Project Proposal Reference No	:	**46S_BE_2153**
Title of the final year BE Project Work (VII/VIII)	:	**DESIGN AND IMPLEMENTATION OF SMART PROSTHETIC HAND USING ARTIFICIAL INTELLIGENCE**
Name of College & Dept		Department of ECE, Dayananda Sagar College of Engineering.
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Venue of project done	:	Dayananda Sagar College of Engineering
Keywords	:	EEG, Brain-Computer Interface, Voice, Gesture
Academic Year	:	2022-2023
Field or area of project	:	Robotics
Project Category	:	UGV
Specific Target	:	To help hand amputees to become independent and improve quality of life.

			
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Abstract: This project presents a system whereby the human voice may specify continuous control signals to operate a robotic arm. Our goal is to help the people with disabilities by assisting them in their daily activities with the help of a robotic arm. Advances in assistive technologies have begun to provide an increase in independence for these individuals, but there is great potential for further technological developments to significantly improve their abilities, independence, and overall quality of life. Electroencephalogram based Brain-Computer Interface (BCI) robotic arm can help as a powerful support for severely disabled people in their regular activities, especially to aid them to move their arm voluntarily. This project is about designing and implementing a smart prosthetic arm to yield different movements in robotic arm.

Problem Statement: The World Health Organization (WHO) reported that about 15% of the world's population suffers from a form of disability. People with disability in hand must be dependent on others for daily activities, to overcome such difficulties, our project aims in designing Smart Prosthetic Arm.

Introduction:

Robot is not only used in industries but they are also used in human life. A robotic arm is a type of mechanical arm, usually programmable, with similar functions to a human arm robotic arms are implemented in different sizes and forms to accomplish tasks. The major goal of this project is to help the physically challenged person in their daily life. Here the robot helps the disabled person to become independent by pick and place any object.

The history of brain-computer interfaces (BCI) starts with Hans Berger's discovery of the electrical activity of the human brain and the development of electroencephalography (EEG). In 1924 Berger was the first to record human brain activity by means of EEG.A BCI is a non-muscular communication channel that enables a person to send commands and messages to an automated system such as a robot or prosthesis, by means of his brain activity. Using BCI we achieve these challenges. Also, to implement a robotic arm that can pick and drop object by adding voice commands and gesture commands. Voice interaction and gesture is crucial because it consists of a user-friendly communication to the robotic system. When instructions are given as input, the preprogramed controller will give the desired output by using robotic arm this system aims to further improve people's quality of life, and more specifically people with physical and mobility impairments.

Objectives:

- To design a smart prosthetic arm, which uses captured signals from the brain and processes it to control the arm.
- To accomplish complex navigational tasks (pick and place objects) in realistic environment for people with disability in hand.
- To be able to design a hand that mimics the gestures and act accordingly.
- To be able to control the hand by giving voice commands.
- To achieve home automation.
- To be able to send an alarming message to the family members in case of any emergency situations.
- To send text message to the care-takers via telegram app in case of critical situations.

Proposed Methodology:

Input:

- **EEG Sensor** is used to record the electrical activity along the scalp. With the help of an electrode, we will be able to collect information of the neuron activity.
- **Bluetooth module (HC-05)** is outlined for wireless communication between the brain headset and the Prosthetic hand.
- **Speech Recognition module** is used to gather voice commands from the user and streams the audio for the movement of the Prosthetic Hand.
- **Flex Sensors** are used to mimic the gestures of another hand if the user wishes to switch to gesture mode. The flex sensor measures the amount of deflection or bending.
- **Power Supply Module** is an electronic circuit that enables a voltage to be applied across a load and ground supply for the servo motors.
- **GPS module** is used to find the location of the user, which helps in case of any emergency.

Methodology:

1. In this project we are basically trying to build a smart Prosthetic hand which is supposed to be controlled by voice, gesture and brain signals (EEG Signals). After, making the required connections between the **Arduino Mega** and respective sensors, the default operation that comes into play is voice-controlled operation.
2. If the user wants to do a specific action through audio, he can proceed in the voice mode. In case controlling the Prosthetic hand using either EEG signals or gesture signals is desired, the control can shift to the respective mode accordingly.
3. The actions they are to be performed in a particular mode would be mentioned in the code. So, when instructed the actions are then processed through **Arduino Mega** and directed to the **Prosthetic hand.**

Output:

1. The **Prosthetic Hand** is constructed using 3D printing materials with servo motors attached. The **servo motors** connected to the Prosthetic Hand are used to move the hand based on the attention values from the brain and the processed signals from the microcontroller.
2. The **LEDs** are used to show home automation based on the different action of the Prosthetic Hand.
3. The **Buzzer** attached to the Prosthetic Hand is alarmed in case of emergency situations if the user gives an audio signal.
4. The **Android App** gives the exact location of the user and helps his relatives find him in catastrophic situations. The app used is password secured and cannot be accessed by others.

