

# Implementation of Emotiv EPOC for controlling Computer Interface – Review Paper

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**Abstract:-** This study appearance at the difficulty of the brain-computer interface (BCI) it's supported information acquisition, process and translation of signals that generated by the basic neural system (CNS) because the side of its traditional operate Brain-computer interface is seen because the bridge that is build up direct unidirectional or two-way communication pathway between the external technical device and also the mind. The work presents techniques supported non-invasive imaging of the brain used for obtaining information in non-invasive brain computer interfaces, and is emphasised on the reading neural activity of the brain victimisation multi-channel medical instrument (EEG). Because the part of this paper our expertise with the commercials on the market instrumentality Emotiv EPOC Neuroheadset supported this technology is introduced.

## I. INTRODUCTION

A brain computer interface (BCI) mentioned as Brain machine interface (BMI), could also be a hardware and package communications system that allows human interaction. BCI creates a raw non-muscular channel for relying a person's intentions to external devices like information processors, speech synthesis, helpful appliances and neural prostheses. A BCI is a synthetic intelligence system which will sense an exact heap of, follows in brain signals following 5 serial stages: Signal acquisition, pre-processing or signal improvement, feature extraction, sorting and also the management interface. [1] The signal acquisition stage captures the brain signals and will additionally perform noise reduction and artifact process. The options extraction stages known discriminative info within the brain signal that are entered. BCI has the potential to make up a new communication interface for helpful technologies. It's used for Neuroprothesis application for repair and restoration of broken hearing sight / movement. In this direct affiliation between Neuroprosthetic and central nervous theme. [2]

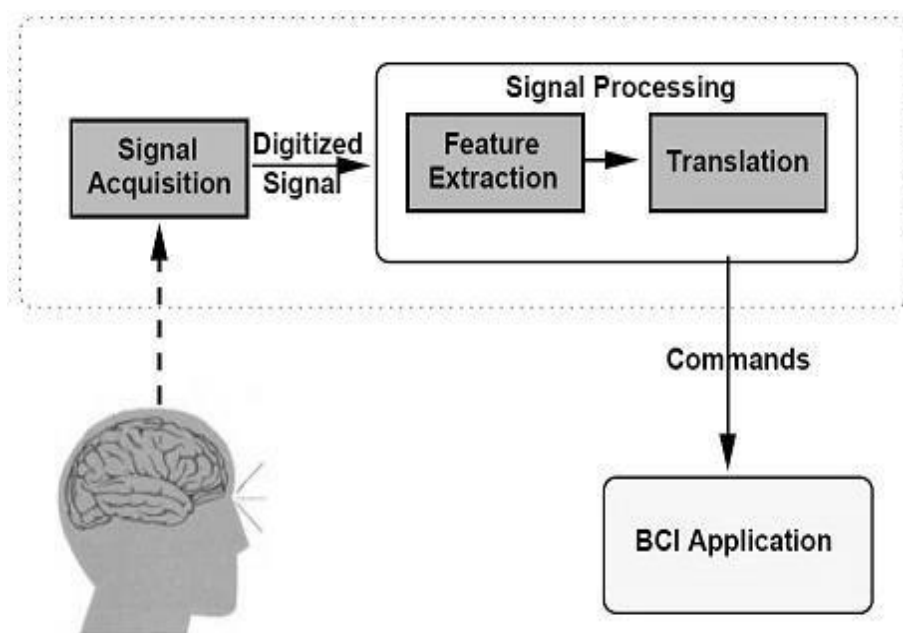


Fig 1: Block diagram of Brain Computer Interface.

The signal in BCI is extracting options which will be translated into a technical man- agement signal acceptable to be used Aquafit on the external devices. A brain computer interface could be a hardware and computer code that gives interactions to a computer directly from the user’s brain. This is often shown in figure one diagram of BCI. Implementing of non-invasive brain-computer interfaces is feasible beneath the foremost repre- sentational conditions of use with stripped-down demand on the wearable hardware and with the advantage of a wireless affiliation to the host computer that’s analyzed and reworking signals to

the technical device that's controlled with the employment of brain- computer interface.

