Sri Siddhartha Institute of Technology

(A CONSTITUENT COLLEGE OF SRI SIDDHARTHA ACADEMY OF HIGHER EDUCATION)

Maralur, Tumakuru - 572105

ELECTRONICS AND COMMUNICATION ENGINEERING

PHASE – I PROJECT

SEMINAR ON

MYO-ELECTRIC HAND:
PROSTHETIC HAND REPLICATION USING EMG BASED APPROACH

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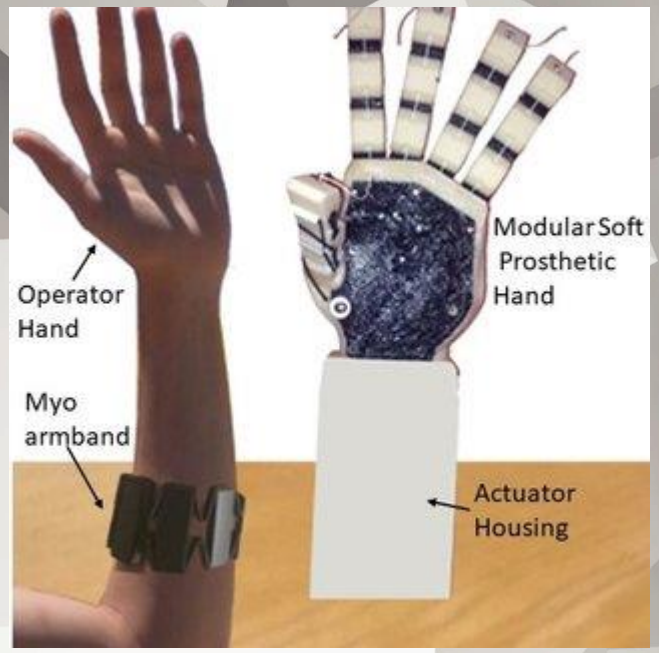
Myo-Electric Hand: “Prosthetic Hand Replication Using EMG Based Approach”

Final Year BE Project Phase-2 Seminar



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1.INTRODUCTION:

- The human body contains many parts and out of these, hand is one of the vital part. Hand parts are very gentle and intricate structure.
- This gives muscles and joints in the hand part a wide variety of actions and accuracy.
- Having the ability to perform important essential actions symbolizes multiple degrees of freedom and is capable of performing integrated functions.
- Joints provide the convenient freedom of movement and muscles serve to transfer rigid segments on each other.
- The present developments in science and engineering technologies have led to the development of prosthetic hand based on muscle operated sensors.

INTRODUCTION CONT. :

- Prosthetics are non-natural devices designed to replace a missing body part, for example a leg or a hand.
- The working principle of prosthetics is based on EMG signals. EMG is abbreviated as Electro Myo-Graph.
- EMG signal is nothing but study of electrical signals in muscles.
- The nervous system in our human body controls the contraction and relaxation activities of the muscles
- This signal is a complex signal and is dependent on the anatomical and physiological properties of the muscle movements.
- The EMG signal gets corrupted with noise as it encounters different tissues in the human body.

1.1 MOTIVATION :

- Approximately 1 in every 200 people in India has undergone an amputation.
- Annually, in India, approximately 156,000 people go through an amputation operation, and, there are currently over 1.7 million people in India with an amputated limb.
- Amputations (because of trauma) have been declining over recent years, as have amputations from cancer.
- Costs Of Arms range from 150K Rs to 360 K Rs depending on functionality and different features.
- Artificial Organs need to be created to replace Human Organs
- There Is no Cheap Alternative For Amputees

MOTIVATION CONTD. :

- When it comes to replacement of hands and legs there is no easy and cheap alternative to it.
- Such people cannot perform functions which require using the hand, not even routine
- activities in day to day life such as holding the objects, moving them, eating and other such similar functions.
- Broadly speaking, these people are not self-sufficient, but they muscles in the remaining part of the arm which functions in a normal way
- So we can extract EMG signals from the remaining part and can be used in limb replacing techniques.

1.2 PROBLEM STATEMENT:

- People with physical disability are facing issues every day for living day to day life
- Amputees face a Psychological Barrier when it comes to the looks and Aesthetics of the body
- Amputees cannot overcome the hurdle of creating their Career as they had dreamed all their life
- Researchers and scientists are working on brain signals controlled bionics hand but it is not 100% workable with everyone as it needs lot of practice for one to operate

PROBLEM STATEMENT CONTD. :

- It will be too Expensive for the middle class and poor people to afford.
- Hand is one of the important parts in a human body and the people who are not having part of hand or whole hand by accident or by birth has lot of obstacles in doing their works.
- There are plastic molded hands but it serves no help in doing the tasks.
- Then we need to overcome the issues of weight , comfort.
- Then we need to provide Accurate and Precise Prosthetics

2.Literature Survey:

Title of the paper	Publications Details	Authors	Methodology	Remarks
TRS Prosthetics Innovative, High performance body powered prosthetic technology	Sage Journals TRS Prosthetics Innovative, High performance body powered prosthetic technology	Bartjan Maat, Gerwin Smit, Dick Plettenburg, Paul Breedveld	The value for the "Potential prosthetic hand users" is the sum of all respondents who use or could use a prosthetic hand	Passive prostheses have received very little attention in prosthetic research and in the literature. Often little function value is attributed to passive hand prostheses when compared to active prosthesis
Design and Control of Artificial Robotic Hand	IEEE 2014 International Conference on robotics and Emerging Allied Technologies in Engineering	Ali Bin Junaid, Muhammad Raheel Afzal, Tahir Rasheed	Techniques are available for dynamics analysis of the system. Forward kinematics method is useful to estimate the position of the fingers in x-y plane.	60% accuracy in gripping functionality and low cost product using two methods which include flex sensors and the processing the data received.

The WILMER Passive hand Prosthesis for toddlers	JPO Journal of Prosthetics and Orthotics	Plettenberg, Dick H. PhD, MSME	The hand features an easy to control passive prehension function. The movements of the fingers are mechanically coupled to the movements of the thumb. Pressing against tips, hand opens and by tilting the object can be grasped	Provides prehensile function where the hand features a low-mass construction which is reliable in clinical tests.
Prosthetic Arm Control using Electromyography(EMG signal)	International conference on Advancement in Electrical and Electronic Engineering \ 22-24 Nov,2018 , Bangladesh	Md. Raju Ahmed, Rupayan Halder, Muslim Uddin, Ashish kumar	The prosthetics arm functions on the basis of EMG signals collected from the human skin surface. Collected EMG signals are processed and then employed to control prosthetic arm.	EMG signals from human biceps for elbow controlling will be captured. Signal amplitude below and above threshold limit may be found at relaxed and flexed condition of the hand.

