UArm

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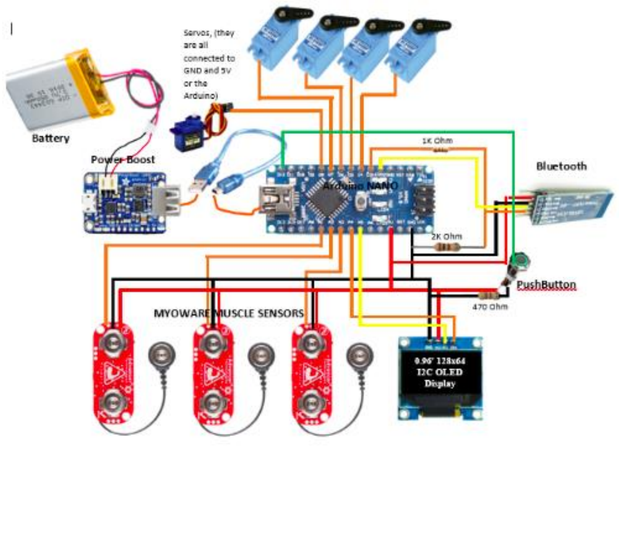
Problem Statement

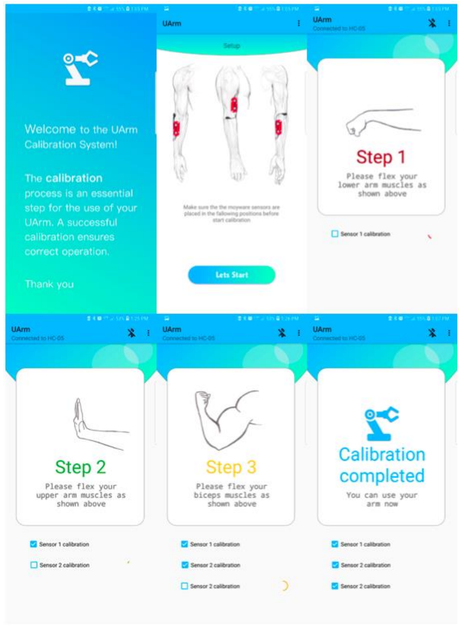
There are a significant number of people that were either born with a missing limb or lost it over the course of their lives. An estimated 1.9 million amputees live in the USA, with approximately 185,000 new amputations performed each year [1]. Throughout the world, amputees face the same issue: existing prosthetic limbs either do not implement all the needed functionality or are unaffordable, with high-end devices costing around $100,000. This is why we developed the UArm, an affordable 3D printed robotic prosthetic arm that uses electric muscle activity to control the movements.

Approach

The UArm is a 3D printed arm designed for people that need a below the elbow prosthesis. The UArm can perform a set of functional gestures like grabbing, pointing, and gripping. Furthermore, the U-Arm is open source, which means that everyone can print and assemble it by following a set of instructions. It is also affordable, with materials costing around a few hundred dollars. The UArm is complemented by a mobile application which helps users calibrate the arm.



Circuit Diagram



Mobile App

UArm Gestures

Technical Details

The UArm was designed using Fusion 360 and was printed on the JCAURORA A5 3D printer using ABS filament. The forearm case contains most of the circuitry: an Arduino Nano, four waterproof metal gear servo motors, a Bluetooth module, and a 3.7V Li-Po rechargeable battery. An additional servo is placed in the palm to add side-to-side movement of the thumb. Three sensors (MyoWare Muscle Sensors) are attached to the user's biceps, flexor, and extensor muscles. Whenever the user flexes one of the muscles, the Arduino reads a signal above a certain threshold and moves the servos to create a gesture. A button on the forearm allows the user to turn the UArm on/off and switch between two sets of gestures. Battery life and the current gesture are displayed on a LCD screen. A mobile app developed in Android Studio offers a user-friendly calibration system for the UArm.

Conclusion

The UArm strives to help the open prosthetics community by providing an original design and implementation of a 3D printed arm.

References

[1] Raichle et al. "Prosthesis use in persons with lower- and upper-limb amputation". *Journal of rehabilitation research and development,* vol. 45, no. 7, 2008, pp. 961-72.