FRONTAL TO MUSCULAR INTERFACE THROUGH STIMULATOR IMPULSE

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ABSTRACT:

Mobility is a vital role to lead a life for a normal human beings. The concept of this paper is to help the person who suffers from various physically impairment. They are in need of person to support for their regular activities. This paper mainly focuses on the nerve conduction patients for necessary needs. The system deals with the mind power of normal person and actuated by ES impulse on target person. First, the acquired signal is processed for feature extraction and classification to analyze the brain signal. The main advantages of this system is to prompt their necessities to manage their life as a typical individuals.

Keywords: ***Mind wave sensor, Matlab software, Embedded controller, Arduino, ES impulse.***

In the following: Sections I provide introduction and Section II provides related work, while Section III presents the proposed work. Section IV shows conclusion and results.

I. INTRODUCTION

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 in specific applications. EEG measures voltage fluctuations resulting from ionic current within the neurons of the brain. In clinical contexts, 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. Diagnostic applications generally focus on the spectral content of EEG, that is, the type of neural oscillations (popularly called "brain waves") that can be observed in EEG signals.

The brain's electrical charge is maintained by billions of neurons. Neurons are electrically charged (or "polarized") by membrane transport proteins that pump ions across their membranes. Neurons are constantly exchanging ions with the extracellular milieu, for example to maintain resting potential and to propagate action potentials. Ions of similar charge repel each other, and when many ions are pushed out of many neurons at the same time, they can push their neighbors, who push their neighbors, and so on, in a wave. This process is known as volume conduction. When the wave of ions reaches the electrodes on the scalp, they can push or pull electrons on the metal in the electrodes. Since metal conducts the push and pull of electrons easily, the difference in push or pull voltages between any two electrodes can be measured by a voltmeter. Recording these voltages over time gives us the EEG.

In conventional scalp EEG, the recording is obtained by placing electrodes on the scalp with a conductive gel or paste, usually after preparing the scalp area by light abrasion to reduce impedance due to dead skin cells. Many systems typically use electrodes, each of which is attached to an individual wire. Some systems use caps or nets into which electrodes are embedded; this is particularly common when high-density arrays of electrodes are needed.

Electrode locations and names are specified by the International 10–20 system for most clinical and research applications (except when high-density arrays are used). This system ensures that the naming of electrodes is consistent across laboratories. In most clinical applications, 19 recording electrodes (plus ground and system reference) are used. A smaller number of electrodes are typically used when recording EEG from neonates. Additional electrodes can be added to the standard set-up when a clinical or research application demands increased spatial resolution for a particular area of the brain. High-density arrays (typically via cap or net) can contain up to 256 electrodes more-or-less evenly spaced around the scalp.

Each electrode is connected to one input of a differential amplifier (one amplifier per pair of electrodes); a common system reference electrode is connected to the other input of each differential amplifier. These amplifiers amplify the voltage between the active electrode and the reference (typically 1,000–100,000 times, or 60–100 dB of voltage gain). In analog EEG, the signal is then filtered (next paragraph), and the EEG signal is output as the deflection of pens as paper passes underneath. Most EEG systems these days, however, are digital, and the amplified signal is digitized via an analog-to-digital converter, after being passed through an anti-aliasing filter. Analog-to-digital sampling typically occurs at 256–512 Hz in clinical scalp EEG; sampling rates of up to 20 kHz are used in some research applications. Fig.1 shows the EEG Waveforms for different activities of the human beings.