**Emotiv EPOC Neuroheadset:**

The Emotiv EPOC Neuroheadset is to build the application of brain computer interface. The low cost, 14 channel EEG hardware commercially available Emotiv EPOC Neuroheadset (Figure 2) for acquiring the raw data from electrodes that are positioned at F3, FC5, AF3, F7, T7, P7, O1, O2, P8, T8, F8, AF4, FC6 and F4 positions, consistent with the international 10-20system.



Figure 2: Emotiv EPOC Neuroheadset

The electrodes F3, F4, AF3, AF4, F7 and F8 are used for neural activity imaging in the lobe’s frontals of the subject’s brain. Electrodes T7, T8, FC5 and FC6, are imaging the lobes temporals of the brain. [5] The lobes parietalis is scanned by P8 and P7 electrodes. The neural activity of the lobes occipitalis is acquired by use of the O2 and O1 electrodes (Figure 3). CMS (on the left side) and DRL (on the right side) are two referencing electrodes used for signal noise reduction.

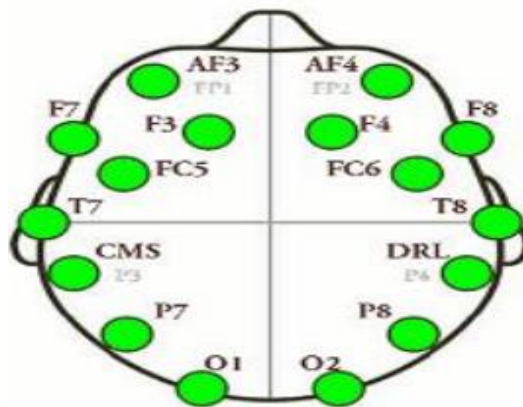


Figure 3: The EPOC electrode positions on the head, approximate the inter- National 10-20 system

**Software:**

The data collected by the receiver are sent to the computer through an associate in Nursing encrypted channel, Associate in Nursing Emotiv offer an application referred to as EmoEngine to decipher and method the info. This provides a number of inherent brain wave process suites together with a communicator, that detects movement of facial features; emotive, giving a life of 5 subjective emotions; and psychological feature, wherever users will

train the system to discover specific thoughts. These suites are mentioned in additional detail below. [5] EmoEngine provides receiver battery level, gyro readings, contact quality data, and man of science versions give access to the raw graph knowledge too. This panel displays indicators that give period of time data regarding EmoEngine standing and neuroheadset detector contact quality. The conductor is fastened in at the position by of victimization the gel for contact quality, i.e. Saline water.

**II. LITERATURE REVIEW:**

The EPOC has sixteen electrodes and was originally designed by work as a brain computer interface (BCI) data input device. The corporation was based in Australia in 2003. The work EPOC at intervals the first version of the EPOC Neuroheadset was discharged in 2009, one in all the primary mobile graph devices on the market to the market. The initial EPOC has been utilized in the analysis and shown to deliver acceptable quality graph for analysis functions. In 2013, the company redesigned and discharged Emotiv EPOC+, a wireless, 14-channel mobile graph system to target skilled use in analysis and industrial applications with upgraded natural philosophy, together with 9-axis mechanical phenomenon sensors, Bluetooth sensible Associ- ate Nursing an improved power supply. In 2013, Emotiv Inc. Discharged EPOC+, which can be researched-oriented wireless receiver that records 14-channel graph. in contrast to con- vent0ional graph systems that use sticky gels, it uses saline primarily based wet sensors. There are 2 reference sensors at P3 and P4 locations. The EPOC+ measures each graph and 9-axis motion knowledge. The Emotiv Insight was created on the market for general unleash in 2015. it's a 5-channel wireless graph device covering frontal, temporal and parietal-occipital locations round the brain. it's designed for everyday use by people trying to know and improve their own brains.

