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3D PRINTED INITIAL PROSTHETIC ARM PROTOTYPE

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Abstract – *This 3D printed prosthetic arm will show case the way by which original product can be delivered with desired modification. Prosthetic arm consist of hand, wrist and forehand. The scope of the research paper is to give the idea about working of prosthetic arm and development of same at lower rate. The overall price of this project was around 7000 INR without shipping charges, it uses 2 servo motors, 1 Arduino Nano and Muscle sensor, that can sense the contraction i.e. signal given to muscle by brain and convert that into digital signal that is forwarded to Nano board.*

Keywords – *Prosthetic Arm, Artificial hand, Hand controlling via Arduino*

I. INTRODUCTION

One of the foremost last technologies accustomed to control prosthetic limbs is termed as Targeted Muscle Reinnervation (TMR) and was developed by Dr. Todd Kuiken at the Rehabilitation Institute of Chicago. To know TMR, you would like to understand some basic physiology. Your brain controls the muscles in your limbs by causing electrical commands down the neural structure i.e. spinal cord so through peripheral nerves to the muscles. Currently imagine what would happen to the present info pathway if you had a limb amputated. The peripheral nerves would still carry electrical motor command signals generated within the brain, however the signals would meet a dead end at the location of amputation and ne'er reach the amputated muscles[3].

In the surgery needed for TMR, these amputated nerves ar redirected to regulate a substitute healthy muscle elsewhere within the body. For instance, the doctor would possibly attach identical nerves that after controlled a patient's arm to some of the patient's chest muscles. after this procedure, once the patient makes an attempt to maneuver his or her amputated arm, the control signals traveling through the initial arm nerve can currently cause a little of chest muscles to contract instead[3]. This is often valuable, as a result of the electrical activity of those chest muscles are often perceived with electrodes and accustomed to give control signals to a prosthetic limb. The end result's that simply by thinking of moving the amputated arm, a patient causes the prosthetic arm to maneuver instead[2].

This was very advanced stage that involves surgery, but for now we are only going to utilise the Myowave Muscle sensor, which is equip with micro scale piezoelectric sensor, which will convert the muscle stretch into digital signal. That will supplied to Arduino Nano, which will actuate the servo motor and so fingers also. This prototype is limited to only fingers motion. Degree of freedom of wrist and forehand are zero.

II. CAD MODEL

In following images the computer aided design of prosthetic is shown which was used to 3D print out of silicon.

