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BCI Interfacing On Disabled People Wheelchair with Wireless User Control

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ABSTRACT Human brain is made of billions of neurons which are interconnected. Interactions within neurons are affected by Human thoughts and their emotions. There is an electrical discharge during interaction between neurons which is unable to measure by current technology. However, Simultaneous activity created by thousands of neurons which produce electric discharges into waves that are measurable. Different amplitudes and frequencies wave patterns are used to diagnose emotional state of the brain. The goal of this project is to measure brain electrical activity during the interaction of neurons, parse wave to obtain consciousness and thinking level of brain and accordingly wheel chair is moved (Kangdra William, Heng John, Subhasis Banerj,May 2008). Foremost technique is Electroencephalogram (EEG) which is used to measure fluctuation of voltage along the scalp. The voltage fluctuations sensed by EEG sensor is processed by a techniques used in microcontroller. Consciousness and thinking levels are obtained from the processed data. Direction and locomotion of wheel chair is controlled by these levels. Ultrasonic sensor detects the distance of the obstacles. Android mobile control the movement of wheel chair by voice, gesture and touch screen.

KEYWORDS : Electroencephalogram (EEG), Brain, Ultrasonic Sensor

Introduction

Improving the quality of life for the elderly and disabled people and giving them the proper care at the right time is one the most important roles that are to be performed by us being a responsible member of the society. It's not easy for the disabled and elderly people to maneuver a mechanical wheelchair, which many of them normally use for locomotion. Wheelchair is designed accordingly, that is intelligent and provides planned and regulated movements.

Brain controlled wheelchair is proposed which uses the analog signals from the brain to control the wheelchair. Electroence phalography (EEG) technique deploys an electrode cap that is placed on the user's scalp for the acquisition of the signals. Voltage fluctuations are measured by EEG along the scalp due to interaction between the neurons.

The data sensed by EEG sensor is stored in microcontroller. The microcontroller uses different techniques to process and parse the data. The attention and meditation levels are obtained from the processed data. These levels are used to control the direction and motion of the wheelchair.

An intelligent wheelchair using smart phone is develop to control the rotation of wheel chair based upon voice and gesture movement for the physically challenged persons. In build voice and gesture function are used to control the wheelchair as well as by using smart phone reading SMS, E-mail, News.

The proposed system is composed of 3 main units namely Voice recognition through Android, Gesture recognition through Android, Motor control through signal conditioning. The system is based on grouping an android phone with a PIC micro-controller and sensors.

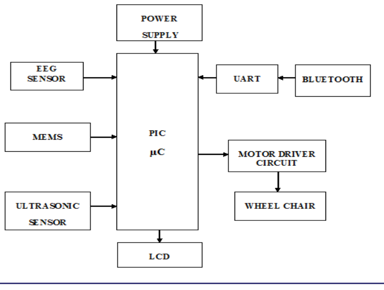

Figure 1 Block diagram of system

EEG Sensor

Earlier, approximately 16–21 electrodes are used to attach on person's scalp using an electrically conductive, washable paste. Based on head circumference measurements electrodes are attached over the head in a standard pattern. Implantable electrodes include sphenoidal electrodes, which are fine wires inserted under the zygomatic arch, or cheekbone. Depth electrodes, or subdural strip electrodes, are surgically implanted into the brain and are used to localize a seizure focus in preparation for epilepsy surgery. The electrodes are used to obtain the electrical activity in various regions of the brain over the course of the test period.

EEG (Culpepper J.Benjamin and Keller M.Robert, December 2003) is a medical imaging technique that obtains scalp electrical activity produced by brain structures. The electroencephalogram (EEG) is defined as electrical activity of an alternating type recorded from the scalp surface after being picked up by metal electrodes and conductive media. The EEG measured directly from the cortical surface is called electrocardiogram while when using depth probes it is called electro gram. In this, we will refer only to EEG measured from the head surface.

Thus electroencephalographic reading is a completely non-invasive procedure that is applied repeatedly to patients, normal adults, and children with no risk or limitation. It's based on ROHS – Restriction of hazards substance .Voltage fluctuations are measured by EEG sensor which senses the electric discharge within the neurons of the brain. Three axis are used x, y, z axis.

