A Survey on Recent Trends in Human-Computer Interaction

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ABSTRACT

This paper identifies the different kinds of methods, which helps human to communicate with computer. Traditionally the user interacting with computer via command line or GUI or common hand-held devices such as mouse and keyboard which is not feasible for a handicapped or a blind or a mute people. In order to interact with computer, the good interface required, the interface is sub part of human computer Interaction (HCI). HCI not only software design, it also concentrates on design of hardware devices. Describe the interaction between Brain and Computer based on EEG patterns. Brain generates EEG signal Based upon that system has to act and it has to perform tasks like human in real world. Thus the research work that is proposed would be to build a human to computer interaction through EEG signal. The system that allow the user to interact directly brain to computer based EEG signal and no need to use any input device to interact with any type of systems such are computer , TV's. This way the computer system can reduce the man work needed to feed information into the system by a large extent.

KEYWORDS

EEG signal, Brain Computer Interface (BCI), Human Computer Interaction (HCI), Speech Recognizer, Neural Networks, Cognitive Science.

1. INTRODUCTION

Interface is collection of methods and techniques to interact with something in the real world. it allows the user to communicate with computer or allows the computer to communicate with end user. In order to communicate with each other we required input and output devices. The use interface allows the user to enter data via input devices such as keyboard, mouse and allows the computer to interact with user in the form of displaying output on screen with help of monitor. The User Interface broadly classified in to two categories as command line interface and graphical user interface (GUI). In command line interface the user has to enter commands as input at command prompt (for example UNIX shells). The second interface GUI consists of Window, Icon, Menus and Pointers. The GUI provides interaction via graphical elements. GUI attracted more to the end user's than command line interface. The icon is a kind of image that represents command, files and folders. Icons are generally having Standardisation. For example Micro soft word contain different kinds of icons such as save ,print , Undo ,open a file icon etc. the same icons are available in MS-Power Point and MS-Excel applications. Command line interfaces are faster than graphical user interface. Other user interfaces are Menu driven and Natural language Interface. Menu Driven interface are Pull down and Pop up Menu's. The Human-Computer Interaction for the most part provides communication between human and computer. Still the computer is tool, which is controlled by human [17]. Communication involves exchange of different kinds of symbols and actions between human and computer. To

exchange information between human and computer used various input devices like keyboard, mouse, showing symbols or graphs on the display [2].the primary way to interact with computer is based on Graphical user interface. Human computer interaction is one of the most power full branches of computer science. It is the combination of computer science and cognitive science. The importance of HCI in computer science to develop the interactive products for computer based system, which can be used to human with in effective manner. Traditional interaction manners are based up on command interface or GUI [1]. Recent technology the cognitive performances of human has been analysed using methods of physiological Parameters for objective and quantitative performance Measurement. The physiological parameters those are widely used is ECG (Electrocardiogram), EOG (Electrooculogram), Heart Rate, Eye blinking, and Heart Rate Variability (HRV) [11].

2. RELATED WORK

In day to day the interaction with computer from a person with disabilities and non-computer professional are more and they become the main body of the system performance, thus the importance of human computer interaction in current technology. For the last few years' technological advancements developed in interactive products with very restricted way for disabled people to control a computer system for effectively. The user can interact with computer with various input products like mouse, keyboard and joystick pen etc. other power full method to interact with computers, mobiles, personal digital assistance (PDA) , TV touch screens, where the user can touch on surface provided. The user can do several manipulation tasks such as selecting particular option, scrolling, highlighting, menu, dragging and dropping etc [22]. The common normal people can interact with computer by entering text and The people with physical handicapped (those who don't have hands and blind) can interact with system through voice of human. One of the ways of interaction to human to computer is done through image interaction. Image interaction means, understanding the image, based on human behaviour, and then reflects to it. The language is most power full, convenient, when you want exchange information [17].The spoken words are inputted to the system in the form of voice with help of speech recognizer and it converted to commands.

