# REPORT ON PICK AND PLACE ASSEMBLY TYPE ROBOTIC ARM



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**Date and time:** 28th November 2022
**Resource Person:** Ms. Priya Jadhav Mam

## Objective:

In this mini project, we are going to devise a pick-and-place assembly-type robotic arm by using Arduino Uno.

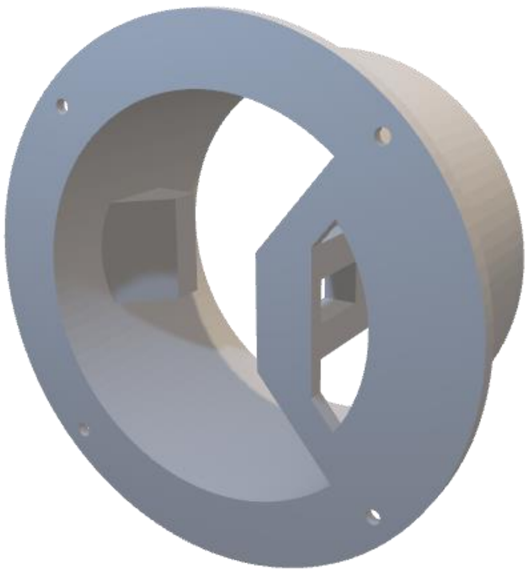
### Printing the parts:

To begin with, we have designed the Robot Arm using Solidworks 3D modeling software. The arm has 5 degrees of freedom.

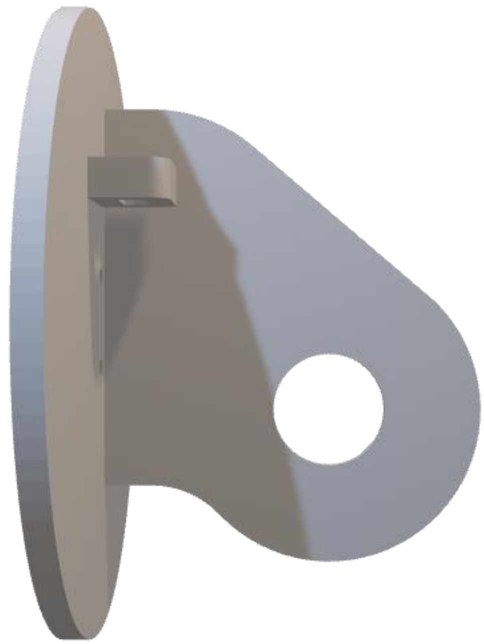
For the first 3 axes, the waist, the shoulder, and the elbow, I used the MG996R servos, and for the other 2 axes, the wrist roll and wrist pitch, as well as the gripper I used the smaller SG90 micro servos.

Using the 3D Printer, Creality Ender 3, and Creality Ender 3 Pro, we have 3D printed all of the parts for the Arduino robot arm. We have used PLA (**Polylactic Acid)**, which is one of the most popular materials used in desktop 3D printing. It is the default filament of choice for most extrusion-based 3D printers because it can be printed at a low temperature and does not require a heated bed. PLA is perhaps the easiest material to 3D print with FDM, and it's also biodegradable and odor-free. Its downside is its low heat resistance, softening with temperatures as low as 60 °C.

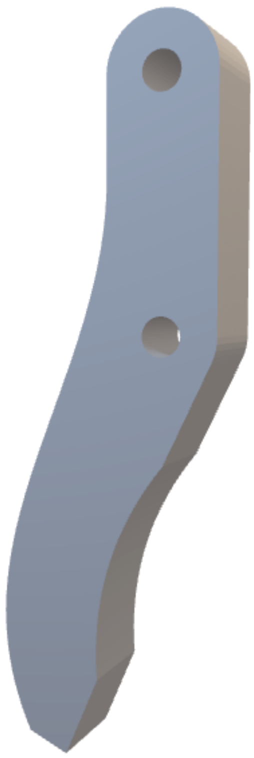
We have set the infill quality to 20% and are printed at Standard quality to print the following parts of the robotic arm.



