

BRAIN-COMPUTER INTERFACE FOR HOME AUTOMATION USING ARDUINO

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ABSTRACT

A brain-computer interface (BCI) may be a new channel between the human brain and a computer. The specific 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 computer game system so as to regulate a sensible home application. It offers an alternate to natural communication and control. it's a man-made system that bypasses the body's normal efficient pathways, which are the neuromuscular output channels. Different brain states are the results of different patterns of neural interaction. These patterns cause waves characterized by different amplitudes and frequencies. Develop open-source software for EEG analysis and brain-computer interfaces. Compare signal quality and BCI performance of varied EEG signals. Processing variable signals received from Brainwave sensor using MATLAB Processing. The signal generated by brain was given by the brain sensor and it'll divide into packets. Therefore the packet data transmitted to wireless medium (blue tooth). The wave measuring block will receive the brain wave data and it'll convert into signal using MATLAB GUI platform. Then the instructions are going to be sending to the house section to work the ON/OFF condition within the modules (bulb, fan, motor).

Keywords- *Brain computer interface, Brainwave sensors, Electroencephalography signals, Bluetooth medium, Arduino board.*

1. INTRODUCTION

Brain computer interface is collaboration between a brain and a tool the permits signals from the brain to direct some external activity, like management of a pointer or a prosthetic limb. The interface permits an immediate communications pathway between the brain and thus the item to be controlled. Electroencephalography (EEG) is academic degree electrophysiology looking at technique to record electrical activity of the brain. It's usually non-invasive, with the electrodes placed on the scalp, the' invasive electrodes unit usually used, as in electrocorticography.

A Brain Computer Interface (BCI) is any system which can derive meaningful information directly from the user's brain activity in real time. The most important applications of the technology are mainly meant for the paralyzed people who are suffering from severe neuromuscular disorders. Most BCIs use information obtained from the user's encephalogram (EEG), though BCIs based on other brain imaging methods are possible. This section briefly describes several EEG-based BCIs. The only alternative for locked-in people is to

establish communication and control channels directly from the brain, bypassing the disfunctioning brain's normal output channels of peripheral nerves and muscles. In a Brain Computer Interface (BCI), signals from the brain are acquired and processed to extract specific features that reflect the user's intent. These features are then translated into commands to operate a device.

A muscle contraction will also create a unique electrical signal. All these electrical waves will be sensed by the Neurosky headset and it will convert the data into packets and transmit through Bluetooth medium. Level analyzer unit (LAU) will give the brain wave raw data and it will extract and process the signal using MATLAB platform. Then the control commands will be transmitted to the home automation to process. With this entire system, we can control home automation according to the human thoughts.

The intelligent vehicle system based on brain-computer interface provides a new way by using brain-computer interface technology. If the brain computer interface can be applied to the concept of smart home.

2. METHODS

2.1 BRAIN WAVE SENSORS

At the basis of all our thoughts, emotions and behaviors is that the communication between neurons within our brains. Brainwaves are produced by synchronized electrical pulses from masses of neurons communicating with one another.

Brainwaves are identified using sensors placed on the scalp. It's a handy analogy to consider brainwaves as musical notes - the low frequency waves are sort of a deeply penetrating drum beat, while the upper frequency brainwaves are more sort of a subtle high pitched flute.

Sort of a symphony, the upper and lower frequencies link and adhere with one another through harmonics. Our brainwaves change consistent with what we're doing and feeling. When slower brainwaves are dominant we will feel tired, slow, sluggish, or dreamy. The upper frequencies are dominant once we feel wired, or hyper-alert.

The descriptions that follow are only broad variety - in practice things are much more complex, and brainwaves reflect various aspects once they occur in several locations within the brain. Brainwave speed is measured in Hertz (cycles per second) and that they are divided into bands delineating slow, moderate, and fast waves.

- **Delta waves (0.5 to 3 hz)**
- **Theta waves (3 to 8 hz)**
- **Alpha waves (8 to 12 hz)**
- **Infra-low(<.5hz)**
- **Beta waves (12 to 38 hz)**
- **Gamma waves (38 to 42 hz)**



Fig 1.Neurosky

LOADS CAN BE CONTROLLED

BULB

Light bulbs can do more than just brighten up a room. They can set a mood, save energy and increase safety. Thing is, you have so many options it can be a challenge to find the right lighting. LED light bulbs, black lights, halogen light bulbs - the list goes on in all kinds of shapes, sizes and watts.