An electroencephalogram (EEG) is a diagnose and evaluate the electrical activity in the brain. Brain cells interact with each other with the help of electrical impulses (Kangdra William, Heng John, Subhasis Banerj,May 2008). The EEG tracks and store brain wave patterns. Small, flat metal discs called electrodes are placed over the scalp with wires. The electrodes obtain the electrical impulses from the brain and send signals to a computer and output is recorded. Diagnostic applications mainly focus on the spectral content of EEG, the type of neural oscillations (popularly called "brain waves") that are obtained from EEG signals

MEMS Accelerometer

MEMS is a combination of mechanical functions (sensing, moving, heating) and electrical functions (switching, deciding) on the same chip using micro fabrication technology to control wheelchair. MEMS sensor is used for synchronization. An accelerometer is a sensor, which converts the acceleration from the motion to the electrical signals MEMS based accelerometers are devices that measure the proper acceleration.

Inertial sensor is the commonly used accelerometer which is dynamic sensor sensing vast range. Accelerometers can measure acceleration in one, two, or three orthogonal axes. They are typically used in one of three modes:

- As an inertial measurement of velocity and position.
- As a sensor of inclination, tilt, or orientation in 2 or 3 dimensions, as referenced from the acceleration of gravity (1 g = 9.8m/s^2)
- As a vibration or impact (shock) sensor.

An analog accelerometer have more advantages compared to liquid tilt sensor such as inclinometers provide binary output information (indicating a state of on or off), it detect when the tilt has exceeded above thresholding angle.

MEMS sensor with three axis is used. Acceleration, inclination and vibration are measured by small and highly sensitive accelerometer that can detect motion in the x-, y-, and z-axis simultaneously. Compensation of mounting angle is done by sensing using sensor and therefore makes it to use normal SMD technology in high density boards. Realization of inclination angle by precise detection. An interface IC within the sensor package has temperature sensing and self-diagnosis functions.

Accelerometer is most common inertial sensors which is dynamic and capable of a vast range of sensing. Accelerometers can measure acceleration in one, two, or three orthogonal axes. The centre of gravity of the rotor is in fixed position. The rotor spins in one axis and is capable of oscillating about the two other axes and thus except for its inherent direction about the fixed point (Li Yuanqing, Wang Chuanchu, Zhang Haihong and Guan Cuntai,June 2008)

Ultrasonic Sensor

An ultrasonic sensor emits ultrasonic waves into the air and obtains reflected waves from an object (Jitkreeyarn Prapon, Nulek Niyom, Tungpimolrut Kanokvate and Chayopitak Nattapon,April 2009). There are many applications for ultrasonic sensors, such as in intrusion alarm systems, automatic door openers and backup sensors for automobiles and also obstacle detection Ultrasonic ranging module HC - SR04 provides 2cm - 400cm non-contact measurement function, the ranging accuracy can reach to 3mm. The modules include ultrasonic transmitters, receiver and control circuit.

The HC-SR04 ultrasonic sensor uses sonar to find the distance of an object like bats or dolphins do. It offers excellent range accuracy and stable readings in an easy-to-use package. Operation of the sensor is undisturbed by sunlight or black material like Sharp rangefinders are Similar in performance to the SRF005 but with the low-price of a Sharp infrared sensor.

The pins in sensor module are 5V Supply, Trigger Pulse Input, Echo Pulse Output and 0V Ground.

Simulation Results

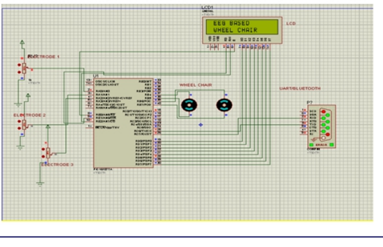

Figure 2 EEG based wheelchair

Figure 3 Hardware implementation of automatic wheel chair

Conclusion

This paper presents a implementation of automatic wheelchair. Also there two types of sensors which increases accuracy of wheelchair and ultrasonic sensor used to detect the obstacle to avoid accidents. This Wheelchair is economical and affordable to common people. New technology is utilized in this wheelchair. This system is made highly efficient and effective if stringent environmental conditions are maintained. By using this system physically handicapped people find easy way to navigate within the house using wheelchair without the external help. This provides ease of operation. As the system uses Smart phone so that the accuracy is increased. The Reading of SMS,E-mail, News can be possible. The ultrasonic sensor is used for obstacle avoidance. If any emergency then the Panic button is there (HELP) it blows buzzer. The running cost of this system is much lower as compare to other systems used for the same purpose

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