LOW-COST MYOELECTRIC PROSTHETIC ARM

Project Reference No.: *47S_BE_0810*

College ***:*** *Canara Engineering College*
Branch ***:*** *Department of Electronics and Communication Engineering*
Guide(s) ***:*** *Dr. Dayanand G K*
Student(S) ***:*** *Mr. Aditya P*
Mr. Sameer Hegde
Ms. Amel Rayaz Bailur
Ms. Nisha Shetty

Keywords:

Prosthetic, EMG, Amputees, 3D Print, Myoelectric

Introduction:

Prosthetic technology has historically been limited by high costs ranging from 1 lakh to 3 lakh INR for advanced prosthetic arms, hindering accessibility for individuals with upper limb amputations. Existing affordable solutions often compromise on durability and functionality. While advancements in material science and engineering have improved prosthetics, affordability remains a significant barrier, particularly in resource-limited regions.

Individuals with upper limb amputations often encounter significant obstacles that impact their daily lives and social integration. This underscores the urgent need for accessible and efficient prosthetic solutions. Despite advancements in prosthetic technology, barriers such as high costs and limited functionality persist, leading to unequal access to optimal limb replacements.

To address these challenges, our project focuses on developing a myoelectric prosthetic arm that prioritizes affordability while maintaining high functionality. By incorporating the Whiffletree mechanism, known for its mechanical efficiency and reliability, we aim to optimize the arm's performance and usability. Our goal is to bridge the gap between advanced prosthetic capabilities and the financial constraints faced by many individuals, particularly those in resource-limited environments. This approach ensures that individuals with upper limb amputations can benefit from innovative prosthetic technology without facing undue financial burdens.

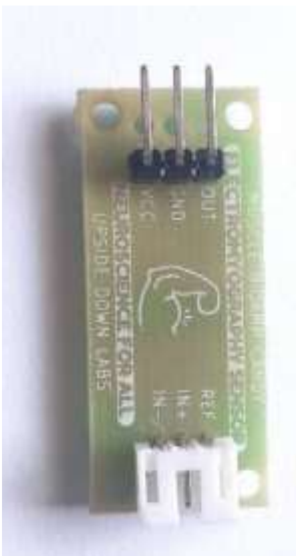
Objectives:

The primary objective of this project is to design and develop a myoelectric prosthetic arm that incorporates the Whiffletree mechanism. The emphasis lies in achieving a perfect balance between affordability and functionality, addressing the considerable impact that upper limb amputations have on an individual's lifestyle. The

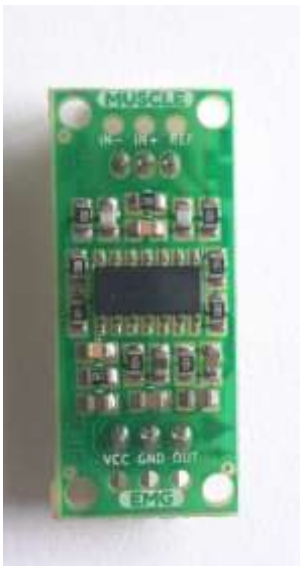
utilization of the Whiffletree mechanism serves as a key design element, enhancing mechanical efficiency and reliability.
In addition to these technical considerations, the project places significant importance on the material used, exploring lightweight composite materials to make an optimal balance between durability, weight, and cost. Ultimately, this collaborative effort seeks to offer a low-cost, adaptive, and user-friendly prosthetic option, thereby enhancing the overall quality of life for individuals with upper limb amputations. We further aim to design the prosthetic hand with a realistic structure to improve aesthetics and user acceptance, while also ensuring that it can perform various grips and tasks efficiently. This project focuses on increasing the capacity to lift objects of up to 1kg.

Methodology:

The methodology for developing a low-cost Myoelectric Prosthetic Hand involves several components and techniques. Firstly, a 3D-printed framework is utilized alongside a BioAmp Candy muscle sensor, servo motors, a microcontroller, and essential materials and tools. Unlike conventional prosthetic hand designs, this approach integrates the Whiffletree mechanism, which employs interconnected strings and pulleys to facilitate adaptive finger movement, conforming to the shapes of objects grasped. Within the myoelectric arm context, the Whiffletree mechanism serves to evenly distribute forces through internal linkages, enhancing mechanical efficiency and reliability. This design also streamlines finger control, requiring fewer actuators. Polylactic acid (PLA) is employed for 3D printing due to its strength, stiffness, cost-effectiveness, and eco-friendliness. A high-torque servo motor enables finger actuation, capable of lifting objects up to 1 kg, while an Arduino Nano microcontroller manages operational dynamics. Additionally, the Muscle BioAmp Candy EMG sensor detects muscle electrical signals for interpretation. This cost-effective approach aims to bridge the affordability-functionality gap in prosthetic technology, the affordability-functionality gap in prosthetic technology, particularly benefiting amputees in India.



