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IMPLIMENTATION OF PROSTHESIS BODY ARM USING NODE MCU (ESP8266)

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Abstract

A prosthetic hand is a device used to replace a lost hand, usually due to an accident, amputation, or medical treatment. They are controlled by sensors implanted in the muscles and allow individual finger movements and different types of grasping. These hands develop dexterity, help manage daily activities, and encourage independence. However, existing solutions are limited in terms of impact control and lack haptic feedback, limiting their usability. As amputations increase, safer, easier and cheaper prostheses are needed. Efforts have been made to create low-cost, lightweight upper limb prostheses, but cost limitations remain an issue. It is important to educate the patient about splint use and post-amputation care. Future designs aim to increase cost-effectiveness, use electronic devices to reduce weight, and improve management to improve patient outcomes.

Introduction

We see there are some people with missing hand, an artificial hand can sometimes replace it. The Fourth Industrial Revolution is the continuous automation of production and marketing using modern smart technology. Integration of the Internet of Things with mass-to-machine (M2M) communication can increase communication and personal care, and build intelligent devices that in the absence of human interference, can recognize and diagnose issues.

This model is artificial 3D printed robotic arm which is help to disorder peoples for do their daily activities efficiently [6]. The prosthetic devices help us to perform regular activities. Our hand is an extremely useful instrument for observing and learning about the world around us. In this world we see many people left their hand due to some unavoidable situations. These individuals constantly feel as though they have lost an intangible aspect of who they are, which is why the "Prosthetic Arm" project was designed for those who do not have arms.

The artificial arm is known as prosthetic arm is not only arm but also a arm which is working over daily use so that the handicapped people will not feel like they don’t have arm [4]. So, the user feels that the artificial hand attached to body is actual part of their body and gives the similar activity to the regular hand. They are accessible in a wide range of dimensions and shapes. This artificial arm consists of head, housing, and accessories that serve as connections from the neck to the joints. It will be connected to the body using cables. The prosthetic limb will work.

Literature Review

Determining accurate kinematic models of manipulators is often difficult and tedious, particularly for a device with the kinematic complexity of the Utah-MIT hand. Considerable effort has gone into developing automatic schemes for calibrating open-loop kinematic chains **[1]**. The tactile data from rugged gloves are providing the foundation for developing autonomous grasping skills for the NASA/DARPA Robonaut, a dexterous humanoid robot **[2]**. This article shows the steps followed in the design and construction of the prosthetic right hand UC-1. This device was designed based on a tree structure: three fingers with a range of three degrees for each finger **[3]**. Analysis of the manipulation strategies employed by upper-limb prosthetic device users can provide valuable insights into the shortcomings of current prosthetic technology or therapeutic interventions **[4]**. In this paper a new prosthetic hand is presented that closely approximates the grasping abilities of a human hand. A large variety of different objects can be grasped reliably and the movements of the hand appear to natural **[5]**. This paper presents a low-cost myoelectric robotic hand which was developed by a 3D printer. The purpose of the developed system is to be used as a low-cost prosthesis. It is controlled by electromyogram (EMG) signals from flexor and extensor muscles in the lower arm **[6]**.

Methodology

The normal artificial hand is just like statue of a human hand. It does not work like human hand and therefore it cannot be used in daily for work or any activities. It does not move and therefore the use of this artificial hand is that handicap person don't miss non-existent hand.

Objective

- The purpose of prosthetic arms is to improve user experience and functionality by improving control.
- Develop safer, easier and cheaper prosthetic arms to combat rising amputations and increase access to solutions.
- Explore new materials, such as polymers specifically designed to reduce the weight of upper dentures without compromising durability or performance.
- Improve patient education to ensure that individuals receive comprehensive training in prosthetic use and post-amputation care so they can get the best results from their prosthetic devices.

