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FPGA BASED BRAIN COMPUTER INTERFACE SYSTEM

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ABSTRACT

Brain computer interface technology represents a highly growing field of research with application systems. Its contributions in medical fields range from prevention to neuronal rehabilitation for serious injuries. Mind reading and remote communication have their unique fingerprint in numerous fields such as educational, self-regulation, production, marketing, security as well as games and entertainment. It creates a mutual understanding between users and the surrounding systems. This paper shows the application areas that could benefit from brain waves in facilitating or achieving their goals using FPGA based Brain Computer Interface System.

Keywords: FPGA, BCI, Brain Wave Sensor, Electroencephalograph.

I INTRODUCTION

A brain-computer interface (BCI) is a new communication channel between the human brain and a digital computer. The ambitious goal of a BCI is finally the restoration of movements, communication and environmental control for handicapped people. An electroencephalogram (EEG) based brain-computer interface was connected with a Virtual Reality system in order to control a smart home application. It offers an alternative to natural communication and control. It is an artificial system that bypasses the body's normal efficient pathways, which are the neuromuscular output channels. Different brain states are the result of different patterns of neural interaction. These patterns lead to waves characterized by different amplitudes and frequencies. This neural interaction is done with multiple neurons. Every interaction between neurons creates a minuscule electrical discharge. This project deals with the signals from brain. Different brain states are the result of different patterns of neural interaction. These patterns lead to waves characterized by different amplitudes and frequencies. The signal generated by brain was received by the brain sensor and it will divide into packets and the packet data transmitted to wireless medium (blue tooth).The wave measuring unit will receive the brain wave raw data and it will convert into signal using MATLAB gui platform. Then the instructions will be sending to the home section to operate the modules (bulb, fan). The project operated with human brain

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assumption and the on off condition of home appliance is based on changing the muscle movement with blinking.

The architecture of the system mainly consists of three main components as shown in Fig.1, the FPGA, and the remote devices and sensors. An interface circuit has been designed which includes sensors as input devices and 220 volt lamp as an output devices which represents the controlled devices. BCI is interface with FPGA. According to Brain sensing, signals are sent to FPGA. The receiver unit will receive these commands from Brain wave Sensor those are given to FPGA. According to that our required fan and motor will be enabled. According to blinking level and meditation level that home automation section will be controlled.

