

Brain Activity Analysis for the Communication in Locked In-Syndrome People

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Abstract: Presently, due to the after effect of the inventions, various techniques are a used for control of home appliances. Particularly, they are particularly designed for the aged people and also for patients. In some cases advanced systems are built for the physically disabled people. The main problem in all current systems is that they are not suitable for all kinds of people and under all conditions. Each system needs a unique design and device, which increases the cost of constructing them and reduction in stability. The main aim of our project is to make a a simple system, which can be used by all types of people in every situation for controlling devices around them. Brain waves can be used to solve this problem. Here, the brain wave has an important role in controlling devices in the home condition and enable communication among people suffering from pseudo coma. The brain waves are detected by use of Neurosky Mindwave sensor and data is transferred using Bluetooth to the CA system. The CA system is made up of an Arduino and its programmed to control all the devices connected. The main advantage of the project is that it can be used by all types of people.

Key Word: NeuroskyMindwave, Bluetooth, Central automation system, Pseudocoma .

I. Introduction

Locked-in syndrome

Locked-in syndrome (LIS), also known as pseudocoma, is a stae of human body in which a patient is aware but cannot move or communicate verbally due to complete paralysis of nearly all voluntary muscles in the body except for vertical eye movements and blinking. The individual is conscious and sufficiently intact cognitively to be able to communicate with eye movements. The EEG is normal in locked-in syndrome.Total locked-in syndrome, or completely locked-in state (CLIS), is a version of locked-in syndrome wherein the eyes are paralyzed as well. Fred Plum and Jerome Posner coined the term for this disorder in 1966.

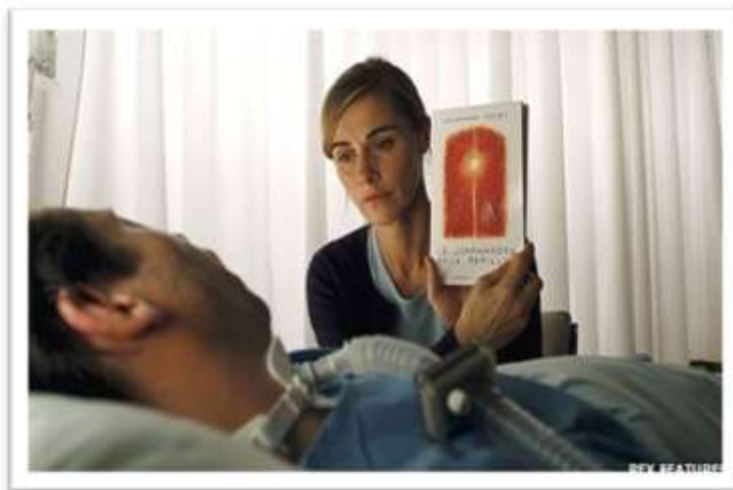


Figure 1 Man suffering from locked-in syndrome

Persons having severe motor disabilities for various reasons can use a wide range of assistive devices (ADs) for managing their daily needs as well as using them for communication and entertainment purposes. The set of ADs ranges from simple switches connected to a remote controller to complex sensors (e.g., mouth mouse) attached to a computer and to eye tracking systems. All of these systems work very well after being adjusted individually for each person. However, there are still situations where the systems do not work properly, e.g., in the case of fatigue of residual muscles. In such a case, a Brain- Computer Interface (BCI) might be a good option, using brain signals (EEG) for control without the need for movement.

II. Methodology

The first step in the study was to analyze the brain waves of locked in people using Neuroskymindwave headset. A detailed description of the analysis, validation and calibration of the same is discussed below.

Neuroskymindwave headset

The human brain is constructed of billions of interconnected neurons; the regularity of interaction between those neurons are defined as thoughts and emotional conditions. Every communication between neurons creates a minute electrical discharge; to detect these signals outside of the skull is very hard. But the interaction between them results in forming a brain signals or waves which can be detected.

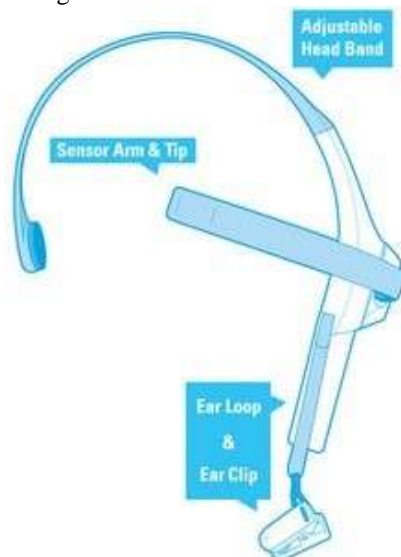
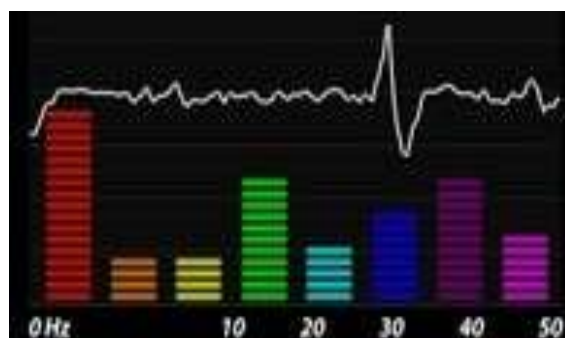


