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A Survey on EMG System for Monitoring Body Nervous System Response

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ABSTRACT: Electromyography is used to estimate and trace the electrical activity formed by muscles of a human body. The main aim of the proposed system is to design and implementation of body nervous system response monitoring using electromyogram technology. The system will detect the electromyogram signals from different area of body which will detect the strength capacity of muscles and convert it in to measurable or understandable data or graphical format. Surface electrodes may be used to pick-up the myoelectrical signal. This noise-like signal is an interfering pattern which is the sequential and spatial amount of action potentials from all the motor units in the area of the detecting electrodes. With the help of this knowledge we can recognize the muscle response ability and ability in the form of electric single from different region of body and can translate electromyogram signals in the form of values or codes and plot it live over graphical tools. The conclusion extracted is that biomedical signals are a promising source for biometric identification at the same time they are used to monitoring patients.

KEYWORDS: Electromyography (EMG), CNS, MUAP etc.

I. INTRODUCTION

Electromyography (EMG) is an electro-diagnostic medication technique for evaluating and recording the electrical commotion produced by skeletal muscles. EMG is performed by an tool called an electromyograph to create a trace called an electromyogram. An electromyograph detects the stimulating potential generated via muscle cells when these cells are electrically or neurologically activated. The signals can be analyze to notice curative abnormalities, commencement level, or enrollment order, or to analyze the biomechanics of human or animal movement. Electromyography (EMG) is the topic which deals with the identification, scrutiny and using up of electrical signals emanating from skeletal muscles. The ground of electromyography is considered in field of Biomedical Engineering plus prosthesis with electromyography is achieved beneath Bio-mechatronics. The electric signal formed during muscle activation, known as the myoelectric signal and is produced from small electrical currents generated by the switch over of ions crossways the muscle membranes and detected with the aid of electrodes. Electromyography is used to estimate and witness the electrical motion created by muscles of a human body. The apparatus from which we gain the EMG signal is known as electromyograph and the ensuing record obtained is identified as electromyogram. The human body is considered to be the speculate of nature. The performance of individual body is a mesmerizing and enthralling activity.

Movement of the human body is a great combination of the brain, nervous system and muscles. It is overall a ordered effort of the brain with 28 major muscles to manage the trunk and limb joints to construct forces needed to oppose gravity and push the body forward with minimum amount of energy expenses. The movement of the human body is achievable through muscles in synchronization with the brain. The brains throw excitation signals all the way through the Central Nervous System (CNS), whenever the muscles of the body are to be engaged for a certain activity. Muscles are junction in groups called 'Motor Units'. A motor unit is the junction point wherever the motor neuron and the muscle fibres congregate. When the motor unit is turned on, it fabricates a 'Motor Unit Action Potential' (MUAP). The commencement from the Central Nervous System is recurring continuously for as long as the muscle is required to breed force. . This sustained establishment produces motor unit action potential trains. The trains from concomitantly active motor units overlay to produce the resultant EMG signal. A group of muscles are mixed up in assured movement of the individual body. The amount of muscles conscripted depends upon the motion in which the body is involved. E.g.

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in lifting a small weight such as a tiny pebble, fewer amount of muscles will be involved as compared to lifting a heavy mass like a 6 kg weight, where the muscles employed will be greater.

In technical terms, whenever it is requisite to create greater force, the excitation from the Central Nervous System amplifies, more motor units are activated and the boot rate of all the motor units raises resulting in high EMG signal amplitudes.

E-Health is the application of Information and Communication Technologies (ICT) in all aspects disturbing to health care, counting diagnosis, tolerant follow-up and management of the organizations concerned in these activities. E-Health systems are usually very costly and offer a elevated complexity to deal with and need a continuous upholding. At the moment, the purpose of different researches is to look for a low cost way out based on the Open Source platforms, The description of biomedical signals consists of all the signals used in the diagnosis or in the medical research which are start off in some way in the body. This field has been advanced in the last two decades gratitude to the development of the signal processing. RECORDING biological electric signals is a essential chore of numerous biomedicine authorities, and is a foundation for both medical practice and basic research exploration in many fields. Even though it is a deep-rooted practice in both clinical and laboratory settings with a huge variety of commercially obtainable instrumentation, progresses in electronics continue to create alteration in the actual systems and techniques that are available for end-users.

II. LITERATURE REVIEW

Prior we cover systems that do scrutiny of muscles of arms. Now we are building this project to examine added parts of body too. We are going to create a details on result of study from diverse part of body and will construct outcome of standard results on a variety of scenario based on which further analysis can be done.

