International Journal of Information Sciences and Application (IJISA). ISSN 0974-2255, Vol.11, No.1, 2019, (Special Issue)

Brain Controlled Wheel Chair and Cursor Control

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ABSTRACT

The main idea of the current work is to use a wireless EEG headset as a hands free control for the wheel chair and to control mouse cursor of a personal computer with the help of face detection and eye blink. The EEG signals captured have to be pre-processed to filter out the unwanted content and then the content of interest has to be represented using some features that can be inputted into machine learning algorithms. These signals produce a threshold value of our attention and meditation to move the chair according to the differently abled person's brain. Extra feature has been added to this device is the cursor control to use the laptop along with the disabilities. For this we are using the face detection algorithms to move the cursor and the Neurosky Mindwave Mobile to detect eye blink to perform click event. This HCI device is a complete package for the differently abled people that will allow you to control your wheel chair using the brain waves and also the mouse cursor with your facial movements that works with just your regular webcam and the Neurosky Mindwave Mobile.

KEYWORDS

EEG, HCI, Neurosky Mindwave Mobile, Classification common spatial patterns (CSPs), Kullback–Leibler (KL CSP).

1. INTRODUCTION

The Electroencephalogram (EEG) signals are collected with the help of electrodes that are placed on the surface in the middle of the forehead, above the junction of the eyebrows. The most widely used electrodes are silver/silver chloride (Ag/AgCl) because they have low cost, low contact impedance, and relatively good stability. Earlier researches in the field of neuroscience has greatly increased our knowledge about the human brain and also the electrical signals released by the neurons firing in the brain. The frequencies and patterns of these electrical signals can be measured by placing a sensor on the forehead. The Mindwave mobile line of headset products contain Neurosky ThinkGear technology, which quantifies the analog electrical signals, commonly referred to as brainwaves, and converts them into digital signals. The ThinkGear technology then makes these signals available to various applications and games. The Table below gives a summary of some of the commonly- observed frequencies emitted from the neurons that are generated by different types of activity in the human brain.

Table1. Frequencies Generated By Different Types of Activities in the Brain

Brainwave Type	Frequency range	Mental states and conditions
Delta	0.1Hz to 3Hz	Deep, dreamless, non-REM sleep, unconscious
Theta	4Hz to 7Hz	Intuitive, recall, fantasy, imaginary, dream
Alpha	8Hz to 12Hz	Relaxed, but not drowsy, tranquil, conscious
Low Beta	13Hz to 15Hz	Formerly SMR, relaxed yet focused, integrated
Midrange Beta	16Hz to 20Hz	Thinking, aware of self & surroundings
High Beta	21Hz to 30Hz	Alertness, agitation

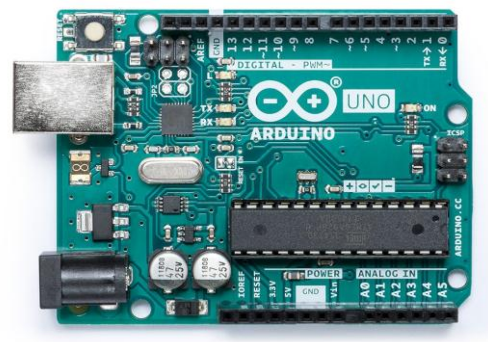
eSense is a proprietary algorithm by NeuroSky for representing mental state of a human being. For calculating eSense, the NeuroSky ThinkGear technology amplifies the raw brainwave signals and removes the background noise and muscle movement. The eSense algorithm is then applied to the remaining signals, resulting in clarified eSense meter values. The eSense meter values do not demonstrate an exact number, but instead describes a range of activity. The eSense meter is a way to show how effectively the user is capturing Attention (similar to concentration) or Meditation (similar to relaxation). The eSense Meditation meter shows the level of a user's mental “calmness” or “relaxation”. Its value ranges from 0 to 100. However, for most people in normal circumstances, relaxing the body often helps the mind to relax as well. Meditation is related to reduced activity by the brain. It has been observed that closing one's eyes turns off the mental activities (like processing of images in the eyes). So, closing eyes is often an effective method for increasing the Meditation level. Distractions, inconsistent thoughts, anxiety, agitation, and sensory stimuli may lower the Meditation levels. The eSense Attention meter shows the value of a user's level of mental “focus” or “attention”, similar to that which occurs during intense concentration and directed (but stable) mental activity. Its value ranges from 0 to 100. Distractions, inconsistent thoughts, lack of focus, or anxiety may lower the attention level.

