EMG Prosthetic Arm

Bionic prosthetic arms typically cost between 1 to 2 lakh INR, making them unaffordable for many. Innovation is being used to make these prosthetics accessible to all, regardless of financial status.

❖ Structure Development Technology (3-D Printing & Filament Making by reusing plastic bottles):-

We are using 3-D printing technology for making the structure of the prosthetic arm. To further reduce the production cost of this structure, we are using PET filaments which are made by reusing plastic bottles.

Prosthetic Arm Structure

We have designed a filament extraction machine to develop filaments from discarded plastic bottles. These filaments are more sustainable and heat resistant compared to other regular PLA filaments which are commonly used in 3-D printing. This process reduce the filament cost more than 100 times compared to other filaments.

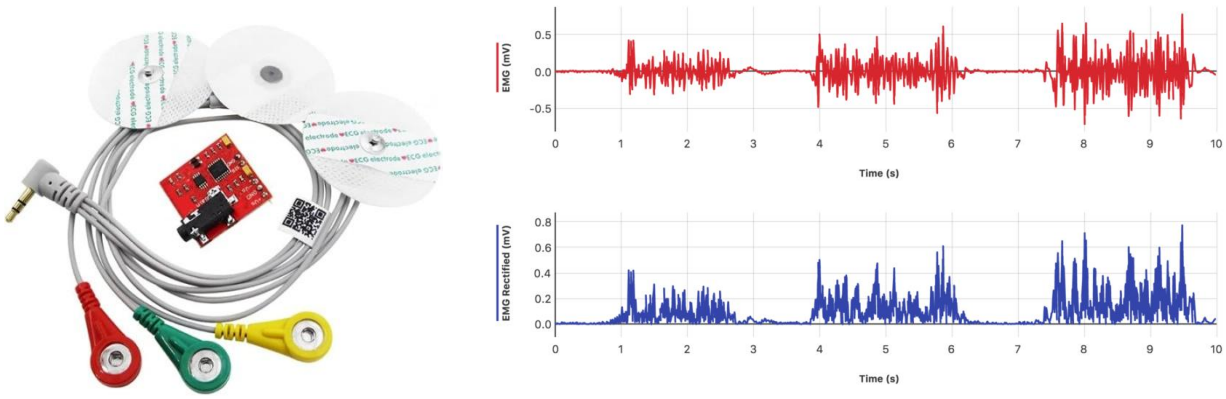
❖ Working Principle and Hardware:-

A carefully selected combination of electrical components has been chosen ,ensuring they are effective ,sustainable and significant contribute to the advancement of prosthetic arm development

➢ EMG Technology:-

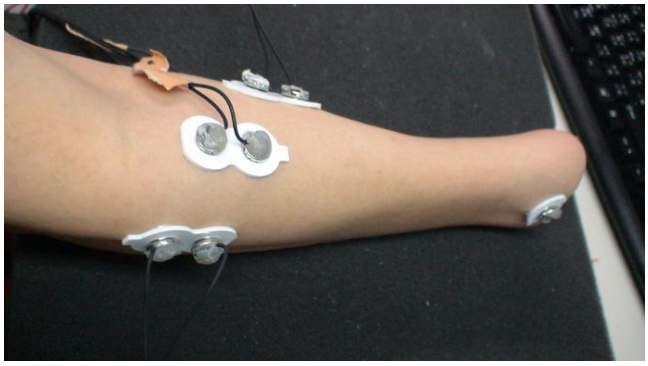
Here we are using EMG sensors to control the prosthetic arm movement.

✍ The EMG sensor picks up the neural activity through Electromyogram signals.



EMG Sensor & EMG Signal Graph

✍ Three electrodes are attached to the remaining portion of the arm of the amputee, one electrode is attached to the base of the remnant muscle body, one at the end of that muscle body and lastly one electrode is attached to the nearest muscle-less portion to extract threshold values.



EMG Sensor Electrodes

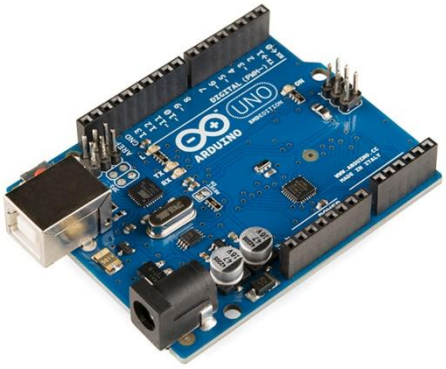
✍ These electrodes then pick up myoelectric signals from the areas they are attached to and send them to the EMG sensor.