Proposed Block Diagram and Flowchart:

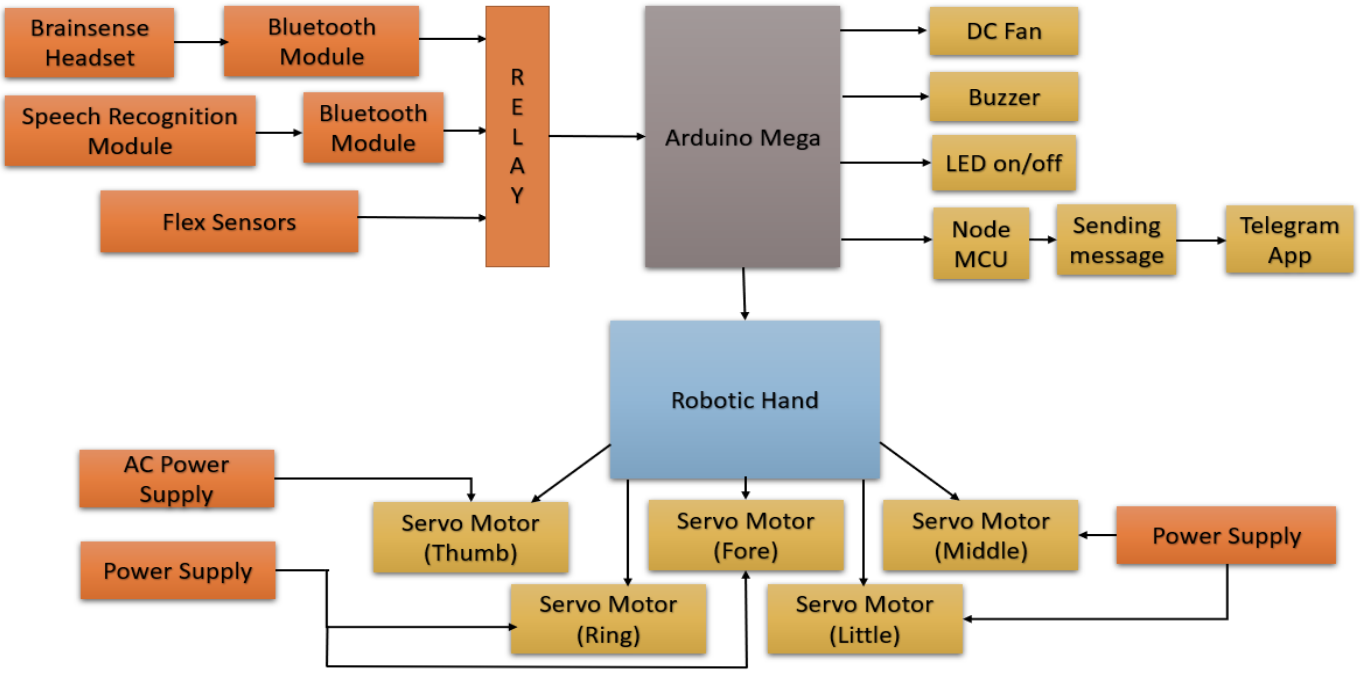

Fig 1: Block Diagram

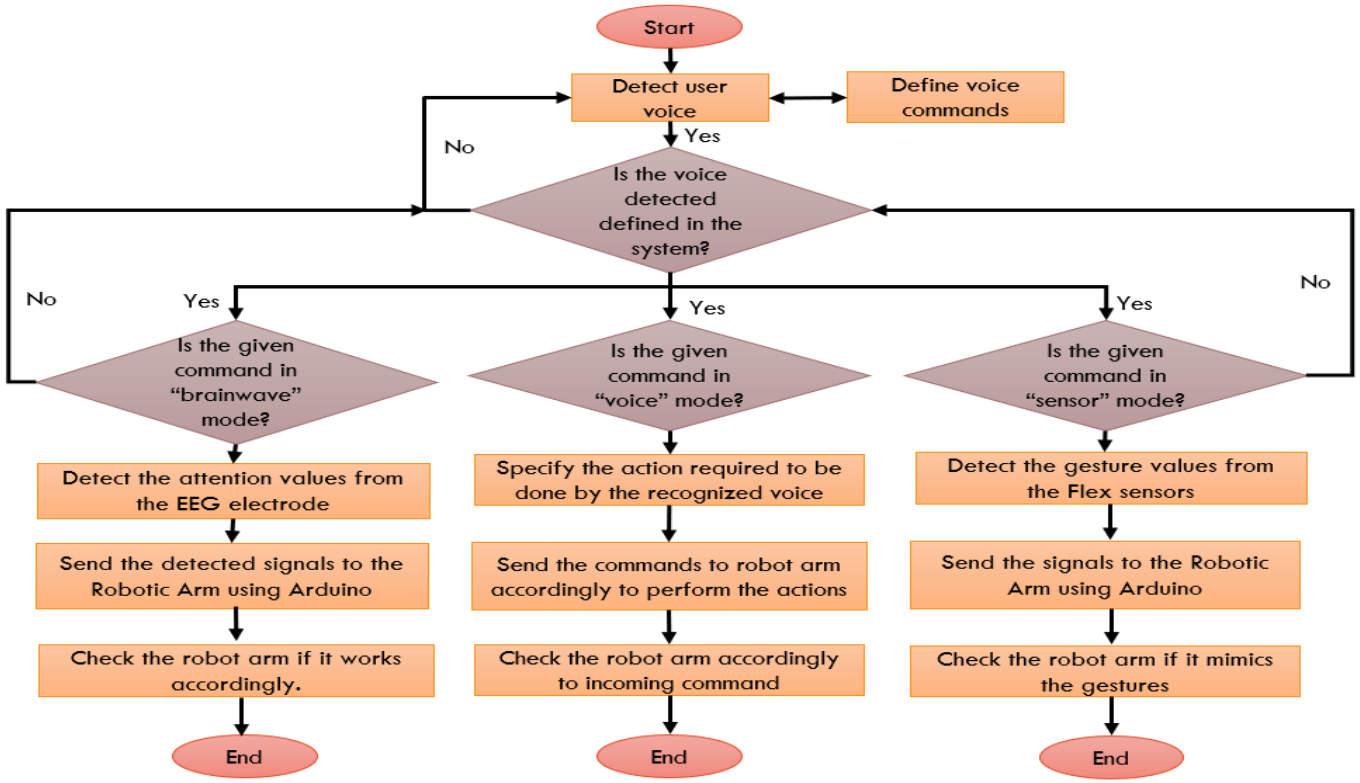

Fig 2: Flow Chart

Tools used:

Hardware:

- Robotic Arm
- Arduino Mega
- Brainsense Headset
- Servo Motor
- HC-05 Bluetooth Module
- Jumper Wires
- Power Supply Module
- Buzzer
- AC Power Supply
- Node MCU
- Relay
- Flex Sensors
- Resistors
- DC Fan

Software:

- Arduino IDE

Scope and Future Work:

The scope of our project is to help people with disability to live and lead a normal life and to do their daily activity without any aid of others in an efficient and better way. It mainly helps people who have lost their hands due to war, paralysis and people who have lost the control over their limbs. BCIs used to transmits the subject thoughts, decoded by brain electrical activity into control signal, for external uses without a need of any brain surgery which in turn supports the person who needs assistance. This technology can make a fully dependent person to a partially independent person, with which they can improve their physical and mental health. The specific goal of the project aimed to make the control of assistive robots more intuitive and to perform various tasks in less time and with less effort based on the voice commands. To design for a relatively simplest prosthetic hand in order accurately mimic just a few of the motions possible with the human hand. It would be difficult and beyond necessity to design a highly complex prosthesis that would mimic all the gestures possible by the hand.