Base



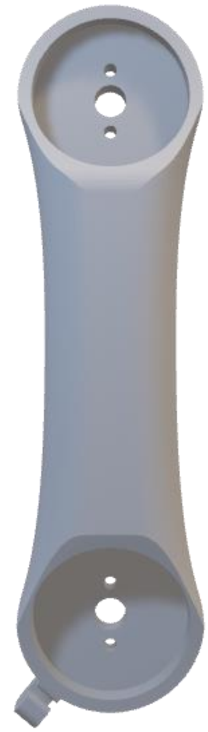
Waist



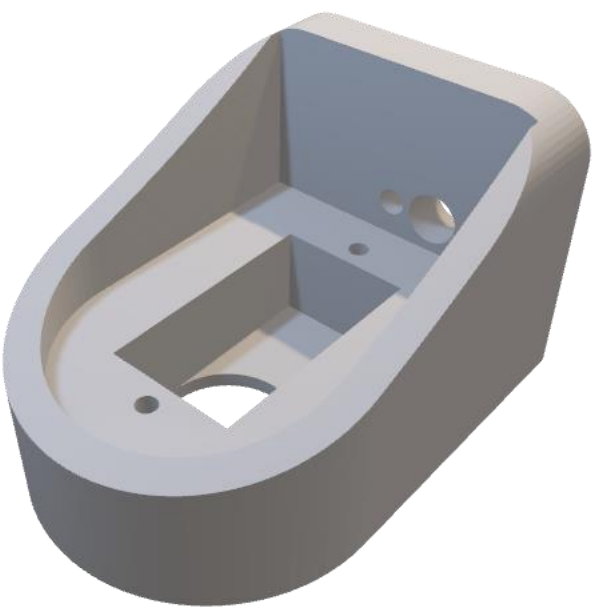
Gripper 1 and 2

Gear 1 and 2

Grip link 1,2,3 and 4

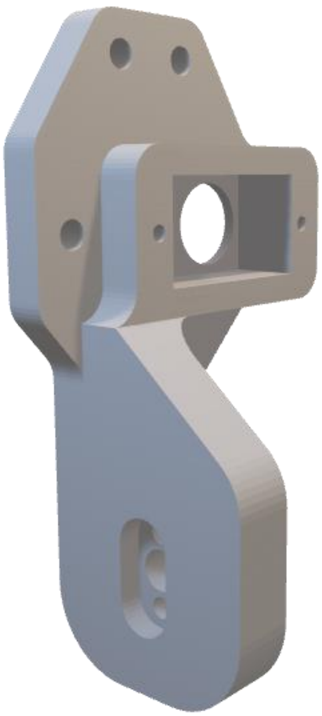


Arm 1



Arm 3

Arm 2



Gripper Base

**List of components printed using the 3D printer:**

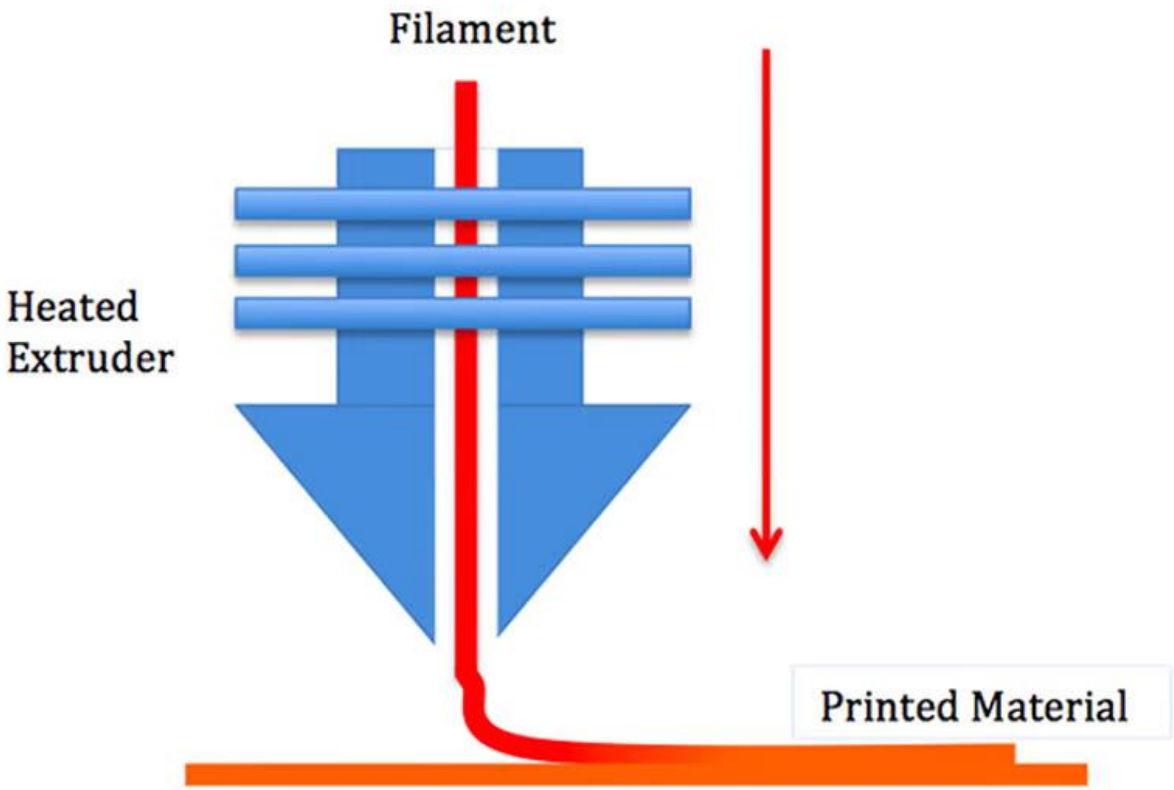
| Sr. No. | Name of the 3D-printed components | Quantity |
|---|---|---|
| 1 | Base | 1 |
| 2 | Waist | 1 |
| 3 | Arm 1 | 1 |
| 4 | Arm 2 | 1 |
| 5 | Arm 3 | 1 |
| 6 | Gripper Base | 1 |
| 7 | Grip Links | 4 |
| 8 | Grippers | 2 |
| 9 | Gears | 2 |

The additive manufacturing technology used to print the above 3D parts is Fused deposition modeling or FDM for short, which is a material extrusion method of additive manufacturing where materials are extruded through a nozzle and joined together to create 3D objects.

In particular, the “standard” FDM process distinguishes itself from other material extrusion techniques, such as concrete and food 3D printing, by using thermoplastics as feedstock materials, usually in the form of filaments or pellets.

A typical FDM 3D printer, therefore, takes a polymer-based filament and forces it through a heated nozzle, which melts the material and deposits it in 2D layers on the build platform. While still warm, these layers fuse to eventually create a three-dimensional part.

Generally accepted as the simplest way to 3D print stuff, FDM is accessible, reasonably efficient, and widely popular.