(a)

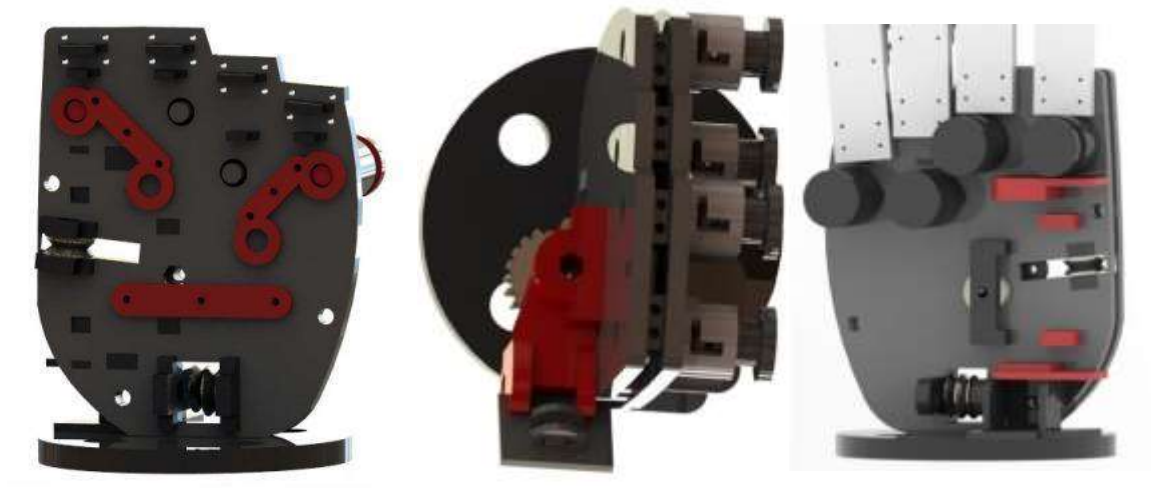


(b)

(c)

Fig 1 (a) Frontal view of BioAmp Candy (b) Rear view of BioAmp Candy (c) BioAmp Candy band with built in electrodes

Figure 1 presents the BioAmp Candy, an EMG sensor. It displays the frontal and rear views of the device, as well as a detailed image of its band featuring built-in electrodes for capturing electromyography signals.



(a) **(b)** **(c)**

Fig 2 (a) Whiffletree assembly in palm (b) Selectively lockable toothed mechanism of the thumb (c) Servo holder on palm

Figure 2 illustrates components of a prosthetic arm, focusing on the palm area: (a) the Whiffletree assembly positioned within the palm, (b) a selectively lockable toothed mechanism located on the thumb, and (c) a servo holder attached to the palm. These features likely contribute to the functionality and control of the prosthetic arm for users.

Conclusion:

To evaluate grasping or holding capabilities, we interacted with various objects replicating common daily tasks. The tested objects included a pen stand, multi-meter, 500ML washing liquid filled can, 600g toolbox, and Helping Hands Soldering Station. This user-centred testing ensured the prosthetic offered practical functionality for real-world scenarios.

The myoelectric prosthetic arm project represents a significant leap in prosthetic technology, introducing features like the Whiffletree mechanism and realistic hand design for improved functionality and affordability. Extensive testing and refinement have tailored the arm to meet the specific needs of users, enhancing their quality of life. Moving forward, efforts will focus on refining key mechanisms, optimizing sensor integration, and reducing costs through mass production. These advancements aim to empower users with greater autonomy and efficiency in daily activities, reshaping the landscape of assistive technology.

Scope for future work:

Looking ahead, the future scope of our project includes ongoing research and development efforts to further enhance the durability, functionality, and affordability of our prosthetic device. We aim to continue collaborating with experts in the field, incorporating feedback from users, and exploring innovative approaches to prosthetic design. Additionally, we plan to expand our reach to serve individuals in underserved communities globally, ensuring that our technology has a meaningful impact on a diverse range of individuals with upper limb amputations. Through these efforts, we aspire to set a new standard for accessible and high-quality prosthetic solutions, ultimately improving the lives of those in need.