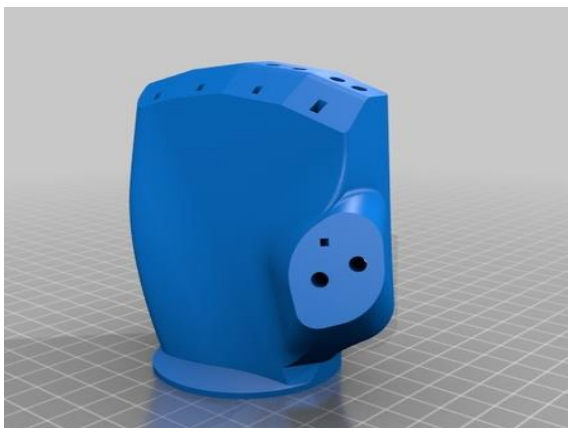


Figure 1 – Front side of Hand

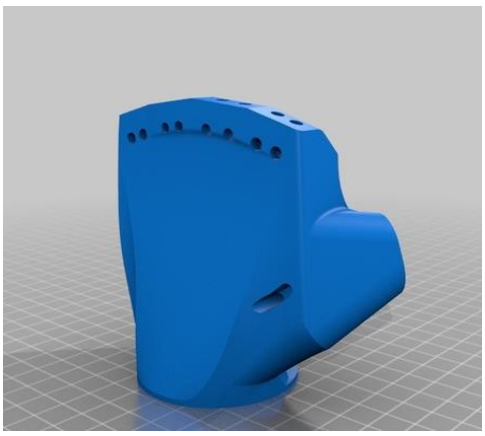


Figure 2 – Back side of Hand

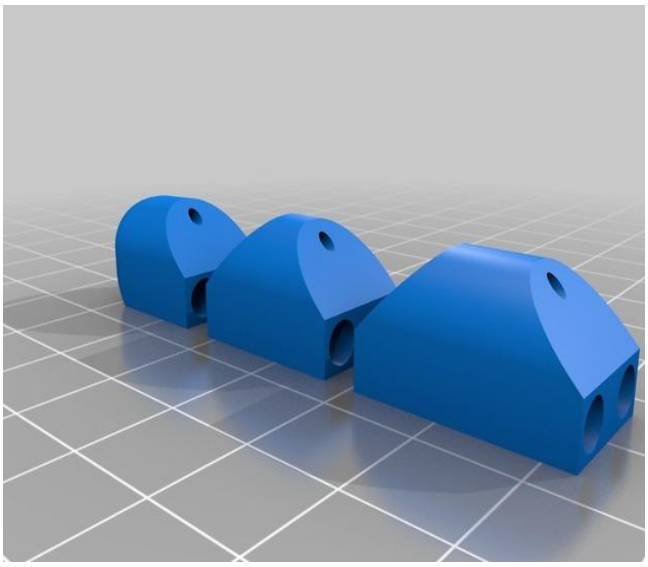


Figure 3 – Index Finger

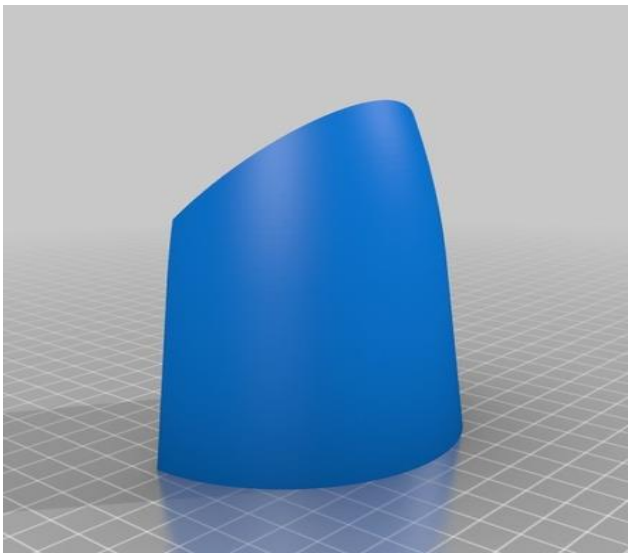


Figure 4 – Wrist Base Part

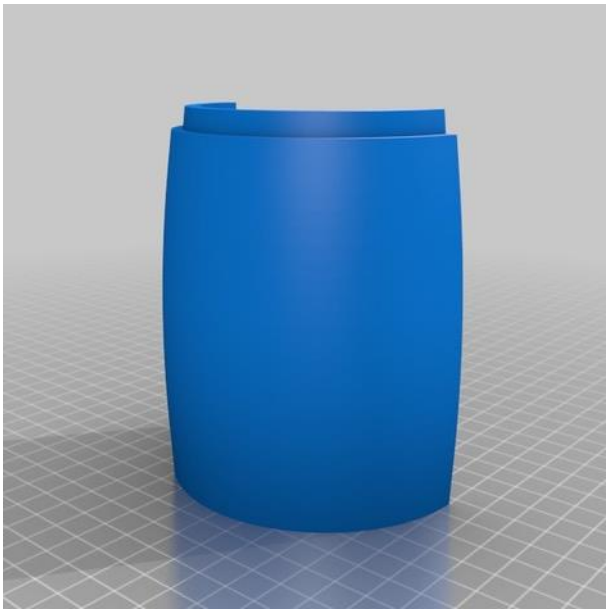


Figure 5 – Forehand Cover

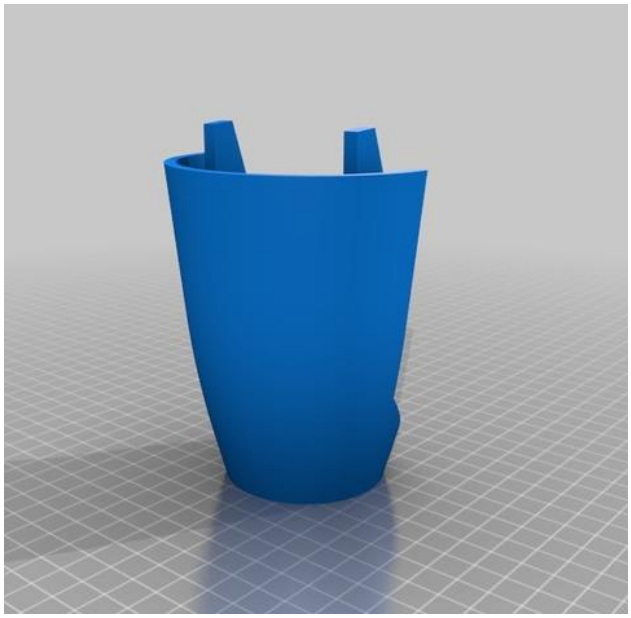


Figure 6 – Wrist Cover

III. LIST OF COMMENTS

This prosthetic arm consist of following,

1. Flexible Nylon Paracord
2. Fishing Wire
3. Two Servo Motor
4. 6V Rechargeable battery
5. Arduino Nano
6. Arduino Nano Compatible IO board
7. Myowave Muscle Sensor, Images of this all products are shown below.

