Control of a Smart Home with Brain Computer Interface by Using Brain Wave Sensor

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ABSTRACT

A brain-computer interface which is a intercourse medium between the human brain wave and a computer machine. The main goal of a Brain computer is the collection of movements, and eco-friendly control for people with disabilities. An electroencephalogram (EEG) is used in brain-computer interface sensor is tend to be connected with a Virtual Real world procedure in view of controlling a smart home application. It gives an alternative option to natural collaboration and control. It is actually a artificial method that flows through the body's normal useful pathways, which are the neuromuscular output channels.

Various brain waves are the result of different wave patterns of neural interaction. These are the waves which is characterized by many amplitudes levels and frequencies. This pattern based neural -interaction is completed with variety of neurons. Every coordination between the neurons leads to some electrical discharge energy. This is the project dealing with signals from the brain. The signal estimated by brain was reached by the brain wave analyzer and it will make separation into the packets, and then data is transmitted to wireless medium (blue tooth).the wave monitoring unit will be getting the brain wave raw data signals and it will transform into signals with the help of MATLAB platform. Then the received output will be forcibly send to the ARM7 controller via UART port by using flash programmer which is written in embedded c to operate the modules . The overall project is operated with human brain wave analyzer sensor and the operation of modules is based on eye-blinking.

KEY WORDS: EEG, MATLAB, UART, ARM7, BCI, Brain wave sensor.

1. INTRODUCTION

Embedded system: It is a real computer system with a ideal need within a bigger machine or power system, with real-time computing constraints. It is *embedded* as one piece of a complete device that includes hardware components and mechanical machine components.

Embedded systems based many devices are in use today. Ninety-five percent of all microprocessors are engineered as parts of embedded systems. Modern embedded systems which are mainly based on microcontrollers.

In alternative view, the processor which is used may be the types ranging from general methods to those specialized methods in particular class of calculations, or even the custom driven design for the application at hand.

People with disabilities: Disability is circumstance or inability when compared to the normal humans beings. It has various functionality that includes physically, sensory, cognitively, intellectual illness, and numerous types of disease.

Mobile phones have been a great improvement to such people but communication with mobile phones by disabled people would be a really challenging task to them.

This chapter focuses on EEG brain wave sensor analyzer for the people who have disabilities to perform different tasks.

Electroencephalography (EEG): An electroencephalogram detects an electrical wave in our human brain by using small sized, flat surfaced metal called electrodes which are kept to your scalp of brain. Your brain cells interconnect through electrical instinct and are engaged all the time, even when we are not in active stage. This process makes as wavy signals on an EEG recording. It is the main diagnostic tests for epilepsy.

Analysation: The process is analyzing the brain wavy signals. Human brain is made up of millions of interconnected and collaborated neurons. The visualizing pattern of these interaction between these neurons are shown as human thoughts and emotional level states.

Based on the human thoughts and emotional level state, this pattern will be changed which in turn produce different electrical waves. A muscle view interaction will also generate a unique electrical wave called as wave signal. All of these generated electrical signals will get be monitored by the brain wave analyzer sensor belt and it can be converted into packets and then transmits through Bluetooth medium. Level analyzer unit (LAU) will get the brain wave raw data waves as signals and it can extracts the recipient data and processes the raw codes using MATLAB platform.

System architecture: At the base view of all our feelings, people emotions and body behaviors is the interconnecting between neurons collaboration within our brains. Brainwaves are produced by Synchronized electrical pulses from millions of neurons that communicates with one other. Brainwaves codes are detected using inbuilt sensors which are yet to be placed on the scalp. They are segregated into bandwidths to explain their activities as slow, sound and functional therapy- to fast and complex.

