

Faster Communication Considering Emotional Quotient Using BCI

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Abstract: *The basic problem of a paralyzed person is the communication of his/her needs to the caretaker. In this Study, Brain Computer Interface can be considered as the solution and can also be convenient way for the patients, who cannot convey even the fundamental need like water, food, washroom urgency etc. Using this BCI device the patient can communicate accurately and adequately. The device doesn't need any physical movements to interact with it. It can be determined using brain activities based on EEG signals. In this Study, we are focusing on developing a practical BCI system or prototype to enable binary communication for patients.*

Keywords: *Brain Computer Interface (BCI); Electroencephalography (EEG); Brain Sense; Paralyzed Person; Binary Communication*

I. INTRODUCTION

Brain computer interface is explicit connection between mind and machine. BCIs have emerged as a great approach to treatment of neurological disorder. It has different types for different users. The main function of BCI is to collect the information from the brain through electrical signals via neurons, and then these signals can further be processed using external devices.

This device has the best application for the paralyzed patients. Since no physical work is required, this device can also be used for the folks who are lazy to do physical work.

A. History of BCI

According to [7] The history of BCI begins with 'Hans Berger' who discovered computerized action of human brain and advancement in electroencephalography (EEG). In 1924 he documented brain action on EEG. He identified oscillatory action known as Berger's Wave or alpha wave (8-13Hz) by interpreting EEG traces. In 1970s experiment

on BCIs were started at University of California, which paved a way for emergence of BCI.

In 1990 first neuroprosthetic accessory for humans were developed. BCIs don't read the mind, but they actually detect the smallest in the energy of brain, when we think about a particular thing and records frequency patterns of brain. In 1998 with the help of brain mapping technique first BCI was embedded in human being. The only use of it was wireless di-electrodes. In 2004 it was first demonstrated that we can control computer using BCI.

In later researches BCI was used as a solution to aid the paralyzed person for his/her communication of their basic needs to his/her caretaker. In the new researches it is found that this technology will grow in applicability to medical field. It is said that the paralytic patients were able to move the onscreen cursor by imagining that their hands are in movements.

B. Future Applications

The chances of discovering new BCI machinery have been exhausted. Due to the evolution of non-invasive devices which is based on EEG is symbolically the future of mainstream receptiveness of BCI technology.

C. Aim of this Study

The main aim of our project is to facilitate the faster communication between the paralyzed person and the caretaker by meeting his/her daily requirements with the help of BCI paradigm.

II. LITERATURE SURVEY

A. *Chang Hee Han, et. al. [1]* This paper provides the details of practical EEG-based BCI prototype for binary communication of the paralyzed person, who is in absolutely locked-in state. Average recorded data accuracy achieved 87.5% using EEG data for 5 seconds. The EEG data was recorded from the electrodes. In the offline experiments they tested for:



Left motor Imagery (LMI), Tongue Motor Imagery (TMI) and Mental subtraction. The patient performed the task for 5 seconds repeatedly for 20 times. RG is used to enhance the classification performance. The performance of RG based classification compare to conventional classification was very useful. Accuracy for the binary classifications was done by performing three tasks which were related to LMI, TMI and MS.