Human sound broadly classified as either voiced or fricative. Voiced sounds occur through the vocal cords from the lungs when air is forced and the vocal cords are two thins of flaps of tissue [7]. For any given Input sentence through voice; natural language processing is done to obtain the output action. The system in turn would give an acknowledgement for the operation being executed and hence this would help the blind to realize if the right process is initiated. Voice interaction is combination of linguistics, psychology, human engineering and computer system technologies are future guide for to develop interactive voice devices [17]. Voice recognition broadly classified into two categories, one is talker recognition other one is voice recognition. Talker recognition further classified into two systems, one is based on relevant to text and other is irrelevant to text [18].Some people are facing with problem of mute and physical handicapped so they can't interact with computer directly. M.Betke, J.Gips, and P.fleming, used a video camera to capture facial regions to provide interaction for disabled users to explore the Internet and spell out message, with the assistance of a spell board [5]. In the VIDEOPLACE environment from Zivkovic [6], optical-flow approach is employed to select a "button" for interaction. S. Sumathi and S.K srivasta presented a vision-based system for detection of long voluntary eye blinks and interpretation of blink patterns for communication between man and computer system ,implementation of system contains three parts, first part facial features tracking , second part Integrating Nose tip movements with mouse cursor and final part replacing the eye blinks with mouse click events [4]. S. Sumathi and S.K srivasta proposed a real time face detection technique by using Six-Segmented Rectangular (SSR) filter, distance information and template matching technique [4].

Voice communication involved extraction and identification of natural speech signal and coverts it's into commands. Lu Ji xiang, Wang Ping, Yu Sui huai, Lu Chang de proposed an algorithm known as spectral subtraction based on auditory masking effect [2]. ZHEN ZHU, JING-YAN WANG introduced a formal model of perception agent [3].

In the first step, Input audio signals are pre-processed and amplified. Second step the conversion happens from analog signal to digital signal with help of digital convertor. In the third step performing noise reduction treatment using filters to identify characteristics of voice [18]. Agent is a kind of program that can substitute user for producing some intelligent behaviour and properties of agent are autonomous, synergic and learning. Autonomous means agent may work over its own actions and do not need people assistance [3]. With help of learning property agent can achieve knowledge from the interaction of people or other agents. Several operations are carried out over the association of monkey and rat cerebral cortices to record the signals to operate BCIs. In this aspect, researcher has come up with some positive results over the monkey in terms of operating the computer using GUI without using any human interventions [8]. In the year 2008 May, Pittsburgh University Medical Center was given more interesting facts and discovery which showed a monkey in commission a robotic arm that has been published in a number of well known science journals, articles and magazines [9]. Ki-Uk Kyung*, Jun-Young Lee** and Mandayam A. Srinivasan designed a haptic stylus interface interacting with a touch screen [22], this stylus provide function of vibration impact, sound and it own battery and wireless communication module. The advantage of touch screens is, can reduce the need of additional resources for input interface system. In this paper they concentrated on reducing the size, weight and power consumption of wireless haptic stylus,is known as 'Ubi-Pen Series'[22]. haptic stylus can be used as pointing device on touch screen, events occurring on computing device are send to stylus with help of Bluetooth method.

Junpei Kaminaka1, Tomonari Yamaguch [10], in this paper researcher was analyzed Electroencephalograph (EEG) signals recorded during miss operation of Brain Computer Interface (BCI) system, found through low frequency component and the Event-Related Potential (ERP) such as P300. A more good enough and precise move toward is Quantitative analysis using Electroencephalogram (EEG, the brain electrical activity) signals by extracting indices and features from EEG signals [11]. In the first step, Input audio signals are preprocessed and amplified. Second step the conversion happens from analog signal to digital signal with help of digital convertor. In the third step Performing noise reduction treatment using filter to identify characteristics of voice is shown in Figure1 [18].

