International Journal of Latest Trends in Engineering and Technology
Special Issue SACAIM 2017, pp. 062-066
e-ISSN:2278-621X

KNOW WHAT A PARALYZED PATIENT HAS TO SAY THROUGH IOT

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Abstract- This paper presents a study on how brain computing interface (BCI) technology with EEG technology helps stroke survivors to interact with their environment through brain signals rather than through muscles.Experimental results show that using Electroencephalography (EEG) technology along with the Adriano chip and Brain Computing Interface, we can design a personal device which will help them to be in contact with other. In order to understand the patient's basic needs such as appetite, temperature, bladder functions, thirst etc,.
Keywords- EEG, Brain Computer Interface, Brain Sensor, Brain Waves, Adriano.

1. INTRODUCTION

Human brain is the vital part of our body. It is the main command center for the nervous system. It receives the input from the sensory organs and sends output to the muscles. The nervous system coordinates the brain activities by transmitting signals to and from different parts of the body. We can visualize the human behavior in terms of motor and sensory states. These states are related with specific signal frequency which helps to understand behavior of the brainstructure. Every Neuron interacts with each other through electrical firing, but it is too weak to be detected at a distance. However, millions of neurons with synchronized activities can be detected on various scalp location using EEG technology. The body system for regulating metabolism is coordinated by the hypothalamus; it controls food and water intake, hunger and trust, body temperature, bladder functions etc,.

A stroke injures the brain. A stroke can cause problems with communicating if there is damage to the left side of the brain, which is responsible for language in most people. It can cause the communication problems if the face muscle, throat or tongue is affected.

Headband using EEG technology and Brain computing interface will allow locked-in people to communicate with the outside world. A Micro controller in the headband parses data from the EEG chip and sends update wirelessly to a base station, where the base station will process the data and generates the alert/message on its screen. [4] This technology will help the paralyzed people to fulfill their basic needs.

2. METHODOLOGY

2.1 Strokes:

CerebrovascularDiseases also known as stroke which consists of ischemic stroke and hemorrhagic stroke, and cerebrovascularanomalies. The incidence of cerebrovascular diseases increases with the age, and the number of strokes is projected to increase on the elderly population grows. A stroke, or cerebrovascular accident, is defined by the abrupt onset of a neurologic deficit that attributable to a focal vascular cause.

The effects of a stroke depends primarily on the location of the obstruction and the extend of brain tissues effected.

Right Brain: if the stroke occurs in a brain's right side, the left side of the body will be effected, which could produce paralysis on the left side on the body, vision problems, quick inquisitive behavioral style, memory loss.

Left Brain: if the stroke occurs in the left side of the brain the right side if the body will be affected, producing paralysis on the right side of the body, speech or language problems, slow and cautious behavioral style, memory loss.

Brain Stem: When stroke occurs in the brain stem, depending on the severity of the injury it can affect both sides of the body and may leave in a 'locked in state'. In this state patient is unable to speak or achieve any movement below the neck

Communication problems faced by paralyzed patients:

Dyspraxia condition affects muscle movement and coordination. They does not have enough mobility or strong enough muscular activity to indicate their needs.

Aphasia can affect language disorders like reading or writing skills, inability to speak and understand what is being said. Patients does not understand when other people speak long complex sentences and can cause memory and concentration problems. [1-5]

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2.2 Neuron transmits messages to the brain –

Nerve impulse is an electrical signal that travels through the nerve cells. When there is any change in our body state, is detected by the nerve receptors, in turn they transmit the messages through nerve impulses to the brain. Each neuron consists of cell body, axon and dendrites. The cell body contains the nucleus and other organelles. Dendrites and axons connect to the cell body. Dendrites receive the nerve impulses from other cells and axons pass those nerve impulses to the other cells. Synapse exists at the end of each neuron to transmit nerve impulses from one neuron to another. It permits a neuron to pass electric impulse to another cell. At the synapse the plasma membrane of signal passing neuron comes in contact to the membrane of the neuron where the signal has to be sent. The signal is the passed through the membranes to the next neuron. [6-8]