Broadly speaking, the extrusion and deposition system can be split into two main assemblies: the “cold end” and the “hot end”.

The thermoplastics used in FDM 3D printing often come in filament spools, and the cold end is responsible for feeding this material from the spool into the 3D printer. As such, the cold end also controls the rate at which material is being deposited on the other end, often referred to as “flow”.

The hot end, on the other hand, is responsible for heating the moving plastic material to the point that it’s adequate for being “purged” through a nozzle, hence its name. This step involves different components, including heating cartridges, heatsinks, and of course, nozzles.

The cold and the hot ends must work synergistically to extrude just the right amount of material at the required temperature and physical state for properly stacking up layers.

FDM offers great value for producing strong and durable functional parts, especially when compared to fragile resin 3D prints.

FDM 3D printing is also very versatile because the print quality can be sacrificed in favor of speed and even sturdiness, making it an excellent tool for producing both pleasing aesthetic parts and more functional, tough ones.

The Actual photos of the parts after 3D printing are shown below:


Gears – 2 and Gripper links – 4

Arm 1

Base

Waist

Arm 2

Arm 3

Gripper Base

Gripper

## Overview:

- First the entire model of the pick and place robotic arm is designed in Creo modeling software and further converted into the required STL files. The arm has 5 degrees of freedom.