A Low Cost Bionic Arm Based on Electromyography Sensor	IEEE Signal processing Society 2020 International conference	S.Bhavani, K.Lokesh Krishna, R.B.Yogananda Reddy, T.geethika	Myoware sensor is utilized in this work to record the electrical activity produced by muscles in the arm. 3-D printed Hand palm section where the movement of the wrist will control the opening or closing action of fingers.	A natural human hand can exhibit hundreds of various gestures. But the bionic arm in this work is designed to perform limited gestures such as point, fist, rest, pinch, wrist flexion and rock.
Design and Development of Real Time Bionic Hand Control Using EMG Signal	IEEE International CONNECT Conference 2018	Praveen L S, Naganand S N, Dr. Preetham Shankapal	EMG Data Acquisition to extract features and are used to control Bionic hand. Using a Bionic hand interface with a controller.	This model helps in development of bionic hand models which can be tested for lower elbow amputees.

An Advanced, Low Cost Prosthetic Arm	SENSORS, 2014 IEEE	Ciaran O'Neill	Electromechanically actuated hand is controlled by EMG sensors placed on the residual wrist flexors and extensors. Flexion of the wrist causes the hand to close while extension forces the arm to open. This allows for variable rate open and close commands for the hand. The use of different pre-programmed grip patterns such as a power grip or a pinch grip allows for greater dexterity and flexibility.	The device was trailed with able bodies test subjects, all test subjects had little to no issue with controlling the arm once the electrodes were correctly placed. achieving some of the thresholds required to switch modes. The device is easy to manufacture, simply requiring access to a hobby level 3D printer and a small number of hand tools.

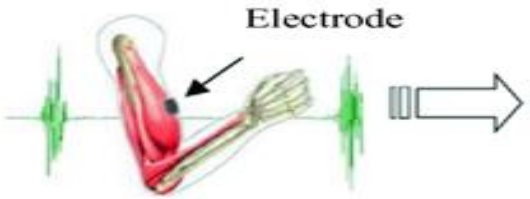
The Development of Body-Powered Prosthetic Hand Controlled by EMG Signals using DSP processor with Virtual Prosthesis Implementation	Hindawi Conference papers in Engineering	Fathia H.A.Salem, Khaled S. Mohamed, Amal A.El Gehani	The proposed system is based on the use of EMG Signals to support the mechanism of the body-powered prosthesis. The proposed system was established through two stages to extract EMG signals and position on the stump.	The development of the body-powered prosthetic hand is meant to help this marginalized group in Libya and that can be done by just inserting electronic circuits. This upgrade of body-powered prosthetic offers great comfort to the patient. However, the recognition stage was simple, and the predictions of the movements were very good.
Passive Hand prostheses	Hand Clinics, 01 Feb 2003	Soltanian H, Beasley RW	The purpose of passive prostheses is to minimize the physical, emotional, social, and economic consequences of deformities. Also, it is fundamentally necessary to appreciate the high level of specificity of all hand prostheses.	Literature indicates that passive prostheses can be improved on pulling and grasping functions. In the literature, ambiguous names are used for different types of passive prostheses.

3. METHODOLOGY:

3.1 INTRODUCTION:

- The proposed system is based on the use of EMG signals to support the mechanism of the prosthesis.
- For the aim of the project, the proposed system was established through two stages as follows.
- A software that is responsible for extracting the EMG signal from the patient and analyze it to figure out the most suitable position on the stump of amputee to collect the signals, and a view of the planned GUI interface is illustrated in the below Figure.
- Also, this software can help to train the patient how to control the three-dimensional hand in the program created using CAD.

Connection Diagram:



