

An Approach For Als Patients To Control Home Appliances Using Beta Waves

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Article Info

Volume 82

Page Number: 7729 - 7733

Publication Issue:

January-February 2020

Article History

Article Received: 18 May 2019

Revised: 14 July 2019

Accepted: 22 December 2019

Publication: 04 February 2020

Abstract:

People with severe disabilities cannot interact with environment as normal people. The aim of this work is to implement a system that controls basic appliances such as fan, light and similar appliances using brain waves generated from brain using EEG for ALS patients. Amyotrophic Lateral Sclerosis (ALS) is a disorder in which due to death of the neurons, people lose control of their senses. They always need personal assistance for doing small tasks like switching on a fan or light. To overcome their disability EEG is used to control their home appliances. By using Beta signals generated from brain and Arduino, automation of electronic appliances is possible for ALS affected patients. The Brain signal detected from the EEG electrodes is transmitted to the computer through Bluetooth transmitter. "Brainwave osc" software is used to detect and show graph of the brain signal.

Keywords: Arduino, EEG for ALS

I. INTRODUCTION

In today's world, neurological complications are encountered in large numbers leading to physical disability. Amyotrophic Lateral Sclerosis (ALS) is one such condition where the nervous system is affected leading to a poor quality of life. Hence, the main focus of the present work was to use a brain wave sensor to obtain the input from the brain waves of an ALS patient to perform certain activities which otherwise is not possible in this condition. Amyotrophic lateral sclerosis is a nervous system disease which affects the nerve cells in the brain and causes loss in muscle control. These nerve cells are responsible for controlling voluntary muscle movement. The voluntary muscles are responsible to produce movements of body parts. There is no cure for this disease. It begins with weakness in limb and becomes worse over time.

There is no effective treatment found till date to overcome and stop the progression of the disease.

The upper motor neurons and the lower motor neurons do not function in ALS patient. UMN and LMN cannot send informative signal to the muscles. Due to muscle weakness, fasciculation a small, local, involuntary muscle contraction and relaxation happens. There will be a gradual decrease in the ability of brain to initiate and control voluntary movements. The voluntary control muscles are all affected, and individuals lose their strength and the ability to speak, eat, move, and even breathe. People with ALS die due to respiratory failure, usually within 3 to 5 years from when the symptoms first appear. However, 10 percent of the people suffering from ALS survive for 10 or more years. In this proposed work EEG signal detected by

the EEG electrodes is transmitted to the computer through Bluetooth transmitter that need to be integrated with the EEG headset. “Brainosc” software is used to process the received signal, for accuracy. “Processing” software is used to convert beta waves into attention value.

BETA WAVE

Beta waves are the brain waves that arise from the human scalp when a person is awake. The frequency range of beta waves falls under 13-40 Hz range. The Beta state is associated with a state when a person is alert, attentive, decision making or problem solving. In Beta state, a person experience varying degrees of being alert, engaged, and having focused mental activity. At the lower end (12–15 Hz), called lo-beta is related to fast idle.. At the mid-range of Beta (16–22 Hz), called Beta is related to high engagement. The upper range of Beta (23–30 Hz), called hi-beta is related to highly complex thought or excitement. The problem is intricate and requires creativity.

ALPHA WAVE

Alpha waves are the brain waves that arise from occipital lobe when a person is awake with closed eyes. The frequency range of alpha waves falls under 7-12 Hz range. It indicates a deeply relaxed state. Alpha is said to be the gateway, the entry node that takes into deeper states of consciousness. Resonant frequency of Earth’s electromagnetic field is called the window frequency or Schuman Resonance. Alpha is also the home of the window frequency.

THETA WAVE

Theta waves are the brain waves that arise from hippocampus during REM sleep or waking. The frequency range of theta waves falls under 4-7 Hz range. Theta is one that holds our sorrows, fears and nightmares. It is an indication of mental disengages and the tasks become automatic.

DELTA WAVE

Signal from the subconscious in the brain is called Delta, that arise from thalamus of cortex of the brain during slow wave sleep. The frequency range of delta waves falls under 0.5- 4Hz range. Delta waves decrease as a person grows older. This signal is obtained as an effect of deep meditation.