✍ The EMG sensor returns some values after evaluating and processing these signals.

✍ These values are then sent to the microcontroller for further processing.

➢ Microcontroller :-

✍ The microcontroller controls the functions of embedded systems. It aids in synchronizing the different mechanisms. In the initial phase of development, we used Arduino board as the microcontroller, but it had come to our attention that Arduino board is derogatory to the sustainability of the prosthetic arm as well as unreliable. Hence we have replaced the Arduino board with "Raspberry Pi Zero W" microcontroller.



Arduino Uno

Raspberry Pi Zero W

✍ Raspberry Pi Zero W is more efficient and faster compared to Arduino. It also has inbuilt WiFi and Bluetooth support which helps us in enabling IOT and A.I-automation.

➢ Servo Motors :-

We have used MG995 servo motors for the movement and mechanism of the hand.

✍ 5+1 servo motors are used.5 to aid the movement of fingers and 1 more to aid the movement of the wrist.

MG-995 Servo Motors

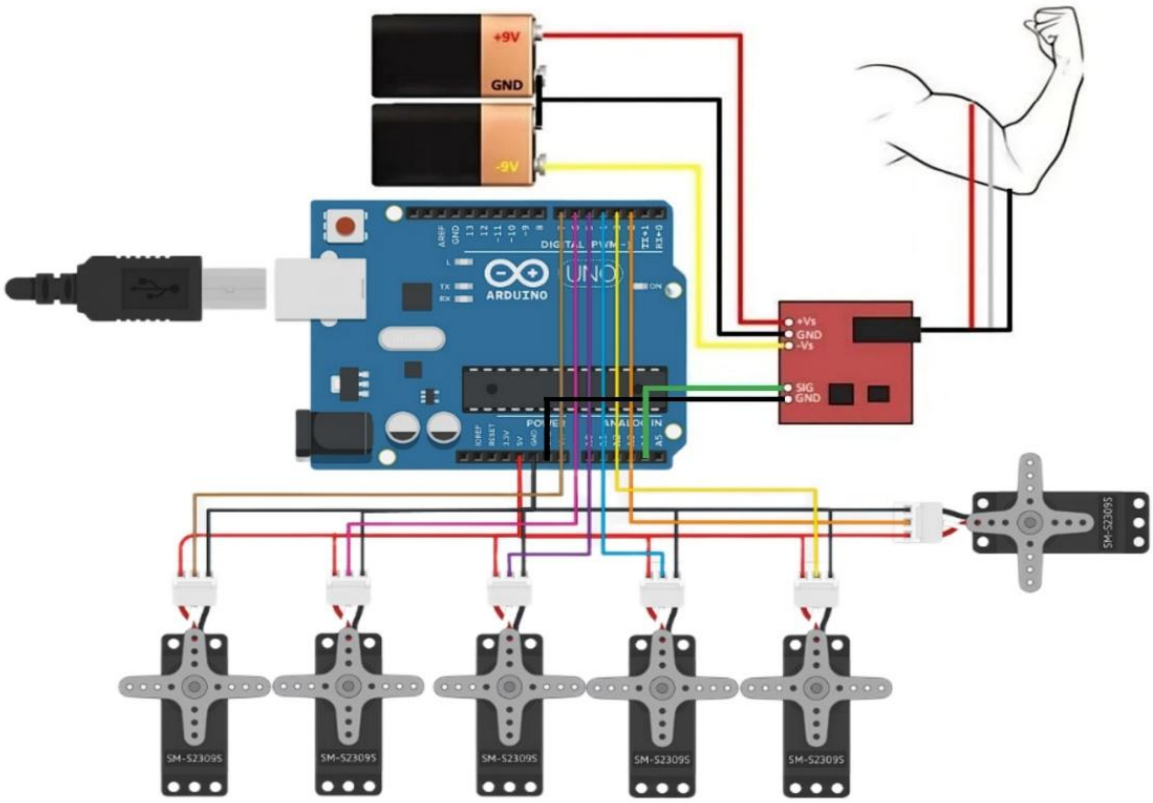
- The wrist freely moves at an angle of 180-degree behaving like a fully functional hWuman wrist. The fingers imitate normal human finger movement with accuracy.
- Nylon/badminton strings are used to make this movement flexible and more human like. The tension in the string modulates these movements.