EMG Signal processing circuit

Training Mode / Practical Mode

Training Mode

Serial Data

Processing IDE

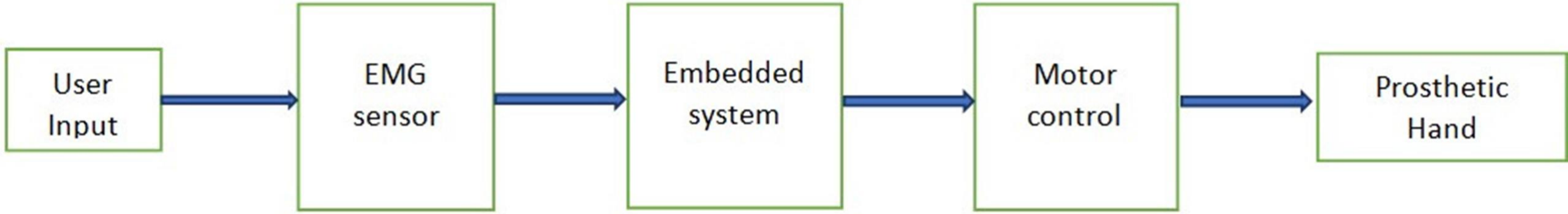
Hand Design in Simulation

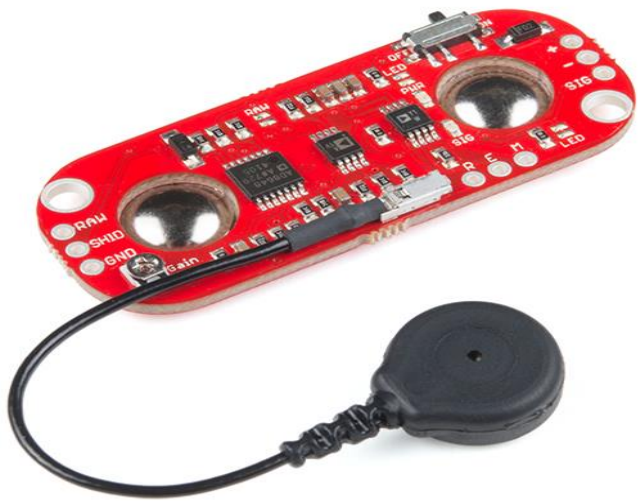
Practical Mode

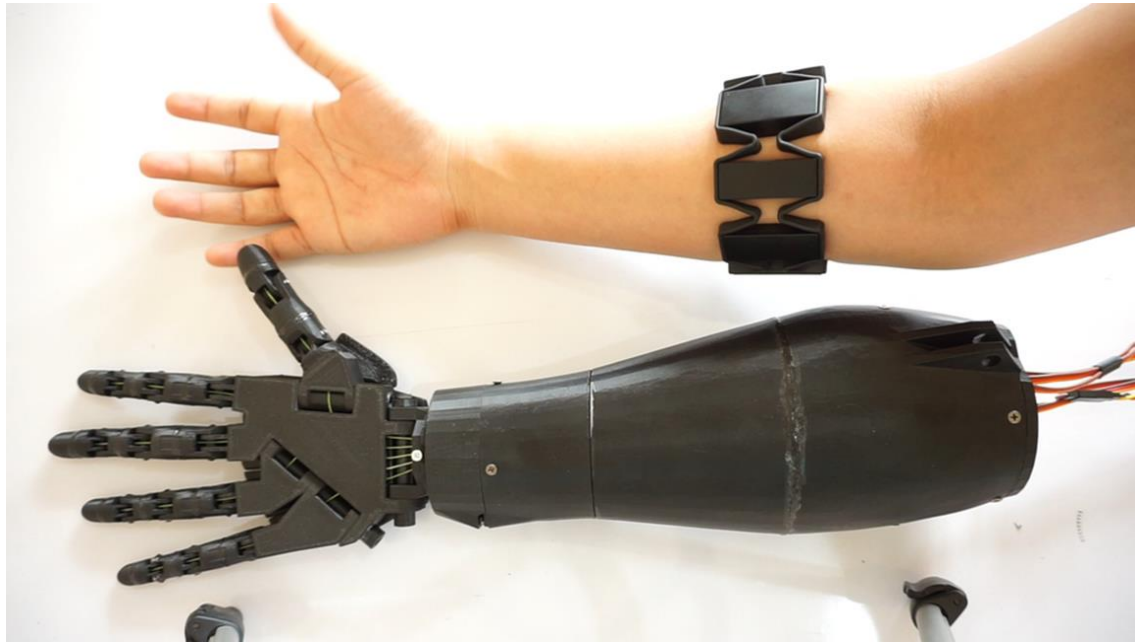
5 Servos

Prosthetic Hand

3.2 BLOCK DIAGRAM:







3.3 HARDWARE AND SOFTWARE :

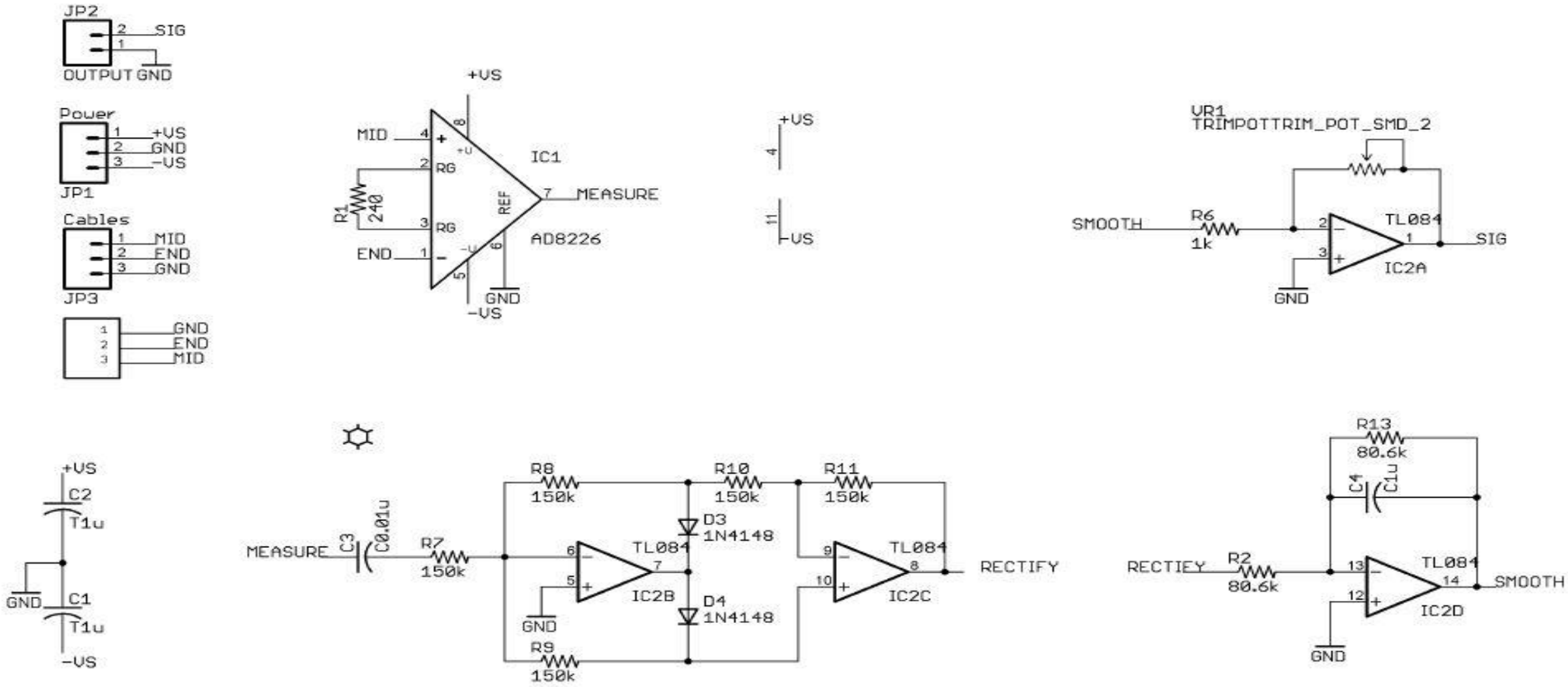
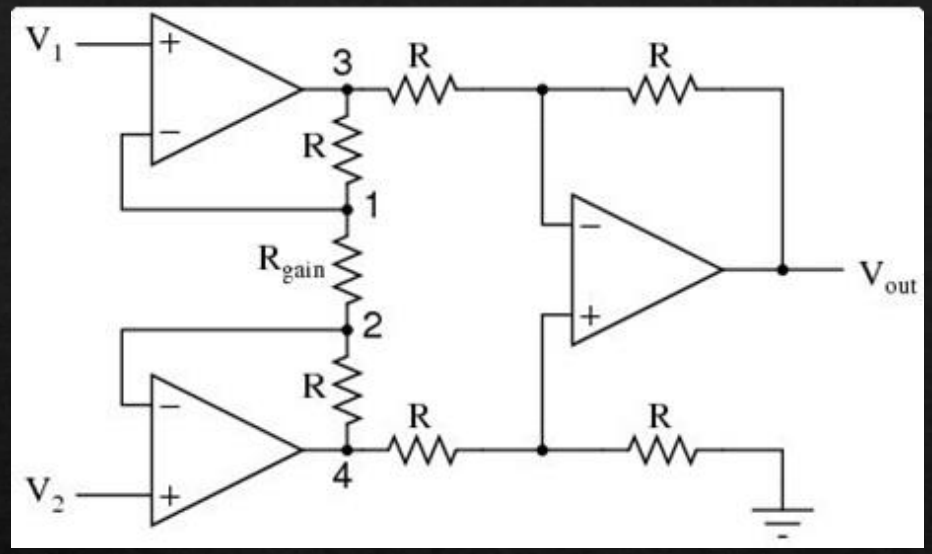
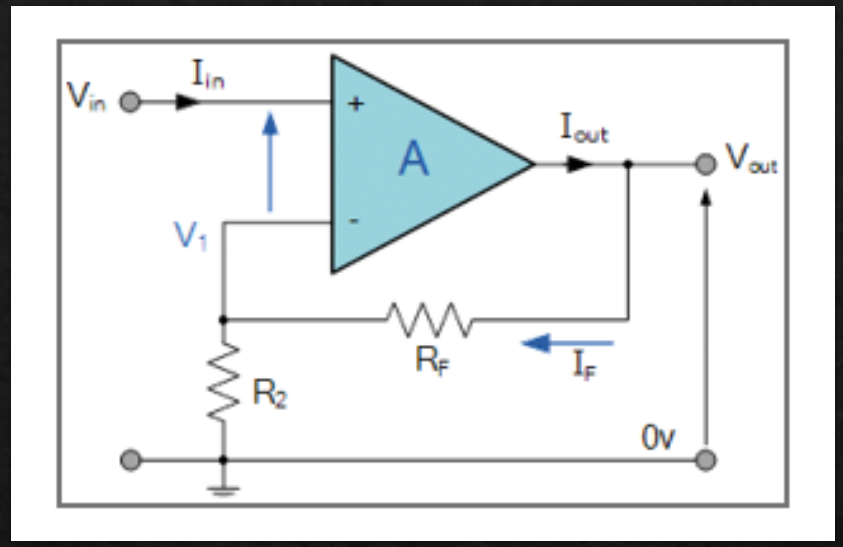