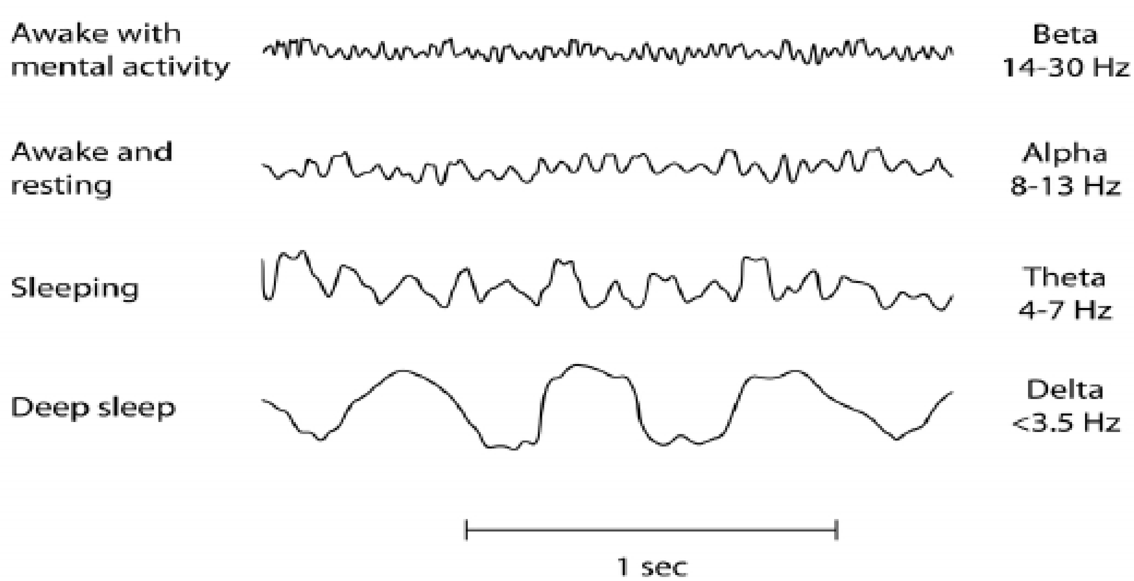

Fig.1 .EEG Waveforms

II. PROPOSED SYSTEM

The Proposed system is mainly depends upon EEG waveforms. Brainwave sensor, Matlab and Muscle Controller are the key parameters of system. Fig.2 illustrates conceptual diagram of the proposed system. The block diagram consists of the following modules:

- EEE Acquisition Unit
- Software Platform
  - Feature Extraction
  - Feature Classification
- Interface Platform
  - ARDUINO Microcontroller
  - Connector Module
  - ES Impulse

