

DESIGN AND CONTROL OF VIRTUAL EMG BASED MCI FOR REHABILITATION PEOPLE

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Abstract - This paper conducts a detailed investigation into the characteristics that electromyography (EMG) signals can represent the human body's motive purpose and details of muscle's motive state. Simultaneously, EMG signals may represent the characteristics of limb movement and its shifting laws, as well as gain the performance properties of limb movement, allowing for an appropriate evaluation of patients' recovery status. Our project aims to develop prosthetics for above-knee amputees, with an emphasis on obtaining EMG signals from the calf muscles of the healthy leg and processing them to generate control signals to actuate the prosthetic leg's knee joint using a microcontroller. We intend to create a low-cost, water-resistant, and simple-to-fit prosthetic leg. We created a mechanical system that can function without the use of a corresponding body part. It is used for patients who are differently abled or people who have lost a functioning part of their body due to an injury.

Key Words: Virtual reality, Rehabilitation system, EMG data extraction, Pattern recognition.

1. INTRODUCTION

With the modernization of the world, even virtual reality has developed rapidly. It has become a new type of rehabilitation therapy, because of its benefits, such as repeated recovery instruction without supervision, interactivity and immersion in a computer simulation, robotic rehabilitation, and guidance. EMG signal is a type of non-stationary weak signal that can represent skeletal muscle activity and nervous system command information. EMG signals may represent the state of limb muscle activity, including movement purpose and movement functions information, and have the advantages of real-time interaction, skin non-invasive operation, safety, and convenience, making them popular in stroke rehabilitation. Providing users with solutions that help them to measure their food intake and collect dietary information are the most valuable insights towards prevention and treatment. EMG signal and virtual reality technologies are mixed in order to integrate the virtual reality's features, real time, stability and immersion.

This project allows leg amputees with the use of EMG sensors to perform efficiently. Manual work is reduced with the use of artificial machine as in actual systems. It executes an appropriate replacement for a normal leg that can handle almost all human leg functions. It provides a recovery solution for amputees in order to enhance their mobility and their ability to perform everyday tasks.

The rotation of an engine of the knee joint with implantable EMG signals from a healthy leg was regulated during the process. The complete prosthesis allows users to move more quickly. The main purpose of this work is to improve the low-cost amputee myoelectric limb. Sensors or electrodes sensed EMG signals. The surface EMG signal amplitude ranges between mV and V. On the basis of EMG signals, a microcontroller was designed in steps based on the DC voltage level to go forward and backward. The dc voltage levels were taken for the EMG signal.

2. RELATED WORKS

[1] "M. Zecca, S. Micera, M. C. Carrozza and P. Dario, Control of Multifunctional Prosthetic Hands by Processing the Electromyographic Signal". Voluntary EMG is the product of voluntary muscle movement and deliberate brain action. For knee rotation of the engine, volunteer EMG from thigh muscles is used. It is necessary to carefully evaluate the skin condition and acceptability of the EMG signal intensity of this site when selecting a site for the extraction of EMG signal.

[2] "C. W. Martin, Otto Bock C-leg: A review of its effectiveness". It is made sophisticated by the use of a microcontroller in the architecture and the control process. In order to improve simple mechanical architecture, researchers have implemented microcontrollers in prosthesis knees.

[3] "K. S. Rabbani, Educational Material: Neuro-Physiological Study and Diagnosis using Evoked Responses". The higher the amount of CMRR, the greater. Such a CMRR value will show that the amplifier amplifies the signal sought and discriminates against the common fashion signal, i.e. the sound. The operating amplifiers used in the amplifier must be similarly balanced and taken from the same IC box for better performance.

[4] “P. Konrad, Signal origin and acquisition”. Electromyography is a method used to calculate the response of the muscle to nerve stimuli. The EMG Signal acquired from the surface of the skin surrounding the muscle. The joints are summaries of the electrical activity of all the MUAPs caused by movement activity.