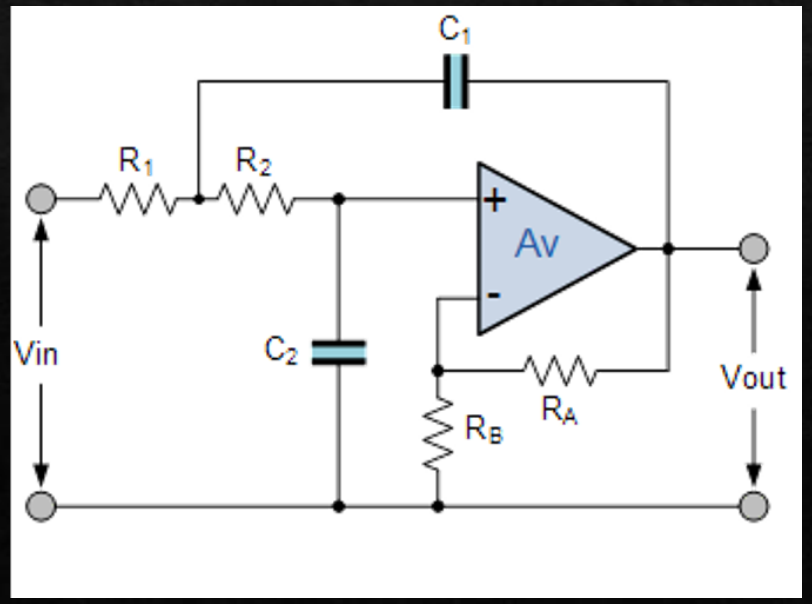
FIG ; Basic over view of Hardware Circuit blocks



