LOW – COST HUMAN HAND PROSTHETIC USING EMG SIGNAL WITH THE HELP OF MICROCONTROLLER (AURDINO, GYROSCOPE, ACCELROMETER)

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Abstract - *The main aim of the project is to create a cost effective prosthetic arm controlled by the surface EMG .The loss of a limb can be a very traumatic experience for a person. Prosthesis is one of the best solutions for it. Prosthesis means the replacement of a missing body part with an artificial substitute. Prosthetics are gadgets that can help re-establish a portion of the usefulness to the user. It consists of mechanical parts and a processor to control it. The prosthesis is designed with basic movement and grabbing features, the design has been done with care so that it can be extended to other hand-movements. Be that as it may, without insurance, prosthetic can be astoundingly exorbitant, making enthusiasm for more proficient and more affordable prosthetic. Our research uses an Arduino microcontroller to outline a minimal cost prosthetic that uses EMG signals from the leftover limb and power servos for movement. The EMG signal is a little electrical current that is generated when a muscle is (*Placeholder1) *contracted. The measurement of the electrical activity of the muscle is the result of a signal generated in the brain which is transmitted through the nervous system to the motor neuron attached to the muscle fibres in the muscle [1]. This paper presents an approach to achieve adaptive grasp of unknown object with the help of human hand prosthetic*

Key Words: **Electromyography (EMG), aurdino, gyroscope, accelerometer, Myoelectric, and transradial amputation.**

1. INTRODUCTION

Prosthetics is the evaluation, fabrication, and custom fitting of artificial limbs, known as "prostheses" [1]. Sorts of Prosthetics: the upper limb prosthetic can be categorized by the degree of amputation. For example, in the upper limb a transhumeral amputation refers to a severing of the arm above, distal to the shoulder, while a transradial amputation refers to a severing below the elbow. So also, the transfemoral and transtibial removal disjoin the leg above and beneath the knee.

One of the most common systems for prosthetics is myoelectric system. Myoelectric prosthetics are controlled by muscle signals that are given off by the residual limb. Generally, these signals are recorded by utilizing electromyography, or EMG. Surface electrodes are set on the skin of human remaining limb to get the signals that are exchange down the nerves to limb.

1.1 ELECTROMYOGRAPHY (EMG)

Electromyography is a technique used to pick up signals produced by the nerves in target skeletal muscles. These signals are grabbed by electrodes and sensors and afterward changed over into an digital signal by an encoder. Electromyography is the instrument which is used to obtain the EMG signal and the resultant record which obtained is known as electromyogram. The estimation of the electrical action of the muscle is the aftereffect of a signal generate in the cerebrum which is transmitted through the sensory system to the motor neuron connected to the muscle fiber in the muscle. This electrical activity produces an electrical signal in the muscle which can be picked up by well-placed electrodes on the surface of the skin [1]. The obtained signal is EMG signal. This signal comprises of a progression of spikes whose amplitude relies upon the measure of power conveyed by the biceps– the more stronger the contraction of the muscle, the bigger the amplitude of the EMG signal [1]. The frequency of the spikes is the terminating rate of the motor neurons. Since the amplitude of the EMG signal is specifically identified with the force applied by the muscle. The EMG signal is very noisy and of the order of micro volts. Faithful extraction of the EMG signal is the prime objective. Since the EMG signal levels are too low to be directly captured by the computer, it is required to feed the signal to signal conditioning unit consisting of amplification rectification and final filtration of the signal. The output of the signal conditioning unit is then converted to digital signal. This digitized signal is used as feedback and control signal for final control of the robotic arm.

The microprocessor can read include from an assortment of sensors and can control different outputs, for example, sound, light, and motor. We are using Arduino Uno as microprocessor because it is relatively compact and quite functional.

1.2 Why use Arduino?

According to Arduino website, Arduino is ''an open source electronics prototyping platform based on flexible, easy-to-use hardware and software." Arduino can be used to make interactive objects or environments. Frequently, the Arduino microprocessor is associated with a breadboard which houses the distinctive portions of the circuit, for instance, resistors and capacitors. The Arduino can read input from a combination of sensors, for instance, touch, and can control diverse output, for instance, sound, light, and motors. The Arduino programming language is approximately in view of the C programming language. There are four basic parts of language: expressions, statements, statement blocks, and function blocks. Expression combines operands and operator. This can be utilized to set factors, add to functions, and so on. Statement finishes a guideline wanted by the software programmer. Statement block comprise of at least one statement assembled together so they are seen by the compiler just as single statement. Generally, these are otherwise called loops (if, else if, for, while, and so forth.). The function block, otherwise known as method, is a block of code intended to finish a solitary task. What separates Arduino from different other microcontroller board is its convenience, rather cheap cost, and extraordinary usefulness. This is the reason we ran with utilizing Arduino. Additionally, we had a little knowledge in the programming language and its different uses.