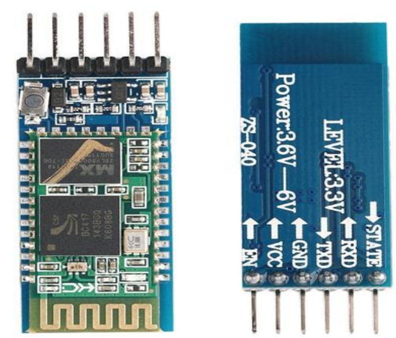
2. RELATED WORKS

The Brain-Computer Interface (BCIs) system are very useful for disabled people. The most preferred algorithm for the EEG are CSPs. The objective of CSP is to present the projection which is discriminative spatial. There are two significant drawbacks for the CSP-based method. Initially, the classification algorithm LDA and the feature extraction algorithm CSP modify different detached functions. Second, the intrinsic nonstationarity of the EEG signals recording in a single session tends to worsen the classification performance with the primary CSP-based method. The divergence-based framework for common spatial patterns algorithms. The divergence-based framework just allows catching different unchangeability and employing details from other substances. Hence, it combines the currently suggested many of CSP alternatives in a principled manner. As well as, it permits scheming novel spatial filtering algorithms by including usual schemes into the accumulation process or appealing different severances. A KL CSP is favored, in which the linear spatial filtering algorithm is used to withdraw characteristics that are robust and inflexible. In opposite, the recommended KLCSP algorithm simultaneously maximizes the variances between the class means and it also minimizes the within-class differences which are unhurried by a loss function. Bayesian learning for spatial filtering in Brain–Computer Interface based EEG. However, there is no established hypothesis for spatial filtering that directly links to Bayes classification error. In order to report this problem for spatial filtering, a Bayesian analysis theory in correlation to Bayes error is proposed. The stationary standard spatial patters for brain-computer interfacing. This method is not only appropriate to Brain signals using EEG but also to the censorious modeling of the innovative standard beyond BCI. In iterative spatiospectral patterns learning (ISSPL), to achieve efficient performance the spectral filters and classifier are simultaneously parameterized for an extension. In ISSPL, a rigorous derivation and theoretical analysis are complicated.

3. METHODOLOGY AND SYSTEM REQUIREMENT

- **Hardware Requirements :**
  - Arduino Microcontroller
  - EEG Sensor (Mindwave Mobile)
  - HC-05 Bluetooth Module
  - Jumper wires
  - Monitor
  - Robotic chassis
  - Wheels
  - Battery
  - DC motors
- **Software Requirements:**
  - Embedded C
  - Arduino
  - Flash magic software





2. HC-05 Bluetooth

- **Steps in working for Brain Controlled Wheelchair :**

- The ThinkGear technology user in mindwave mobile takes out brainwave signals and removes muscle speed and noise of the atmosphere.
- The fetched brain signals are transmitted to the Arduino with the help of Bluetooth HC-05 module.
- Designed to control robotic modules, the DC motor involves Arduino Microprocessor.
- For monitoring the direction of the robot the attention level was used .

3. Mindwave Mobile

- **Steps in working for Cursor Control :**

- Blinking your eyes (Blink (v.) - To close the eyes partially, like in the strong sunlight)
- Fluttering
- Moving your head in side to side axis and vertical axis.
- Opening your mouth (a little bit, yes)

International Journal of Information Sciences and Application (IJISA). ISSN 0974-2255, Vol.11, No.1, 2019, (Special Issue)
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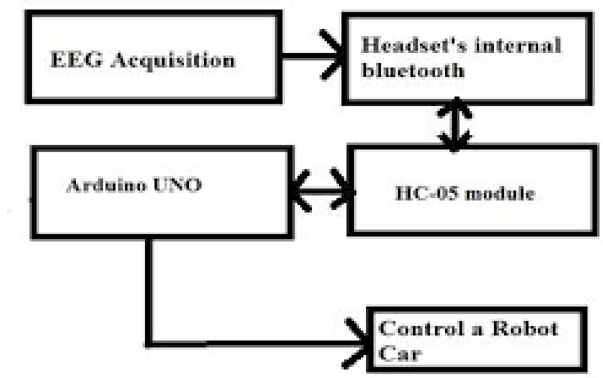
4. DATA IMPORT

In both the cases (Brain Controlled Wheel Chair and Cursor Control) the data is imported in live mode, that is, from the individual.



4. Flow Diagram

5. DISCUSSIONS

- Existing systems does not include the scanning of handwritten documents. Systems provides questionnaire and user have to choose options according to their own understanding. This is not easy for a non-graphologist to choose the appropriate options because they have less knowledge about graphology. So the result may be incorrect or not 100% correct. The whole process of graphology cannot be replaced by the computerized system because the analysis needs to be carried out by analyst who has a good knowledge and experience in graphology or by a trained graphologist. Those processes that can be computerized are data collection, access and retrieval, analysis checklist and generation of reports.

6. CONCLUSION

The development of Brain Controlled Wheel Chair and Cursor Control has attracted the attention of many researchers and innovators. This is indeed a great research in the field of technology because it helps people with physical disability to move around. And with the help of cursor control they can even work on computer systems. This makes their daily life much easier and they remain connected to the world. In this research paper we have presented an up-to-date study of the complete working system, tools and techniques used and major challenges faced.

7. REFERENCES

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