In paper [1] Noninvasive ECG and EMG Patch system is demonstrated confined signal with filter, amplifier, ADC circuit system. ECG heart rate special unevenness indication is done correlation analysis. EMG signal is muscles correlation analysis. The bio electrode structures unite bio senses system proposes a reliable method for the science technology micro-electronic product application.

Approach in [2] illustrates a structure, able to gauge a range of parameters. This enabling technologies were surface sensors used to compute the EMG signals, signal processing apply to renovate the signals in to feature sets, and pattern classifier to offer adequate robustness for the nonlinear and non-stationary nature of the basic signal data. The major confront were to pertain this categorization for HMI for the advantageous of human beings, improve the classification by applying multilevel neural networks.

In PIC microcontroller in paper [3] based Peripheral Nerve Stimulator with electromyography, PIC microcontroller facilitates to invent simple [3], quick and elastic design and completion. It generates PWM depending on selection of stimulation modes which encourages motor nerve. The action potential attained from muscle contraction is good judgment by EMG sensor, amplified and displayed on LCD in graphical format. The extent of contraction is displayed in terms of percentage, by this means making the device highly objective in terms of getting exact results during anesthesia and surgery.

In paper [4] Author 1Kittikhun Thongpull designed wireless EMG streaming system that able to operate as a real-time. By applying audio compression technique, which implemented based on existing methods for compressing EMG signals. The number of data to transfer was compact due to the compression technique.

4-bit ADPCM has generated minimal compressed data which reduced 60% from raw signal and the packet rate also decrease to 2.55 packet/s. However, the minimal of data have affected highest signal error at 34.5% from original signal. The power efficiency of the Sensor Device has been improved by a factor of 1.43. After taking 4-bit ADPCM the operated power indulgence and interactions protocol overhead, a improvement in battery life can be extended to 12.88hr.

Study in paper [5] grants a organized evaluation of agreement/accuracy performance between three publicly available algorithms which perform decomposition on indwelling EMGs. Our comparison information is important to the interpretation of results crosswise studies using different analysis techniques. For the quadrifocal experimental data, median agreement between the Montreal and Fuzzy Expert algorithms at 10%, 20%, and 50% MVC were 95%, 86%, and 64%, respectively. For the single channel control and patient data, median agreement between pairs of the three algorithms was 97% and 92%, respectively, for each pair. Agreement across algorithms and accuracy within algorithms

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were strongly related to the DI. When agreement was high between algorithm pairs applied to the simulated data, so was the individual accuracy of each algorithm. These results, therefore, provide confidence that the algorithms perform reliably on experimental quadrifilar and single channel indwelling EMGs.

In paper [6] demonstrated that it is likely to plan a system for the wireless footage biological signals from *in-ovo* chicken embryos, based on a low-cost discrete component architecture. All system components were designed, built and tested; the performance is perfectly well-matched with the requirements and the design assessments, and the system is fully operational and currently used to perform EEG/EMG recordings. More than 90 high-quality, continuous multi-day recordings have already been made. Moreover, the system, which is based on a straightforward all-digital architecture that makes use of a microprocessor, can be easily customizable by software modifications to adapt it to many different scenarios.

The main aim of the proposed system is to design and implementation of body nervous system response monitoring using electromyogram technology. The system will detect the electromyogram signals from different area of body which will detect the strength capacity of muscles and convert it in to measurable or understandable data or graphical format. This collected data from EMG module will help in conditional analysis of body muscle. So the following are the main objective of the system,

III. PROBLEM STATEMENT

- To identify the muscle reaction ability and capacity in the form of electric signal from different area of body.
- To alter electromyogram signals in the form of standards or codes and plot it lives over graphical tools.
- Store and manage all records for further analysis in biomedical sense.
- The system which we are building is wireless wearable device which is portable. Earlier systems are wired. Earlier system provides only muscles analysis of arms. We are making wearable device which will show results of more than one part. We are aiming to make reports on various activities of different persons. How the result varies from normal to patient. We will generate reports by testing different individuals and make standards based on output.

IV. PROPOSED SYSTEM

Proposed system is to design and implementation of body nervous system response monitoring using electromyogram technology. The system will notice the electromyogram signals from different area of body which will spot the strength capacity of muscles and translate it in to measurable or understandable data or graphical format. This will aid in conditional investigation of body muscle. The voluntary contraction in human skeletal muscles which may be regarded as an electromechanical transducer, takes place whenever they are active. It produces two phenomena, force and a bioelectrical signal recorded as the electromyogram EMG [1]. Surface electrodes may be worn to pick-up the myoelectrical signal. This noise-like signal is an interference pattern which is the temporal and spatial sum of action potentials from all the motor units in the region of the detecting electrodes.