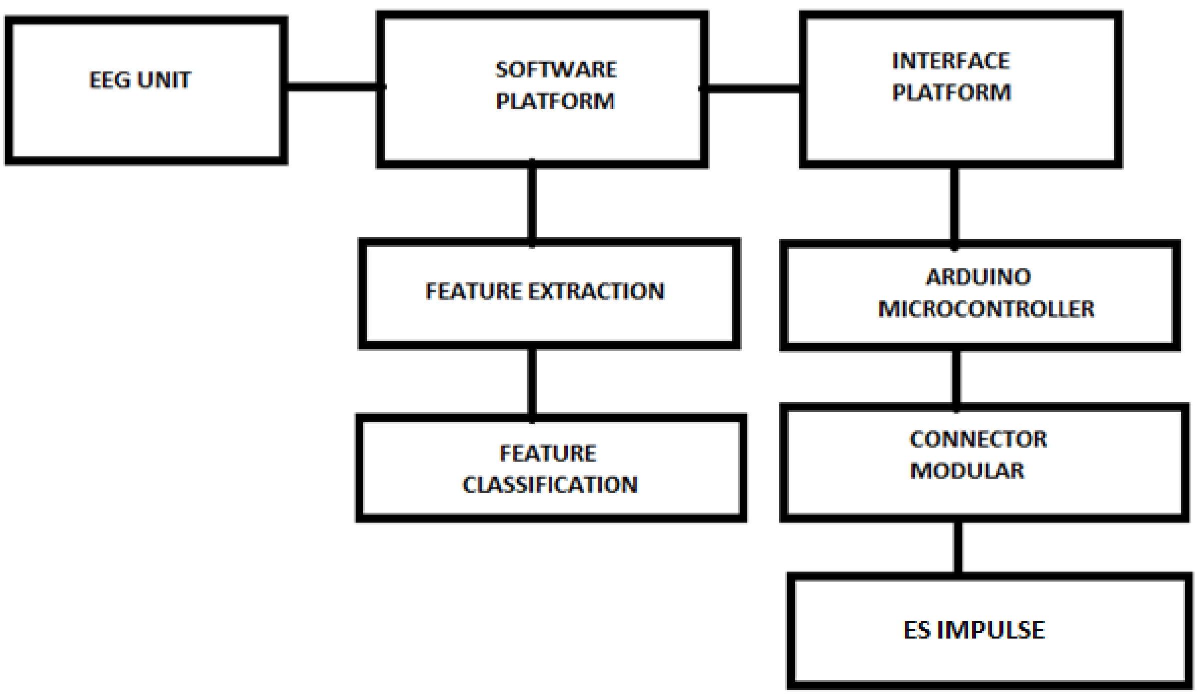

Fig.2. Block Diagram Representation

a) EEG Acquisition Unit

*F*NIR systems provide real-time monitoring of tissue oxygenation in the brain as subjects take tests, perform tasks, or receive stimulation and allows researchers to quantitatively assess brain functions such as attention, memory, planning, and problem solving while individuals perform cognitive tasks. It eliminates many of the drawbacks of MRI and provides a safe, affordable, noninvasive solution for cognitive function assessment. The *F*NIR device provides relative change in hemoglobin levels, calculated using a modified Beer-Lambert law. The powerful spectroscopy imaging tool measures NIR light absorbance in blood of hemoglobin with and without oxygen and provides about ongoing brain activity similar to functional MRI studies.

Fig.3. EEG Sensor

b) Signal Processing

The processing of the different signals is done in two phases namely Feature Extraction and Feature Classification.

i) Feature Extraction

In this paper, the processing of EEG data is done using the new technique, Fast Fourier Transform Analysis and Wavelet transform for feature extraction. First, the raw EEG data is retrieved. This EEG data had not been processed in the way as EmoState. Therefore, Fast Fourier Transform is applied to convert the complicated EEG waveforms into a simpler waveform.

This processing method is able to produce a waveform which is easier for analyses and differentiate from others. Training for the mental command is also required for this approach. The waveforms after the FFT process are recorded during the training session. Then, the detection of the mental command is carried out by classifying the detected waveform to the recorded waveform.

ii) Feature Classification

Support Vector Machine (SVM) is primarily a classifier method that performs classification tasks by constructing hyper planes in a multidimensional space that separates cases of different class labels. The SVM must be trained, just as an Artificial Neural Network must be trained. It maps training data in the input space into a high dimensional feature space.

It determines a linear decision boundary in the feature space by constructing the optimal separating hyper plane distinguishing the classes. This allows the SVM to achieve a nonlinear boundary in the input space. The support vectors are those points in the input space which best define the boundary between the classes.

Potentially difficult computations in the feature space are avoided by using a kernel function, which allows computations to be performed in the input space. Fig.4 demonstrates the System architecture in which the feature classification from the data acquisition unit and then the output is sent to the control unit.