We are also using gyroscope and accelerometer as helping microcontroller with arduino.

Gyroscopes measure rotational movement in degrees every second. They won't specifically reveal to you data about tilt, just movement around an axis. Accelerometers measure acceleration, you can without much of a stretch utilize this data to ascertain the tilt of a object by subtracting the present accelerometer information from a value that you know to be zero tilt.

2. RESULT AND DISCUSSION

The metals used in the construction of the arm are of ~0.5-inch and ~0.3-inch diameter aluminum pipe. I ran with aluminum since it is amazingly moldable, adaptable, and lightweight. For prosthetics, being lightweight is a key fragment, or if nothing else life-like. The elbow was picked because it was the least complex of movements, flexion and expansion, diverged from the wrist or fingers, which have an immense measure of movements. The finger joint made of The 0.5-inch aluminum pipe and extraordinarily composed hinges made out of a thin sheet of aluminum. After beginning this task, I was exceptionally ambitious. My underlying thought before proposing the project was to work with making a low cost human hand prosthetic.

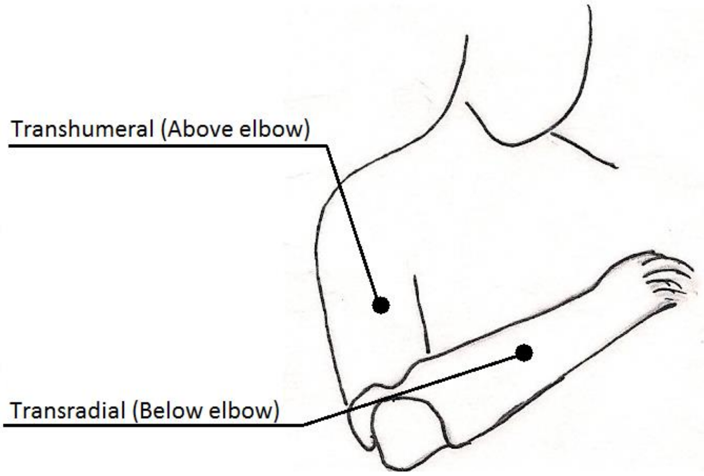

Fig.1. Categorization of upper limb prosthetic

I first began by wiring up the Motor Shield in order to get the servo motors moving. A servo consists of three basic parts: an electric motor, a feedback potentiometer that connects to the output shaft, and a controller. This allows the servo to rotate to specific angles by keeping track of its current angular position. I faced many problems in shaping the finger joint especially the thumb with aluminum pipe and wiring the circuit for the servos and microcontroller.EMG should be attached to residual limb, as well as to the Arduino Uno microcontroller. In the processing the arduino code there is an import for the processing.serial library. This allows for arduino talking with other microcontroller (6DOF MPU-6050 Module) and display and saving the EMG data. However, when trying to compile the program, there was a processing.serial error, specifically, it was not allowing me to import the processing.serial library into the Arduino program. Without this library, I would have no way to visualize the results of the muscle contractions. After extensive troubleshooting, I was not able to resolve this problem. Since the Muscle Sensor was not working very well, I focused more on the motor movement itself. Ideally, I wanted to have the motor flex arm a certain degree, and then move back to its original position after a certain amount of time. There are various example codes in the Arduino library that assisted me in working with this undertaking. By using the servo library. I was able to set the swipe angle in order to achieve the desired distance that the arm would move, as well as be able to release it back to its original position after a given time.

Had time permitted, I would have run an experiment using a number of subjects to measure the EMG activity from their biceps brachia muscle. Surface skin electrodes would be placed on the residual limb muscle group of each of the subjects. This real time information would have been imputed into the Arduino Processing data provided by the EMG sensor. This data would then have been perused by the Arduino, and once the muscle contraction surpassed that predefine amplitude, the motor would move until the point when contraction stops. Upon relaxation of the muscle, the motor would have moved reverse and the arm would have moved back to its original position.

