

BIONIC ARM

Teknofest Aerospace & Technology festival

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Highschool Level

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PROJECT SUMMARY:

In today's modern age, we still have amputees with non-functional prosthetics or no prosthetic at all. This comes down to two main reasons, first being that most of them are useless, and don't serve as good purpose, and second being that which do function are way to expensive for everyone to afford (The cheapest functioning one is around 3lacks/-pk). So, our project is to make a prosthetic limb/hand that is both functional and cheap under 10,000/-pk (estimated).

The main idea of our project is to make high quality, low cost & a fully functional bionic arm. To make it accessible by anyone, and easy & less arduous maintenance. And have features that are present in only high end & expensive bionic arms and open source. And most importantly, be extremely reliable, and perform well in any condition.

Because this is supposed to be a part of the user's body, so to make it feel as natural as possible these features must be present in it.



We aim to design it with 3D arm structure with moving fingers in which we will connect the Arduino uno as the brain of the arm.

Our project Will help all the Amputees around the world according to the WORLD HEALTH ORGANIZATION (WHO) there are around 30 million people around the world who require the prosthetic limbs. The positive point of our project is low-cost budget which will definitely help the children who grow with time after birth they can change their prosthetic limbs after several months in a very low cost.

we have completed our first prototype which was fully functional so we aim to finish this project very soon if our project detail report is accepted on the time specified on the project calendar.

THE PROBLEM FACED:

In this era of technological advancements, we still don't have prosthetic arms which are both affordable, and reliable for amputees to use in their day-to-day life, and the solutions which are present in the market are really heavy, and taxing on the user, and too expensive, hence out of the reach of many individuals. And there isn't any bionic arm that provides sensory feedback to the user.

This eliminates any chance of the amputees with not so good financial conditions getting any sort of quality bionic arm, and many don't use them as they are too heavy for them, such as small children. And are many being not comfortable wearing them as their looks aren't that good, and bring a sort of stigma with them.

And the biggest issue is socket soreness, traditional prosthetics use molding and casting to manufacture them, and as it's not the case of one size fits all, many prosthetics can cause discomfort and pain.



So, in conclusion, the problems of traditional prosthetic arms are as follow:

- Not reliable
- Too expensive for many

- Not comfortable
- Many are too heavy
- No sensory feedback
- Doesn't look and feel natural

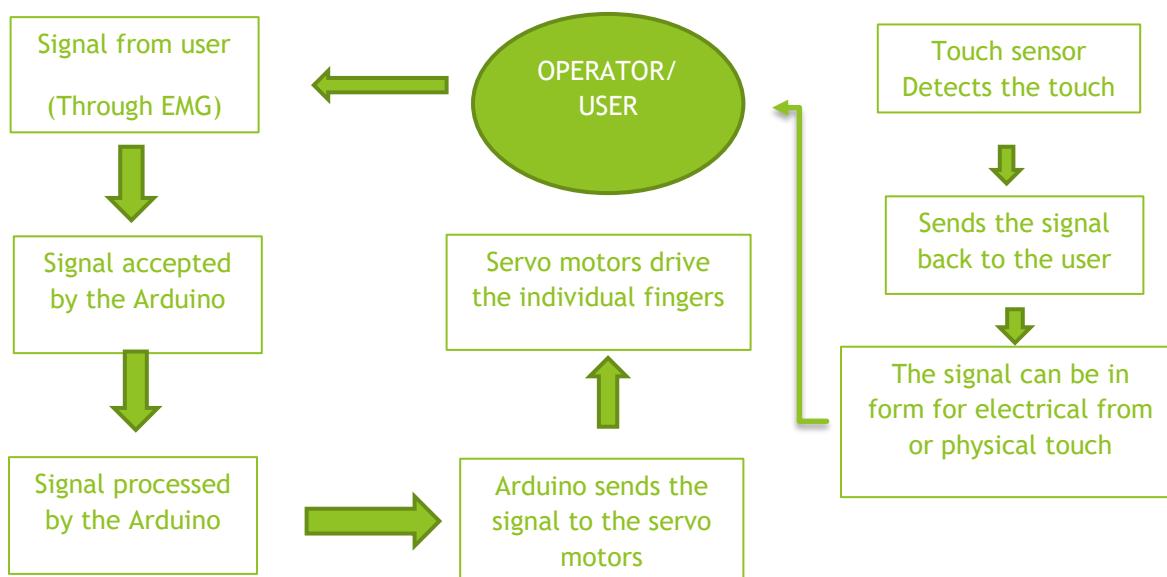
These are the problems we aim to address in our project.

SOLUTION

So, as the solution we thought of making a Bionic arm that solves all the problems mentioned above. The pricing should be kept nominal, so that anyone can afford it, the material and the component choice should be selected in such a manner that the weight doesn't become a burden on the user, make it comfortable, have all the advanced features in it. And in order to remove the stigma related to amputees, make it look natural, or futuristic as the user likes, and most importantly make it feel like the extension of the user's body, to be reliable

METHOD:

For all this to be possible we need a way to sense the signal generated by the brain, to convert it into digital signals, and then process it, and then finally convert it into physical motion as required by the user. To accomplish this, we used Arduino nano as the brains of the operation, to sense the signal we used EMG muscle sensor which takes the signal and sends it to the Arduino and then the Arduino processes it to convert it into physical motion by the help of servo motors. Then at the palm we added touch sensor, as they are cheap and easily available, and will provide the user with the touch feedback.