- B. *Mikhail A Lebedev, et. al. [2]* This paper focuses on Brain machine interface gives sensual prosthetic result to the people with auditory, motor and mental disabilities. The next level was brain machine brain interfaces (BMBIs) were developed to extract the intentions of the human using artificial sensations such as intracortical micro stimulation. With the help of spatial memory and attention information can be interpreted from cortical activity. Information will be stored in prefrontal cortex of the intellect. To examine this alternative activity of PF neurons were recorded in different working memory. This experiment allowed them to classify the variables.
- C. *Tomislav Milekovic, et. al. [3]* This paper tells that the patients quality of life is severely impacted and this entails stigmatic burden which affects the socio-economic costs. ('One Degree of Separation, Paralysis and Spinal Cord Injury in the United States' 2009; "Towards concerted efforts for treating and curing spinal cord injury" 2002; Arno, Levine, and Memmott 1999). Restoring movement and independence for people affected with paralysis remains a challenging clinical problem, currently with no viable solution. Recent findings of intracortical BCI's, neuroprosthetic devices that acts as a bridge between a person and a machine based on invasive recordings of a person's brain activity, has the potential to restore any reflexes and communication.
- D. *Abhinav Das, et. al. [4]* This paper focuses on BCI, the device can be considered as a persistent way out and it can also be the finest way of conveying by way of which the patients, who are affected by paralysis will be having physical action disability, they can manage to handle electronic devices and can easily interact with the system. BCI do not need any outer physical action to interact on, patients can use the device and regulate it with brain activities (using waves) using BCI. Using a method called EEG, in this paper, the different types of Interface for Human Brain Interaction has been explained. There are many types of human BCI's being described. The main function of a BCI is to fetch the electrical signals passing from our brain via neurons, and further these signals can be processed by using some external devices. A person wears an electroencephalography cap in which there are several connections of electrodes and amplifiers as well. As Brain computer Interfaces do not associate the physical activities (Use of muscles). So its uses are wide and very useful for the patients with physical disabilities

like spinal problem and other motor movement problems. This can be very convenient for people like who are lazy and can use it for the purpose of entertainment. BCI provides the facilities to the persons having Physical disabilities to communicate easily. As we humans are getting very lazy in terms of activities which requires physical movement of our body.

III. EXISTING TECHNOLOGY

A. Neurosky

According to [9] Neurosky technology started working in 1999. In 2011 Neuro Wire showcases Nekomimi, an inspired feline ear built on a mind wave band set. The brain can be designed to optimize health, education, alertness and overall functioning.

B. OCZ Technology

According to [10] Gaming controller, be it a gamepad, joystick, mouse. Neural Impulse Actuator (NIA) is used to detect 3 types of bio-signals generated by your brain, facial muscles, and muscles of eye through a particular head band.

C. Speech Generating Devices (SGD)

According to [11] The famous Stephen Hawking and the late Roger Ebert have used this device. This is necessary for people who have slight means of cooperating vocally.

IV. PROPOSED DESIGN

A. Core Technical Innovation

In the present days people are suffering with a lot of health problems. A normal person can express their feelings by saying it. But the deaf and dumb humans those who are already suffering from paralysis cannot say what they need because their motor nerves are affected. So, to overcome this problem and to help paralyzed people with the help of BCI system we come to notice what they must be feeling and what they need.

B. Uniqueness of our Project

Many of the projects which are developed are related to BCI are between a normal person and performing some experiments on the specimen they have got the output. But in our project with the help of the same device rely on the range frequencies that we get we determine what that person requires can be sent to their caretaker.

C. Objective

The main intention of our proposed project is with the help of BCI between paralyzed person and device and sends the received information in the form of message to the caretaker.

V. BLOCK DIAGRAM

BCI is usually a very complicated control measurement. During this process, measurement of brain