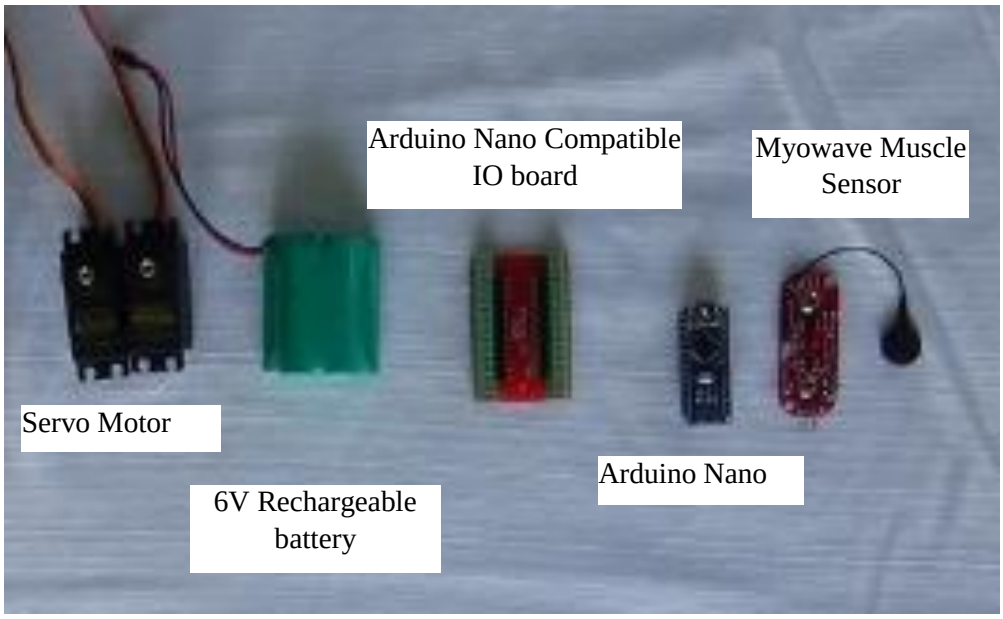


Figure 7a – Electronics component

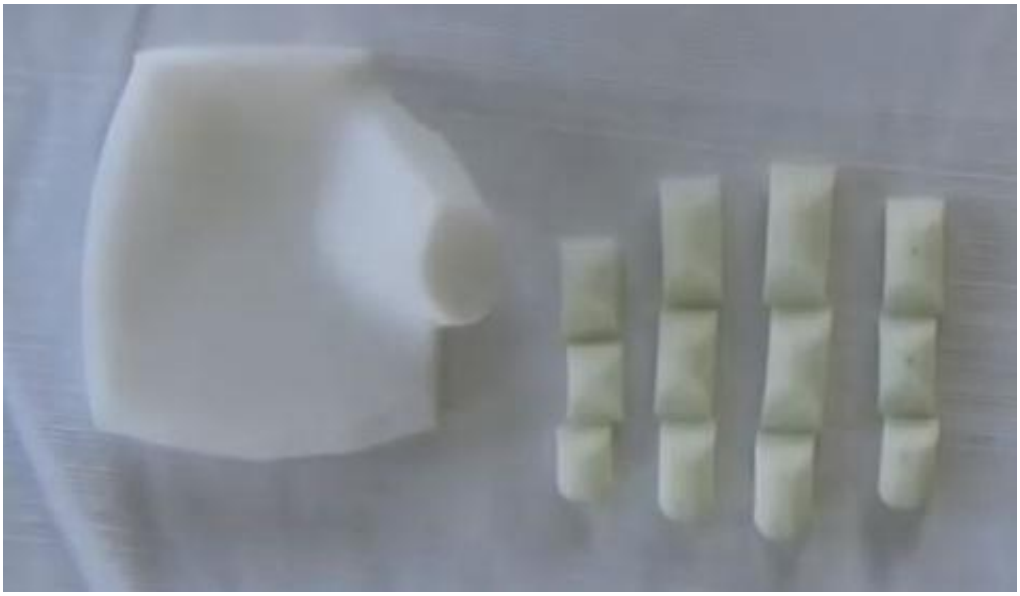


Figure 7b – 3D printed silicon hand

IV. ASSEMBLY AND TESTING

Insert the nylon paracord as shown in figure 8 followed by fishing thread from tip of the finger to bottom. Once the assembly of all the fingers are completed than this fingers are attached to the hand as shown in figure 9.