Fig; Differential amplifier



Fig; Band pass filter



Fig; Non inverting Amplifier

Fig: Arduino Nano

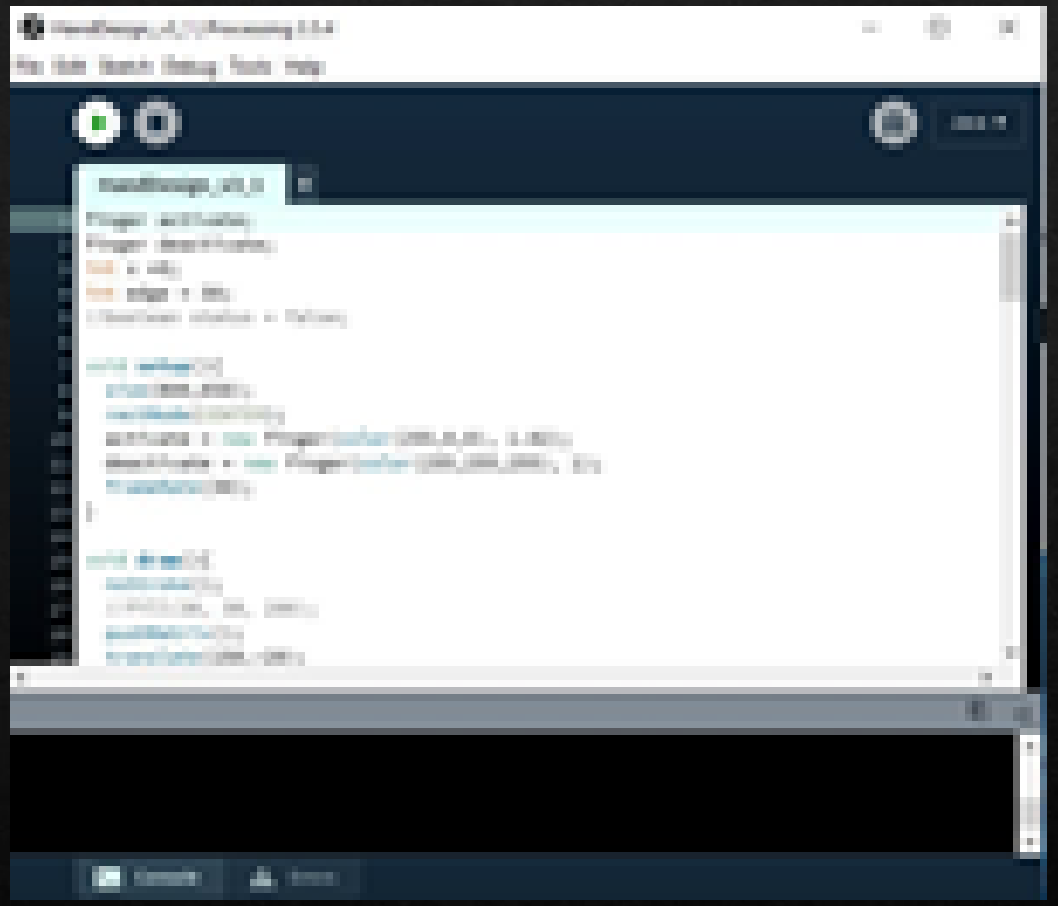


Fig: Software IDE

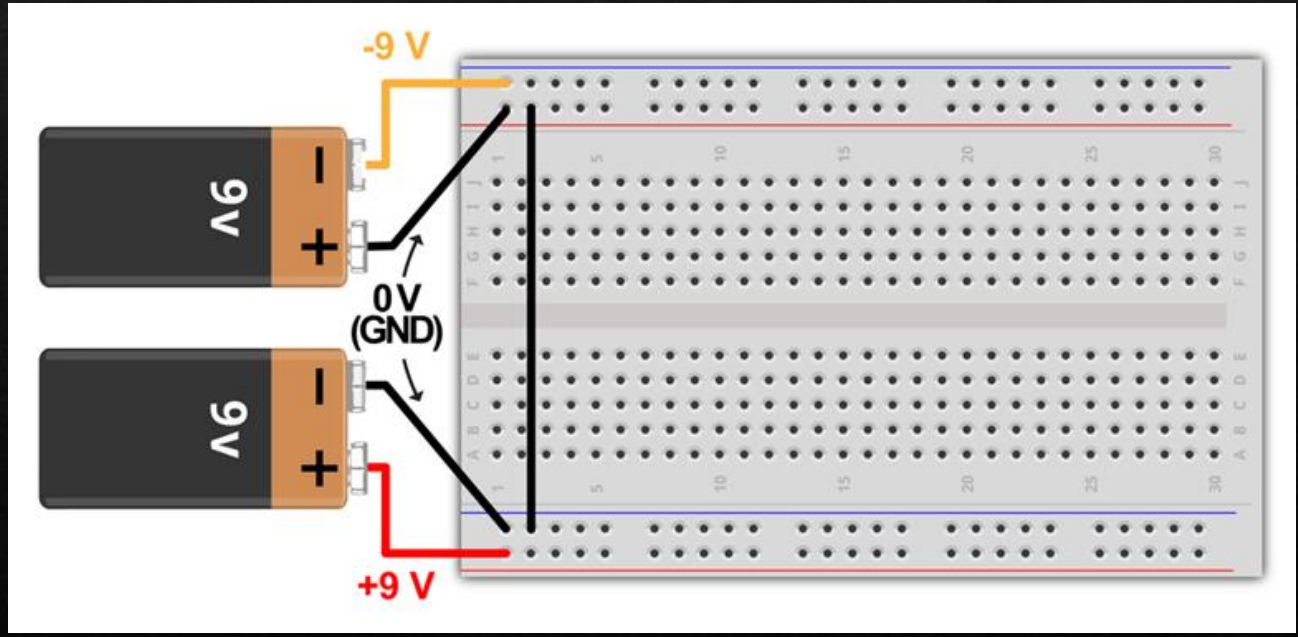
- An EMG signal is an Electric Potential generated by Muscle Contraction.
- It may be measured on the skin surface or by embedding sensors into deeper layers of the muscle.
- Medical reference suggests that different compartments of the ear muscle related to hand and finger movement and EMG signal can still be measured from the forearm muscle even after the hand is amputated.
- Therefore, theoretically, it is possible to use the EMG signal to control hand and finger movements.
- Then the EMG signals need to be measured through the electrodes placed systematically

- Then the EMG signal needs to be filtered and pre processing needs to be done.
- Then the processed signal needs to be input to a microcontroller.
- Then the signals are used to control micro switches and the Servo Motors in the Artificial Arm.
- Then the assembly in placed in a Container and placed on the arms of the User.
- Then Succesive Iterations of Testing Is done and the Accuracy of the Grips Is Fine Tuned.

4.SYSTEM IMPLIMENTATION:

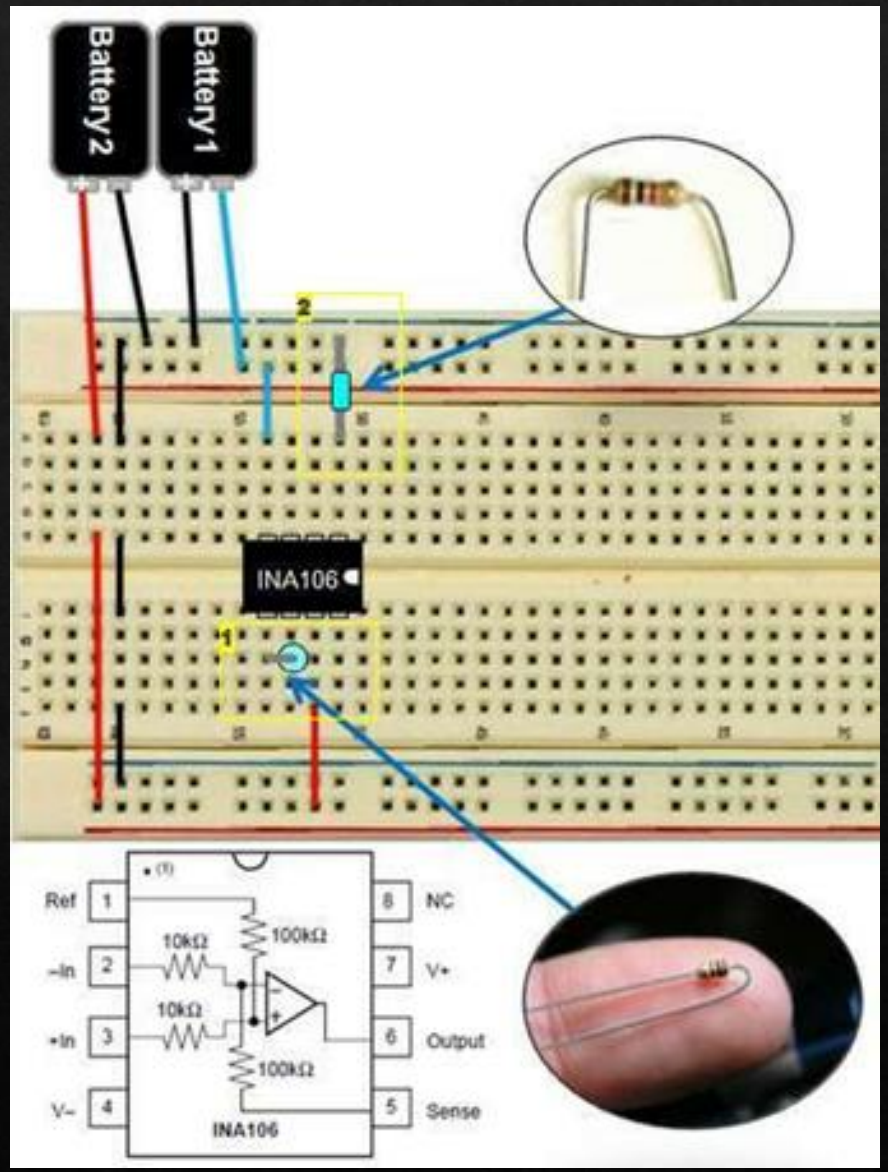
4.1 POWER SUPPLY

- Two 9 volt batteries are both a convenient and safe way to power our EMG amplifier. Because we'll be attaching ourselves to the circuit, we don't want our circuit connected in any way to AC power from the wall.
- The diagram below illustrates how to connect the batteries in a ±9 volt arrangement.