Figure: Diagram of a basic NeuroSky headset

Different brain conditions are due to different patterns or structure of neural interaction. These structure or brain patterns lead to brain waves characterized by different amplitudes and frequencies; for example, brainwaves in between 12 and 30 hertz are classified as Beta Waves, these are linked with concentration ; waves between 8 and 12 hertz are classified as Alpha Waves, these are linked with relaxation and a state of mental calm. (as the muscle expand and close some patterns are generated the sensor detects these for more accurate data.)

All types of electrical actions produce these signals (including light bulbs), thus all electrical equipments produce some amount of “noise”; this “noise” interact with the waves originating from the brain, that’s why most of the EEG devices will pick up readings even when they are not connected to a persons head. Analysing mental activity through these signals is like trying to overhear a conversation at a loud music contest. In the past, EEG devices avoided this problem by analysing these signals in surroundings where electrical activity is rigorously restrained and increasing the signal power of the data coming from the brain through various techniques.



Raw Brainwaves and Power Spectrum

However, most patients do not have rooms in their house lacking electronic devices nor do the people want to apply a conductive liquid to their head each time they use a BCI device. NeuroSky has found complex algorithms and built it into the products which cleans out this “noise”. NeuroSky's white paper claims the Think Gear technology has been tested at 96% as accurate as that within research grade EEGs.

How it works



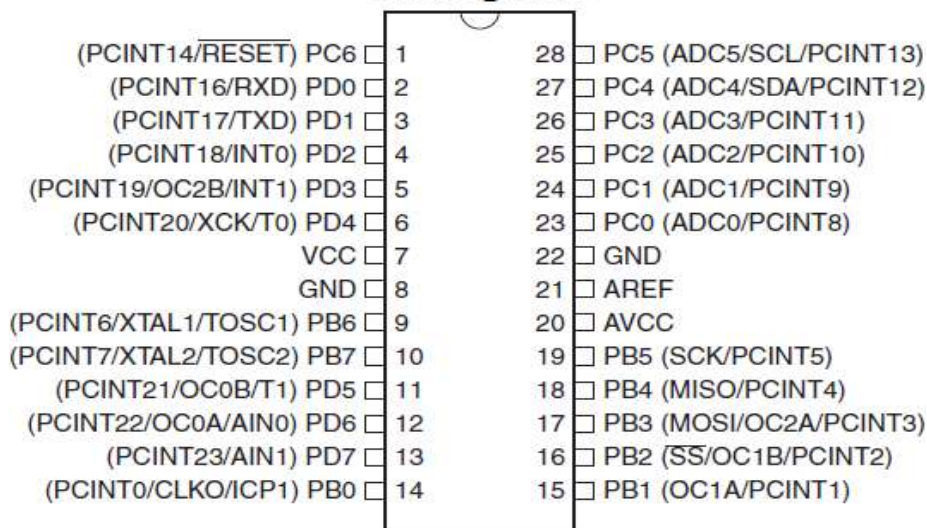
Microcontroller

The ATmega328 is a single-chip microcontroller created by Atmel in the mega AVR family. It has a modified Harvard architecture 8 bit reduced instruction set computer processor core.

The chip is a 8-bit AVR RISC-based microcontroller which consists of 32 kB In System Programming flash memory with read while write capability, 1 kB EEPROM, 2 KB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, 3 flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, 6-channel 10-bit A/D converter, programmable watchdog timer with internal oscillator, and five software selectable power saving modes. The device operates between 1.8-5.5 volts. The device achieves throughput approaching 1 MIPS per MHz.

ATmega 328 consists of a 1KB Electrically Erasable Programmable Read Only Memory (EEPROM). This shows that if the current supply supplied to the micro-controller is terminated, even then it can store the data and can provide results after providing it with the electric supply. Moreover, ATmega-328 has 2KB Static Random Access Memory. ATmega 328 has different features which make it the most popular device in current market. These properties consist of advanced RISC architecture, good performance, low power consumption, real timer counter having separate oscillator, 6 PWM pins, programmable Serial USART, programming lock for software security, throughput up to 20 MIPS etc.

