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Design Of Brain Operated Robotic Arm for Amputee Patients

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Abstract - In this paper, a model of a robotic arm is designed and manufactured using a 3D printer, which is to be operated via human gesture by using the Brain Sense. This arm is proposed to help in the medical field, in military operations, in hazardous conditions, and in industries to maximize human safety. The robot arm is designed such that, it has 5 degrees of freedom controlled by human brain. The module will replicate the movement of the user's hand to extend, retract, and rotate accordingly to accurately position as required for the application. The user's finger action is used to manipulate the working of the gripper. Therefore, gesture control in a broad sense is a computerized interface that allows to record and interpret those gestures into commands to adhere to actions.

Index Terms – 3D printer, robot arm, operation, humam.

I. INTRODUCTION

In our challenge we make a robotic arm for someone who has no hand, first we make a layout with the help of SolidWorks software and after a layout. we print the components in 3d printing. After printing we collect that issue and after meeting electronic additives to be mounted inside the robot arm for automatic capabilities like sensors, wireing, and PLC programming. 3d printing is new technology nowadays in market.

Robots are electromechanical machines that are programmed to perform a chain of operations with or without human supervision. This scope of being self-sufficient makes them appropriate for usage in diverse fields inclusive of medication, army, enterprise research, and so on A robotic arm is an assemblage of mechanical linkages that are typically programmable, with competencies to feature further to a human arm. Such robotic arms are then used to perform the project with unmatchable consistency and accuracy. Gesture recognition and control is one of the methods that is used to interface human instructions in the form of gestures into executable operations of the arm. In this paper, hand gestures are focused upon as they may be appreciably mapped and used for controlling robot hand movements. The following are the targets of this painting: To build a 5-axis robot arm. To put into effect gesture-assisted management at the robotic arm. To incorporate and familiarize with the working of flex sensor. The working idea of this arm is that it makes use of Arduino Uno as the micro-controller platform for the prototype arm and is programmed with the procedure the enter signals by using the person towards the usual library code. The designed robotic arm prototype can mimic the positive hand moves of the consumer in real-time. Characteristics including surviving repeated usability and having a sensible extent in its work area all even as keeping the whole version easy in production, mild in weight, reasonably priced, and durable are desired.

II. LITERATURE SURVEY

A survey on Arduino Controlled Robotic Arm by Ankur Bhargava. In this paper, a 5 Degree of Freedom (DOF) robotic arm has been developed. It is controlled by the Arduino Uno microcontroller which accepts input signals from a user a set of potentiometers. The Robotic Manipulator is made from four rotary joints and an end effector, where rotary motion is provided by a servo motor. Each link has been first designed using a Solid Works Sheet Metal Working Toolbox and then fabricated using a 2mm thick Aluminum sheet. The servomotors and links thus produced assemble.

Review on development of industrial robotic Manipulator by Rahul Gautam This selective operation robotic control method is needed to overcome the problem such as placing or picking objects that at distant from the worker. The robotic Manipulator has been developed successfully as the movement of the robot can be controlled precisely. It is expensive to change the cable and therefore the design to reduce the friction on a table is crucial to increase the time between maintenance.

Survey on Design and Development of competitive low-cost Robot Arm with Four Degrees of Freedom by Ashraf Elsassian In this paper, the representation of the design, development, and implementation of the robot arm is done, which can perform simple tasks, such as light material. The robotic arm is designed and made from acrylic material where servo motors are used to perform links between arms. The servo motors consist of an encoder so that no need to use a controller. However, the rotation range of the servo motor is less than 180º, which greatly decreases the region reached by the arm and the possible positions. The design of the robot Manipulator was for four degrees of freedom. The end effector is not considered while designing because a readily available gripper is used as it is much easier and economical to use a commercial..