When different ions cross the neuron membrane action potential occurs. It is an explosion of electrical activity created by depolarizing current, this means some stimulus cause resting potential to move towards 0mV, when depolarization reaches the threshold above -55mV a neuron will fire an action potential, if it doesn't reach this critical threshold than no action potential will fire. [9]

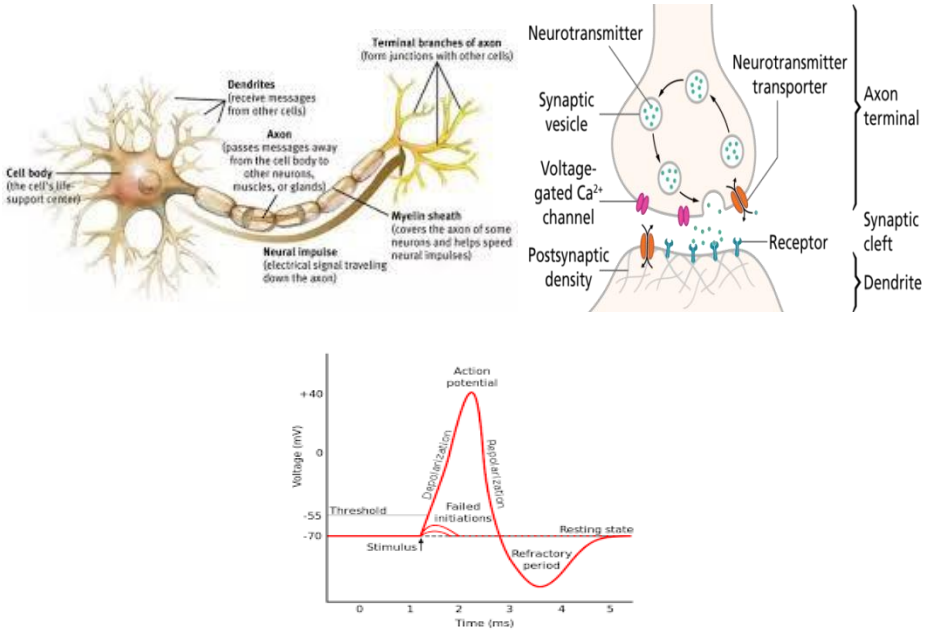


Figure 1. (a)Neuron Structure (b) Working of neuron. (c)Action Potential

2.3 Hormones released by hypothalamus-

The Hypothalamus is responsible for the regulation of certain metabolic processes and other activities of the autonomic nervous system it synthesizes and secretes certain neurohormones, releasing hormones or hypothalamic hormones, and these in turn stimulate or inhabit the secretion of pituitary hormones. The hypothalamus controls body temperature, hunger, and important aspects of parenting and attachment behavior, thirst, fatigue, and circadian rhythms.

The Hypothalamus acts as the connector between the endocrine and nervous system. It plays a part in many essential functions of a body such as: Body temperature, Thirst, Appetite and weight control, Emotions, Sleep cycle, Blood pressure and heart alive, Production of digestive juices, Balancing bodily fluidsetc,.

As signals are sent to the brain from different areas of the body, theylet hypothalamus know if balances is not been achieved, the hypothalamus then responses by releasing the right hormones into the blood streams to balance the body back out.

The hypothalamus is also closely related to the pituitary gland, which makes and sends other important hormones around the body. Together, the hypothalamus and pituitary gland work to control the entire endocrine system, the glands the produce many hormones of the body [10-12].