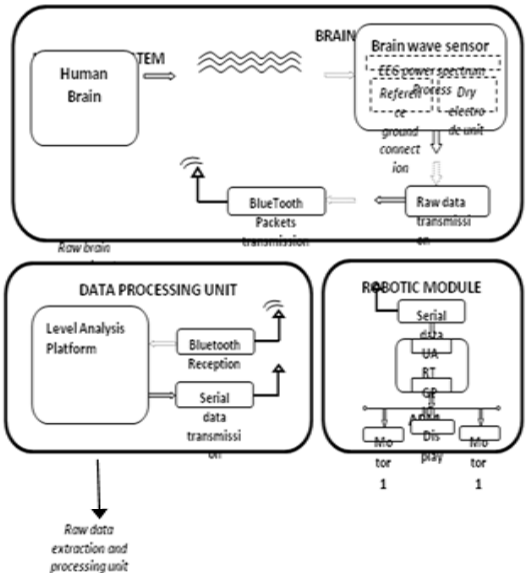

Figure.1. Block diagram

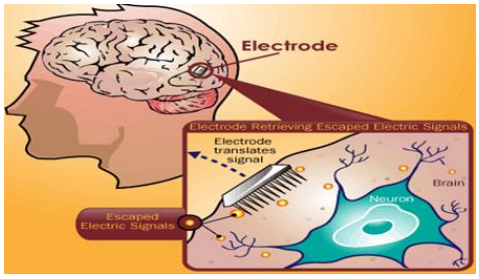

Figure.2. Electrode placement

It is a part of analogy to think of Brainwaves codes as musical notes in nature. The low frequency level waves are likely showing drum beat tone, while the higher frequency level brainwaves are more like a high pitched flute tone.

Likewise, the higher and lower frequencies levels links and interact with each other via harmonics. Our brainwaves changes according to our body muscular and mental movement. When slower brainwaves are flexible.

We can feel so tired, slow in activity, or dreamy. The higher frequencies level are dominant when we feel wiredly, or hyper-alert activity.

Brainwave speed is measured in Hertz (cycles per second).

Brain wave sensor:

Figure.3. Brain wave belt

Zigbee module: There are several high data communication guidelines that are in available stage, but none of these meets the brain sensors analyzer and controls the communication standards require low-frequency and low-energy even at a lower bandwidths. The available wireless medium are Zigbee technology which is a low-financial and low-power taker and characteristics will make communication suitable for various embedded applications , industrial uses, and smart home automation, and so on.

Zigbee communication is identically designed for sensor networks on IEEE 802.15. Standard for the wireless personal area networks (WPANs).

This communication feature defines the physical medium and Media Access Control (MAC) layers to handle several devices at a very low-data levels. The date rate level of 250 kbps is ideally suited for two way transmissions of data in between brain analyzer sensors and controllers modules.

Zigbee is a low-financial mesh network widely developed for controlling and maintaining applications where it covers 1100 meters within the specified range. This communication and collaboration system is less expensive and easier than other short-range wireless sensor networks as Bluetooth and Wi-Fi.

Zigbee supports numerous of network infrastructures for master head to master head or master to slave head collaboration. And also, it can be operated in several modes and the battery power is saved. Zigbee are available in space with the collection of routers and transmits with each other for developing a wider area network.

Figure.4. Zigbee module

Flash programmer: Flash programmer is a Straightforward and initially a user interface. There are five step wise for clearing and programming a device and controlling any options desired. The programs are enabled with Intel Hex Files. It automatically verifies after each completion of programming.

It fills unused Flash to increase firmware security of the program. It has capability which automatics the program checksums. By taking the checksum calculations routines your firm can easily verify the consistency and flexibility of a Flash which is a block, ensuring that unauthorized people or hacked one code can ever be executed.