Block Diagram

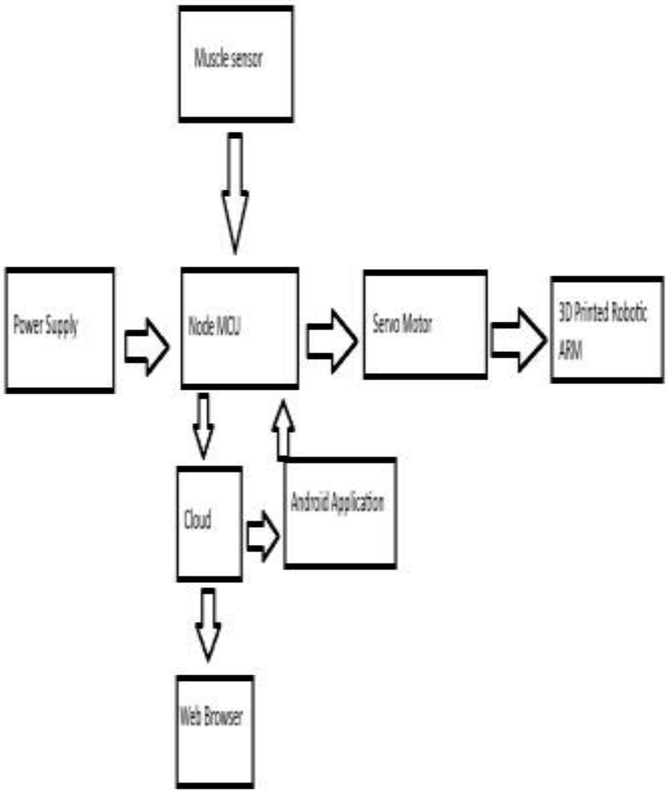


Fig. 01. Block Diagram

Hardware Implementation

DFD Diagrams

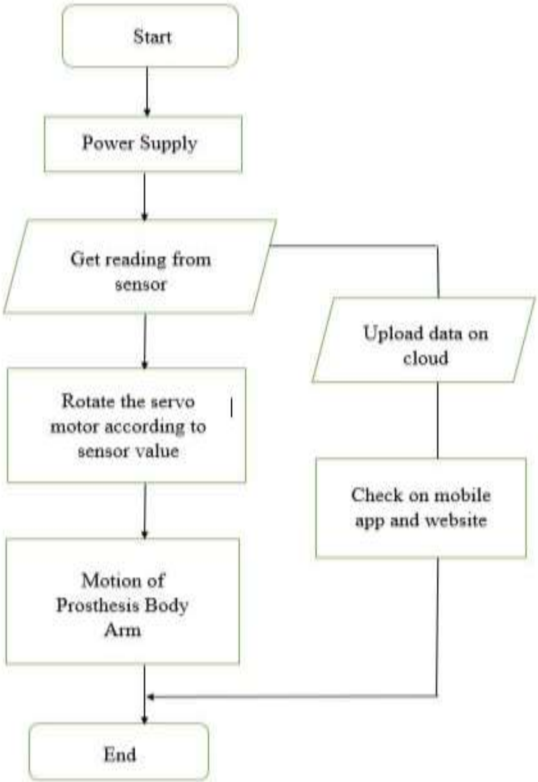


Fig. 02 DFD Diagram of Prosthesis Body Arm

Steps required

The steps followed in the design and development of Prosthesis Body Arm are described in detail here and it is also presented in figure no. 01 and 02.

First Step (Power Source): Main power supply to whole system.

Second Step (Node MCU): Node MCU is known as the system's brain. It operates or provides reputable hardware and software with input/output instructions.

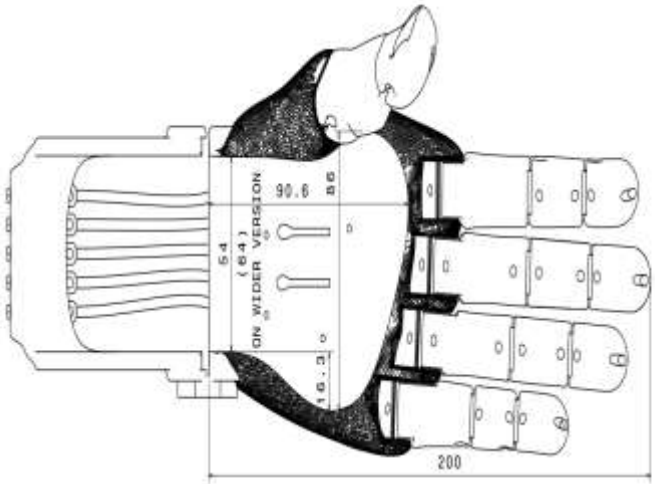
Third Step (Muscle Sensor): The prosthesis's servo motors will move in accordance with the electromyography sensor's readings. It measures the patient's muscle strength.

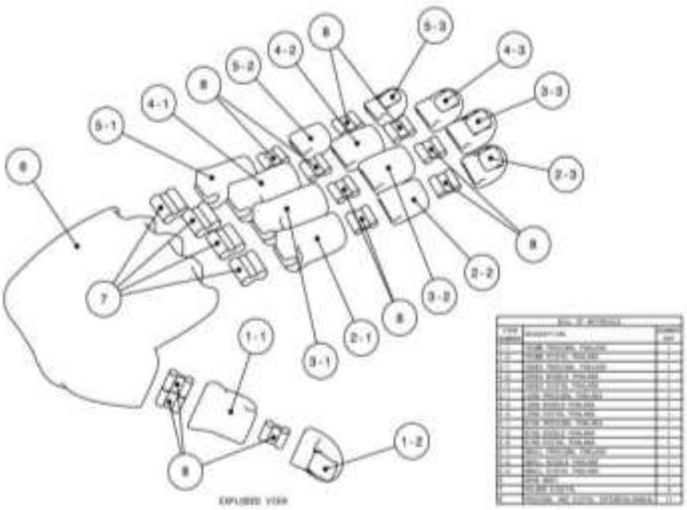
Fourth Step (Cloud): This refers to the internet-based delivery of computer services such as networking purposes, programming, storage space, servers, the form of databases, statistics, and information.