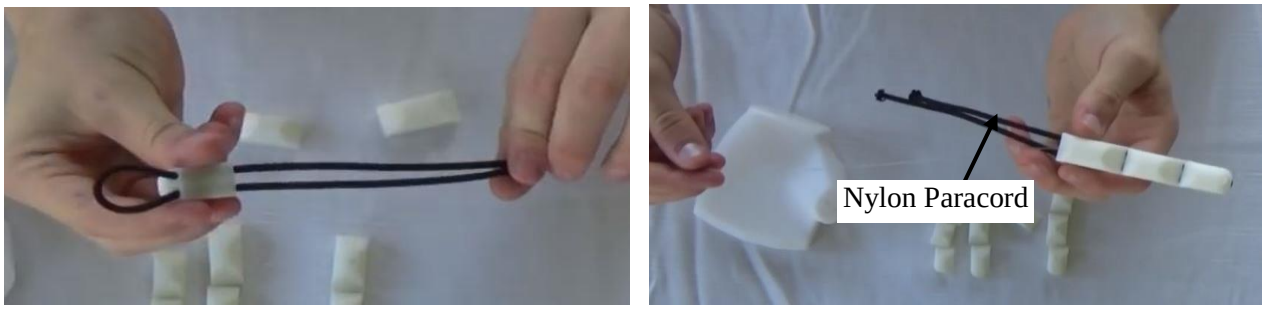


Figure 8a – Finger assembly

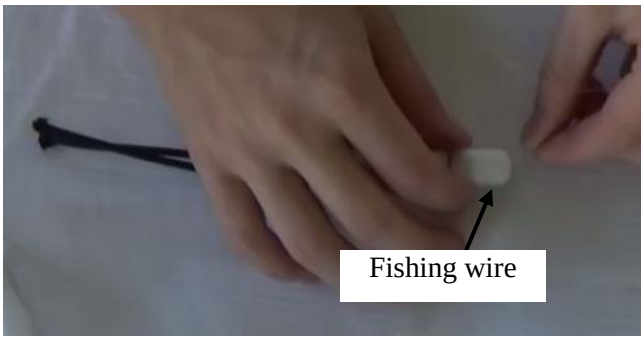


Figure 8b – Finger assembly

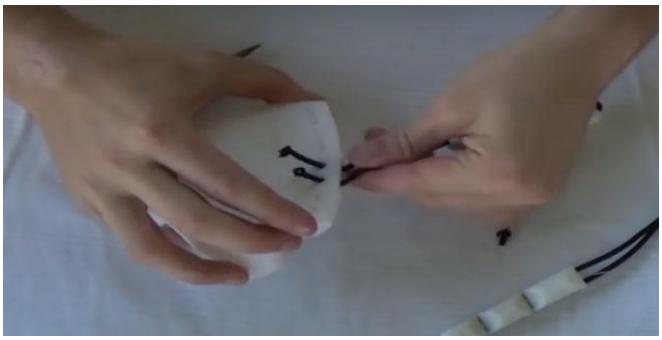
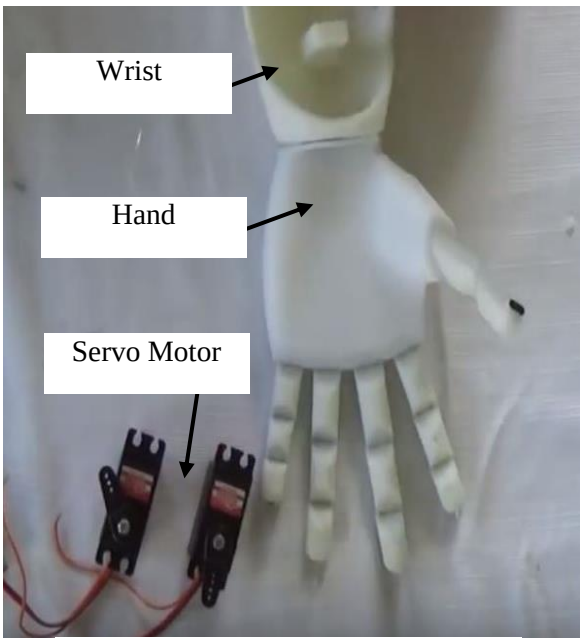


