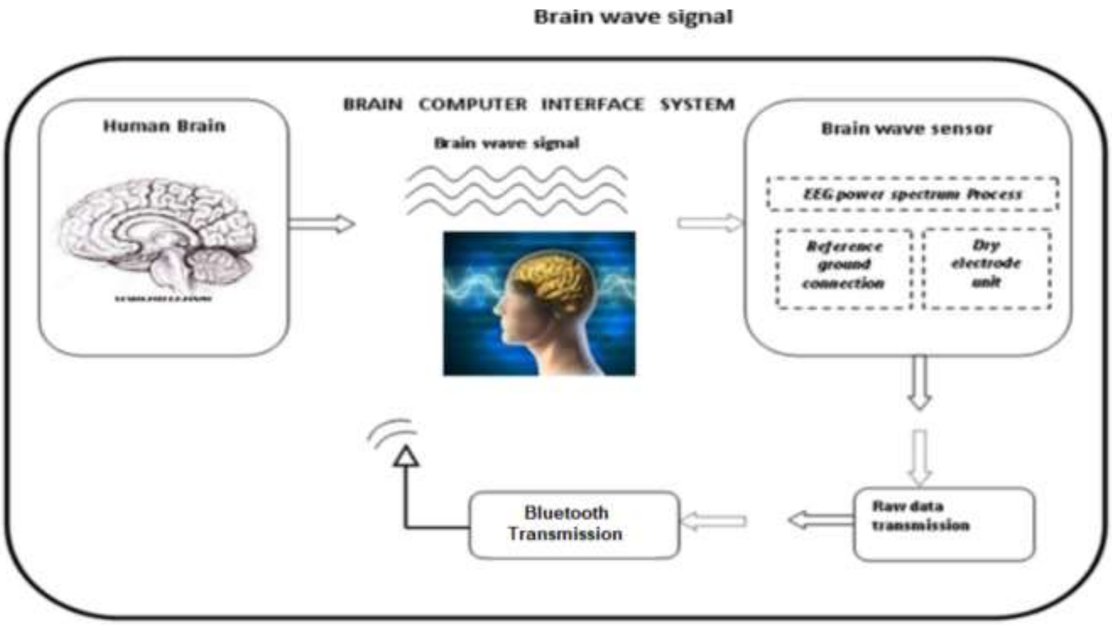

Figure 5. Transmitter

A Brain-computer interface (BCI), sometimes called a neural-control interface (NCI),mind-machine interface (MMI),Direct neural interface (DNI), or Brain-machine interface (BMI), is a direct communication pathway between an enhanced or wired brain and an external device. BCI differs from neuromodulation in that it allows for bidirectional information flow. BCIs are often directed at researching, mapping, assisting, augmenting, or repairing human cognitive or sensory-motor functions.

3.2 RECIEVER

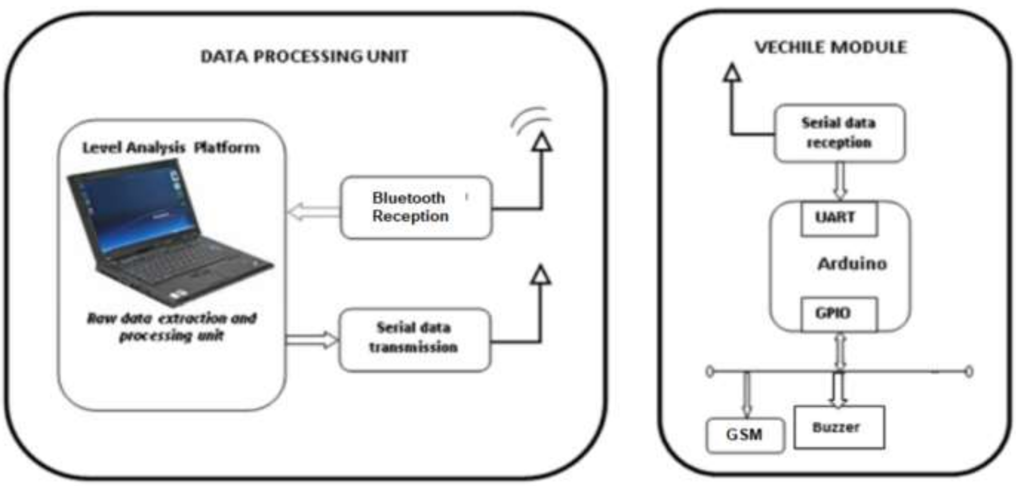

Figure 6. Receiver

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Brainwaves are produced by synchronized electrical pulses from masses of neurons communicating with each other. Brainwave speed is measured in Hertz (cycles per second), Brainwaves are detected using sensors placed on the scalp.Typical uses of buzzers and beepers include alarm devices, timers, and confirmation of user input such as a mouse click or keystroke. This buzzer can be used by simply powering it using a DC power supply ranging from 4V to 9V. A simple 9V battery can also be used, but it is recommended to use a regulated +5V or +6V DC supply. The buzzer is normally associated with a switching circuit to turn ON or turn OFF the buzzer at required time and require interval.