Most EMG measurements are intended to obtain an indication of the amount of electrical activity of a given muscle or group of muscles, rather than of an individual muscle fiber. The action potential of a muscle fiber has a fixed magnitude, regardless of the intensity of the stimulus that generates the response. Thus, the intensity by which the muscle acts does not increase the net height of the action potential pulse but does increase the rate with which each muscle fiber fires and the number of fibers that are activated at any given time. The EMG waveform appears very much like a random noise waveform, with the energy of the signal as a function of the amount of muscle activity and electrode placement. So, the amplitude of EMG signal can act as a signal to the activity. Unfortunately, this way is only a rough indication of the amount of muscle activity. The most meaningful method of quantifying the EMG signal is the time integral of the EMG waveform.

Surface EMG electrodes bring in a non-invasive technique for measurement and detection of EMG signal. The theory at the back of these electrodes is that they figure a chemical stability between the detecting surface and the skin of the body through electrolytic conduction, so that current be able to run into the electrode.

These electrodes are easy and very simple to implement. Application of needle and fine wire electrodes entail strict medical supervision and certification. Surface EMG electrodes need no such formalities. Surface EMG electrodes have

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bring into being their use in motor behavior studies, neuromuscular recordings, sports medical evaluations [9] and for subjects who object to needle insertions such as children. Separately, surface EMG is being increasingly used to detect muscle activity in order to control device extensions to attain prosthesis for physically disabled and amputated population.

Surface EMG has some boundaries as well. Since these electrodes are applied on the skin, hence, they are generally used for superficial muscles only. Crosstalk from other muscles is a major problem. Their position must be kept stable with the skin; otherwise, the signal is distorted.

V. RESEARCH METHODOLOGY

The voluntary contraction in human skeletal muscles which can be regarded as an electromechanical transducer, takes place whenever they are active. It manufactures two phenomena, force and a bioelectrical signal recorded as the electromyogram EMG. Surface or needle electrodes may be used to pick-up the myoelectrical signal. This noise-like signal is an intervention pattern which is the temporal and spatial summation of action potentials from all the motor units in the region of the detecting electrodes. EMG signal has little amplitude level, fewer than 1 mV and its frequency response attained only into the few kHz regions.

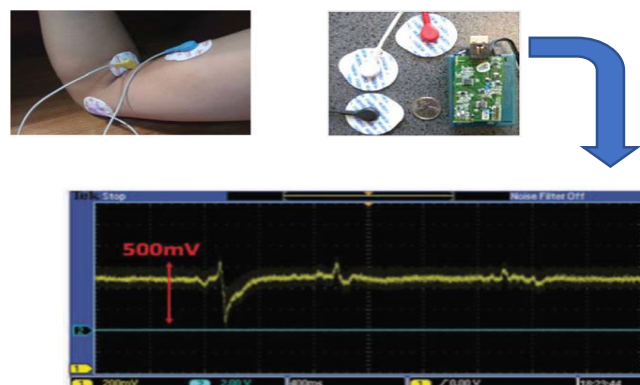


Fig. 1.0 System process Flow

Figure 1.0 describes the basic process flow of proposed system where electrodes will be linked to the muscles area all along with the reference voltage electrode. These electrodes will sense the low voltage collected crosswise the reference voltage and the collecting points. These signals are extremely low and want to strengthen before transferring it to microcontrollers ADC port for further processing hence the instrumental amplifier circuit will intensify the signals and conditioned it. These signals are then fed to computer system for further analysis and computer software will plot the signals in graphical format. Following are the stages involved in complete system development.

- Plan and make a myoelectric signal or electrodes generated signal detector circuit.
- Build up a signal amplifier circuit that will next magnify the electrode signals and outdo it to ADC of microcontroller.
- Develop a microcontroller based development board.
- Design and develop embedded program to renovate these signals in to particular action or codes and pass those codes to PC system for further examination.
- Develop computer software for data analysis.

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Modules Details:

Module 1- Microcontroller setup for taking input voltage generated.

- Selection of microcontroller board.
- Working with Atmel Studio 6.0.
- Reading value from ADC port.
- Working with LCD of development board.
- Dumping/ Writing program into microcontroller.

Module 2- Design and development of signal acquisition circuit.

- Instrumentation Amplifier
- Noise reduction circuit
- Filtering
- Voltage conversion for ADC

Module 3: Interfacing of microcontroller Unit with PC through serial communication.

- Serial communication will be wireless using Bluetooth.
- Reading incoming data on serial data reader software like HyperTerminal.

Module 4: Implementation of user interface in Visual Studio.net.

- Serial port class for serial port data reading (USB).
- Chart control for displaying various class (Graphical Analysis).

