PROJECT TITLE: FUNCTIONAL PROSTHETIC ARM CONTROLLED BY VOICE INPUTS

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ABSTRACT:

India has 7 lakh people who struggle to complete their everyday activities as they have lost their arm either by birth or by accidents. So, the bigger challenge that they face is, the cost of having a product that can remarkably improve their quality of life is beyond their affordability. The other challenge is, the policies and implementation of policies towards physically-challenged in India are extremely poor which makes them struggle everywhere and in every situation. Witnessing this as a socially relevant situation, this project has been taken up to provide an artificial functional Prosthetic Arm for hand amputees.

In this project we propose to develop a fully functional prosthetic arm which works solely based on the input taken by amputee. The input to the controller is taken from the flex sensor which is attached to the arm at elbow. The controller sends signal to the servo motor which is in turn connected to the fingers. The fingers and palm are 3D printed and have joints for flexibility. Taking the voice inputs from amputees, we have developed a functional arm with finger movements satisfying the objective of pick and place. The controller converts the signals obtained by the sensor into readable inputs for the servo motor. The project is dedicated to the social cause of helping the amputees.

Further the same skeleton of our project can be altered according to the needs of individual amputees taking care of their personal requirement. This system eliminates the difficulties that the hand amputees face while using the non-functional cosmetic arm.

Key words: Prosthesis, Amputee, Arm.
INTRODUCTION

The practice of developing prosthetic limbs to help the amputees has been a part of all the civilizations even from the ancient times. Beginning with the wooden arms made during the old times to the most advanced nerve based prosthetic arm, the field of prosthesis and artificial limb making is still a matter of curiosity for the researchers and engineers. In this regard, we have taken up this project to help the amputees who do not have a forearm. The project lets the amputee to have an artificial hand, which has a pick and place functionality working automatically as and when required. The flex sensor used in the model picks up the signals by the voice command given by the amputee, helps in getting the servo motor to run. The servo motor is in turn connected to the strings of the 3D printed fingers which are a part of completely 3D printed arm. The controller converts the signals obtained by the sensor into readable inputs for the servo motor. The new technology of 3D printing has enabled us to get a perfect hand model made of ABS material (sturdy and light weight).

NEED ANALYSIS

Every year, so many people undergo amputation in India; some are performed due to different diseases while others are performed due to road accidents. Due to the lack of cost effective functional arm in the market, a group of students is working on a technology that can fulfill the market need. The fact is that there is 10 million world populations of amputees and out that figure 30% are missing an arm. Out of 3 million of arm amputees worldwide, estimates of 2.4 million are from developing countries. The World Health Organization estimates that out of the 10 million amputees throughout the developing world, only 5% of them have access to any form of prosthetic devices or assistance. Unfortunately, in many cases where assistance is available, amputees do not have the resources to pay for the help that they desperately need. This gap between the need and available solutions, leave millions of amputees without hope of ever regaining their mobility and independence. ‘We5’ is a functional prosthetic arm that is durable, user friendly, and affordable. This prosthetic arm provides the user the opportunity to do day-to-day activities.

MOTIVATION

The main reason for choosing this project is that we want to develop a prosthetic arm to help an amputee and thereby help to the society. During the survey, it was found that people with no upper arm are not able to lead their life as a normal person with or without non-functional arm. In the local market there is only availability of cosmetic hand which provides just mechanical support. There are some products available in the International markets which are out of price range for the larger population in the country. These two problems serve as a
motivation to take up this project and provide a great opportunity to design a prosthetic arm which is functional and inexpensive.

PROBLEM STATEMENT

Designing a Prosthetic palm that is reliable, enable tasks like clamping of cups, lifting a minimum weight of 250gm and is user friendly while being cost effective and durable.

OBJECTIVES

The objectives of the product are as follows:
1. To make the whole system safe for usage in most of the environmental conditions.
2. To make the arm functional, which will let the amputee to hold an object or move the object from one place to another.
3. To make the product user friendly and compatible, as the amputee needs to wear the arm for a long period of time throughout the day. This also includes weight of the material used, type of sensors used and ergonomics of the forearm being attached.
4. The project should also be cost effective, making it affordable for each and every individual in need.