Incandescent light bulbs were the traditional light bulb standard for many years, but LED light bulbs are the new go-to bulb for many reasons. They use less energy and last longer. They get bright instantly and can produce a light color range from warm yellow to cool bluer white.

CFL_light bulbs are also long lasting, up to ten times longer than incandescent while using around 75 percent less energy to produce the same brightness. The CFL light color ranges from warm yellow to cool blue.



Fig 2.Light bulb

FAN

A fan may be a powered machine wont to create flow within a fluid, typically a gas like air. A fan has a rotating arrangement of vanes or blades which act on the air. The rotating assembly of blades and hub is understood as an impeller, a rotor, or a runner. This might direct the airflow or increase safety by preventing objects from communicating with fan blades. Most fans are powered by electric motors, but other sources of power could also be used, including hydraulic motors, hand cranks, combustion engines, and solar energy.



Fig 3.Fan

DC MOTOR

A motor is an electrical machine which converts electrical energy into mechanical energy. The **principle of working of a DC motor** is that "*whenever a current carrying conductor is placed in a magnetic field, it experiences a mechanical force*". The direction of this force is given by Fleming's left hand rule and its magnitude is given by $F = BIL$. Where, B = magnetic flux density, I = current and L = length of the conductor within the magnetic field.

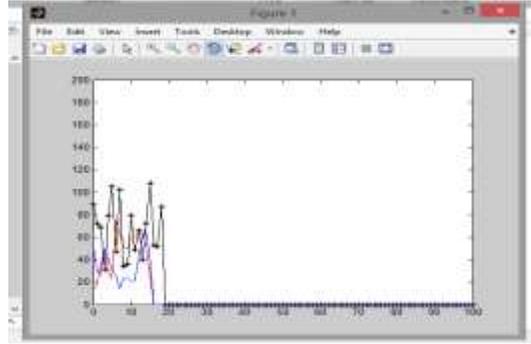


Fig 4.Attention Graph for Fan, bulb, motor

2.2 EMBEDDED SYSTEM

A system is some things that maintains its existence and functions as an entire through the interaction of its parts. E.g. Body, Mankind, Access Control, etc A system may be a part of the planet that an individual or group of persons during a while interval and for a few purpose prefer to think of an entire , consisting of interrelated components, each component characterized by properties that are selected as being relevant to the aim .

- Embedded System may be a combination of hardware and software won't to achieve one specific task.
- Embedded systems are computer systems that monitor, answer, or control an external environment.

An embedded system isn't a computing system that's used primarily for processing, not a software on PC or UNIX, not a standard business or scientific application. High-end embedded & lower end embedded systems. High-end embedded system - Generally 32, 64 Bit Controllers used with OS. Examples Personal Digital Assistant and Mobile phones etc. Lower end embedded systems - Generally 8, 16 Bit Controllers used with a minimal operating systems and hardware layout designed for the precise purpose.

2.3 BCI SYSTEMS

The main purpose of the present chapter is to review recent advances within the EEG field. To understand these developments it'll initial be necessary to detail the physiological basis of the EEG signal. After, vital problems associated with knowledge acquisition, signal process, and quantitative analyses are getting to be mentioned. As we are getting to discuss, maybe the simplest advancements within the EEG field within the last 5-10 years are achieved within the event of these localization techniques. Especially once utilized together with high-density EEG is recording, realistic head models and different purposeful neuro imaging techniques.

The unit of time temporal resolution of EEG permits scientists to research not solely fluctuations of electroencephalogram activity to operate of task demand. The review of the muscular and physiological basis underlying the generation of various EEG oscillations.

2.4 ARDUINO UNO

Arduino is an open-source physical computing platform. It's supported an easy I/O board and a development environment that implements the Processing / Wiring language. Arduino are often wont to develop stand-alone interactive objects Otherwise it are often connected to software on your computer. A physical Input / Output board (I/O) with a programmable microcircuit (IC).

The Arduino Uno R3 may be a microcontroller board supported a removable, dual-inline-package (DIP) ATmega328 AVR microcontroller. Its 20 digital input/output pins. Programs are often loaded on thereto from the easy-to-use Arduino computer virus. The Arduino has an in depth support community, which makes it really easy thanks to start working with embedded electronics. The R3 is that the third, and latest, revision of the Arduino Uno.