Results and Conclusion:

A Smart Prosthetic Arm that can perform various actions like pick and place objects for the given voice, gesture and text inputs. Also, able to perform different actions based on the transmitted EEG signals from the brain. It should also send an alarm in case of emergency.

Human Robot Interaction (HRI) has a wide range of applications, Prosthetics is one of them. This project proposes and implements a holistic methodology to acquire EEG signals from the Brain using Brains electrodes and perform actions accordingly. The speech recognition module will collect the data through vocal command and will perform efficiently. A hand gesture recognition system is built using Flex Sensors. The transmitted data will be mapped onto the arm to perform various actions. The Smart Prosthetic Hand will be integrated with signals from brain, voice commands and hand gestures. Also, a buzzer is included in case of any emergency.

Achievements:

- Published paper in international Journal of Engineering Technology and Management Sciences (IJETMS).
- Conference presentation in Third International Conference on advances in Science &Technology (ICOST-2023) organized by Global Conference Hub, Tamilnadu, India on 28th & 29th January 2023.
- Awarded Second Place in 16th National Level Inter Collegiate Project Competition conducted by "Sambhram Institute of Technology" on 5th May 2023.
- Participated in State level Project Exhibition 'PROTATVA 2023' on 27th April 2023 at RV Institute of Technology and Management, Bengaluru.