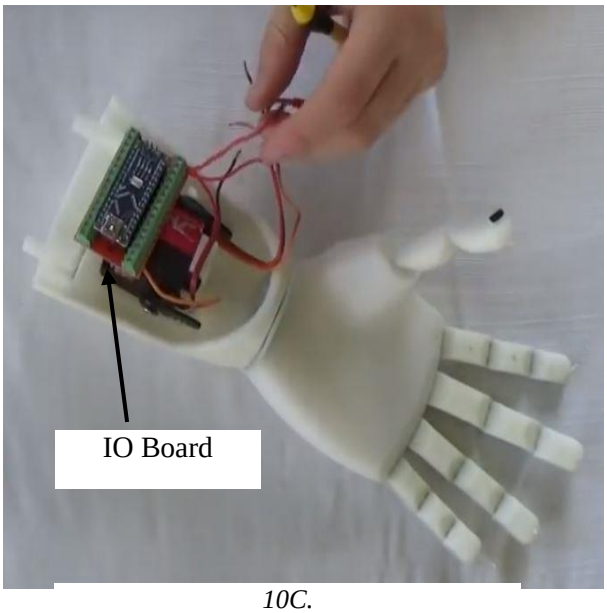
Figure 9 – Finger attaching to Hand

After completing installing of fingers to hands, electronics components i.e. servo motors, Arduino Nano and IO board will be installed in the wrist as shown below. Fishing wires from all the four fingers are connected to one servo motor and wire from thumb is connected to another servo motor.

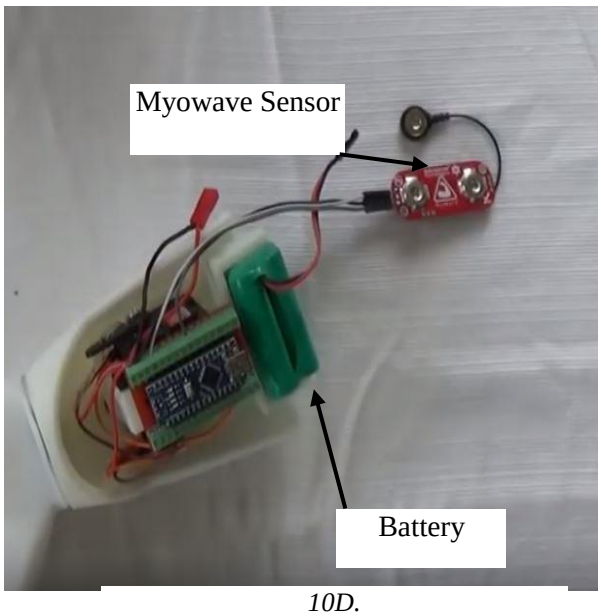


10A.

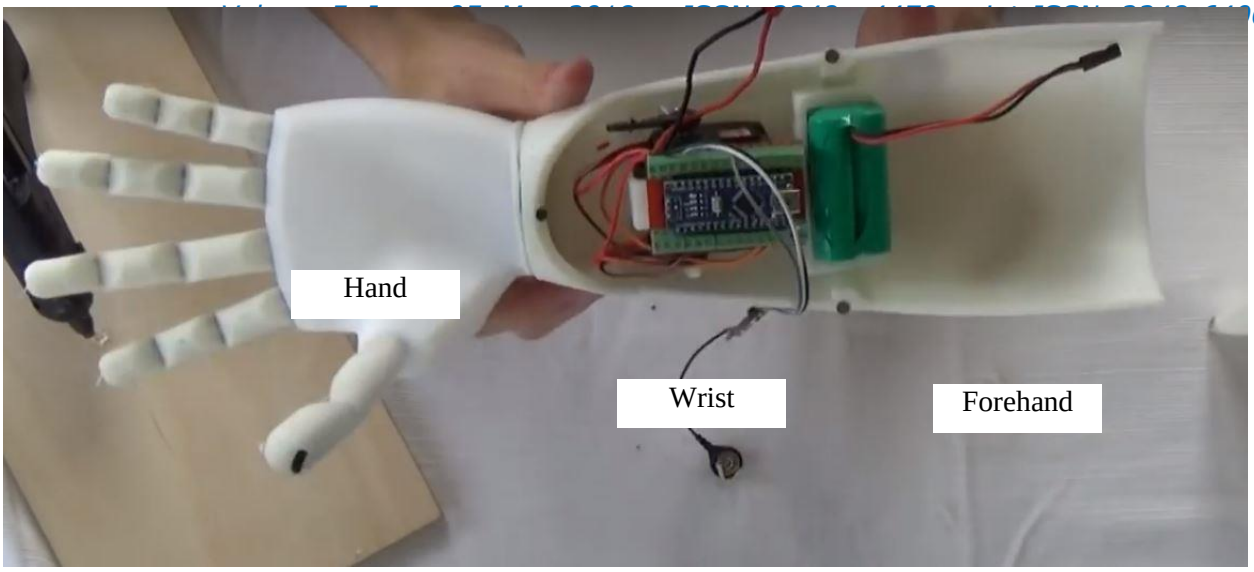
10B.