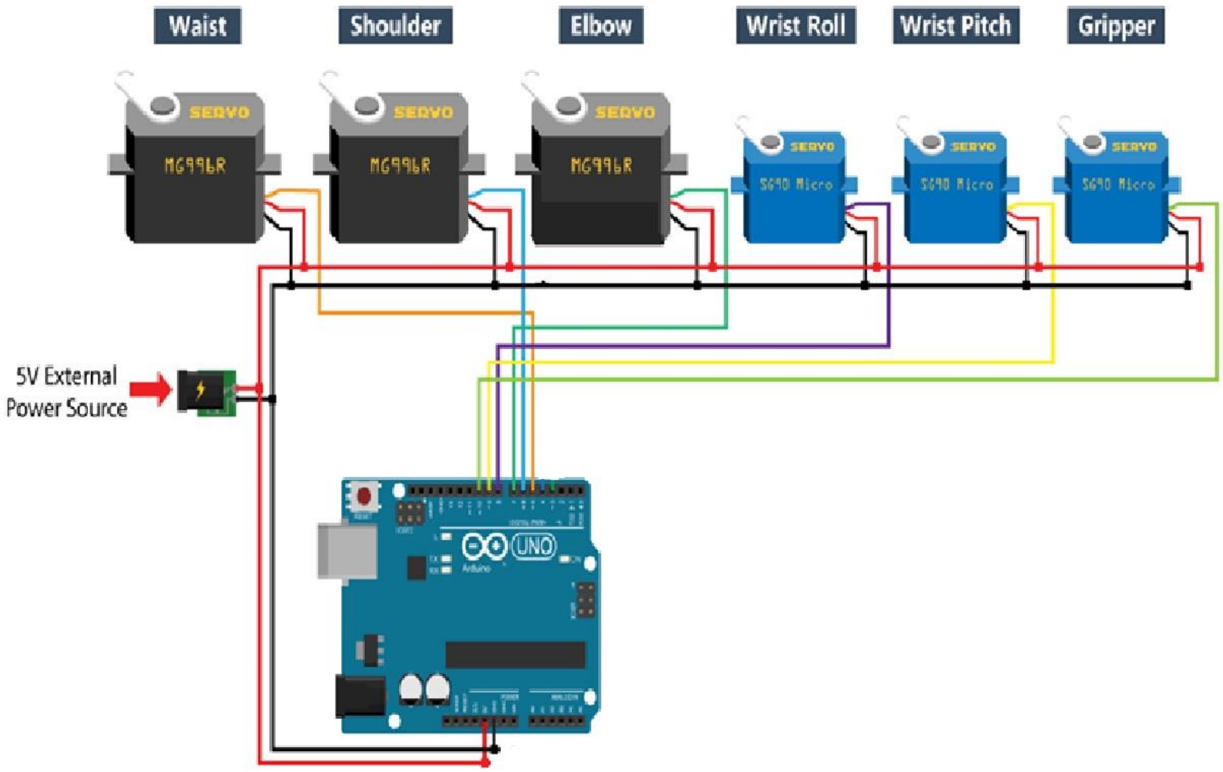
- The STL file of each of the individual parts of the robot is further sliced in the Ultimaker Cura to obtain the g-code file.

- The g-code file is further fed into a FDM-based 3D printer by the memory card or pen drive and the individual parts are printed out which is an additive manufacturing process.

- We used the larger MG996R servos for the first three axes - the waist, the shoulder, and the elbow and the smaller SG90 micro servos for the gripper and the other two - wrist roll and wrist pitch.

- Then we have to assemble the entire robotic arm.