[5] “A. Narayan, H. Dasgupta, and H. Pal, Instrumentation of a portable EMG sensor in a single PCB for human motion pattern detection”. In many areas of health, EMG signals have been important. EMG signs should be monitored regularly for illnesses such as Huntington disease, myopathic diseases or muscle disorder, and complications such as heart attacks or strokes can be timely addressed.

[6] “A. Phinyomark, R. N. Khushaba, and E. Scheme, Feature extraction and selection for myoelectric control based on wearable EMG sensors”. Works were recently created to conduct filtering analysis, to consider achieving minimum sampling frequency parameters in order to decide more favorable processing times and their implementation in portable acquisition systems.

3. EXISTING SYSTEM

The remaining body part of the amputee is simulated with an artificial leg in a biped robot with heterogeneous legs (BRHL) that gives the bionic leg the exact gait after the trajectory. In light of the coexistence of rolling and slipping between femur, meniscus and tibia it designs a four-link bionic knee. Two pneumatic artificial muscles (Pam) have been taken as extender and bending muscles in the hip, drawing on the moving mechanism of the leg muscles. Both PAMs turn in the opposite way, pushing the artificial leg movements of the knee. A closed loop controller and sliding mode controller for the bionic knee (PID) are planned for the kinetic equation of the knee. The current procedure controls the location of the bionic knee with four links.

4. PROPOSED SYSTEM

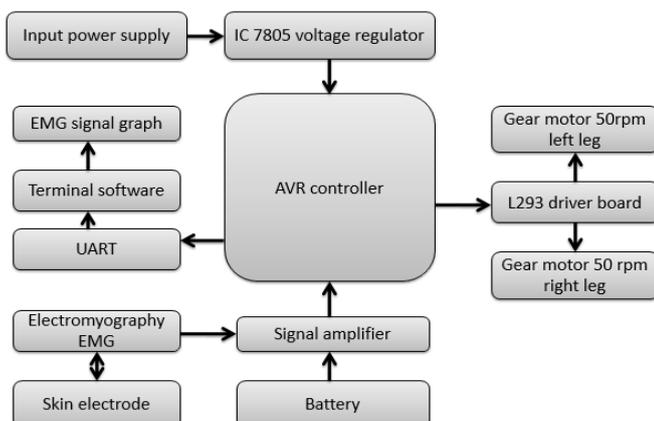


Fig-1: Block diagram of virtual EMG based MCI for rehabilitation people

The architecture, design, simulation, and the prototype of a myoelectric prosthesis leg are implemented in the proposed scheme. It uses the patient's EMG cues to guide the prosthesis leg motions. The sensor helps the operator to calculate the muscles electrical activity. It is also used for the prosthesis system control. The signal obtained from the patient's body is sent to the microcontrollers after proper processing and uses the collected muscle signal as an input for driving motors, which are connected to the prosthesis leg in turn. The amputee was carrying the leg which triggered the control system.