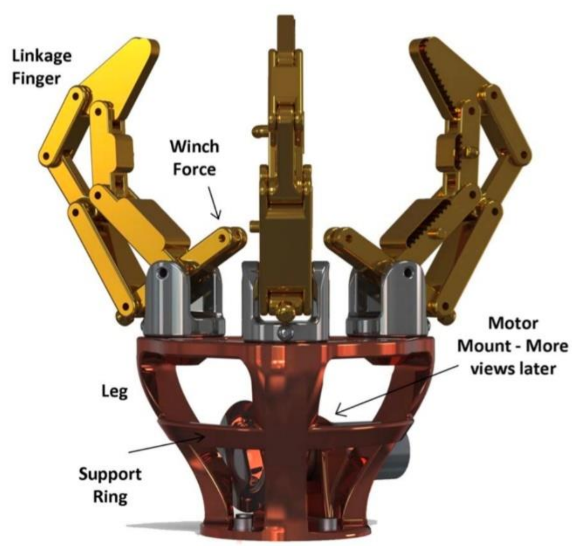

Fig1.1 Robotic Arm

III. COMPONENTS DESCRIPTION

The different mechanism used in this project are as given below:

1) Base Structure

2) End Effectors (Fingers)

3) Spring

4) Servo Motor

5) Sensors

6) Nut & bolt

7) Electromyography sensor

8) Resistor

9) Capacitor

10) Servo Drive

11) NodeMCU

12) IC 7805

13) IC 7905

1. Base Structure

The base serves as the foundation of the robotic arm. It provides stability and support, ensuring the arm remains balanced during operation. The base houses the motors and mechanisms necessary for rotational movement along the horizontal axis.

Fig1.2 Basic Structure

2. End Effector (Fingers)

The **end effector** is the part of the robotic arm that interacts directly with the environment. In the context of fingers, the end effector refers to the gripping mechanism or tool attached to the arm.

Robotic fingers can be designed for specific tasks, such as picking up objects, manipulating tools, or performing delicate operations. End effector is combination of different parts lower finger, middle finger, upper finger for giving desired motion.

Fig1.3 End Effector(fingers)

3. Spring

Springs are often used to counterbalance the weight of robotic arms. When a robotic arm needs to hold a specific position without external force, springs provide the necessary tension to offset gravitational effects. By adjusting the spring tension, the arm can maintain equilibrium at different angles.

4.Servo Motor

A **servo motor** is a rotary or linear actuator that provides precise control over position, velocity, and acceleration in a mechanical system.it give precise arm movements and gave also moment to joint control and end effector position.

5. Sensors

The combination of these sensors allows robotic arms to interact with their surroundings, perform tasks with precision and ensure safely in various applications from manufacturing and healthcare.

6.Nut & bolt

Nut & bolt assembly is used for assemble the Components to base and give the end effector

7 . Electromyography sensor

EMG sensors work by placing electrodes or senses close to your muscle groups.These sensors are much more effective on superficial muscles as they cannot bypass the action potentials of superficial muscle tissue.The power activates, and its length decreases during signal processing.

Additionally, the muscle, skin, and electrodes

Essentially, EMG signals originate from the electrical or electric potential of muscle fibers active during a contraction.

8. Resistor

The term "resistor" refers to a device that acts as a two-terminal passive electrical component that is used to limit or regulate the flow of electric current in electrical circuits. And it also allows us to introduce a controlled amount of resistance into an electrical circuit. The most important and commonly used components in an electronic circuit are resistors.

A resistor's main job is to reduce current flow and lower voltage in a specific section of the circuit. It's made up of copper wires that are wrapped around a ceramic rod and coated with insulating paint.

9. Capacitor

The capacitor is an electric component that can store energy in the form of electrical charges that create a potential difference, which is a static voltage, much like a small rechargeable battery.

The most basic design of a capacitor consists of two parallel conductors (Metallic plate), separated with a dielectric material. When a voltage source is attached across the capacitor, the capacitor plate gets charged up. The metallic plate attached to the positive terminal will be positively charged, and the plate attached to the negative terminal will be negatively charged.

10. Servo Drive

A servo drive is an electronic device that controls the speed, position and torque of brushless servo motors. They are also known as servo amplifers or motor controllers. servo drives work by adjusting the , wires and voltage applied to the servo motor through closed loop control. this allows the servo drive to make motors speed up, slow down, stop, or even go backwords.