Name of Pa- per	A device used	Parameter	Methods & Classifier	Result	Refer- ence number
Analysis of Performance metrics using Emotiv EPOC+	Emotiv EPOC+	Facial ex- pressions, performance metrics & Mental com- mands.	-----	Detection of Medical fields.	7
Using Emotiv EPOC Neuro- headset to ac- quire infor- mation in brain computer inter- face	Emotiv EPOC Neu- roheadset	Facial ex- pressions	Non- Invasive Method= Structural brain imaging Functional brain imaging	Focus on low cost EEG hardware Emotiv EPOC Neu- roheadset was de- scribed.	6
Implementa- tion of SSVEP based brain computer inter- face with Emo- tiv EPOC	Emotiv EPOC	BCI, SSVEP (Steady State Visual Evoked Po- tential), Ca- nonical cor- relation anal- ysis (CCA)	Visual Stimu- lator Algorithms (CCA)	Accuracy rate 95. 83+ 3.59% Information transform rate (ITR) with 22. 85+1. 85bit/min Detection duration 5.25+2. 14 Sec.	14
Creating by imaging use of natural and in- tuitive BCI in 3D CAD modelling	Emotiv EPOC	Facial Expressions	CAD Application Emokey Testbench	3D CAD ap- plication models generated from the developed system are presented in addition, observation from a preliminary human factors study are outlined.	12
Data Acquisi- tion in Non-in- vasive Brain computer inter- face using Emotiv EPOC Neuroheadset	Emotiv EPOC	Facial ex- pressions	Morphologi- cal and func- tional brain imaging tech- nique	Focus on low Cost EEG hardware Emotiv EPOC Neu- roheadset was de- scribed.	1
Detecting Emotion from		Excited	LDA	Discriminate between	

EEG signals using the Emotiv EPOC device	Emotiv EPOC	States	SVM	high-versus-low arousal and positive-versus-negative valence.	9
Development of mind control system for Humanoid robot through a brain computer system		Mental activity	-----	To control humanoid robot system	13
EEG wave identification in human brain with Emotiv EPOC for motor imagery	Emotiv EPOC	6 scenarios- Left hand movement. Right hand movement. Simultaneous Left- & Right-hand movement. Simultaneous Left hand & head nodding movement.	SVM	Implemented motor imaginary application using Emotiv EPOC.	11
Emotion recognition using Emotiv EPOC	Emotiv EPOC	Emotion based	SVM, K-NN, Naive Bayes, Ada-Boost.M1.	The capture EEG signal in emotion recognition application for recommender system in e-commerce, entertainment & society.	8
Investigating Emotiv EPOC for cognitive controlling at a limited training time	Emotiv EPOC	Cognitive Control Affective Suite Facial Expression	P300 or SSVEP	Success rates: 16% to 75% The Avg. For 1 <sup>st</sup> & 2 <sup>nd</sup> Study = 36.25% & 46.83% Respectively.	3

Table 1. Literature review

In that higher than table compare with Emotiv EPOC 3 suite with their basis expressions shows that countenance (Reference variety (7 & 1) & 6) is the end result shown focused on the device were to use and detects medical fields. Likewise, wherever use to find the 3D CAD application models generated from the developed system are conferred additionally, observation from a preliminary human factor study are printed. (Reference variety 12). within the emotional suite to match receptive paper result discriminate between high-versus-low arousal and positive-versus-negative valence. (Reference variety 9) In that mental

activity (cognitive suite) to the end result of the enforced motor notional application victimisation Emotiv EPOC. And to regulate golem system for (Reference variety eleven &13)

**Implementation work:**

Emotiv Epoc have 3 suites:

1. Expressive Suite
2. Affective Suite
3. Cognitive Suite

**Expressive suite:**

Expressive suite detects the countenance in keeping with user’s graph signals associated uses an animated figure (Face). within the center of series graph, are displayed that

indicates the assorted expression detection event signals. in this communicatory suite mimic your countenance within the camera read (Not mirrored).