We are going to connect the EMG sensor to the Arduino nano, using jumper wires. The EMG is going to output values depending on the activity of the muscles. Which is then going to be sorted into different hand movements by experimenting with different sensitivities with the user and then adjusting the code accordingly to provide the motion with comfort to the user. A touch sensor will be placed on inside of the palm, which are going to be connected to a servo which is going to touch the limb of the user, giving touch feedback. For each finger to be controlled individually we are going to attach a servo motor to each finger giving the user more gripping power and precise control over the movement of the hand.



1st prototype

(Our prototype was fully functional with minor errors)

INNOVATIVE ASPECT

The innovation we hope to bring is that make it futuristic, so that the inferiority complex related to the lack of some body parts. Making our prototype the only bionic arm that is cheap, reliable, have user adjustable features, all the bells and the whistles, and be easy to manufacture and repair if needed.

We are going to make it easier implement and cut the enormous cost of the prosthetic, which isn't available on the market yet. And the ones available for the cheap on the market unlike our bionic arm aren't full packed of features. And as our is a 3d printed design, it can be modified for the user, or by the user if he decides to change the look of his arm or the color, or something breaks.

To make it feel natural we are going to minimize delay in our codes, and make it constantly check for changes in the signal activity, which isn't available anywhere.

APPLICABILITY

Our project is designed to be user friendly and cost efficient. Being user friendly nearly anyone can use it. And it can be easily turned into a product, with no workshop or expensive machinery needed to manufacture it, our project can be replicated on a larger scale.

We can't trust machines as much as human body parts, there is a risk involved that the prosthetic might fail out on a critical moment or get water damaged no matter how precisely and up to standards is it built, there is always going to be these sorts of risks involved.

PROJECT BUDGET

Description	Quantity	Price in PKR	Price in Lira
9g Servos	6	400	22
EMG Sensor	1	2600	144
Arduino nano	2	690	38
Touch Sensor	1	250	14
18650 Batteries	6	150	16
18650 BMS	1	450	56
3D Printed Arm Structure	1	1500	166
Switches (toggle switches)	2	200	11
Jumper Wires Sets (male - male, male - female, female - female)	3	300	16

Total items in the project = 9 items

Total expenses of the project = 10780 Rupees /594Lira

NOTE * as we aren't buying parts in bulk, we are subjected to higher pricing

COMPARISON OF THE PRODUCT PRESENT IN THE MARKET:

Cost of bionic arm in Pakistan	3-lakh rupees
Cost of bionic arm in turkey	15k lira
Average cost in rest of the world	8000\$

Hence our bionic arm is way lesser than the product available in the market.

PROJECT SCHEDULING:

Deciding the project idea	10-FEBUARY
Discussion with teachers about the project idea	11-FEBUARAY
Applying for the project	27-FEBUARY
Project pre-Evaluation Report	10-APRIL
Project detail report	15-25 JUNE
Visit to market for the prices of the hardware required	22-JUNE
Finalizing the project detail report	28-JUNE
Prototype of the project	Already completed on 13 April
Purchasing of materials	Will be done after the acceptance of PDR
Finishing of the project	Will be done after the acceptance of PDR
Teknofest	21-26 September

TARGET GROUP:

Our main target group was the middle and the lower-class people, those who couldn't afford the luxury of buying an expensive prosthetic hand, and went with non-functional hands or simply without any, by this project we could cut down the cost so much that they could afford this functional hand, and have a normal life. Such as the labor who have lost his/her arm in a work-related incident or any other reasons, or a kid born without a hand, or had it amputated due to a medical condition.

RISKS:

As with any man-made object there is a fear of it breaking down or failing. But this can be minimized through quality manufacturing. The main issue would be the shortage of components or the parts wouldn't arrive in time, which would cause discomfort for the user.

The problem that is going to be is that the coding values are going to be unique to each individual user, hence then user and the programmer of the prosthetic are going to sit together and then experiment with different sensitivities in order to find the optimal sensitivity for the user which he/she can enjoy using. The structure is also going to be unique to each amputee's socket, hence requiring a detailed model of the amputee's socket to make it comfortable.

RESOURCES:

Amputees in the world	http://universalprosthetics.com/issue.html#:~:text=The%20World%20Health%20Organization%20estimates,life%20increases%20in%20these%20countries
Amputees in Pakistan	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4866834/
Cost of bionic arm in Pakistan	https://www.wamda.com/memakersge/2019/01/robotic-arms-pakistan#:~:text=Bioniks'%20prosthetics%20cost%20%242000%20and,in%20Pakistan%2C%20%2480%9D%20says%20Qureshi.
How does bionic arm work	https://www.youtube.com/watch?v=F_brnKz_2tI https://www.youtube.com/watch?v=GgTwa3CPriE https://www.youtube.com/watch?v=luHmXHEpF7w&t=199s
Traditional Bionic arm issues	https://www.youtube.com/watch?v=rvkMauaHxBw
EMG sensor working	https://www.youtube.com/watch?v=1LjE07z5r7c