An Alternate Assistance Device for Motor Disabled using Electromyography

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Abstract— **In the study of the functions and mechanisms within the living system which is nothing but the Physiology, stimulus is the detectable change in the internal and the external environment. And sensitivity is the response by a living organism for that stimulus. This response can be either easily detectable or not easily detectable. In the case of latter, such responses can be easily detected and analyzed by using the Surface EMG technique where the semg electrodes are placed on the skin surface in order to detect the motor responses. Specially abled people with physical and mental incapability's like physically disabled, deaf or hard of hearing, intellectual disability, acquired brain injury, patients at ICU, motor disabled face the problem while responding to the stimuli or in expressing their attention physically and also for the normal people at the time of hearing test as a part of non-verbal communication. An emg detects the electric potential generated by the muscle cells when these cells are electrically or neurologically activated. The electrodes will pick up the electrical variations of the muscle and this information is given to the signal conditioning block after which the obtained analog signal is converted into a digital signal which will be formed into packets. These packets can be sent to the software in order to observe the emg waveform. And the detected response is sent to the receiver block through the wireless communication , which is through Bluetooth in this project . LCD and buzzer has been provided for easy detection of the response at the receiver here.**

Keywords— *motor disability ; electromyography ; electromyograph ; electromyogram ; surface emg*

I. INTRODUCTION

In physiology, a stimulus (plural stimuli) is a detectable change in the internal or external environment. The ability of an organism or organ to respond to the external stimuli is called sensitivity. When a stimulus is applied to a sensory receptor, it normally influences a reflex . Specially abled people with physical and mental incapability's like physically disabled, deaf or hard of hearing, intellectual disability, acquired brain injury, patients at ICU (suffering from bedsore), motor disabled ones face the problem while responding to the stimuli or in expressing their attention

physically and also for the normal people at the time of hearing test as a part of non-verbal communication.

Electromyography (EMG) is an electrodiagnostic medicine technique for evaluating and recording the electrical activity produced by the skeletal muscles. EMG is performed using an instrument called an electromyograph to produce a record called an electromyogram. An emg detects the electric potential generated by the muscle cells when these cells are electrically or neurologically activated. In this project we are trying to detect the response of the person by using surface emg electrodes which is very much useful & has many applications. The electrodes will pick up the electrical variations of the muscle. This information is fed to the signal conditioning block. The obtained signal is low in amplitude so to process this signal, it needs to be amplified using instrumentation amplifier. Then the microcontroller converts this analog signal to digital signal using 10 bit resolution with 256 samples/second. The converted digital signal will be formed into packets. The packets are then sent to the software (Electric Guru) in order to obtain the EMG waveform on the personal computer. A buzzer has been provided to obtain beep indication at the point of detection of the EMG signal. And this detected response will be sent to the receiver block using the wireless communication (Bluetooth) and is displayed on a lcd for easy detection.

II. SYSTEM DESIGN AND METHODOLOGY

The design of the system includes two blocks majorly ; they are : the transmitter block and the receiver block .

A. Transmitter Block

The transmitter part of the system includes the surface emg electrodes primarily which detects the electric potential generated by the muscle cells when these cells are electrically or neurologically activated. As the next sub block, there is signal conditioning block where the information or the signal obtained from the semg electrodes is processed. The obtained