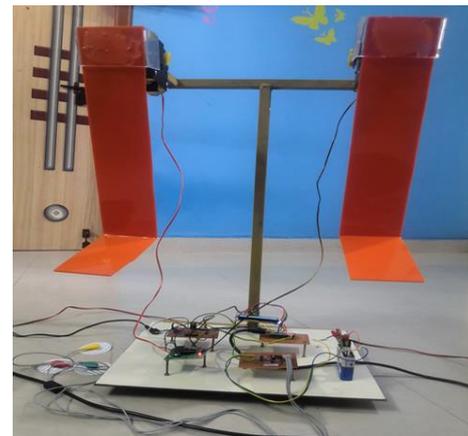


Fig-2: System design

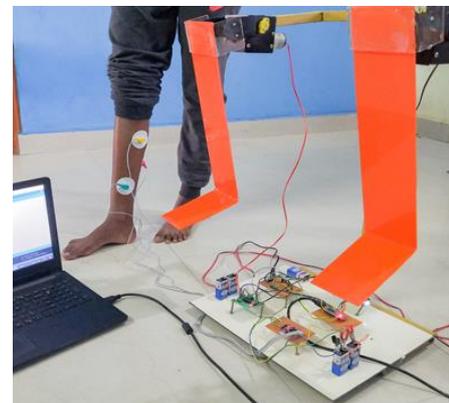


Fig-3: Muscle connected to the rehabilitation system

4.1 Hardware Specification

- Nano Microcontroller
- Battery
- LCD
- Power supply
- Voltage regulator
- EMG electrodes
- UART
- L293 driver board
- Gear motor

4.2 Software Specification

- Embedded c
- Terminal software
- Keil C

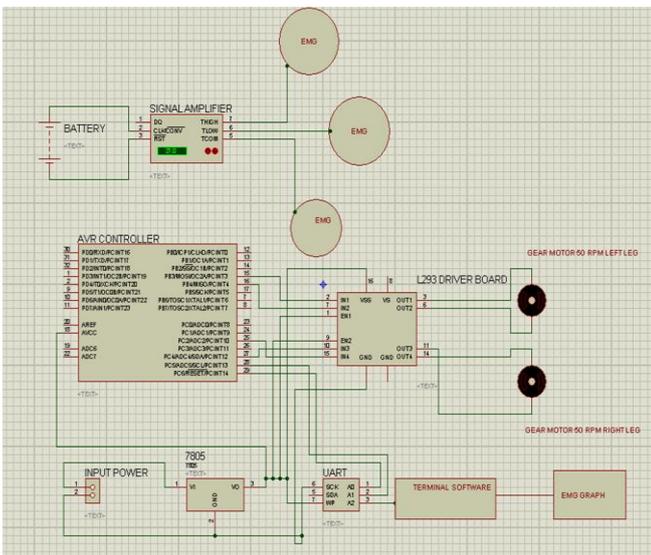


Fig-4: Circuit diagram of Rehabilitation System using EMG

5. EXPERIMENTAL RESULT

After retrieving the local entropy ability of wavelet network and pattern recognition, the experimental results indicate that the recovery training system will correctly receive the subjects' subjective motion goal. This highlights the relevance of an EMG-controlled rehabilitation training system in achieving the subjects' autonomous rehabilitation.

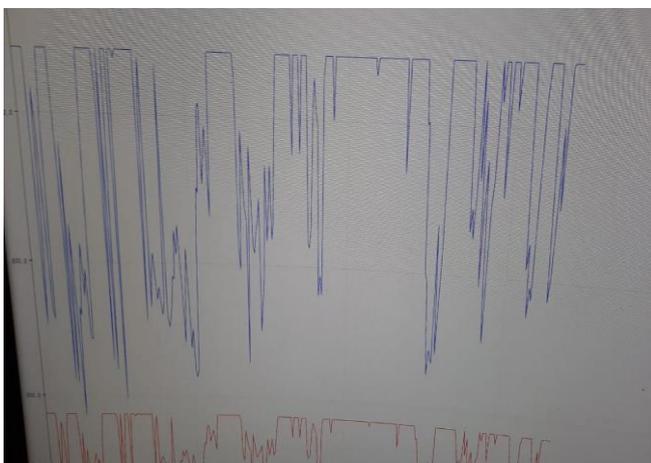


Fig-5: EMG signal

6. CONCLUSION

We used an effective method to track the patients' muscle function in this project. The EMG electrodes used in this system performed better in sensing EMG signals produced in the patients' lower limbs. The detected signals would then be sent to the signal amplifier, which would intensify the signal since it is small. The amplified signal will be sent to the controller, which will process it according to the specifications before being displayed in Terminal. On the computer, there is software. As a result, our machine successfully incorporated the tracking of EMG signals, allowing us to track the muscle movement of the patients' lower limbs. We'll be able to regulate the leg's activity with better tracking. With a high utilisation rating of about 92 percent, our system performs better.

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