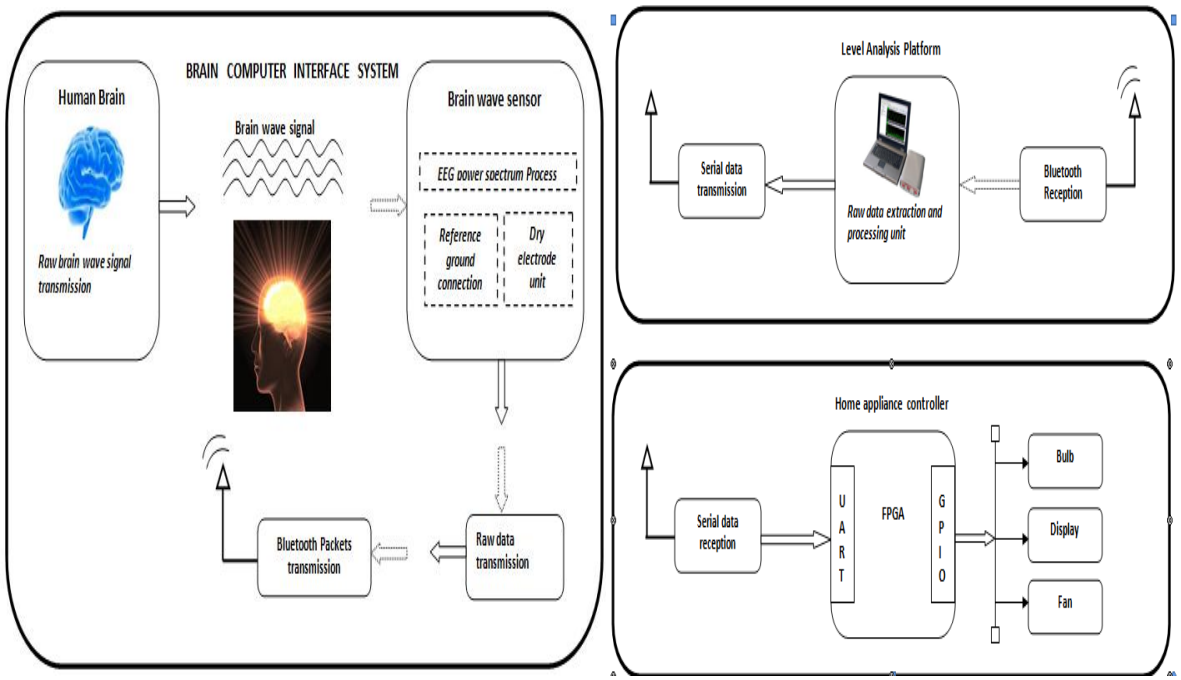

Fig.1 FPGA Based Brain Interface System

II. DEVELOPMENT of BCI

Initially, Connect Brain wave sensor to the Level analysis platform (Personal Computer) through Bluetooth. Electroencephalography (EEG) is the measurement of electrical activity in the living brain .A brainwave sensor MW001is used to analyse the EEG signals. This design discusses about processing and recording the raw EEG signal from the Mind Wave sensor in the MATLAB environment and through Zigbee transmission control. Mind wave sensors are not used in clinical use, but are used in the Brain Control Interface (BCI) and neurofeedback (one of biofeedback types). The BCI is a direct communication pathway between the brain and an external device. Now Connect the brain wave sensor around the head chose the software and install App central for mind wave. Fig.2 shows the brain wave signals.

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Fig.2. Recording of Brain Wave Signals.

Connect the FPGA kit to the PC using the USB port. FPGA kit is connected to the PC via COM port COM3.The COM port is detected though the device manger under the properties of my computer. Fig.4 and Fig.5 shows the FPGA based system developed for brain interface system.