Tools for Development

System Tools

Operating system: Microsoft windows XP or greater O.S. Version

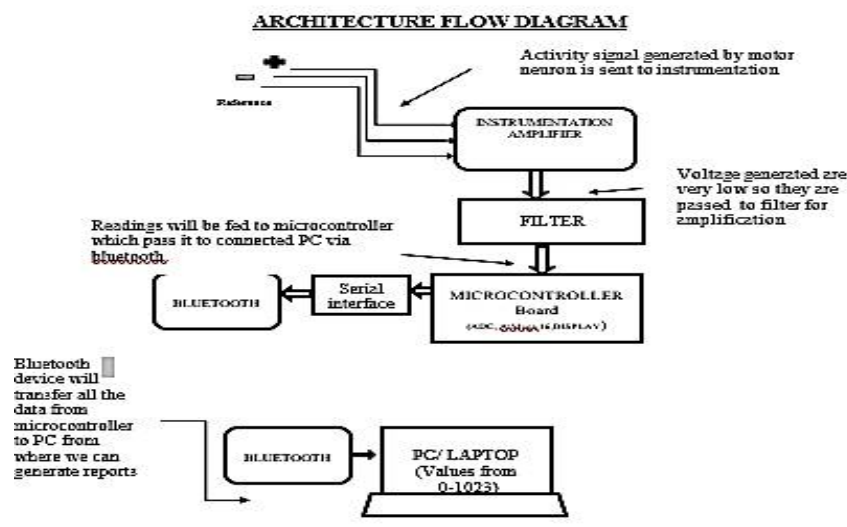
Development tools: Microsoft dot net 2010 (For windows application).

Embedded 'C' (For Atmega16 Programming)

Hardware:

- Disposable Electrodes
- Electrodes snap lead cables
- Signal amplifier circuit
- AVR Development Board
- ISP Programmer
- USB to Serial interface circuit

Architectural Flow Diagram



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VI. ADVANTAGES

- Simple and easy to operate.
- Small size and low power consumption.
- Low cost.
- A built - in filter to eradicate the Ac interference and other types of artifact.
- High CMRR, high input impedance, and elevated control gain amplifier.
- Good stability, bipolar surface electrodes have been used.
- They require no more than a brackish solution to soak their felt tips. The processing stages which serve the sport field applications are bring into being after their requirements have been translated into these stages.
- The system unquestionably will boost its performance when a multichannel recorder of high frequency response is used. From the obtained results, some points may be concluded:
- The amplitude of EMG signal serves as a semi qualitative indication of muscle activity.

There is a linear relationship between muscle electrical activity and tension level. Males provide less activity than what females contributes to reach the same level of tension. As the tension level increases, the EMG signal seems to contain higher frequency components.

VII. EXPECTED OUTCOME AND FUTURE SCOPE

Using this technique, the system will discover the electromyogram signals from different area of body that will detect the strength capacity of muscles and convert it in to measurable or understandable data or graphical format. This collected data from EMG module will help in conditional analysis of body muscle. With the help of this technology we can identify the muscle reaction ability and capacity in the form of electric single from different area of body and can convert electromyogram signals in the form of values or codes and plot it live over graphical tools. Apart from that there is possibility to store and manage all records for further analysis in biomedical sense.

In future, based on the analysis we can even detect the disease of the organ. The major challenges faced are: electromechanical implementation, use of EMG control signals and the interface between robotic and clinical communities [26]. Designing a robotic mechanism which is fully capable of integrating with human neuromuscular system is a tough proposition. The requirements can only be fulfilled if the apparatus is of light and flexible material with small but powerful actuators, size effective electronic components, sensors which can easily adapt with the skin and a long lasting battery life. Only then the machine will qualify to be used in everyday practical life. The human hand has 20 degrees of freedom, and the body works in a unique variety of ways to tackle various hindrances placed in front of it. It is therefore, a great challenge to extract all of these motions from the body and utilize them in a resourceful way. Nowadays, two degree of freedom mechanisms are most common. To achieve further DOFs, sensors will be required to be placed at more sophisticated locations, which is a tough task.

VIII. CONCLUSION

Designing the EMG based muscles reaction detection system will help the biomedical researchers investigate the effect of different muscles connected problem in diverse scenarios. The proposed biometric system uses the physiological data of the human body to try to discover the differences between people. This can be achieved using Galvanic Skin Response (GSR), Electromyogram (EMG), and Electrocardiogram (ECG), being parameterized statistical data and Shannon entropy. The conclusion taken out is that biomedical signals are a promising source for biometric identification simultaneously they are used to monitoring patients. In particular, GSR, ECG and EMG gives good results when featuring them and using a blend of these features in a neural network. Taking into account that the results in this area can be obtained in a proposed approach.

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