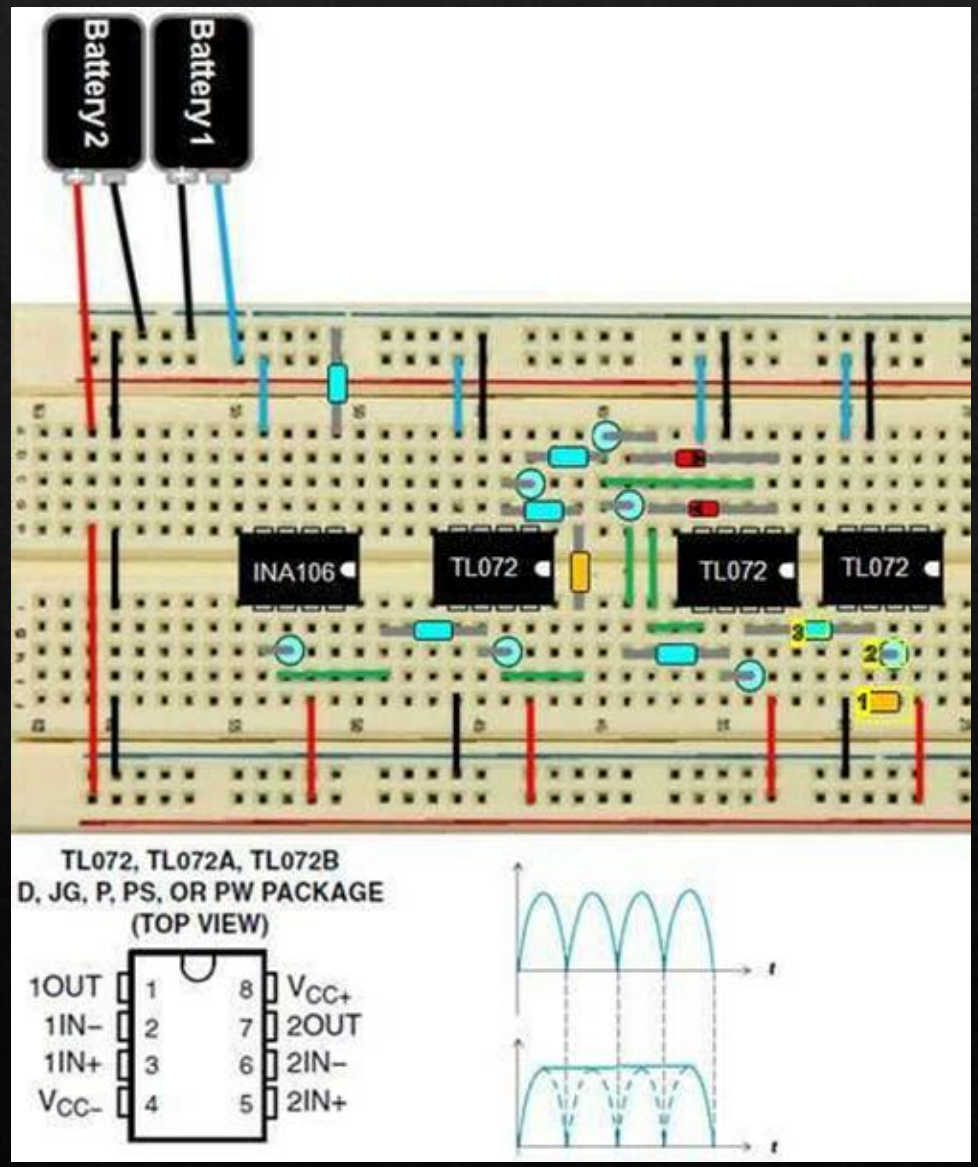
4.2 – SIGNAL ACQUISITION

Next, we will work on the signal acquisition phase of your EMG circuit which we will use to measure our body's nervous system's electrical impulses used to activate muscle fibers.



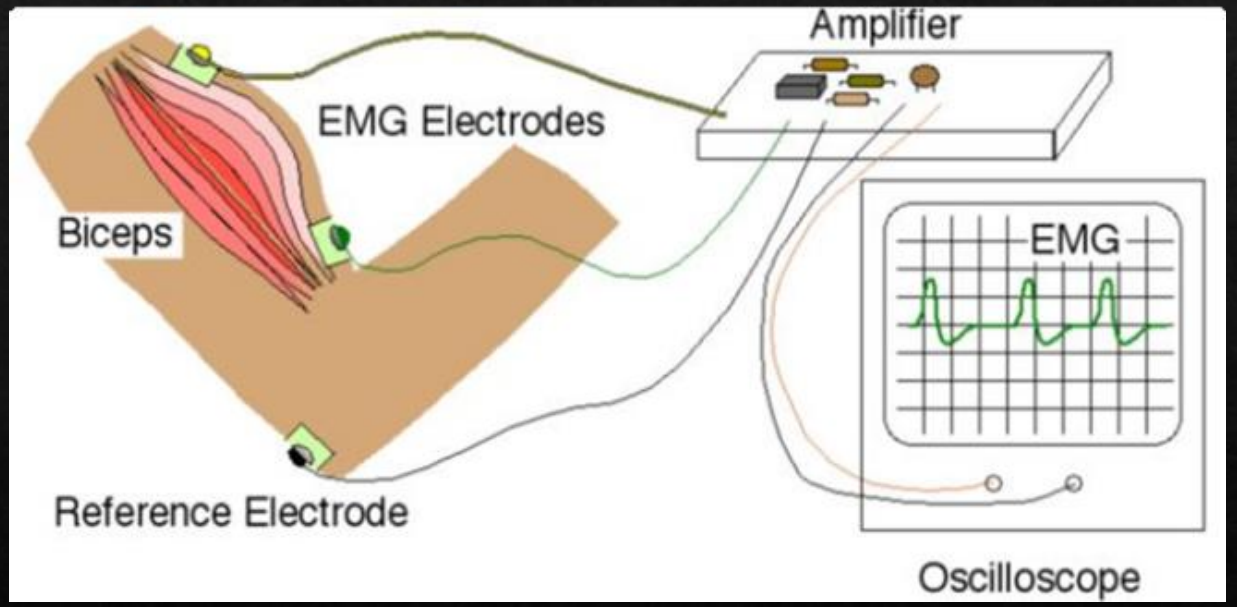
4.3 - SIGNAL CONDITIONING

- In this phase, we're going to take those very small signals measured in the SIGNAL ACQUISITION phase and amplify them.
- First we will be inverting amplifier with a gain of -15. An inverting amplifier does exactly what it sounds like. It amplifies your signal but also inverts it.
- Next, we are going to add a capacitor to AC couple the signal. AC coupling is useful in removing DC error offset in a signal.
- Next we are going to add another inverting amplifier with a gain