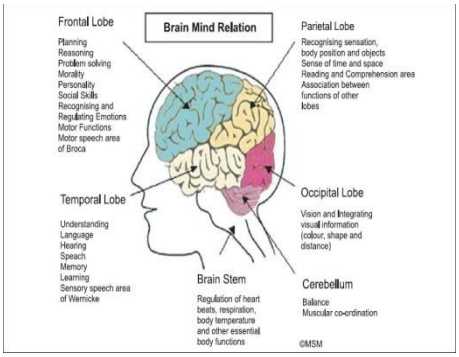


Figure 2. (a) Brain Mind Relation

2.4 Electroencephalography (EEG)-

Electroencephalography or EEG is the physiological method of choice to record all the electrical activity generated by the brain from electrodes placed on the scalp surface .EEG measures electrical activity generated by the synchronized activity of thousands of neurons. The electrical activity is measured in voltages. EEG provides excellent time resolution allowing you to analyze which brain areas are active at certain time.

Since the voltage fluctuations measured at the electrodes are very small, the recorded data is digitized and sent to an amplifier. The amplified data then can be displayed as a sequence of voltage values. EEG is one of the fastest imaging technique available as it can take thousands of snapshots per seconds (256 Hz of higher).

The system of placing electrodes on the scalp is known as international 10-20 system of electrode placement the underlined principal is that accurate measurement of the skull using specific identifiable landmarks can be subdivided into smaller distances based on 10% or 20% implements of the total distances.

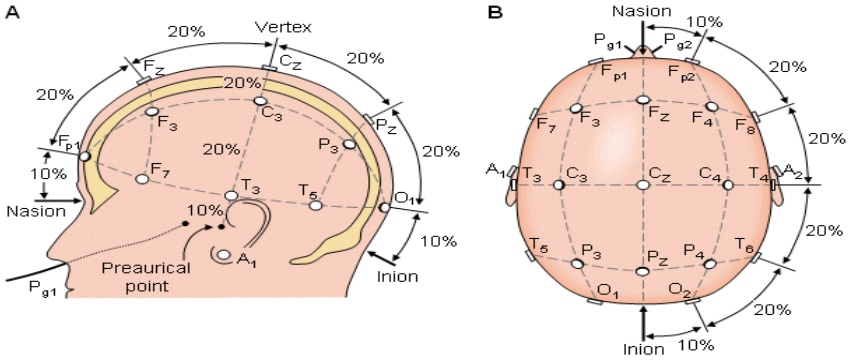
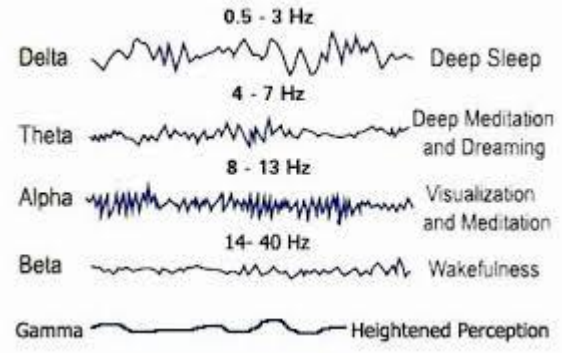


Figure 3. Electrode placements in standard EEG

EEG activity is recorded in the form of frequencies, amplitude, distribution or location, symmetry, synchrony, reactivity, morphology, rhythmicity and regulation. The frequencies are divided into four standard frequency ranges or bands. [13-17]

Band	**Frequency Range**	**Usual Location**
Alpha	8 to <13Hz	Occipital
Beta	>13 to 25Hz	Frontal, central
Theta	4 to <8Hz	Central, Diffuse
Delta	<4Hz	Focal or diffuse



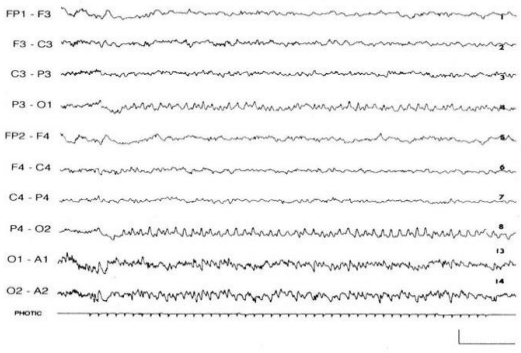


Figure 5. Frequency range used to measure brain waves

2.5 Brain wave monitoring with Arduino:

Arduino Board is used to measure brain waves through EEG technology and processing by sending an alert messages to specified device by which the signals can be detected . A headband will be connected to the brain which holds the EEG hardware.A micro controller in the headband parses the data from the EEG chip and sends updates wirelessly to a base station /device. The base station will retrieve the appropriate data and display the alert or a message on the screen.[18-24].