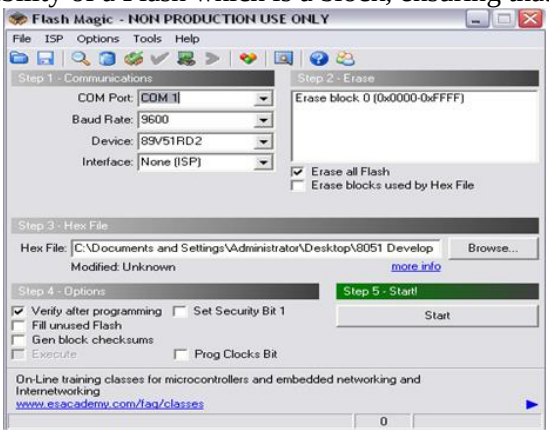

Figure.5. Flash programmer

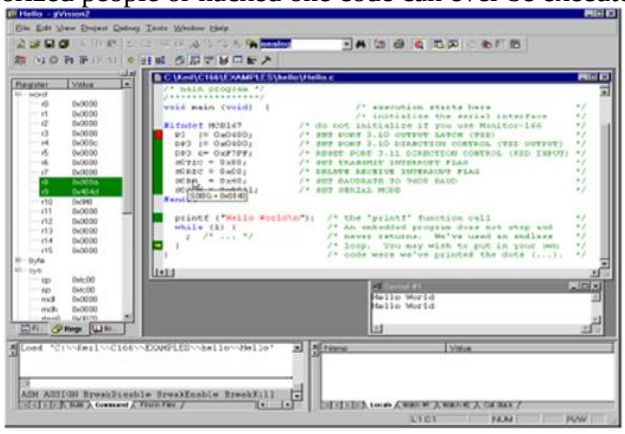

Figure.6. Keil IDE c compiler

Embedded C: The C for microcontrollers and the standard C with syntax and semantics are slightly different in nature. The c is focussed at the general purpose programming language whereas in later is for a specific microcontroller program such as 8051.

The main fact is that everything will be full flexed mapped into the microcontroller engaged in machine code. If a particular feature called as indirect access to I/O registers is inhabited in the 8051 microcontroller, the compiler used here will also restricts the same but at the higher level. Likewise, some C operators with functions which are meant for general purpose computing are also not available with the C for microcontrollers used.

Even the operators and constructors which may lead to memory inefficiency are not available in C programming meant for microcontrollers.

Keil IDE C Compiler: Keil Software, world's largest developer of Embedded Software, makes an ANSI C-compilers, the macro assemblers, the real kernels, code debuggers, the linkers, the library managers, simulators, the integrated environments. Keil IDE Software was implemented the first C code compiler which is modulated from the ground-up functionality for the 8051 microcontroller.

Keil development are the tools offers a full flexed development work space for ARM, Cortex-M, and Cortex-R processor-based systems.

They were made easy to learn by humans and to use flexibility, yet the most powerful for the most abandoned embedded applications. The MDK Core consist all development tools including IDE, code Compiler, and code Debugger. The new Pack Installer updates Software Packages for systems, CMSIS, and middleware.

Software Packages that add support view for a full microcontrollers are called Device Family Packs. Today only some devices are made by Device system Software Packs, but we will be doing support for more microcontroller devices shortly.

MDK-CORE is dependent on µVision computation with most emerging view for Cortex-M systems including the new ARM8 architecture. DS-MDK contains of Eclipse-based DS-5 IDE/Debugger and gives most supports 32-bit a Cortex-A level processors or a hybrid with 32-bit Cortex-A level and Cortex-M.

MDK compiler level contains the ARM7 C/C++ Compilers and highly maximum code size and performance. Software Packages can be added any time to MDK-Core or DS-MDK creates a new device support system and middleware updatations which are independent from the toolchain. They include several device supporters, CMSIS library modules, code with templates and example such projects .New is the IPv4/IPv6 networking communication level stack that is enlarged with ARM embedded software components to enable Internet of Things (IoT) applications.

Data flow diagram: The XBee®/XBee-PRO OEM RF system interface to a host system through the logic based asynchronous level serial port number. Through its serial port, the modules can collaborate with any logic and voltage levels UART port; or through a level intermediator to any serial parallel medium. Through a Digit proprietary RS-232 or USB interface board. Uart Serial Port to Ethernet Wi-Fi Wireless Network translating Adapter Module Features are as follows: This product is a embedded system , is fully depedent on the universal level serial user interface which accords with the network standard, built-in TCP/IP for protocol stack, can realizes the user with a serial port.