Input Audio signals

Preprocessing

Analog to Digital conversion

Filtering

Database

Compression

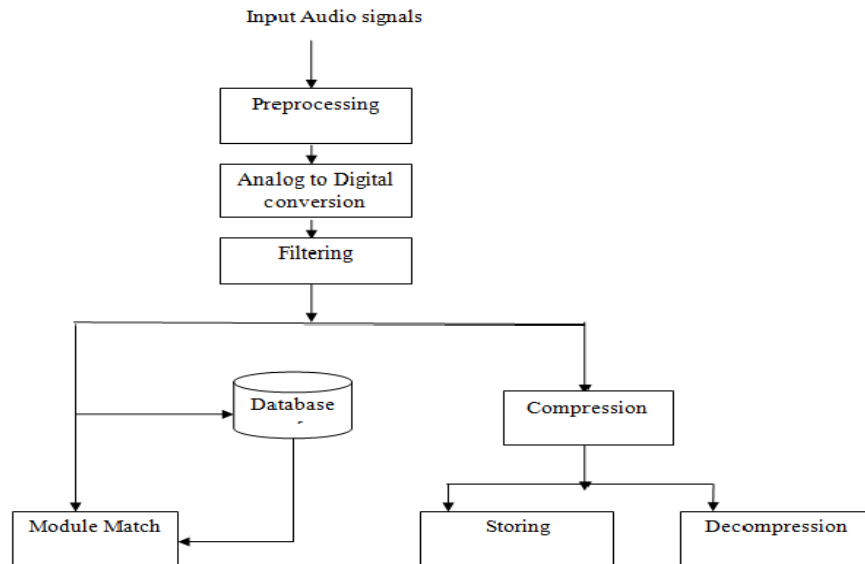Module Match

Storing

Decompression

Figure 1. The Architecture of signal Processing.

Takuya Nishimoto, Nobutoshi Shida, Tetsunori Kobayashi, Katsuhiko Shirai [20], developed multi model drawing tool known as speech-input tgif,in short form S-tgif. this model contains two major modules. first on client system drawing module and other system is speech recognition server system. The server system communicates to the client drawing system through X window system protocol [20]. It uses Hidden Markov Models, which recognizes 75 Japanese words. In S-tgif, they developed prosody-based rejection systems, based on the principle of distributions of the logarithm power [20]. In this paper they left some of the future works such as the investigation of the usage of speech output, customizing mechanism and the integration with gaze tracking system [20]. The man machine interactive system [21], study of perception process. Xianyi Qian, Xianjun Wang and Jiansheng Zhang [21]. The multi Paths Model tells us, the user can interact with computer in multiple paths such as audio, gesticulation, face expressions, with thought full observation, body language and some daily communication paths [21]. The architecture of multi paths, Human computer interaction model shown in below figure2 [21]. Since last five decades, many technologies have come out, but still we don't have any system to establish a computer's thinks likes human [22].
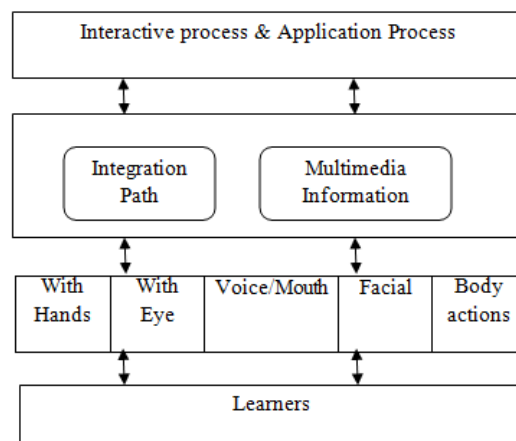
Interactive process & Application Process

Integration Path

Multimedia Information

With Hands

With Eye

Voice/Mouth

Facial

Body actions

Learners

Figure 2. Multi Paths Human Computer Interaction Model.

3. EEG SIGNAL ACQUISITION AND PREPROCESSING

EEG signals Acquisition and pre-processing involved the following steps and given in figure 3.

3.1 Acquisition

EEG signal gained are perform in technique based on wired EEG acquisition system, as well as, wireless EEG headset. Electrode placements are mostly based on standard.

3.2 Pre-processing

In this step performs filtering and artifact removals for EEG signal and signals contains amplitudes of the order of micro volts and contain frequency components up to 100Hz.Notch filter used to remove noise with cutoff frequency 60 Hz. There are different kinds of noise which effects EEG signals are breathing frequencies, dc drift, and high frequency noise [12].