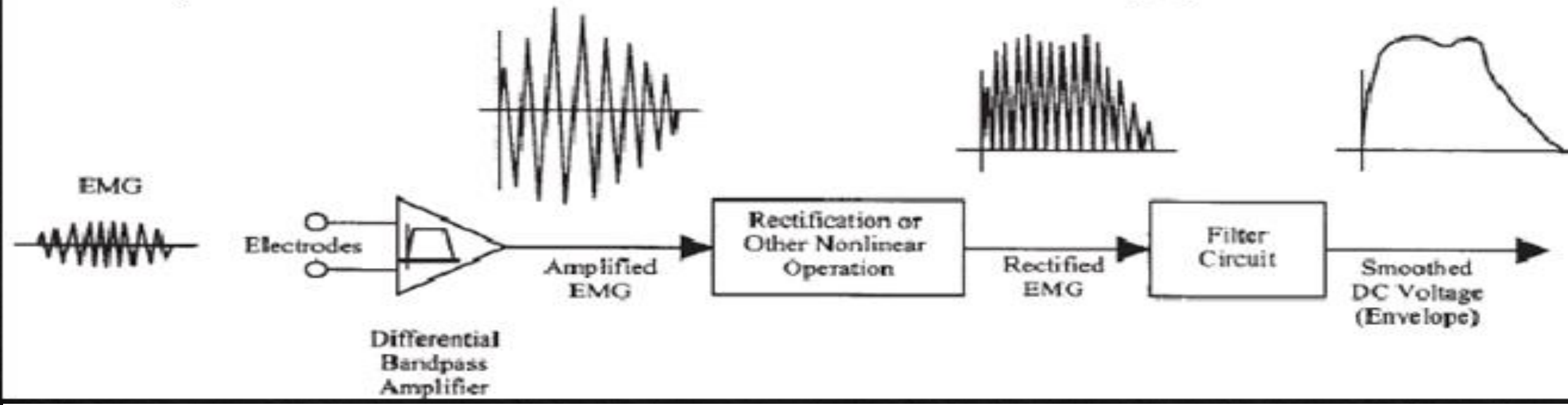


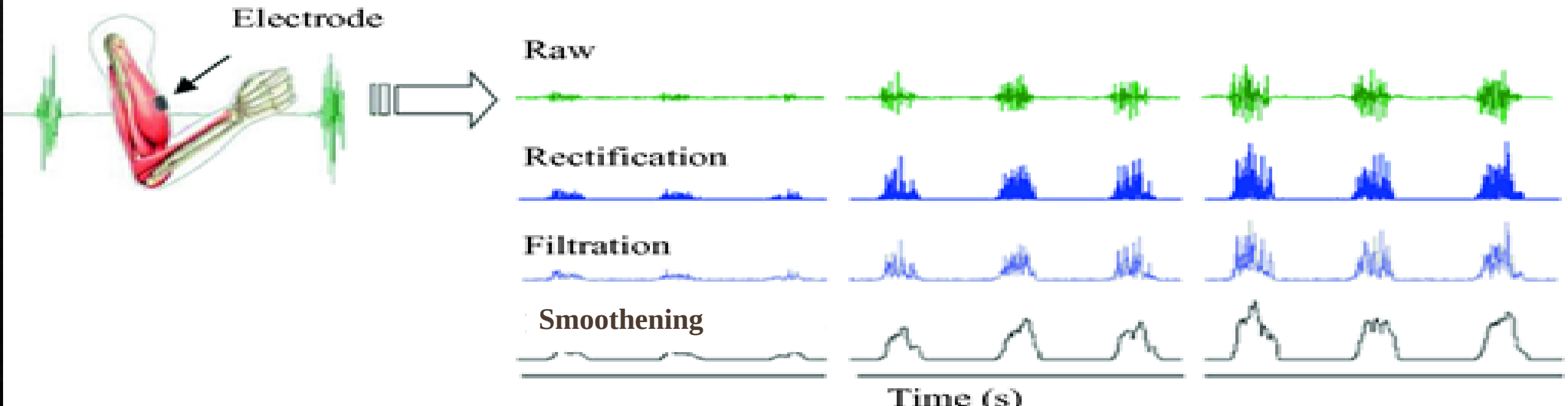
4.4 – CONNECTING THE ELECTRODES

- For the bicep, the elbow is a suitable placement for ground.
- The positive and negative electrodes should be placed on the upper arm as shown in the figure.
- In my experience, the signal was stronger when electrodes were placed closer to the center of the body (medially) when the palm is facing upward.



true depiction of muscular contraction force [8].