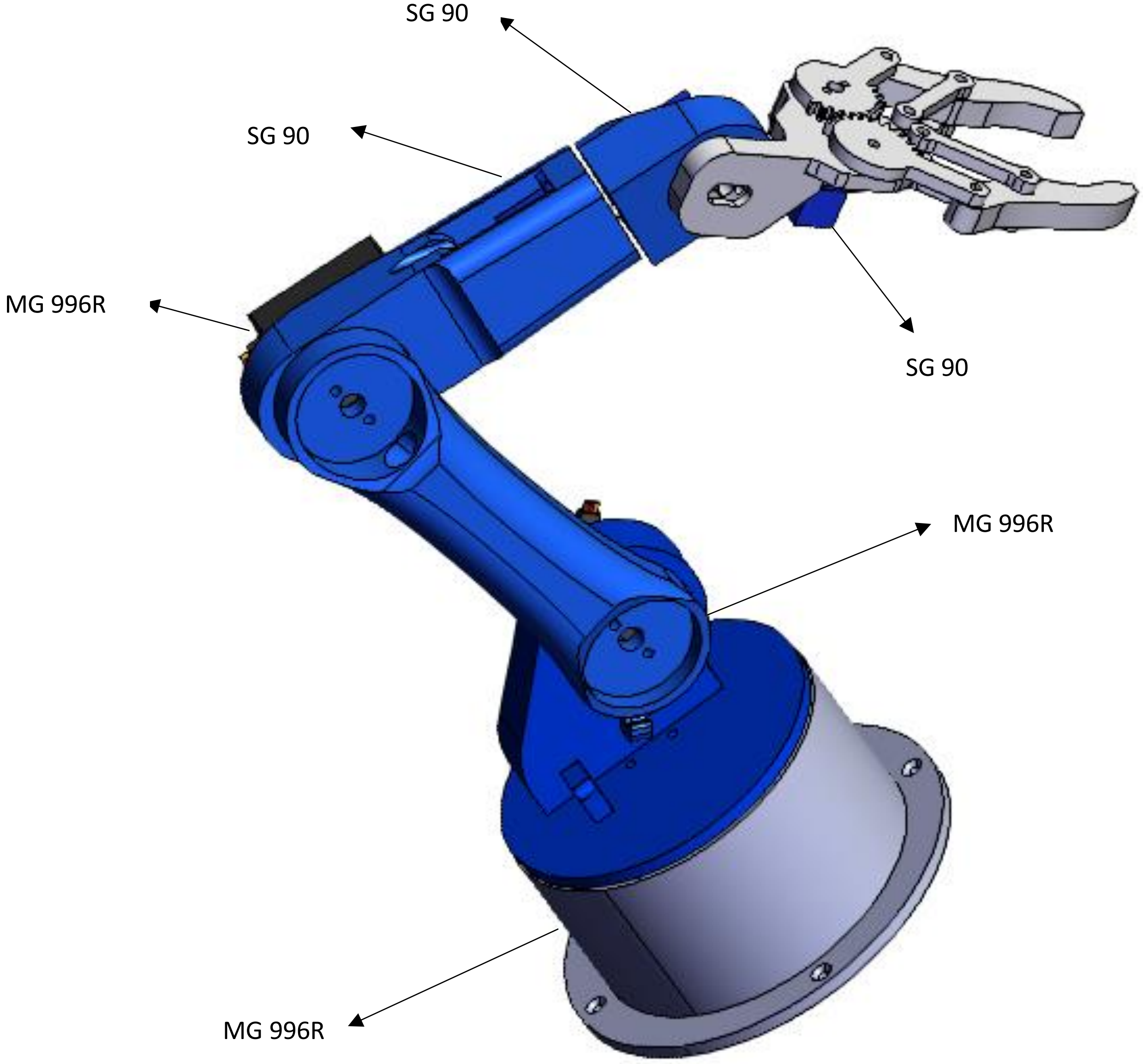
**Circuit:**

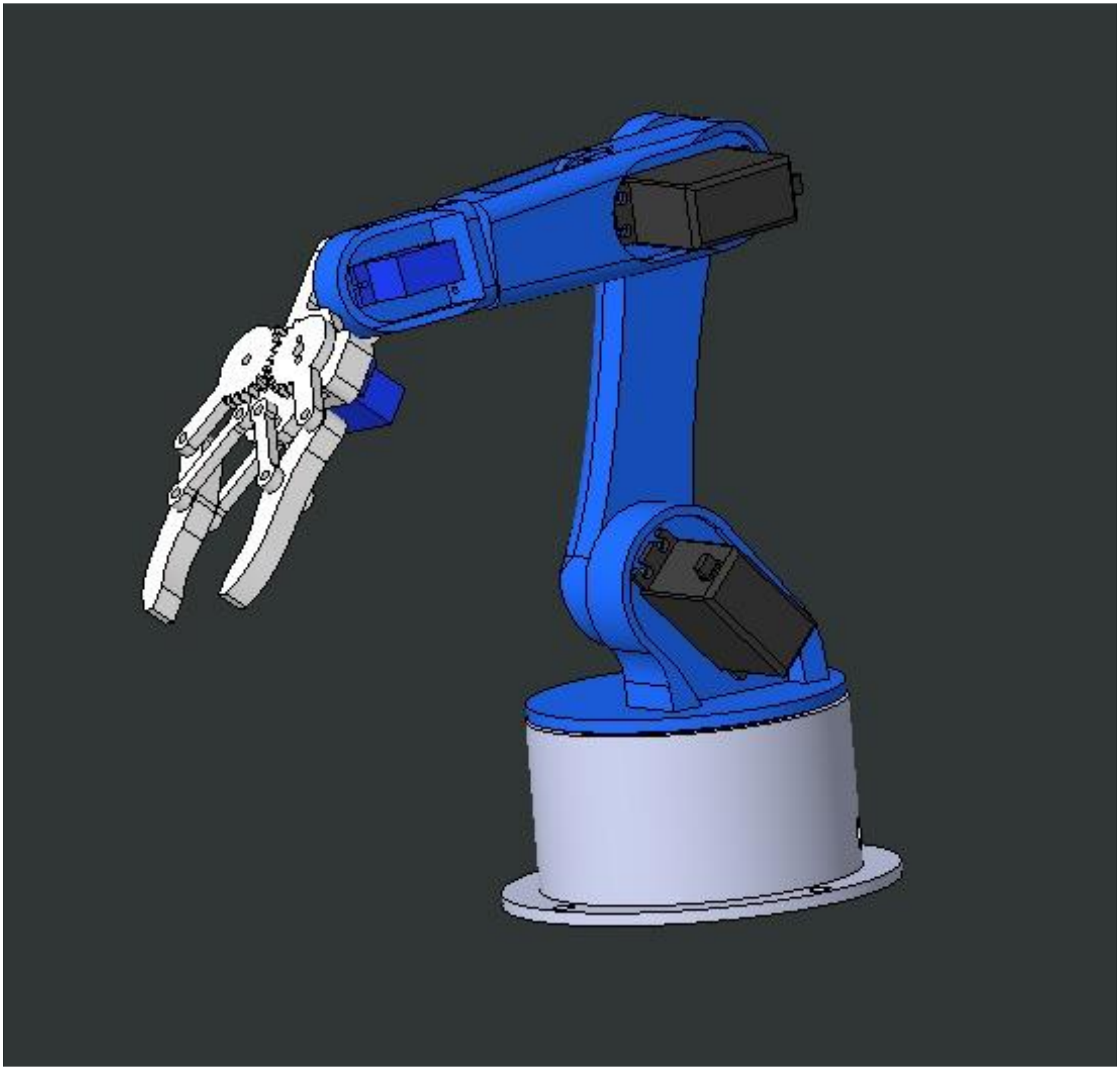



- The six digital pins of the Arduino board are wired to the control pins of the six servo motors.

- We need 5V to power the servos, but this must come from an external power supply because the Arduino cannot manage the total current that they can all need. A minimum 2A of current must be supported by the power supply. Therefore, once everything is connected, we can proceed to program the Arduino.

## Design:





## Working:

- The key component of any automatic robotic arm is its ability to learn motions or the ability of arms to be programmable by the user. This usually involves programming the arm each time with a set of instructions to be followed.
- The 6 Dof arm makes use of 6 servo motors controlled by an Arduino Uno controller.
- The arm gripper is made up of 2 claws which are also controlled by a servo motor. The gripper angle is also be rotated by another servo for a 180° orientation to pick up and place objects of any orientation.
- The controller can now repeat the set of steps so as to execute the entire movement command with desired coordination with each servo to achieve the program repetitively.