Fifth Step (Web Browser and Mobile Applications): This helps in data visualisation with help of concept of Cloud Computing. Using an Android application and an online browser, a nurse, doctor, family member, and additional doctor advisor can keep a close watch on the patient.

Sixth Step (Alert System): If the patient's health changes, the blub flashes in accordance with the needs of Alert System.

Hardware Design





Detail operation of the Prosthesis Arm

1) Android Application with MIT Inventor

Google first released MIT App Inventor, a unified platform for development for online applications. It enables non-programmers to create applications for mobile i.e Android or for the operating systems (OS) of mobile and iOS which are now in final beta testing as of July 8, 2019. The program is available for free and is published under two licenses: an Apache License 2.0 for Use the Creative Commons Attribution Share Alike 3.0 Unported licence along with the source code.

Developers can create their own mobile(android) applications by dragging and dropping visual items into the graphical user interface (GUI). Additionally, an App-Inventor Companion (The software that enables the application to operate and debug on) iOS-powered devices is still in development. Google based on a wealth of past research in educational both internal work and computing on web-based development environments while developing App Inventor.

Constructionist learning theories—which highlight that programming is a tool for actively engaging with strong ideas—are the foundation for the app Builder task, along with others. Consequently, it is a part of a continuous trend in computers and education that started in the 1960s Mitchel Resnick worked on Star Logo and Lego Mindstorms, also the efforts taken for the MIT Logo Group and Seymour Paper. Cloud data use is also supported by App Inventor.

2) Arduino IDE

The language used for Arduino programming is built upon Processing, a very basic hardware programming language that shares similarities with the C language. Once the sketch has been written in the Arduino IDE, it needs to be uploaded to the Node MCU board in order to be executed. Linux, Mac OS X, and Windows can all run the free and open-source Arduino IDE.

3) Cloud Computing with Google Firebase

Google created the Firebase platform to allow developers to create both mobile and web applications. In 2011, it was launched as a stand-alone business. The platform was purchased by Google in 2014, and it is currently their main app development product.

Implementation results and discussion

Cloud server of Private view

The above screenshot is of front page of things speak application. The graph showing muscle power verses time.

Cloud Server Channel setting

This screenshot gives the idea of channel settings in the app. The channel number, field and other information about channel is given.

Cloud server of Sharing

The above screenshot shows, how data is shared on server is given. Also gives information about the server.

Data Import/Export

It is about the input data and according to that what will be output data is shown.

Results

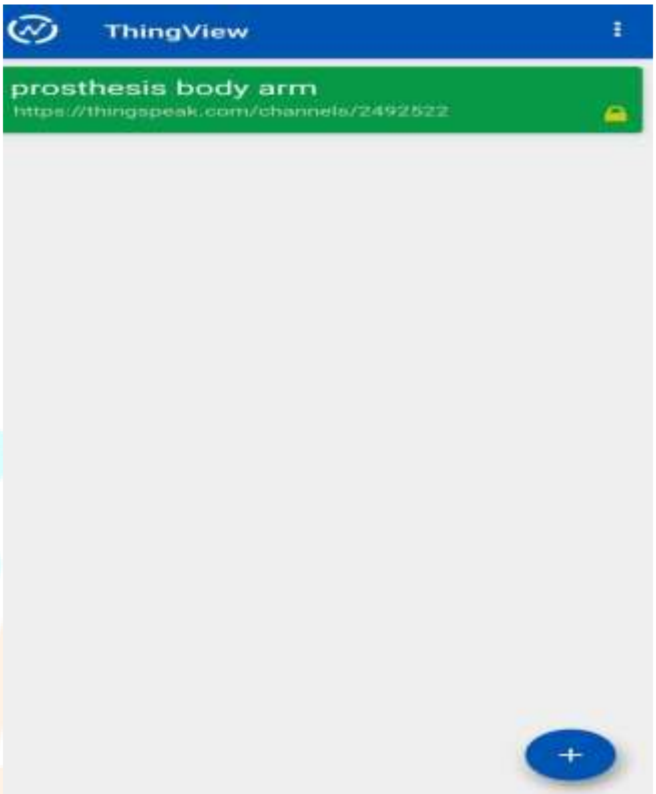


Fig: Home page of application

We are using things speak application for visualisation. The above screenshot is of front view of that application. We are seeing channel name in it.

