A Scenario of Brain Computer Interaction with Different types of Face Recognition Techniques

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Abstract- Brain computer interaction technology has been developed to record the brain signal activity through various methods like Digital Electroencephalography, EMG , FMRI and face recognition. These are the advanced technology to measure and diagnose the disability.

Keywords - BCI ,Digital EEG, FMRI, EMG, Face Recognition.

I. INTRODUCTION

A brain computer interaction is a communication system in which messages or commands that an individual sends to the external world do not pass through the brain's normal output pathways of peripheral nerves and muscles." In other words A brain-computer interaction is a communication system for translating brain activity into messages for computer applications and various devices. This innovative technology is currently being used primarily not only in medical applications but also in bio medical engineering like human computer interaction. With this technology we are recording the brain activity of each subject expressions by attaching the electrodes on the scalp with the model of 10-20 system. In this research to use brain computer interaction technology for functional monitoring of dynamic cognitive processes in the context of different applications. The use of EEG signals as a vector of communication between men and machines represents one of the current challenges in signal theory research. The principal element of such a communication system, more known as "Brain Computer Interface", is the interpretation of the EEG signals related to the characteristic parameters of brain electrical activity[1,2].

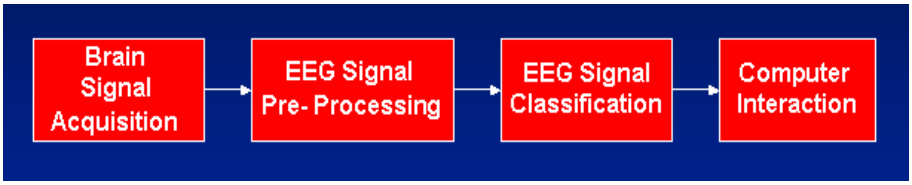

Fig.1 EEG based brain computer interaction

- **Signal Acquisition:** The EEG signals are obtained from the brain through invasive or non-invasive methods (for example, electrodes). After, the signal is amplified and sampled.
- **Signal Pre-Processing:** once the signals are acquired, it is necessary to clean them.
- **Signal Classification:** once the signals are cleaned, they will be processed and classified to find out which kind of mental task the subject is performing.
- **Computer Interaction:** once the signals are classified, they will be used by an appropriate algorithm for the development of a certain application.

II. TECHNIQUES

This technology playing a vital role for clinical and laboratory perspective such as digital EEG, EMG, FMRI and face recognition also. But it consist of a major factor ' signal to noise ratio'.

- *Digital EEG*

  An electroencephalogram (EEG) is a test that measures and records the electrical activity of brain. Special sensors (electrodes) are attached over the head and hooked by wires to a computer. The computer records the brain's electrical activity on the screen. This technique is mostly used for expression recognition of subject[3].

Fig. 2 Electrode placement in EEG

- *Magnetoencephalography (MEG)*

This technique used for mapping brain activity by recording magnetic fields produced by electrical currents occurring naturally in the brain, using arrays of superconducting quantum interference devices. Applications of magnetoencephalography include basic research into perceptual and cognitive brain processes. By using this method can also recognize face expression with The magnetoencephalography signals derive from the net effect of ionic currents flowing in the dendrites of neurons using synaptic transmission[4]**.**

Fig. 3 Magnetoencephalography test.

- *Facial Electromyography(FEMG)*

Facial Electromyography refers to an electromyography technique that measures muscle activities by detecting and amplifying the tiny electrical impulses that are generated by muscle fibers when they contract. It primarily focuses on two major muscle groups in the face, the corrugator supercilli group which is associated with frowning and the zygomaticus major muscle group. Basically facial magneto encephalography has been used as a tool for measuring emotional reaction of human subject. The facial magnetoencephalography data is collected using standard placement of electrodes over the facial muscles responsiblefor different facial actions[5].

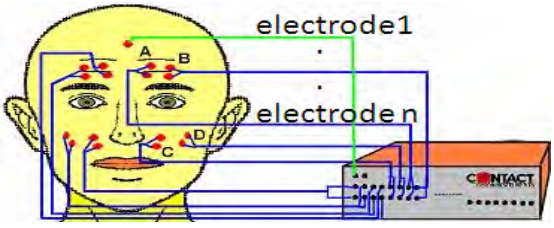

Fig. 4 Electrode placement in facial EMG test.

- *Functional Magnetic Resonance Imaging (FMRI)*

The recent discovery that functional magnetic resonance imaging can be used to map changes in brain hemodynamics that correspond to different expressions extends traditional anatomical imaging to include maps of human brain function[6,7]. The ability to observe both the structures and also which structures participate in specific functions is due to a new technique called functional magnetic resonance imaging, This techniques have the advantage of great spatial resolution; however, this method has limitations due to its low temporal resolutions. Some fMRI studies have emphasized the role of the amygdala, specifically in perception of negative facial emotion (Adolphs, 2002; Morris et al., 1996).In contrast, Winston et al. (2003) concluded that the amygdale responds to stimuli of motivational significance independent of their valence. Kesler-West et al. (2001) presented results showing increased activation of left inferior frontal gyrus and lateral occipital gyrus during the perception of angry-face compared with happy face[8].