METHODOLOGY:

SPECIFICATIONS

The specifications of the product are as follows:
1. Material used: ABS is used to make the palm which is light, non-reactive, heat resistant, skin resemblance.
2. Finger size: Adult finger size.
3. Weight: The weight of the product is 300 grams.
5. Actuation: The arm is actuated by voice inputs.
6. Power source: Rechargeable batteries

CONSTRAINTS

The constraints of the product are as follows:
1. Voice recognition: This aspect might act as a constraint if the user develops a severe cold or cough and the individual’s voice changes for a certain period of time. As the voice instructions are authenticated, it might pose a problem.
2. Battery life: The battery required by this system is huge by size and weight. Until lighter weight batteries are available which serve the purpose, the extra weight has to be carried by the user.
IMPLEMENTATION
In this section, we discuss the implementation of various hardware units, software units and 3D printing technology used in this project.

Phase-1
The phase 1 of product development was implemented using a button system. The button was provided at the foot of the user (in his footwear). This button acted as the actuation signal for the whole system. Blue-tooth module was used for transmission and reception of actuating signals. The receiver of the module was connected to the controller. The controller in-turn had motor-driver circuit connected to it. Motors were connected to the motor drivers and the fingers were connected to the motors using the thread mechanism. When the button was pressed, the Blue-tooth module would activate and send signals to the receiver indicating the rotation of the motor. When the button was released, the motor stopped rotating. Similarly, when the motor was again pressed continuously, the motor would rotate in the opposite direction. Thus the curling and uncurling action of the fingers of the arm was achieved.

Phase-2
The phase 2 implementation methodology was changed from blue-tooth input to voice signal input. The electronics and mechanical development of the product is as explained below:

HARDWARE REQUIREMENTS:
Electronics used:

1. Voice signal receiver (microphone)
2. DSP voice recognition board - Voice module l1293
3. 8051 Microcontroller
4. ARM processor - Arm LPC2148
5. 7805 voltage regulator
6. BC547 transistor
7. Mechanical Actuation Unit
   • Motor driver circuits
   • Servo Motors
   • Mechanical arm

SOFTWARE TOOLS USED:
1. Autodesk inventor
2. Cube Pro
3. Keil microvision
4. Flash magic
**BLOCK DIAGRAM:**

![Block Diagram](image)

**RESULTS:**

![Prosthesis Arm](image)

Figure: Top view of Prosthetic Arm
Figure: Side view of Prosthetic Arm

The prosthetic arm works according to the voice inputs given by the patient. The voice commands were further sent to the ARM board and this board acts as the brain of the system which senses the voice commands and processes it and then the movement of the motors at the fingers is actuated according to the requirement. There are basically four type of actions in our product like pinch, point, drop, lift.

CONCLUSION
As the prosthetic control is an emerging phenomenon in today’s world, thus this project work will definitely embrace an important role in case of handicapped people. Further developments related to the design and functional accuracies will be the aim for future researchers working in this field.

1. As the prosthetic control is an emerging phenomenon in today’s world, this project will definitely embrace an important role in case of handicapped people. Further developments related to the design and functional accuracies will be the aim for future researchers working in this field.
2. The Human and Product-Interface can be easily adjusted even if there is growth in the muscles of the user.
3. User can easily control the actions of arm using voice input
4. Thus, this provides a better ease of working similar to normal human hands.
FUTURE WORK
The following points present the suggested future work for the implemented prototype:
1. Movement of individual fingers as per the requirement of the user and free wrist movements of the Prosthetic Arm will bring about drastic developments and similarities to a human hand.
2. This sector has a huge market if concentrated both on Arms and Legs prosthetics, i.e. 3 million people are arm amputees and other 7 million of them are leg amputees. After completion of Hand prosthesis, the team looks forward to go into Leg prosthesis.
3. Push buttons are to be included for actuation of signal (to operate arm) along with voice recognition module, just in case the user is unable to speak or their voice has changed.
4. Mirror is another feature which can function by imitating the other normal hand.