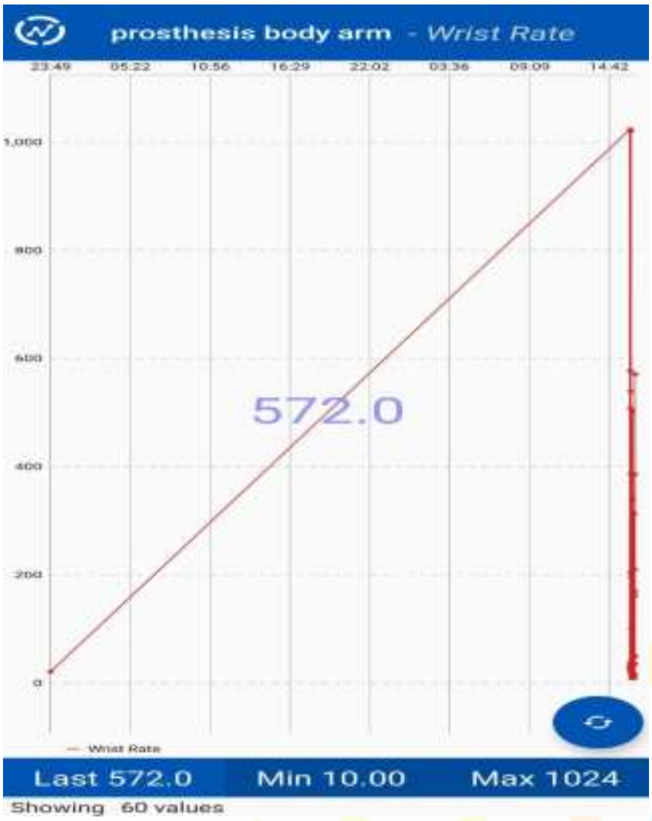


Fig: Graph of prosthesis body arm

Above screenshot is final output which shows graph of muscle power verses time. It is continues time signal.

3D printed Prosthesis Body Arm

Fig: image of 3D printed Prosthesis Body Arm

The above photo is of final implementation of project.

System Requirements

1) Node MCU (ESP 8266)

Fig. Node MCU ESP8266

Node MCU is short form of Node Microcontroller Unit which is is an open source platform for development of software and hardware projects in low cost using ESP8266. Designed and manufactured by Espressif Systems, the ESP8266 has the core components of a computer: Random Access Memory (RAM), Central Processing Unit(CPU), WiFi network, SDK, routines. This makes it the best choice for many Internet of Things (IoT) projects.

ESP8266 is microcontroller chip which is very difficult to use and handle. To perform the simpler tasks, as sending keystrokes to the "computer" on the chip or turning on power, you need to connect its pins with the appropriate analog voltage. Low level Machine instructions are used for this Node MCU. Using the ESP8266 as a control chip in a large electronic device ensures that this integration does not cause problems. This is a burden for hobbyists, hackers, or students who want to try their own IoT projects.

2) Muscle Sensor

Fig. Muscle Sensor

The EMG muscle sensor module, containing cables and electrodes, will measure the filter and correct the electrical activity of the muscles; outputs 0-Vs volts depending on the activity level of the selected muscle; where Vs represents the supply voltage. Measurement of muscle activity with electromyography (EMG) is routinely used in clinical research. This muscle sensor can measure, filter, adjust and present the electrical properties of muscles and generate an analog output.

3) Servo motor

Fig. Servo motor

Position feedback is used by the servo motor, a closed-loop servo mechanism, to regulate its angle and tip position. An analogue or digital signal that indicates the output axis' command position is the control idea.

For providing position and speed feedback, the motor is paired with a position encoder of some kind. The simplest scenario involves measuring merely position. The defined position (external input of controller) and measured output are compared.If the output position deviates from the required position then error signal is generated. Due to this the motor rotates in either direction as many times as needed to move the output in the desired direction. The engine shuts off and the error rate lowers to zero when the position is achieved.

As servo motor works smoothly and efficiently than other dc and stepper motors, Hence we used this servo motor.

Conclusion

Those missing hands can benefit from our prosthetic arms. They use this in their daily lives, and it makes them happy and gives them the will to die. Additive manufacturing-produced prosthetic hands are the most economical option for manual labour. This is an interdisciplinary effort that combines computer-aided design and manufacturing with medical science. It serves as a link between the advancement of the field and upcoming technological advancements. Prosthetic hands made using 3D printing are robust, adaptable, long-lasting, and appropriate for any setting. It is also less expensive than current prosthetic hands. Because of this, it is a distinctive, well-liked, and frequently used product by users.

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