GAMMA WAVE

Gamma waves are the brain signal arising from parietal, temporal and frontal region of the brain. The frequency range of gamma wave falls under 25 and 100 Hz, with around 40 Hz being typical in humans. Gamma waves occur during full state of wakefulness.

BLOCK DIAGRAM

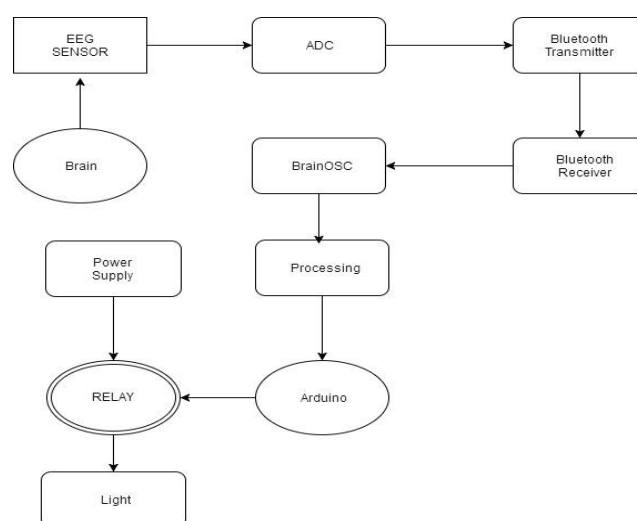


Figure 1 Block Diagram

II. HARDWARE COMPONENTS

EEG SENSOR

An electroencephalogram (EEG) is used to detect and record the electrical activity of the brain. EEG signals provide information of brain activity. The signals are recorded using a computer. “Mindwave” EEG Sensor is used to detect these brain signals. It safely measures brain wave signals and monitors the patients attention level. Think Gear ASIC is used to convert the analog brain waves into digital bit streams.



Figure 2 EEG SENSOR

III. SOFTWARE USED BRAINWAVE OSC

Each brain wave is separated in terms of frequencies such as low Beta, high Beta, high Gamma, Low Gamma, Theta, low Alpha and high Alpha. Output port of Brainwave osc is used to provide input for “PROCESSING” Software. Brainwave Osc software is used to show a graphical representation of received brain wave signal in the form of digital bit streams. COM port of Bluetooth is used to collect the digital bits received by the receiver. Brainwave Osc plots a graph with time along horizontal axis and amplitude along vertical axis. These processed brain waves are stored in temporary folder which is accessed by “processing” software for conversion of beta wave into Attention.

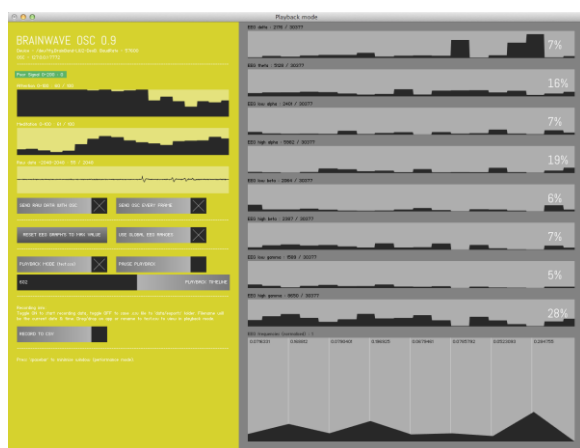


Figure 3 Brainwave oscillator plot

a. PROCESSING

Processing is a Java based programming Software. Output of Brainwave Osc is stored in a temporary folder. . It is an integrated development environment for beginners to learn programming for electronic arts. This folder is accessed by

“Processing” software. Real time monitoring and filtering of brain waves can be done using Processing Software. It is used to decode the data streams received through Bluetooth and convert it into attention value. It is programmed to convert beta waves into attention values. Baud rate must be set by “Processing” software to establish a communication between “Processing” and Arduino. COM port of Arduino is used to write the attention value. This attention value is given to Arduino using Serial Bus data cable. Output console of processing displays attention level at each and every second.