Servo drives are made of circuit boards, microchips, wires and connectors. they are connected to the following from the components motorwindings, controller, power supply, and motor feedback drive.

Servo drives monitor the feedback signal from the servomechanism and continually adjust for deviation from expected behaviour. For example, motion control master software may command a servo drive to move a desired profile velocity.

11. NodeMCU

The name "NodeMCU" combines "node" and "MCU". the term "NodeMCU" refers to the firmware rather than the associated development kits. Both the firmware and prototyping board designs are open source. The firmware uses the Lua scripting language.

Fig1.4 NodeMCU

12. IC 7805

The **7805** is a member of the family of voltage regulators. It is a three-terminal linear voltage regulator with a fixed output voltage of 5V. The output remains constant even if there are changes in input voltage or load conditions. The 7805 acts as a buffer, protecting components from damage due to voltage fluctuations.

13. IC 7905

The 7905 is a member of the family of voltage regulators.It is a three-terminal linear voltage with a fixed output voltage of -5v. The output remains constant even if there are changes in input voltage or load conditions. The 7905 acts as a buffer, protecting components from damage due to voltage fluctuations.

14. Breadboard

It is a rectangular board with small embedded holes to insert electronic components. A breadboard is also categorized as a solderless board. It means that the component does not require any soldering to fit into the board.

15. Jumper wires

Jumper wires are simply wires that have connector pins at each end, allowing them to be used to connect two points to each other without soldering.

16. PCB

A **PCB** (Printed Circuit Board) is a copper-laminated and non-conductive board that connects all electrical and electronic components in a single assembly. Instead of using individual wires, PCBs provide a compact and organized platform for interconnecting components.

PCBs are found in various electronic devices, including TVs, mobile phones, digital cameras, computers (such as graphic cards and motherboards), medical devices, industrial machinery, and automotive systems.

IV. METHODOLOGY

The method we followed to Complete the project is as follows

1.Collecting research Paper: Collecting research paper from the internet on the Design of robotic arm controlling with brain Collecting research paper on design of robotic arm collecting research controlled by brain.paper on design and various parameters of robotic arm.

2.Project proposal: Making a project proposal for the selection of project and experiencing our ideas with project Guide and getting suggestion and submitting the project proposal to the project guide.

3.Selecting area of work: After project finalization we have to decide and area of work for Design of brain operated robotic arm for amputee patients. Making CAD design model and start simulation making the CAD model of robotic arm. explain all the factors related to structure and also to the end effector. Making the animation of robotic arm and start testing.

4.Finding resources: Resources should be fined for design of robotic arm it requires some part which making on 3d printing machine.the product prepared and give the finishing touch.

5.Collecting different components: after designed the components should be collected and the assembly is done. assemble all the components of design as according to CAD and animation make sure that is relative motion between parts is efficient and the mechanism used in design is properly working.

V. WORKING

1.Design – first, we made design of robotic arm on solidworks software of three end effector and done simulation. We also done test simulation like tensile,loading condition etc.

2.3D printing - the design is finalized we create a 3d model on 3d printing and make parts on machine while the used of 3d printing.of pla material .when the component is made we gave final touch for finishing and assemble the parts to each other.

3.Servo Motor – we mounted the servo motor on base structure to give connection in three end effector and perform working with the help of motor. We also use spring in the end effector to give moment according to signal called.

4.First brain signal (ECG) singnal is catched by the ECG sensor and then after send to the driver which is programed by pcb. pcb manipulate that signal and after manipulating or calculations pcb send the required amount of voltage to servo motor for motion of fingers henced motion desired motion is achieved.

4.Brain signal – we take the reading of amputee patients brain and feed into components.when the one hand is working as its working of other hand perform same action with the help of sensor and signal gave to hand.

VI.CONCLUSION

In amputee patients robotic arms controlled with Brain needs to perform the task of amputee patients.

The amputee freely and not required from other Person to help them.it gave a new life to do any work with the help of robotic arm.the role of amputee

Patients not required to spent large amount on Artificial robotic arm.it is easily made in low cost.

It also used in the field where dangerous being like ex: chemical surgery and hardworking in acid condition.

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