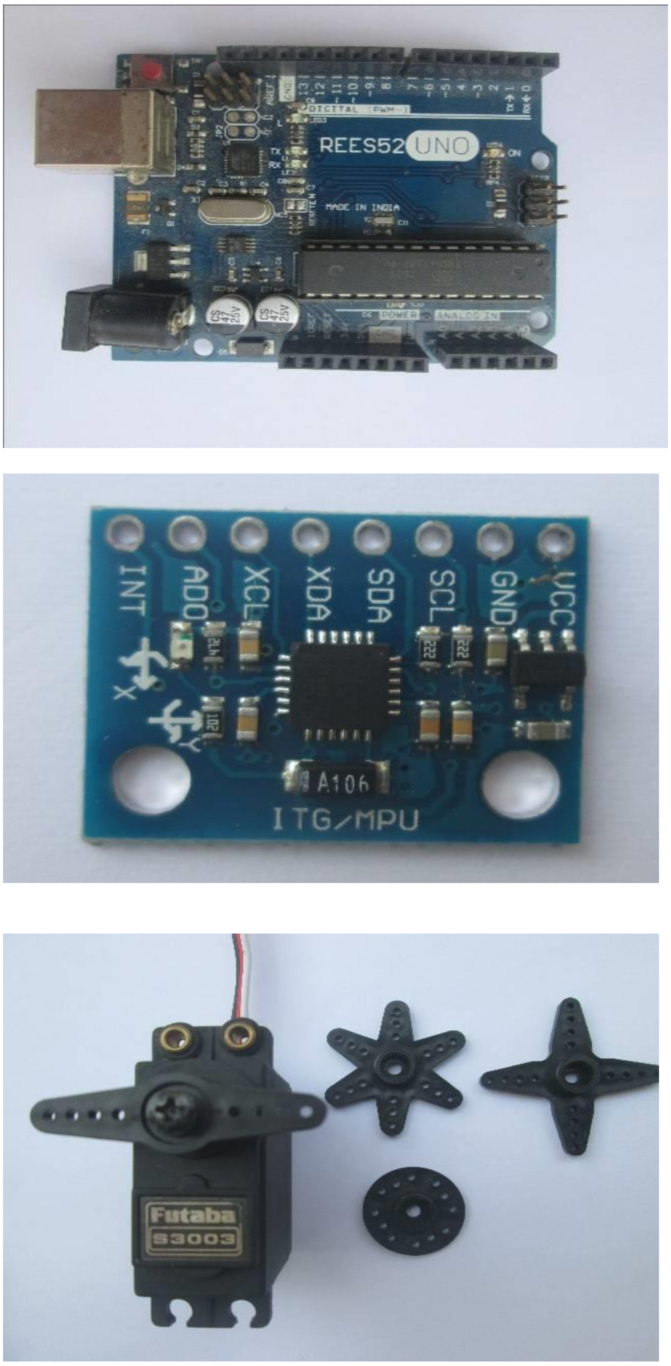

Fig2.(a) Arduino Uno (REES52). (b) 6DOF MPU-6050 Module 3- Axis Gyroscope Accelerometer Module for Arduino. (c)S3003 Servo Motor

3. CONCLUSION AND FUTURE WORK

Overall, the project shows how versatile Arduino can be. The concept behind the project holds, in that using Arduino provides a cheap and effective way to create or tweak a myoelectric prosthetic. The current design I created is basic and can be upgraded with a little imagination and hard work. The metals that were used were relatively cheap. The Arduino itself, along with the motors, shield, and sensors, total roughly 2000RS. The Arduino arm may not be as sturdy or versatile as these more advanced prosthetics, but the ardiuno controlled human hand prosthetic is versatile and can aide in your research for design for a new limb. Arduino software is very open, and anyone with a creative mind can put to great use. It can be further improved with highest possible dexterity and with 3D printer proper size and proportions of prosthetic hand can be made , with carbon fibre material its weight can be reduced which will provide good comfort for the wearer and Efficient control with appropriate robustness. Finally, besides reducing the cost of the arm, even though it is low cost as is, more research can be done on increasing the amount of functionality in the arm.

4. REFERENCE

[1] http://www.columbia.edu/~njr2121/mark-novak.pdf