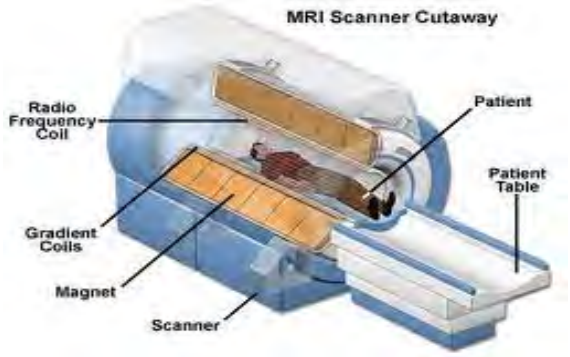

Fig. 5 FMRI test

- *Quantitative Electroencephalographic (qEEG):*

This method is used for evaluating of brain function based on brain electrical activity mapping. In this form of functional brain imaging, the brain's electrical activity, as measured in nineteen or twenty five sites on head, is analyzed using complex mathematical and statistical tools in comparison to norms or averages. By using this method can also recognize the brain activity for different face expressions[9].

III. APPLICATIONS OF BCI

There are many areas where BCI playing a major role such as [10,11].

1) **Bioengineering applications:** Assist devices for disabled people.
2) Human subject monitoring: Sleep disorders, neurological diseases, attention monitoring, and/or overall "mental state".
3) **Neuroscience research:** Real time methods for correlating observable behavior with recorded neural signals.
4) **Man machine interaction:** The interface devices between human and computers machines.
5) **Brain (neural) signal acquisition:** The development of both invasive and non-invasive techniques for high quality signal acquisition.
6) **Algorithms and processing:** advanced machine learning and signal processing algorithms, which take advantage of cheap/fast computing power (i.e. Moore's Law2) to enable online real-time processing.
7) **Underlying neuroscience:** To better understanding of the neural code, the functional neuro-anatomy, the physiology and how these are related to perception and cognition, enabling signals to be interpreted in the context of the neurobiology.

IV. FUTURE SCOPE

The BCI play vital role like: games, neuroprostheses, online cognitive research, cognitive enhancement.

V. SUMMARY

This technologies is a rapidly growing research area for human kind with innovative future applications in medical and regular users. In the four case scenarios, the most important application of BCI for users with disabilities and healthy users. The future success of BCI research will rely on public acceptance of the technology.

REFERENCES

[1] Vrushsen Pawar, Arun Marwale and S.C. Mehrotra "Brain computer Interaction through Digital Electroencephalogram technique" IEEE international conference on Microwave-ISM06, IEEE PP-584-591, NIMHANS conventional center, Bangalore, India, 15-17 Dec 2006.
[2] B.Z. Allison, E.W.Wolpaw, and J.R.Wolpaw. Brain-computer interface systems: progress and prospects. Expert Review of Medical Devices, 4(4):463– 474, 2007.
[3] J.DBayliss,"A Flexible Brain Computer Interaction ", university of Rochester,2001.
[4] P.Ekman, "Method for Measuring Facial Action", In K.R.Scerer and P.Ekman (EDS.), Handbook of method in Nonverbal Behavior Research, Cambridge University Press, PP.45-90,1982. Rosenberger E. and Ekman, E., Coherence between expressive and experimental system in emotion. Cognition. Emotion, 8, 201-229,1994.
[5] R. Lehembre, Q. Noirhomme, and B. Macq. Inverse problem applied to BCI's : Keeping track of the EEG's brain dynamics using kalman filtering. In Proc. of the 3rd Internationnal Brain Computer InterfaceWorkshop, pages 32–33, 2006.
[6] K.-R. Muller and B. Blankertz. Toward noninvasive brain-computer interfaces.
[7] IEEE Signal Processing Magazine, 23(5):125–128, 2006.

[8] 11. Wheeler, R.E., R.J. Davidson and Tomarken, A.J., Frontal brain asymmetry and emotional reactivity: a biology substrate of affective style, Psychophysiology, 82-89, 1993.
[9] 12. G.R. Muller-Putz and G. Pfurtscheller. Control of an electrical prosthesis with an SSVEP-based BCI. IEEE Transactions on Biomedical Engineering,55(1):361–364, 2008.
[10] E. Niedermeyer and F. Lopes da Silva. Electroencephalography: basic principles, clinical applications, and related fields. Lippincott Williams & Wilkins, ISBN 0781751268, 5th edition, 2005.
[11] Dinesh Jain and Dr. V.P Pawar ," Brain Computer Interaction Of Indian Facial Expressions Recognition Through Digital Electroencephalography " in International ((IJCSIS) International Journal of Computer Scienceand Information Security, Pittsburgh,USA , Vol. 9, No. 2, pg. 212-215, ISSN NO1947-5500.

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