3. EXPERIMENT AND RESULT

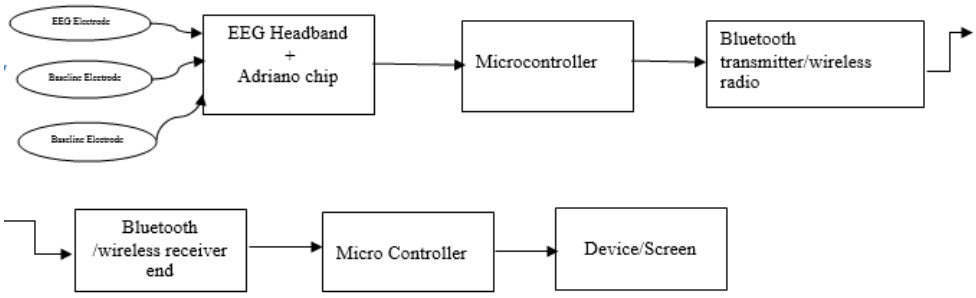
A head band is connected to the scalp of the brain, which detects the brain wave signals using EEG technology, this technology consists several electrodes which detects the appropriate metabolic signals for appetite, thirst, kidney functions, and temperature changes in the body from the hypothalamus. Hypothalamus detects several kind of signals some of the signals which senses the metabolic activity in a body are:

- Hypothalamus produces the hunger hormone called as Ghrelin, produced by ghrelinirgic cells in the gastrointenstinel track. The secretion of the ghrelin takes place when the stomach is empty and it stops when the stomach is full, the receptor for ghrelin, ghrelin or growth hormone secretagoguereceptor(GHS-R) is located in the hypothalamic ventromedicalnucleua and arcuate nucleus.
- Osmometric thirst occurs when the medianpreoptic nucleus and the subfornical organ receivesdecreased volume and increased osmolite/salt concentration, the signals are sent to the hypothalamus where it produces the thirst hormone called as Vasopressin released by the pituitary gland.
- Antidiuretic hormone (ADH) is an hormone synthesized as the peptide prohormone in neurons in the hypothalamus and it's converted to AVP. it is received by the supraoptic nucleus and paraventricular nucleus of hypothalamus AVP hormone is released in high concentration of urine in order to reabsorb the solute free water and return the body fluids towards normal.[25]
- For regulation of body temperature thyrotropin releasing hormone(TRH) released by the hypothalamusand that will be connected to room air conditioner and it will keep the body to maintain a constant temprature

Head band detects the EEG signals from EEG electrodes and base line electrodes into the Arduino EEG chip which in turn sends the signals to the microcontroller. This microcontroller transmits the signal to the base station through wireless radio or Bluetooth transmitter.

The Bluetooth or wireless receiver end receives the wireless signals sent by the transmitter and this signals is passed through microcontroller which process the signals and an appropriate alert message is sent to the device and displayed on the screen

The Proposed Structure:



4. CONCLUSION

This paper is mainly focusing on how IOT can help the stroke patients in order to communicate with the people around them. This device uses EEG technology, brain computer interface and Arduino in order to detect the signals and help to understand the metabolism undergone in the body of a stroke patient and fulfill their needs accordingly by detecting the signals displayed on the device/screen. It is going to help the patient in knowing when the patient is hungry, when the patient is thirsty etc., so that one can take better care of paralyzed/stroke patient. In future we can enable a voice control device, where it will act as vocal cord for the paralyzed/stroke patient.

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