Figure 4: Expressive Suite panel

Parameters	Events Difference
Blink	Low level indicate is not any blink and high level indicate is blink and it's cannot train signature that's why is termed a universal signature
Right wink	In that share common graph line, Center position has no wink and high level indicate faction, it's cannot train signature that's why is termed a universal signature.
Left wink	In that share common graph line, Center position has no wink and Low level indicate Left wink, it's cannot train signature that's why is termed universal signature.
Look right	In that common graph line and single sensitivity slider management, Center position has straight and high level indicates eye right, and it's cannot train signature that's why is termed a universal signature.
Look left	In that common graph line and single sensitivity slider management, Center position has straight and Low level indicate eye left, and it's cannot train signature that's why is termed a universal signature.
Raise brow	Graph level increase or decrease depends upon the amount of expression, Low level indicate No expression and high level indicate most level of expression detected.
Furrow brow	Graph level increase or decrease depends upon the amount of expression, Low level indicate No expression and high level indicate most level of expression detected.
Smile	Graph level increase or decrease depends upon the amount of expression, Low level indicate No expression and high level indicate most level of expression detected.
Clench	Graph level increase or decrease depends upon the amount of expression, Low level indicate No expression and high level indicate most level of expression detected.
Right smirk	In that common graph line, center level has No smirk and high level indicate Right smirk.
Left smirk	In that common graph line, center level has No smirk and Low level indicate Left smirk.
Laugh	Graph level increase or decrease depends upon the amount of expression, Low level indicate No expression and high level indicate most level of expression detected.

**Application:**

- Sensitivity is exaggerated or reduced by moving the sensitivity slider to the correct or left.
- If you are feeling straightforward to trigger a selected expression, otherwise you see “false positive” expression, then decrease by moving the sensitivity for that expression.



Laugh Event



Clench Event



Right Smirk Event



Left Smirk Event



Raise Brow Event



Furrow Brow Event



Smile Event

**Affective suite:**

- In that Affective suite individual data is collected each user and is saved in the user’s profile while the Affective suite runs. It is vital that a replacement user profile is chosen when a replacement user puts on the neuroheadset.
- The Affective suite panel contains two graphs which can be customized to display different combinations of detections and time scale.

Parameter	Events Difference
Instantaneous Excitement	In that experienced as an awareness of feeling, of physiological arousal with a positive value.
Long-term Excitement	The detection is designed and turned to be more accurate when measuring changes in excitement over a longer time period, measure in minutes.
Engagement / Boredom	It is experienced as alertness and the conscious direction of attention towards task-relevant stimuli.
Meditation	Meditation is an ancient practice that cultivates a calm, yet focused mind, Meditation is an effect on cognitive functioning.



Figure 5: Affective suite panel

**Application:**

- Affective detections search for brainwave characteristics that are universal in nature and don’t require a particular training or signature-building tread on the a part of the user.
- The controls to the proper of the charts are often wanting to select the detection output to be plotted and to customize the color of every plot.

**Cognitive suite:**

Cognitive suite is the brainwave activity. The detection is meant to figure with up to 13 different actions: 6 directional movements (push, pull, left, right, up and down) and 6 rotations (clockwise, counter-clockwise, left, right, forward and backward) plus one additional action that exists only within the realm of the user’s imagination: disappear. The detection reports one action or neutral (i.e. No action) at a time, along with an active power which represents the detection’s certainty that the user has entered the cognitive state associated with that action.