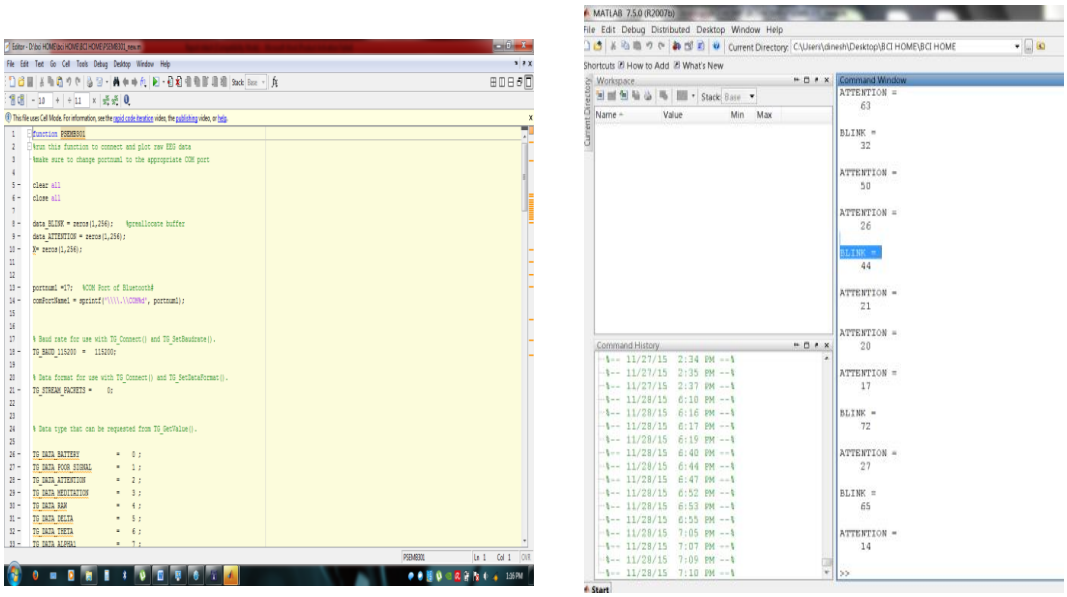

Fig. 3 Matlab Code and the Blink and Attention Values on the Screen

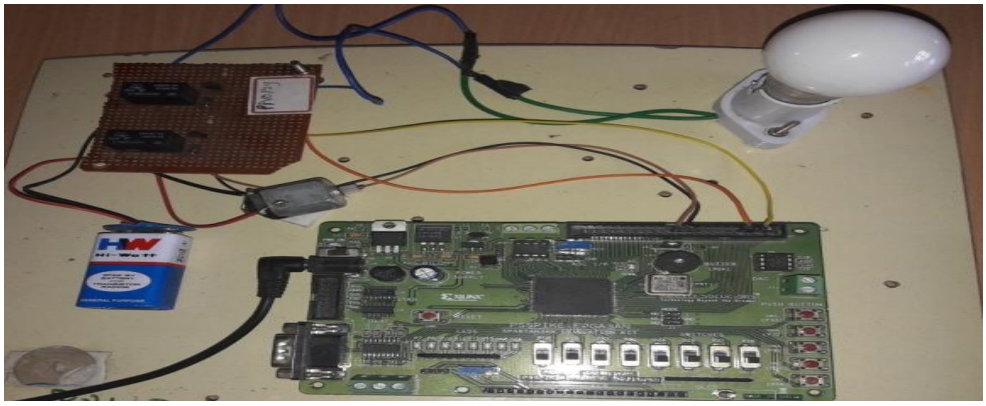

Fig.4. FPGA Kit with Motor and Light

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In this project both Fan and light are controlled by the blink values of eyes. The blink values of eyes give the attention values. If the attention value is more than 30 the light is ON and if the attention value is further more Motor is ON. In this way both the home appliances are controlled by the eye blinks. If the attention value is less than 30, it is calculated as meditation value.

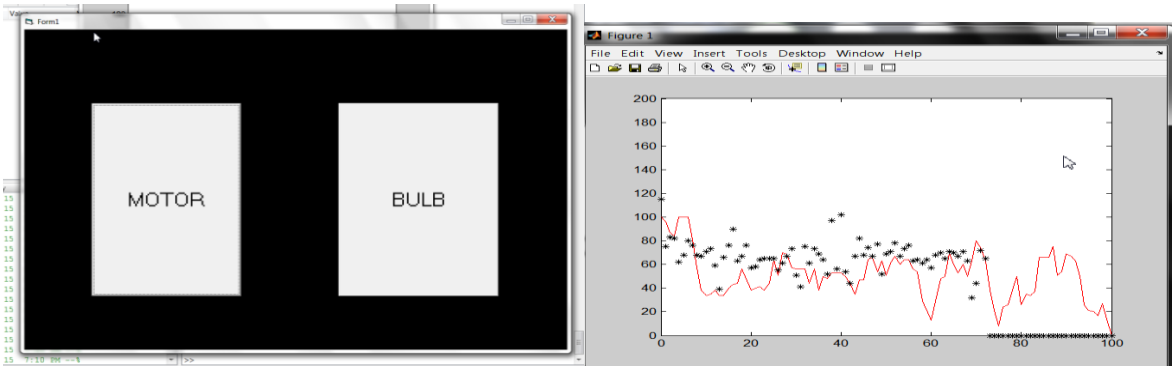

Fig.5 Controlling of Motor and Bulb on the pop up screen and amplitude and frequency of the generated brain wave signals

IV. CONCLUSION

BCI has been used for controlling the Fan and light of the house using the brain wave signals which are sensed by the Brian wave sensor. This brain wave sensor is connected to the analysis platform through Bluetooth. The signals that are detected as eye blink signals by the surface electrode in terms of electrical signals are monitored on the Neurosky app.The system has been designed and implemented in hardware using Matlab and Xilinx Spartan 3E FPGA. The system is suitable for a real time monitoring in home security as well as controlling and sensing in home automation with large number of controlled devices. The design was simulated and working operation of the whole system is verified.

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