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signal is low in amplitude that is in milli volt or sometimes in micro volt so in order to process this signal, the signal needs to be amplified using the instrumentation amplifier. Then there is a microcontroller (ATMega-2560) with inbuilt ADC (Analog to digital converter) which converts the obtained analog signal to digital signal using 10 bit resolution with 256 samples/second. Then the converted digital signal will be formed into packets and those packets are sent to the software to obtain and observe the EMG waveform on the personal computer. A buzzer has been provided to obtain a beep indication at the point of detection of the EMG signal. And this detected response is viewed on the OLED in the form of waveform. And there is a Bluetooth module which will aid the process of sending the detected response to the receiver block and it acts as the mode of wireless communication in the system. The block diagram of the transmitter block is shown in the Fig. 1.
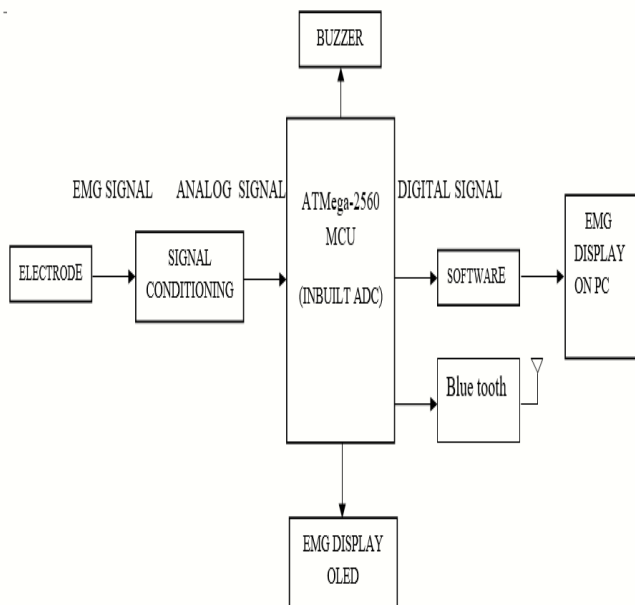

Fig. 1. The block diagram of the Transmitter Block

1)   Signal conditioning block

In the signal conditioning block , the processing of the obtained analog signal from the semg electrodes is done . Since the obtained signal is low in amplitude that is in milli volt or sometimes in micro volt so in order to process this signal, the signal needs to be conditioned by a series of sub block processes.

Initially considering how the electric potentials are generated by the muscle cells within the human body, the electrical events occur in the muscle during the resting condition as well as the active conditions. Electrical potential changes during the Muscular Contraction in the muscle during resting condition is called resting membrane potential. Electrical changes that occur in active conditions, i.e. when the muscle is stimulated are together called action potential. Electrical potentials in a muscle (or any living tissue) are

measured by using a cathode ray oscilloscope or computerized polygraph. Physical change which takes place during the muscular contraction is the change in length of the muscle fibres or change in the tension developed in the muscle. And electromyography is the study of electrical activity of the muscle. Electromyogram (EMG) is the graphical registration of the electrical activity of the muscle. Cathode ray oscilloscope or a polygraph is used to record the electromyogram. Two types of electrodes are used for recording the electrical activities of the muscle and one of which is the surface electrode or skin electrode for studying the activity of a muscle and the other is Needle electrodes for studying the electrical activity of a single motor unit but here in this project we are making use of the surface emg electrodes (semg). Electrical potential recorded from the whole muscle shows smaller potentials if the force of contraction is less. And when the force increases, larger potentials are obtained due to the recruitment of more and more number of motor neurons.

Bioelectric events have to be picked up from the surface of the body before they can be put into the amplifier for subsequent record or the display. This is done by using electrodes. Electrodes make a transfer from the ionic conduction in the tissue to the electronic conduction which is necessary for making measurements. The surface electrodes pick up the potential difference from the tissue surface when placed over it without damaging the live tissue. Here primarily there will be three electrodes and they are : left electrode , right electrode and the reference electrode . Fig. 2. shows the sub blocks that are involved in the signal conditioning block.
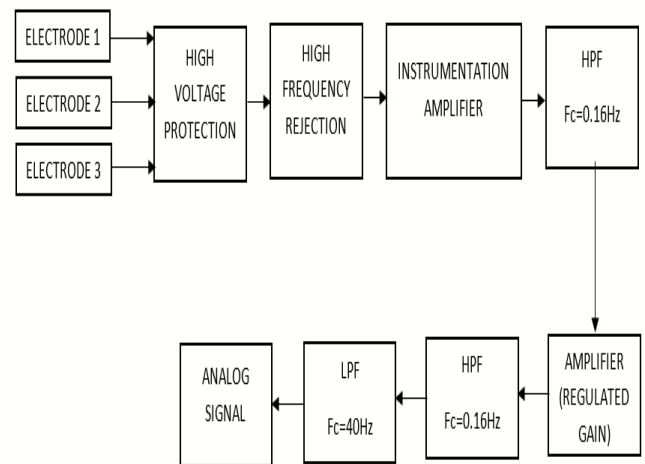

Fig. 2. The block diagram showing the signal conditioning block within the transmitter block