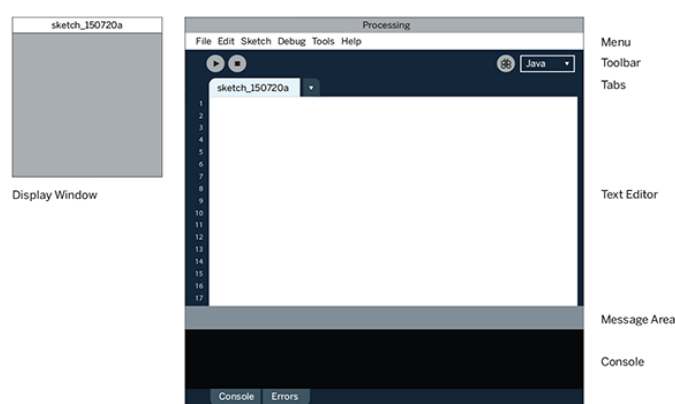


Figure 4 Output Console

ARDUINO

The Arduino Integrated Development Environment (IDE) is a software for coding and a microcontroller in it as a hardware part. Threshold limit for attention is programmed by Arduino.

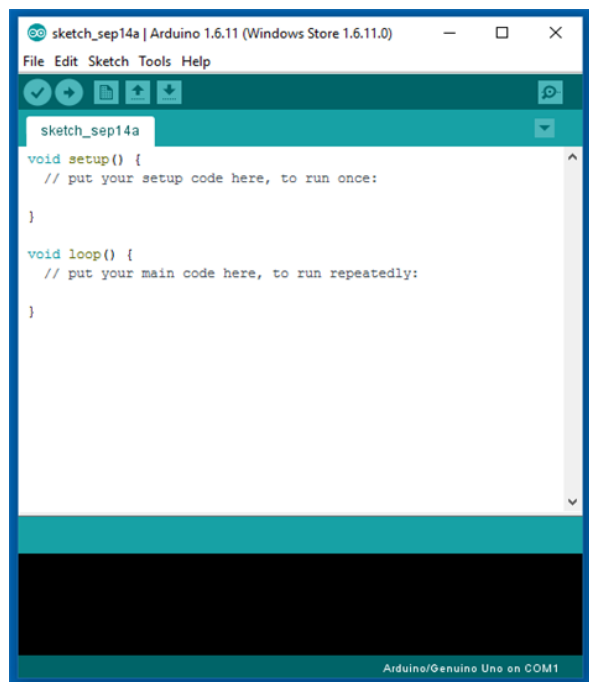


Figure 5 IDE

IV. RESULTS AND DISCUSSIONS

SOFTWARE OUTPUT



Figure 6 Arduino coding

The above figure indicates the coding that is to be uploaded to the Arduino. After uploading the program, attention values are obtained as output in real-time.

HARDWARE OUTPUT



Figure 7

Figure 7 depicts the setup before Beta waves are processed.



Figure 8

Figure 8 represents the final required output after the Beta waves are being collected and processed. Thus using the Beta waves generated from the brain of an ALS patient, a bulb has been successfully switched ON.

V. CONCLUSION

Medical teams when collaborate with engineers to acquire technical assistant, innovative technologies can be used effectively. Health care can be taken care in order to provide a better quality of life. The quality of life of ALS patients can be improved by this work. The patient may feel comfortable in doing the simple control like on/off. Thus this work would be a stepping stone in helping the ALS patients by providing self-confidence and reducing dependency on others to certain extent.

VI. FUTURE SCOPE

BCIs in future can greatly help people suffering from neuromuscular disorders. Brain signals are used in controlling wheel chairs, cursors and artificial limb. Brain signals carry the encoded information about the action to be done, which is decoded by the BCI and converts into instructions to perform users thought. The patients suffering from such neuromuscular disorders can lead a better life. In near future BCI may become a new communication and control technique for people with neuronal diseases and also for normal people. EEG signal recording is a very big problem, nowadays electrodes are fixed inside the brain for getting good resolution signals. MRI is also used to record the brain activity with a good quality resolution.

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