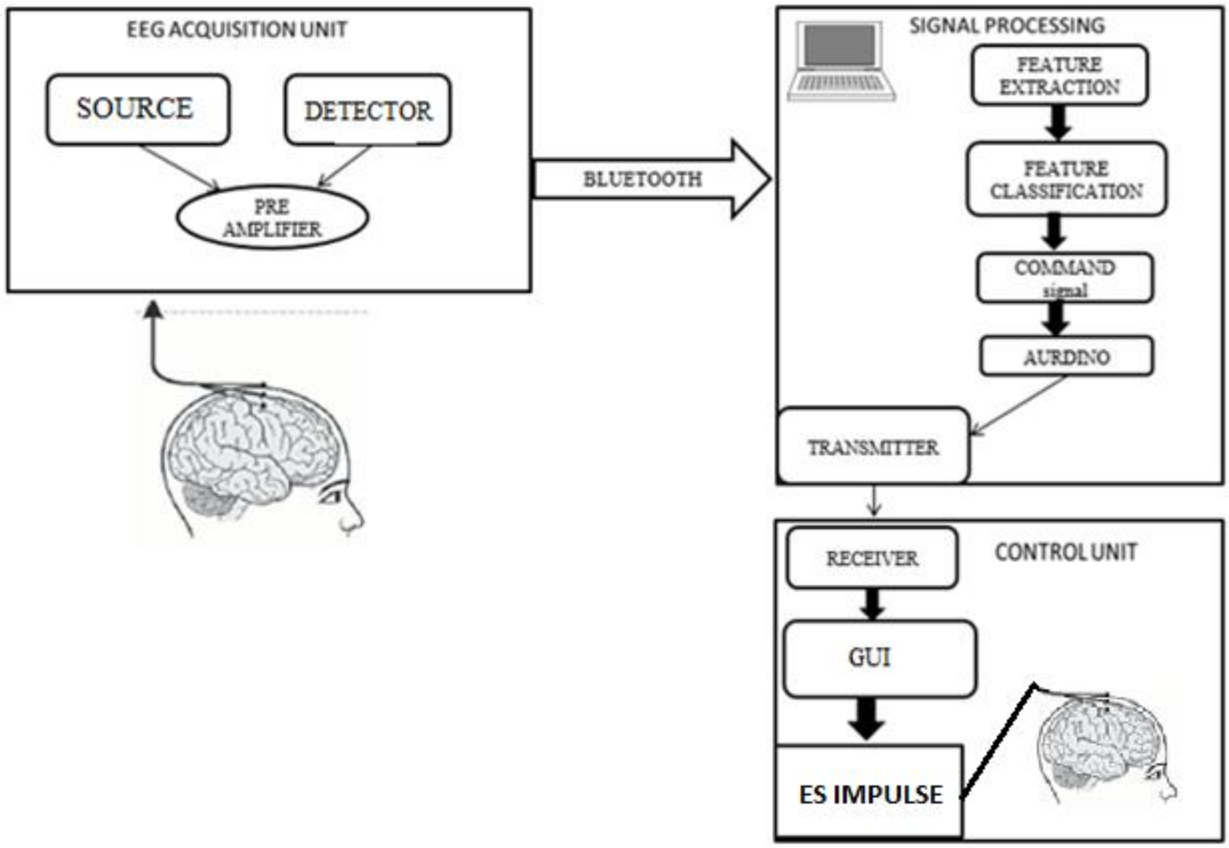

Fig.4. System Architecture

c) Interface Platform

The interface platform is programmed by ARDUINO Microcontroller, then connector module and ES Impulse. The following is the operations of these three modules.

i) ARDUINO Microcontroller

The controller board for the controlling the entire electrical wheelchair is Arduino Uno microcontroller board. The Arduino Uno microcontroller is selected due to it consists of enough I/O pins. It is able to control the entire electrical wheelchair system. Besides, Arduino Uno microcontroller is relatively small size.

ii) Connector Module

This RF module comprises of an RF Transmitter and an RF Receiver. The transmitter/receiver (Tx/Rx) pair operates at a frequency of 434 MHz an RF transmitter receives serial data and transmits it wirelessly through RF through its antenna connected at pin4. The transmission occurs at the rate of 1Kbps - 10Kbps.The transmitted data is received by an RF receiver operating at the same frequency as that of the transmitter.

iii) ES IMPULSE

Electrical current stimulation (ES) passes current through the muscle. A small electric current (1–2 mA) is delivered to the muscle by a battery-driven device connected to two surface electrodes. The current is not sufficient to generate action potentials but instead alters neuronal resting membrane potentials. In patients with stroke, ES has been found safe, and a number of studies suggest the potential to improve certain behaviors.

III. CONCLUSION

Cognitive tasks captured will be used for computer interface. Main goal of the proposed work to convert mental task related to nerve conduction. Here input to the proposed system will be brain signals, output will be analog movement of the target person. This is helpful to people especially for stroke patients.

IV. DISCUSSION

We rely on our cortical-to-muscular interface, improves upon previous human brain-to-brain interfaces on:

- magnifies the scale of brain signal to multiple human subjects working;
- The system is considered where every subject can both send and receive data using the cortical interface;
- Receivers are capable to learn to segregate the dependability of data conveyed to their brains by other subjects.

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