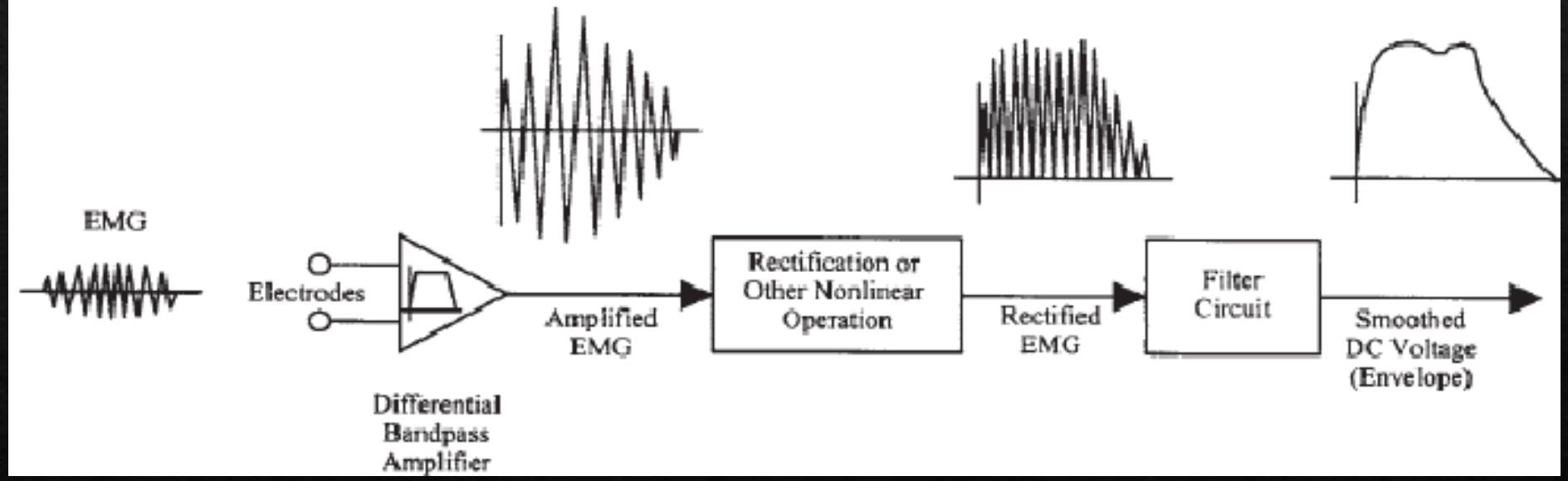


5. RESULTS AND DISCUSSIONS:

- The EMG Signal was Acquired from the EMG Sensor
- A EMG Signal Was fed into the Micro Controller which in turn perform the required necessary actions which is called Training
- Then Serial Data from the Micro Controller is fed into the Simulating Software Called as Processing IDE
- Then the minimum Threshold for reading the data is set.
- Button Logic is used to train the Model
- Tap and Hold Logic is used using Time as a Reference Value

- The Data is then Processed in the Processing IDE
- The Prosthetic Hand then Mimics the actions of the Simulated Hand in IDE

true depiction of muscular contraction force [8].



6.1 ADVANTAGES

- Easy To Use
- Inexpensive
- Affordable to the Masses
- Light Weight
- Accurate Grips
- Repeatability and Mass Production is possible
- Less Training is Required
- Since Threshold is set few noise signals are also avoided

6.2 DISADVANTAGES

- Takes time to Train
- Many Small Tiny parts are required which are hard to assemble
- Assembling is Difficult
- Accuracy takes more time to Achieve
- Precision needs to Fine Tuned

6.3 APPLICATIONS:

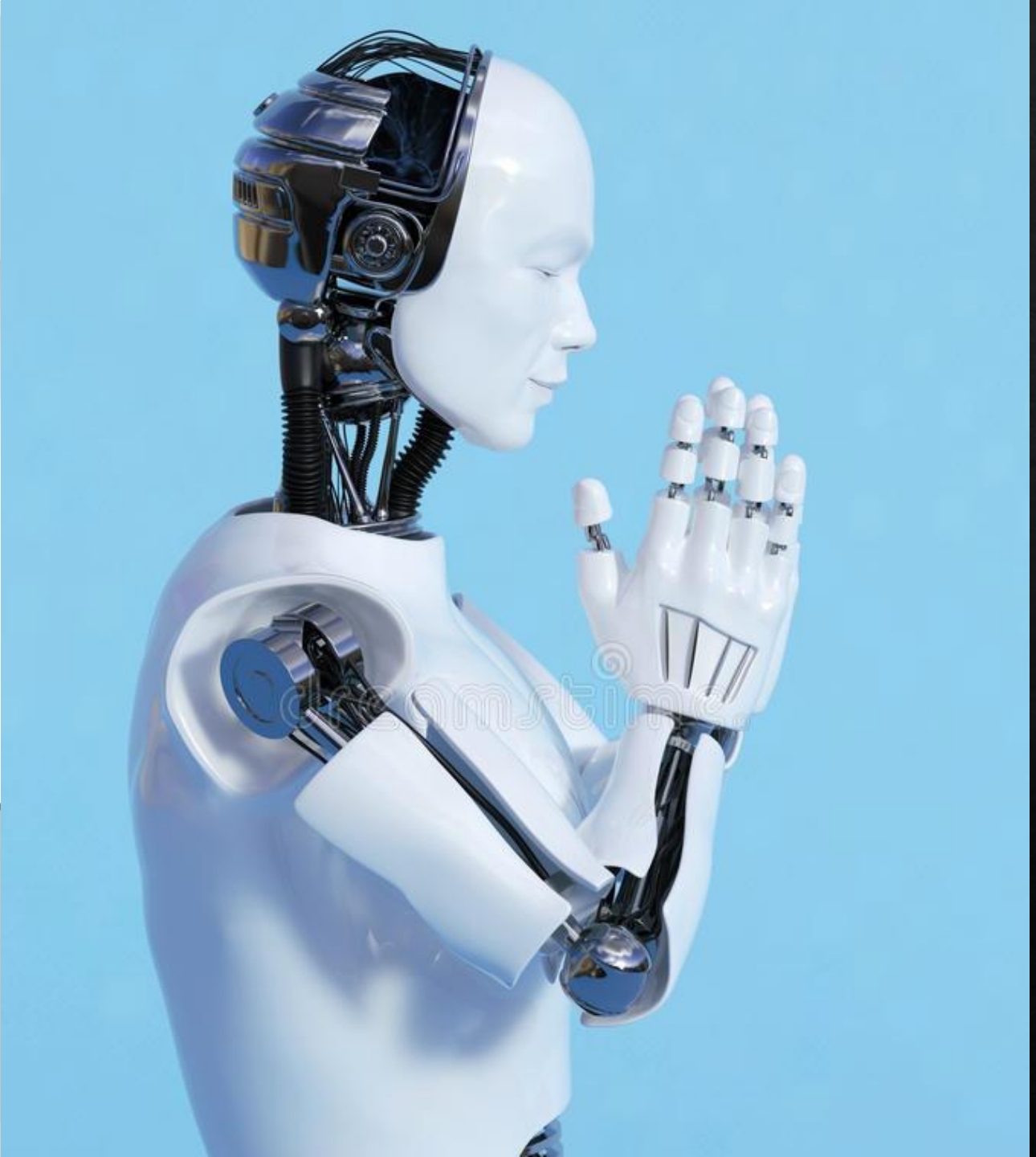
- Prosthetic Hand acts as an Extension Of One’s Hand
- People Who have lost A Part of their Arm can use this Prosthetic Hand
- It can sometimes be used to reach places where a normal hand cant reach
- It can be used in Environments where a regular Arm cant be used
- It can be a substitute arm for Amputees

7. CONCLUSION

- One of the main requirements of artificial arm is the functionality, since it should be as natural hand as possible.
- In this study, a prototype of a prosthetic hand will be developed considering two movement opening and closing the hand and this will be the result of several designs.
- More comprehensive study to cover a wider range of gestures can be considered in the future, for example, individual finger movements

8. FUTURE SCOPE:

- Brain Signals in Addition Of EMG Signals can be used as inputs to power the upcoming prosthetic arms
- A mini Solar Panel can be used as a Substitute Power Source
- Electrodes Insertion can be made simpler and more Aesthetic



THANK YOU