➢ Power Supply :-

Rechargeable lithium ion batteries are used to supply power to the prosthetic arm. There is a small c-type port of battery charging module which is used to charge the prosthetic arm.

Type C Battery Charging Module & 2000mAh-3.6v Batteries

❖ Circuit Diagram :-



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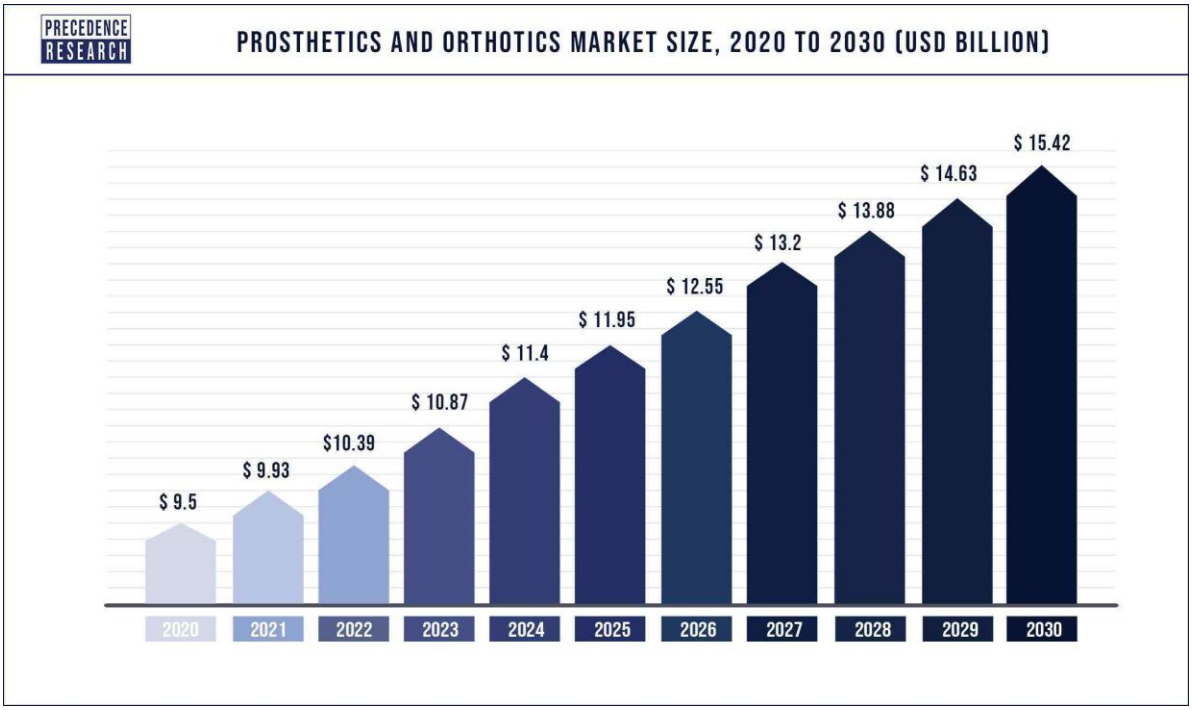
❖ Business Prospective:-

While this project was created to help others, it's also clear that limb attachments also have some strong business potential.

➢ **Global Potential :-**



The demand for prosthetic attachments is increasing over time, with costs typically ranging from 1 lakh to 2 lakhs, or even more. Around 100 million people worldwide need a prosthetic limb or an orthotic device, but it's estimated that 80% of them, particularly in low- and middle-income countries, lack access to these services.

Through innovation, a limb attachment has been developed at a fraction of the usual cost, allowing consumers to purchase it for just 5000.

❖ Cost Analysis:-

Components & Other	Rate for Making Single Unit	Rate for Mass Production(Per Unit)
3D-Printing (Filament +Electricity)	100+55	100+55
EMG Sensor (With Electrodes & Patches)	1600	1000
Microcontroller	2000	1500
Servo Motors (5+1)	1500	1200
Strings & Wires	100	10
Nut & Bolts	100	50
Total	5455	3915
Selling Price	6000	5000
Profit	545	1085