Atmega328



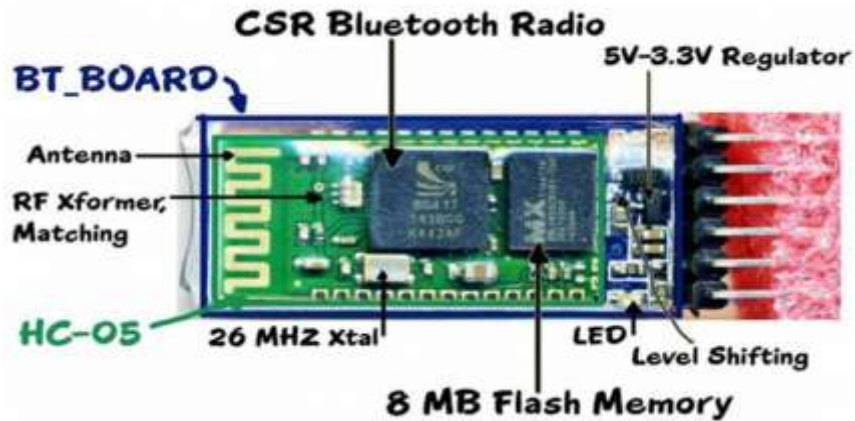
HC-05 Serial Bluetooth Module

Bluetooth is a technology used for wireless communication. It's created to replace cable connections. It make use of serial communication to communicate with devices. It communicates with microcontroller using serial port (USART). Usually, it connects small devices like mobile phones, PDAs and TVs using a short-range

wireless connection to exchange documents. It uses the 2.45GHz frequency band. The connection can be point-to-point or multi-point where the maximum range is 10 meters. The transfer rate of the data is 1Mbps. HC-05 Bluetooth module provides switching mode between master and slave mode which means it able to use neither receiving nor transmitting data.

Comparing it to the HC-06 module, which can only be set as a Slave, the HC-05 can be set as Master as well which enables making a communication between two separate Arduino boards.

A Bluetooth module can simply be used for a serial port replacement to establish connection between MCU, PC to the embedded projects and etc.



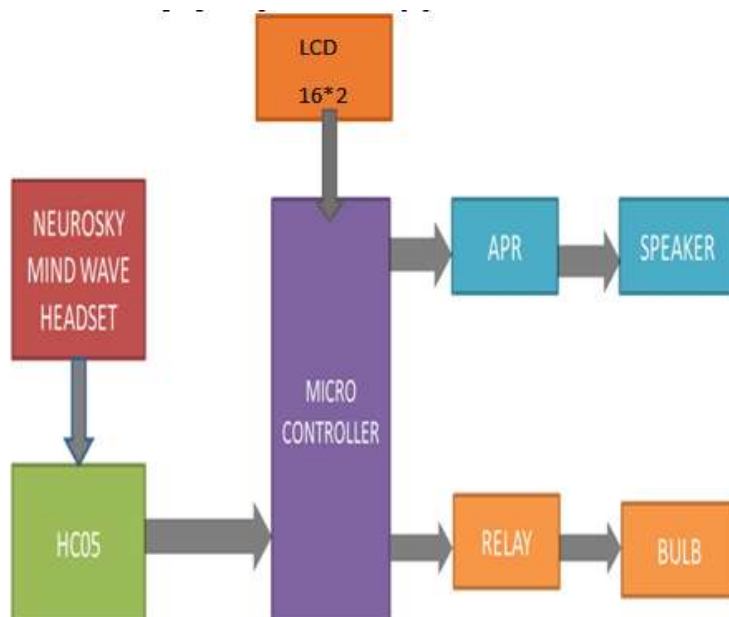
APR9301 Voice Recorder

APR 9301 is a single chip Voice recorder and Playback equipment used for 20 to 30 seconds voice recording and play back. It's an excellent IC for automatic answering machine, door phones etc. This IC has data memorizing capacity and needs no software or microcontroller. It gives high quality voice recording and play back up to 30 seconds.

This ic operates in 2 modes of operation-recording and playback modes.The ic requires only low voltage to function (5 volts).

III. Block Diagram & Result

The block diagram provides with explanation of how the system works. The BCI is highly evolving technique; it can be utilised for many things like controlling appliances, gaming etc. we here define the use of BCI with an APR module for language interpretation and equipment control.



Brainwaves are tiny electrical impulses produced when a neuron fires in the brain. NeuroSky's brain - computer interface (BCI) technology works by monitoring these electrical impulses with a forehead sensor. The brain signals are input into the Think Gear chip, and understood via the patterned Attention and Meditation algorithms. The analysed electrical signals and calculated readings are then provided as output and as digital messages to the computer, toy, or mobile device, allowing you to see your brain waves on the screen, or use your brainwaves to affect the device's behaviour.

HC05 bluetooth module is used here for receiving the data collected by the Neuroskymindwave headset. HC05 then serially transfers these collected informations to the Atmega328 microcontroller in the Arduino board. The collected data includes the various mind states such as meditation, concentration and attenuation. A comparison between these collected and saved data is processed inside the microcontroller and finally provides the required results. The result can be a recorded APR audio, a buzzer, or home automation.

IV. Conclusion

Based on the outcome of the study it is proved that it is no longer required for the locked in people to completely depend on their bystander. They can make use of these simple profile to communicate and in home automation. We can make use of advanced technologies in the proposed system by use of mind reading and mind controlling mechanisms. Further research is required to replicate and clarify these results.

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