IV. RESULTS AND DISCUSSION

In this work, various parameters of the patient were monitoring using internet of things. In the patient monitoring system based on Internet of things project, the real-time parameters of patient's health are sent to cloud using Internet connectivity. These parameters are sent to a remote Internet location so that user can view these details from anywhere in the world.

4.1 OUTPUT

Figure 7. Output from the system

There is a major difference between SMS based health monitoring system and IOT based patient monitoring system. In IOT based system, details of the patient health can be seen by many users. The reason behind this is that the data needs to be monitored by visiting a website or URL. Whereas, in GSM based patient monitoring, the health parameters are sent using GSM via SMS.

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4.2 EEG WAVEFORM

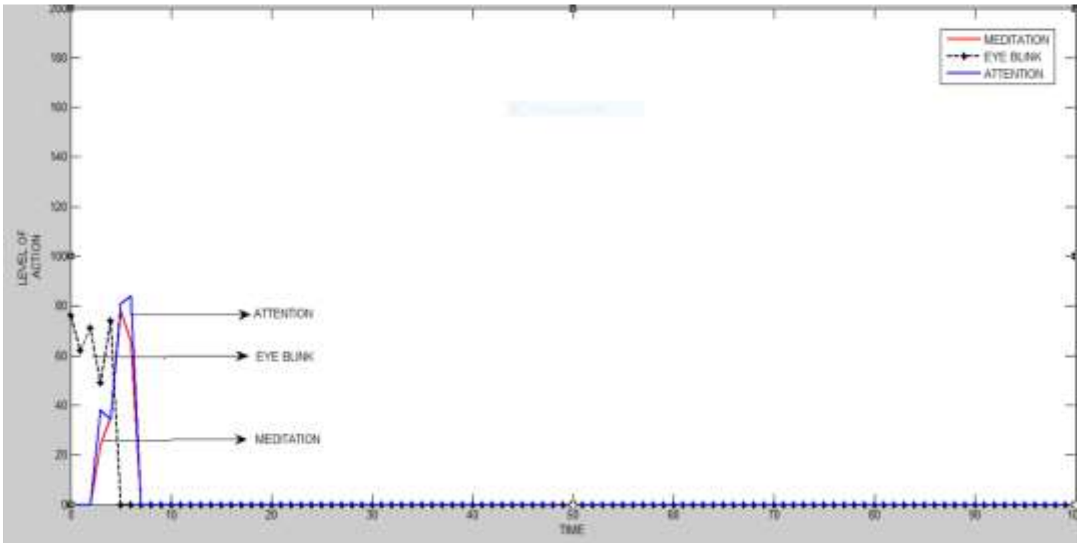

Figure 8. EEG Waveform

This is one of the systems related to Medical applications which engineering students can select as their final year project. One more benefit of using IOT is that, this data can be seen using a desktop computer, laptop, using an Android smart phone comma using a tab or Tablet. The user just needs a working Internet connection to view this data. There are various cloud service providers which can be used to view this data over Internet. Things speak, Spark fun and IOT Geek are few famous and easy to use service providers among these.

The main contribution is securely distributing the patient data in multiple data servers and employing the cryptosystems to perform statistical analysis on the patient data without compromising the patient'sprivacy.We are monitoring the patient using brain computer interface in this BCI using for if a patient wakeup in the system to intimate the all respective person.The recording is obtained by placing electrodes on the scalp with a conductive gel or paste. The number of electrodes depends on the application, from a few to 128, and they can be mounted on a cap for convenience of use The electric signal recorded is of the order of few microvolt, hence must be amplified and filtered before acquisition by a computer. The electronic hardware used to amplify, filter and digitize the EEG signal is of the size and weight of a book; it is easily transportable and relatively affordable. Spatial resolution is on the order of centimeters while the time of response to a stimulus is on the order of 100s of milliseconds.

Table 4.1 Frequency Rating

S.No.	Attention	Meditation	Eye Blink

1	Beta (12-30Hz) Rating -40%	Theta (4-7.5Hz) Rating -75%	60 Hz Rating -60%
2	Alpha (7.5-12 Hz) Rating-80%	Delta (up to 4 Hz) Rating-150%	

V. CONCLUSION

This system designed and developed a reliable, energy efficient for monitoring a person in coma state. A neural oscillation was observed using a mind wave headset during the diagnostic process. A real-time EEG-based brain computer system was proposed for monitoring the comma patient. The received EEG data was processed by the software and results were transmitted to the embedded system to analyze the condition of the patient. This will be useful for the comma patient and monitor them continuously.

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