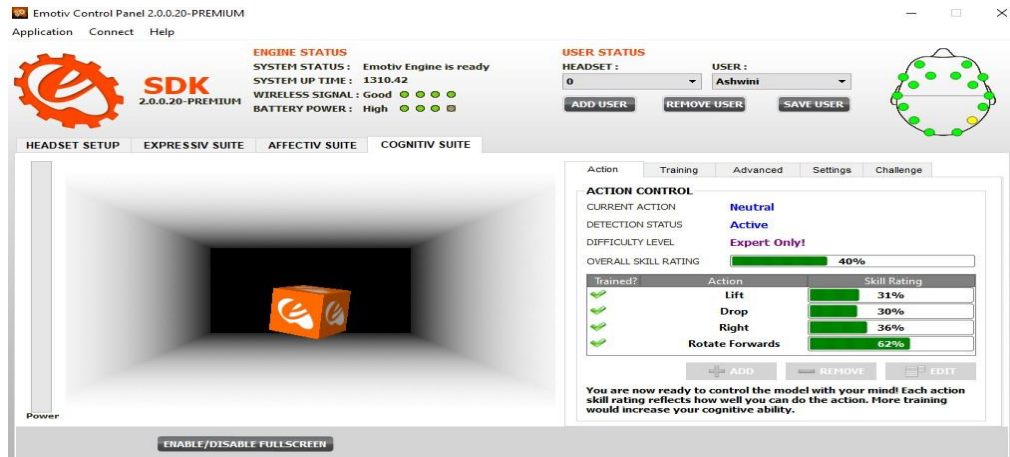


Figure 6: Cognitive suite panel

The COGNITIV SUITE panel uses a virtual 3D cube to display an animated representation of the Cognitive detection output. This 3D cube is additionally wanted to assist the user in visualizing the intended action during the training process. The Power gauge to the left of the 3D display is an indicator of the action power, or relative certainty that the user is con- sciously visualizing the present action.

In the Cognitive panel is the Action tab use of default. This tab displays information about the current state of the Cognitive detection and allows the user to define the current set of actions. In that using 6 directional and 6 rotational movement are present in the cognitive suite panel and one action is depending on the user imagination i.e. Disappears.

Pull	In the Cognitive suite actions, uses virtual 3D cube and then Pull actions present 3D cube is size enlarge towards our side. This suite is depending on the Mindware activity.
Push	On the Push Event uses in cognitive actions virtual 3D cube size is to- wards the center and size will be very small to depending on the brain wave activity.
Left	In that cognitive actions the virtual 3D cube represents the Left side directional movement. It is depending on the how users think to the pre- form the cognitive actions.
Right	In that directional Movement the virtual 3D cube represents the Right side of the control panel. If a user thinks in a very rapid manner to show the result will be rapid way. Then it is depending on the brain wave activity.
Lift (Up)	In the cognitive actions these movements use virtual 3D cube and it is depending on the brain wave activity. In that directional movement the how users think in the rapid way.
Drop (Down)	In that cognitive actions they use virtual 3D cube this event showing the cube will be represent in the Downwards (Drop) directions.
Rotate Anti-Clock- wise	In that Cognitive action called Counter Clockwise. Then 3D cube, will perform the actions Rotating anti- clockwise rotational movement. It will depend on Mindware activity.
Rotate Left	Rotate Left cognitive actions depending on Mindware activity. Then it will use that virtual 3D cube for the Cognitive actions will be per- formed. In that cube are Rotating Left side of the training period of time.
Rotate Right	Rotate Right cognitive actions depending on Mindware activity. Then it will use that virtual 3D cube for the Cognitive actions will be exe- cuted. In that cube are Rotating Right side of the training period of time. Actions will perform 30seconds training period.
Rotate Forward	In that cognitive actions the virtual 3D cube Rotating Forward move- ment. Popular this action limited time period of trained action. More training would increase cognitive ability.



Rotate (Backward)	Reverse	Rotate backward cognitive action is the use virtual 3D cube for performing the cognitive actions the cube will be Rotating Backward direction. The 3D cube is set at the center position, at only Rotate Backward from user Mindware ability. This action performs 30 seconds of the time period.
Disappears		Disappear cognitive actions the virtual 3D cube represents the display of cognitive output. The cube will be performed in the limited preparation time, then the cube is Invisible after the time period although they are Vanish it.

**Application:**

- It is very important that every user masters the employment of the psychological feature detection one action at a time, solely increasing variety |the amount |the quantity of simultaneous actions once he has initial gained confidence and accuracy with a lower number of actions.
- In order to facilitate the acquisition of this information, and since most users have a neater time maintaining a relaxed status for extended periods of your time, the coaching tab provides second methodology for coaching Neutral.
- The detection becomes more and more precise. Most users usually come through their best results once coaching every action many times.



Pull Event



Push Event



Left Event




Right Event



Lift Event 


Drop Event 



Rotate Clockwise 

Rotate Anti-Clockwise 



Rotate Left 

Rotate Right 



Rotate Forwards



Rotate Backwards



Disappear Event

**III. CONCLUSION:**

This paper presented brain-computer interface because the technology capable of building the channel between external technical device and central system a nervosum and enables one-way or two-way communication. Brain imaging techniques with stress along the functional brain imaging techniques and particularly the multi-channel electroencephalography (EEG) was introduced and also the experience with low-cost EEG hardware Emotiv EPOC Neuroheadset was described.

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