The information or the signal from the semg electrodes is given to the high voltage protection and high frequency rejection blocks consecutively in order to avoid the reverse flow of the energy signal. And since the obtained signal is low in amplitude that is in the milli volt or

sometimes in micro volts, this signal needs to be amplified using instrumentation amplifier. Then the obtained signal is fed to the high pass filter block with the cut off frequency, Fc = 0.16 Hz. Further again the signal is amplified and then the signal is fed to the band pass filter block where the cut off frequency for the high pass filter is same as the previous and that's for the low pass filter is Fc = 40Hz and as a result we obtain a analog signal which is ready for the analog to digital conversion.

B. Receiver Block

In the receiver section the signal which is sent by the transmitter is received via blue tooth module at the receiver block. Further the processes are very basic in this block. Thus the detected response is sent to the receiver block through the wireless communication , which is through Bluetooth in this project. Then the signal is given to ATMega-328 microcontroller unit in order to aid the process of displaying a message regarding the response on the LCD and also a buzzer has been provided for the easy detection of the response at the receiver. The Fig. 3. shows the block diagram of the receiver block.
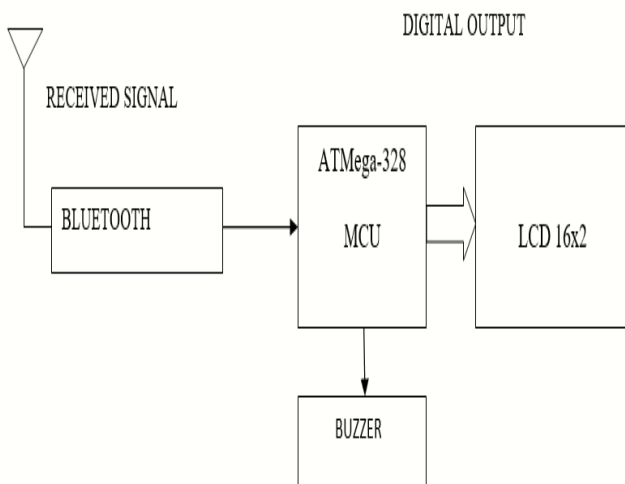

Fig. 3. The block diagram of the receiver block

III. ADVANTAGES

A. Electromyogram is useful in the diagnosis of thneuromuscular diseases such as motor neuron lesions, peripheral nerve injury and myopathies.

B. Useful for the specially abled people with physical and mental incapability's like physically disabled, deaf or hard of hearing, intellectual disability, acquired brain injury, patients at ICU (suffering from bedsore), motor disabled ones who face the problem while responding to the stimuli or in expressing their attention physically and also for the normal people at the time of hearing test as a part of non-verbal communication.

C. Also useful for the common diseases of the skeletal muscles like Muscular dystrophy , Diseases involving muscle tone, Fibrillation and denervation hypersensitivity , Myasthenia gravis , Lambert-Eaton syndrome , McArdle disease , Mitochondrial myopathy , Nemaline myopathy.

LIMITATIONS

A. In the case of involuntary muscular movements or the motor responses ,the system may give false alarms.

B. The semg electrode is sensitive to the external changes and noises and it may cause inefficient results.

IV. FUTURE SCOPE

A. The system can be made flexible by giving options for the different threshold considerations for the semg electrodes either it may be through software or by providing a manual switch.

B. Advanced wireless communication techniques can be made use of for the transmission and reception of the response.

V. CONCLUSION

An alternate assistance device for the motor disabled ones has been developed in order to detect their response which has importance, useful and has several applications using electromyography. This system helps the people with motor neuron lesions, peripheral nerve injury, myopathies and specially abled people with physical and mental incapability's like physically disabled, deaf or hard of hearing, intellectual disability, acquired brain injury, patients at ICU (suffering from bedsore), motor disabled ones who face the problem while responding to the stimuli or in expressing their attention physically and also for the people with Muscular dystrophy , Diseases involving muscle tone, Fibrillation and denervation hypersensitivity , Myasthenia gravis, Lambert-Eaton syndrome , McArdle disease , Mitochondrial myopathy , Nemaline myopathy in spite of the limitations. This system helps the care takers and the clinical persons who look after such people in one or the other way.

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