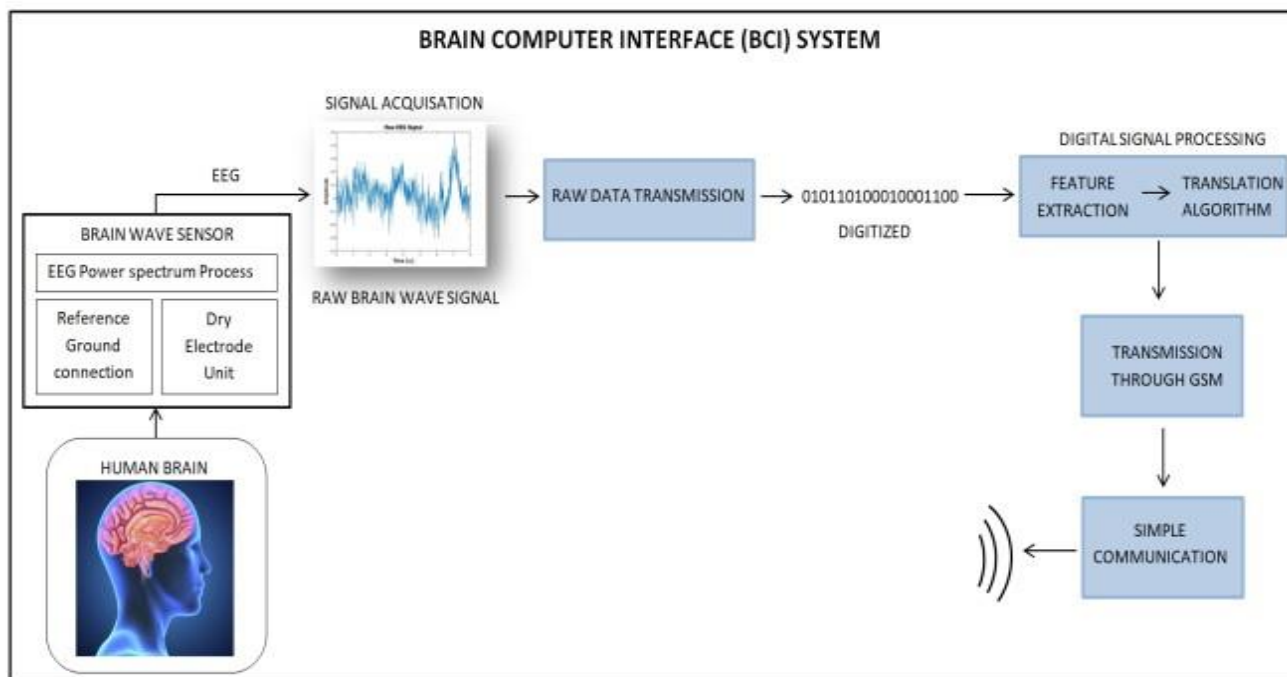


Fig 1. BCI system

signals, many problems arise at the stage of signal acquisition, signal processing and in controlling the device.

According to [8] the recording of brain’s electrical pulses for a certain period of time is called EEG signal (electroencephalogram). At first the brain signals are fetched from the brain through electroencephalography signals. The measurements of these EEG signals are very difficult because these EEG signals have very small amplitude waves (micro volts). The position of electrodes will also be crucial in this stage. These electroencephalography signals are digitalized and sent it to the major important stage of the BCI system is the DIGITAL SIGNAL PROCESSING stage as shown in below Fig 1.

It has 2 blocks

- Feature extraction
- Translation Algorithm

A. Feature extraction

These Algorithms are in accordance with frequency analysis (DFT) and Higher Order Statistics (HOS) also in relevance with the wavelet transform and Auto aggressive model. [8] DFT operates based on voluntarily selected sections of signal. In each instant Discrete Fourier Transform is calculated.

B. Translation Algorithm

It takes the abstract feature vectors from EEG signal which reflects the specific aspects which encodes the message a user wants for communication and transforms these vectors into implementation device command. [8] The target of the Translation algorithm is to maximize the

performance of the Application. In these Bluetooth packets, the signal is transmitted to the outermost receiver. Through the external receiver the caretaker of the paralyzed person can communicate or understand what the person is trying to tell easily through GSM Transmission or via speaker.