10C.



10D.



10E.

Figure 10a/b/c/d/e – Stepwise installation of parts

After installation of electronics component, Arduino Nano in installed and programme was uploaded for testing as shown in figure 12.

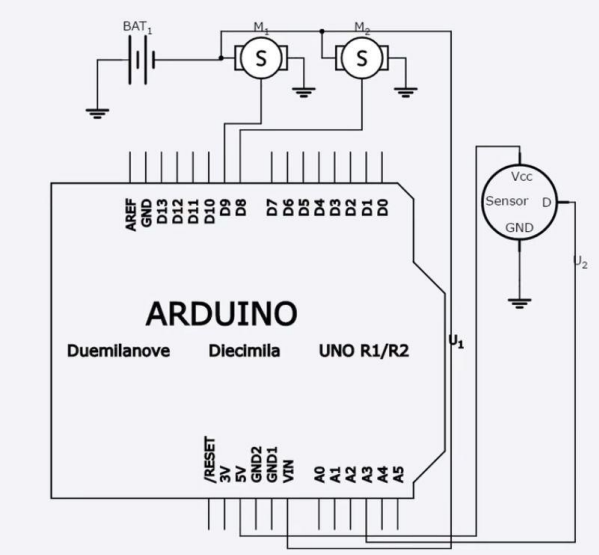


Figure 11 - Connection Diagram

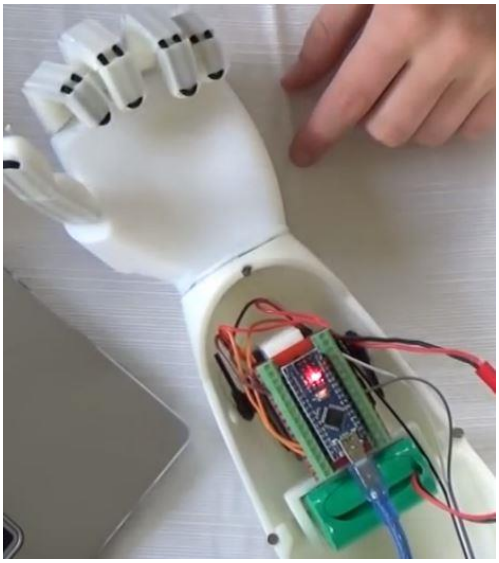


Figure 12a – Testing

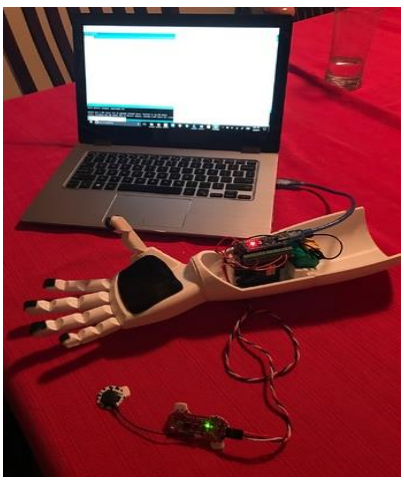


Figure 13 – Program Uploading

Figure 12b – Testing

V. CONCLUSION

This prosthetic model was first step toward developing artificial limbs. Our design was restricted to movements of fingers only, still we can add rotation of wrist and forehand. But main scope of this pet project was to understand and mimic the real case prosthetic limb scenario and that was done pretty well. Our hand can hold an object, However person cannot feel the object.

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