2.4.1 PIN CONFIGURATION

"Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno and version

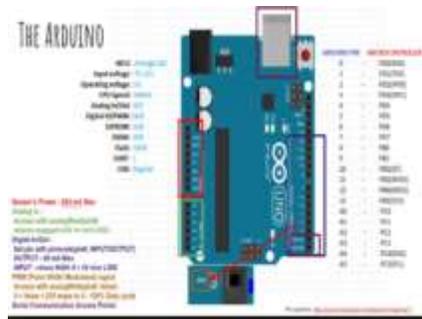


Fig 5.Pin Configuration

2.5 ZIGBEE

The technology defined by the Zigbee specification is supposed to be simpler and fewer expensive than other wireless personal area networks (WPANs), like Bluetooth or more general wireless networking like Wi-Fi. Applications include wireless light switches, home energy monitors, traffic management systems, and industrial equipment that emerge short-range low-rate wireless data transfer.

Its low power consumption limits transmission distances to 10–100 meters line-of-sight, relying on power output and environmental characteristics.

Zigbee devices can transmit data over long distances by passing data through a mesh network of intermediate devices to achieve more distant ones.

ZIGBEE MODEM



Fig 6.Zigbee modem

Zigbee was conceived in 1998, standardized in 2003, and revised in 2006. The name refers to the waggledance of honey bees after their return to the beehive.

2.6 SYSTEM ARCHITECTURE

This architectural diagram deals with the unique electrical signals produced as a result of different brain states. These signals are going to be sensed by the brain wave sensor. It'll convert the info received into packets then transmit them through Bluetooth medium. The extent analyzer unit will receive the brain wave data and it'll extract and process the signal using MATLAB platform. Subsequent step includes sending the instructions to the concerned section so as to work the modules like bulb, fan and lots of other electrical appliances. This project is entirely supported by the thought that blinking along with concentration power are often used to automate any electrical appliance.

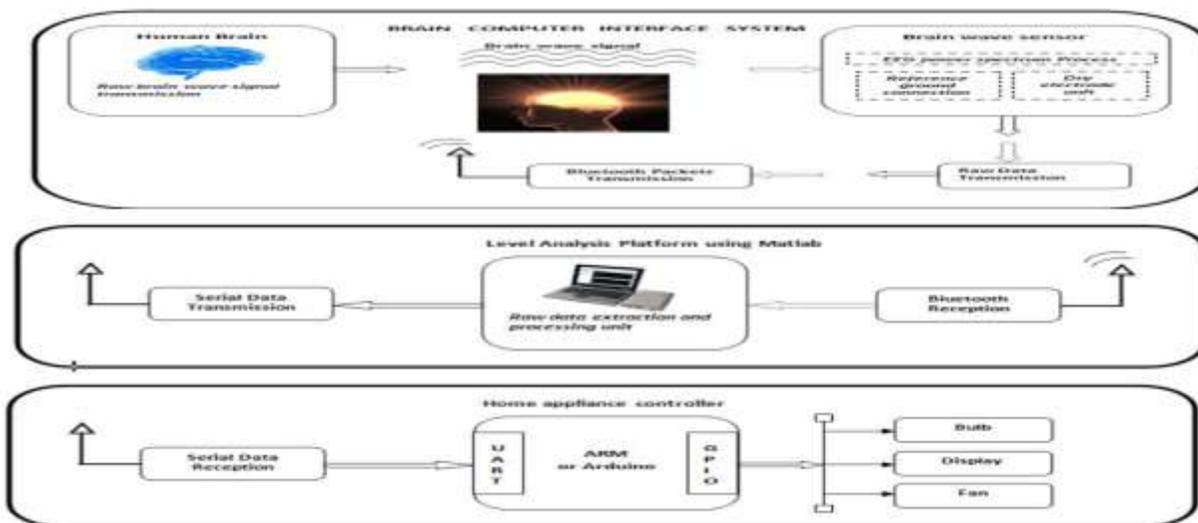


Fig 7. Architecture diagram of BCI for home automation

3. CONCLUSION

The objective of the project is for the important time support for disabled and paralyzed patients. Once implemented, we are sure that it's a useful tool for both patients and doctors. The blink and meditation values vary for various sorts of persons. We check for a few threshold values to work the peripherals. It's very easy to use the top set over the head scalp whereas there's no harm in using this. The BCI sensor sends the brain waves signals to the private computer through Bluetooth medium. Brain computing system uses brain signals in sort of Attention Level through Mind wave Headset to regulate the Bulb and Fan. Received BCI signals processed in pc and therefore the transfer to the Arduino controller. Attention values get measured between 1 to 100 number values. Depends on pc serial data. Arduino controller controls the house appliances.

FUTURE ENHANCEMENT

We can add some complementary options like computer science, control, sign, and an alarm. However, the fundamental practicality remains unchanged apart from blind individuals, for whom we have a tendency to insert the conductor within the brain.

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