VI. SYSTEM FOR DIGITAL SIGNAL PROCESSING OF EEG SIGNALS

There are three elements for the Digital Signal Processing System, namely,

- Data conditioning and Digitalization
- Digital filtering of Bandpass signals
- Spatial power computation

A. Data Conditioning And Digitalization

According to [5] A-D converters in Apple II require an analog signal to be placed fully within the range of 0 – 5V. The recorded EEG signal data must be played back through a DC bias of +2.5V which makes the signal come to the centre within the conversion range. The adjustable voltage amplifier simultaneously adjusts the amplitudes of both channels of EEG signals so that this signal occupies the range of 0 – 5V. This allows maximum conversion for 8-bit A - D converter. It is noted that from the usage of bias voltage, a DC component would be introduced in the EEG signals.

B. Digital Filtering Of Bandpass Signals

This filtering process is done to extract the signal power lying between the frequency range 7-12 Hz. [5] This

represents alpha band of EEG. There are many approaches for this job:

- A Band pass analog filter is used to filter the EEG signals before digitization and subsequent power calculations.
- The digitized EEG data is Fast Fourier Transformed (FFT) and pick the spectral power line within the alpha band. [6] The signal length for each segment is 10000 – 17000 data points/channel of EEG depending on the Data range. Hence this is not desired.
- The spectral computation post digitized EEG data is performed based on the digital Band pass filtering. This is the highly preferred approach compared to other 2 approaches as demonstrated in Fig 2.

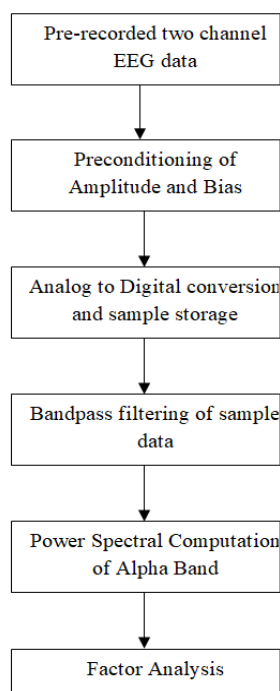


Fig 2. Digital Signal Processing of EEG signals

C. Spectral power computation

According to [6] This step involves the calculation of the power of the output sequence $y_5(k)$. In principle if there are N data points in the sequence, then the power of the sequence can be computed as explained in eq 1.

$$P = \frac{1}{N} \sum_{k=1}^N y_5^2(k) \quad (1)$$

VII. HOW BCI HELPS PARALYZED PATIENTS

In this analysis, we focus on condition called totally locked-in state which can be termed as CLIS. In this circumstance, intentional perceptions can infrequently be acted over physically, as many doctors believe that the peculiarity of life in paralysis is extremely low and to

continue to live their life is burden for the patient, in this research, we have found out a solution for that particular problem, A Brain Computer-Interface can be used by paralyzed patients, which helps to convey with an electronic device for their daily needs such as, if a person is feeling hungry or if they need to go to the washroom or if they want to express their feelings with their caretakers or if they want to switch on/off lights etc., All these basic things can be accomplished using a brain computer–interface, which can able to detect EEG signals from the brain and which will predict the outcome in conformity with the threshold frequency, by this, paralysis people can able to express their intentional thoughts.

VIII. DISCUSSION

The BCI is a straight intercourse route between a wireless brain sense and an outermost device and sometimes called neural control interfaces, mind machine interfaces, etc., This is very advantageous for paralyzed people as the technique is improving to make paralyzed people feel happy and comfortable and they are not losing their expectations about life by seeing improvements in the latest technology. The main outcome of the BCI technique is for the peculiarity life of patients and their families. In this analysis we have contemplated a method which can assist paralyzed patient through BCI which performs some basic useful needs.

IX. CONCLUSION

The biggest impact of BCI on paralyzed person is that the BCI reads the brain's blood oxygen stages and permits communicating by decoding the intentions of a person who are totally paralyzed and incapable to talking.

This BCI works on Electroencephalography which measures the electrical activity on different parts of brain of a human being and visual traces on oscilloscope screen. This technology is very much useful for the paralysis people because this is a system which permits human to interact as normal person, mind machine interface is developing more features day by day for the sake of people, it is very useful in real world application.

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