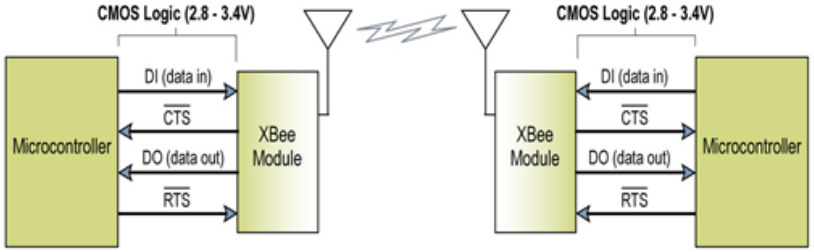

Figure.7. Data flow diagram

ARM 7 Controller: Incrementally, embedded systems modules and system-on-chip developer's selects particular microprocessor and a collection of tools, libraries, hardware components to fastly improve new microprocessor used products and web applications. ARM7 is one of the highlighted options available for embedded system designer. The ARM7 architecture has useable feature, the most used 32-bit architecture in the emerging world, with wide available rate of ICs that are from several IC manufacturers. ARM controllers are embedded particularly in products ranging from mobphones to automotive business bus braking systems. A community class of ARM7 partners and third-party vendors has developed among semi-conductor and product design companies, including hardware.

An ARM7 processor is one among the class of CPu s based on the RISC (reduced instruction set computer) architecture was deployed by Advanced RISC Machines (ARM). ARM makes use of 32-bit and 64-bit RISC multi-core processors.

RISC processors which are made to built the smaller variety of numerous of computer instructions rules so that they can emerge from a higher speed, performing more trillions of instructions per second (MIPS). By stripping out the useless instructions and optimizing ways, RISC processors gives the outstanding performance at a fraction of the power of CISC (complex instruction set computing)

ARM7 configuration are 32-bit and 64-bit processors which are designed to perform a lesser number of computer instructions rules so they can evaluate over a higher speed, performing more trillions of instructions per second (MIPS).

It stores the entire architecture. It is an orthogonal emerged instruction set. It is mostly executes the single-cycle execution. It has Enhanced feature of power-saving designs. Its configuration are 64 and 32-bit execution states for scalable high performance. It contains a hardware virtualization support.

The simplified user design of ARM7 processors enables the more efficient and relevant multi-core processor and way easy for coding by developers. While they have the same data raw computation throughput as the product of x86 market leader Intel, ARM processor sometimes exceeds the performance limit of Intel processors for application that exists on both architectures.

Figure.8. ARM 7 module

The RS-232(X) cable is an interface cable, commonly used for the transferring and receiving the serial data between the two devices. It provides both synchronous and asynchronous data rate for transmissions. Many systems in the industrial work are using RS-232 cables. Rs-232 interface cable is used to detect the distinguishes of two signals levels between the logic 1 level and logic 0 pattern. The logic 1 is represents by the -12Volts and logic 0 is represents the +12Volts. The RS-232 interface cable works at a many baud rates like 9600 bits/s, 2400bits/s, 4800bits/s etc. The RS-232 cable has important two terminal devices particularly Data Terminal Equipment device and Data communication Equipment. Device etc.

2. CONCLUSION

Brain signals will be use as the communication source especially for humans with disabilities. So, for each blinking of an eye, the brain waves will vary accordingly, the captured brain signals from Bluetooth plays as the important input aspect of this project. Then the signals are transmitted through ARM7 controller, finally transmitted to ZigBee module which is attached to modules. for the assumption, left eye blinking is tend to operate the fan and right eye blinking is tend to operate bulb etc.., In this work, the devices used here are cost-effective, highly power consumable, gives accurate results. The electrode used here is tend to transmit brain waves signals patterns into electrical signals. So, now humans with disabilities who can't operate the home devices on their own, can use this brain wave sensor belt which is not dependent on others.

The drawbacks of earlier using brain wave sensor have multiple electrodes. Since multiple electrodes are used, it will generate EEG paste which is very harmful to human body. In order to solve this problem, we have proposed a project having brain wave sensor analyzer with a single electrode which in turn no harm to human body. In this belt, we are having an inbuilt Bluetooth for communicating the signals (brain waves).

In future enhancement, we can raise this project by enabling concentration module. Though now we are operating the devices with the help of an eye blink, this can be deployed further by using concentration level of the people brain. Here no need to blink the eye for operating the devices. Instead, we have to concentrate in a particular device to operate on its own.

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