3.3 Feature Extraction And Classification

The most power fully early techniques Fast Fourier Transform (FFT) and spectral analysis is widely used for feature extraction. With help of this approach we can allows examining the changes in the ratio of specific frequency band such as alpha band changes with mental workload, stress and fatigue [13].

EEG signal change suddenly in a very short period of time and nature of EEG is non stationary. With this extracting feature of EEG signals is not easy. It is unlikely to

Know how the frequency characteristics change for different epochs. Therefore, Short Time Fourier Transform (STFT) and/or wavelet transform methods are considered to be more efficient as these methods can analyze the signal in time-frequency domain whereas the standard Fourier transform can only localize in frequency [13].the most widely used methods for feature are Principal Component Analysis (PCA), Independent Component Analysis (ICA) and Mutual Information (MI)[15].Mohammad Ali Naderi, Homayoun Mahdavi-Nasab[16] Proposed a technique for Automatic detection of epileptic seizure in EEG signals. Proposed system is based on time series signal, Spectral analysis and recurrent neural networks (RNNs) [16]. Welch method used to extract feature by using power spectrum density (PSD). Recurrent neural network methods are used to classify EEG signals [16]. The dual-channel analysis system urbanized to strengthen comparing analysis of multi-signal Feature with multiparameter [14]. Researcher consider as Epileptic EEG signal to analyze.
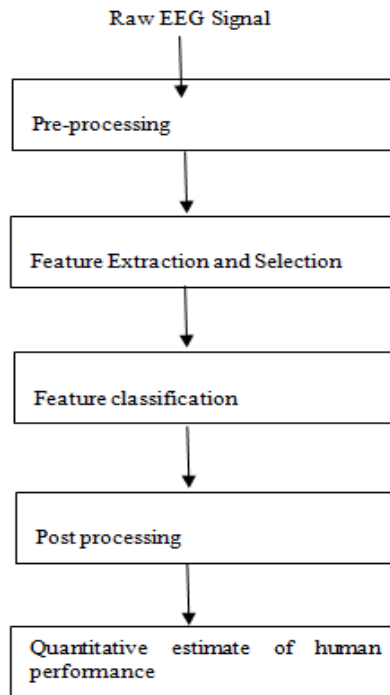
Raw EEG Signal

Pre-processing

Feature Extraction and Selection

Feature classification

Post processing

Quantitative estimate of human performance

Figure: 3. Simple technique of Quantitative estimate for human performance based on EEG signals [11].

Biomedical sensor → Electrophysiological Amplifier → Data Acquisition Card → Signal display y and / Lab VIEW
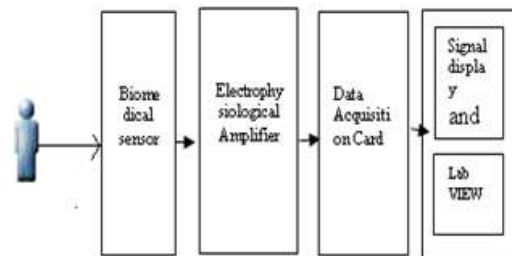
Figure 4. Block diagram for EEG Acquisition in Time-frequency

Above figure 4 biomedical sensors is used to sense the   EEG signal from human brain [14]. In the mean while with help of preamplifier noise signals are converts to proper signal and sent to data acquisition card which will transfer analog data to digital signals. After this stage, pre-processing of EEG required for to reduce noise [14].

4. CONCLUSIONS

This paper, focused on human computer interaction from traditional to current decade. Discussed different input components for interaction with computer; such as mouse, keyboard, voice etc, for the common and disabled people. In most techniques researchers are focused on user interaction with traditionally those are not feasible to disabled people (don't have hands, unable to speak and communicate). By acquiring EEG signal through biomedical sensor is to interact with computer. Moreover this paper could help for the efficient human computer interaction, which mainly supports the physically challenged people to pick up their signals in terms of voice or any other sources such as blinking eyes through that the usage of peripheral

devices as keys, mouse can be eradicated drastically. The main discussion of human computer interaction over this paper is to minimize the Input channels and to improve the interactions through the signals generated by the human beings. Need to focus on more methodologies in this paper as literature survey such as touch screens, voice recognition, and different kind of software interfaces etc.

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