## BOM (Bill of Materials) with all the components:

| BOM Of mini project | | | | | | | |
|---|---|---|---|---|---|---|---|
| **sr no** | **part type** | **main part** | **subpart name** | **description of part** | **qty** | **rate** | **price** |
| 1 | Mechanical parts | robot | robot base | 3 D Printed parts | 1 | 0 | 0 |
| 2 | | | joint 1 (Waist) | 3 D Printed parts | 1 | 0 | 0 |
| 3 | | | joint 2 | 3 D Printed parts | 1 | 0 | 0 |
| 4 | | | joint 3 | 3 D Printed parts | 1 | 0 | 0 |
| | | | joint 4 | 3 D Printed parts | 1 | 0 | 0 |
| 5 | | gripper | mounting body | 3 D Printed parts | 1 | 0 | 0 |
| 6 | | | geared link 1 | 3 D Printed parts | 1 | 0 | 0 |
| 7 | | | geared link 2 | 3 D Printed parts | 1 | 0 | 0 |
| 8 | | | link | 3 D Printed parts | 4 | 0 | 0 |
| 9 | | | set of jaws (lh+rh) | 3 D Printed parts | 1 | 0 | 0 |
| 10 | | hardware for assembly | nut bolts | m4x10 | 10 | | 20 |
| | | | screws | m3x10 | 50 | | 20 |
| 11 | Electrical parts | Arduino board (Uno ) | electric circuit | R3 AT mega 328P | 1 | 800 | 800 |
| | | | | | | | 0 |
| 12 | | SERVO MOTOR | | MG 99 6R | 3 | 400 | 1200 |
| | | | | | | | 0 |
| 13 | | MICRO SERVO MOTOR | | SG 90 | 3 | 250 | 750 |
| | | | | | | | 0 |
| | | | | | | Total | 2790 |

## Future Scope:

Here in the future scope, we will try to operate the robot via the smartphone with the help of the HC-05 Bluetooth module.

Project Charter: Pick and place Robotic arm 28.11.2022

**Background**

This project is undertaken to get more insights and practical knowledge on how the pick-and-place robotic arm works in the industry.
To understand the type of infrastructure required to install these types of robotic arms in the industry.
To understand the type of skillset required to build these types of robotic arms.

This pick-and-place robotic arm can be implemented in an industry where automation is the first priority.
It will reduce the time required in material handling and also increase the productivity and output of the industry which was getting otherwise reduced in manual production.

**Goals**

- To design the robotic arm as per required in Solidworks.
- To 3D print all the parts that the robot framework consists of.
- To assemble the Robot body and attach the motors and other attachments necessary.
- To program the Robot accordingly as we need it to move.

**Scope**

[What will be the end result of the project? Describe what phases of work will be undertaken. It's alsoimportant to mention what activities will not be included in this project.]
The End result of this project will be to operate the pick and place robotic arm with the help of the smartphone.
Phases:

- Designing the entire robot.
- 3D print all the parts.
- Assemble the Robot.
- Programming the Robot.
- Connecting the Robot with the mobile application.

Some of the activities such as

- The robot will not be able to move from one position to another are not included in this project.
- The robot has only a single gripper so it can either do the loading of the finished product on the conveyor belt or unloading of the raw material from the conveyor belt, it cannot perform both tasks simultaneously. For such a task multiple grippers are required.

**Key Stakeholders**

| | |
|---|---|
| Client | Symbiosis Institute of Technology |
| Sponsor | Symbiosis Institute of Technology |
| Project manager | Symbiosis Institute of Technology |
| Project team members | Piyush Sharma, Prathmesh Bhumkar , Sayandip Paul , Susnehal Lade |

**Project Milestones**

Start Date: 12/9/2022
End Date: 28/11/2022
Completed 3D printing : 4/10/2022
Buying the Electronic Equipment: 8/10/2022
Assembling the robot: 10/11/2022
Coding and Testing: 18/11/2022
Dispatching the final product: 28/11/2022

**Project Budget**

Monthly Recurring

| | | | | | |
|---|---|---|---|---|---|
| Hardware for assembly | nut bolts | m4x10 | 10 | | 20 |
| For Assembly | screws | m3x10 | 50 | | 20 |
| Arduino board (Uno ) | electric circuit | R3 AT mega 328P | 1 | 800 | 800 |

Non-Recurring

| | | | | |
|---|---|---|---|---|
| SERVO MOTOR | MG 99 6R | 3 | 400 | 1200 |
| MICRO SERVO MOTOR | SG 90 | 3 | 250 | 750 |
| BLUETOOTH MODULE | HC-05 | 1 | 400 | 400 |

**Constraints, Assumptions, Risks, and Dependencies**

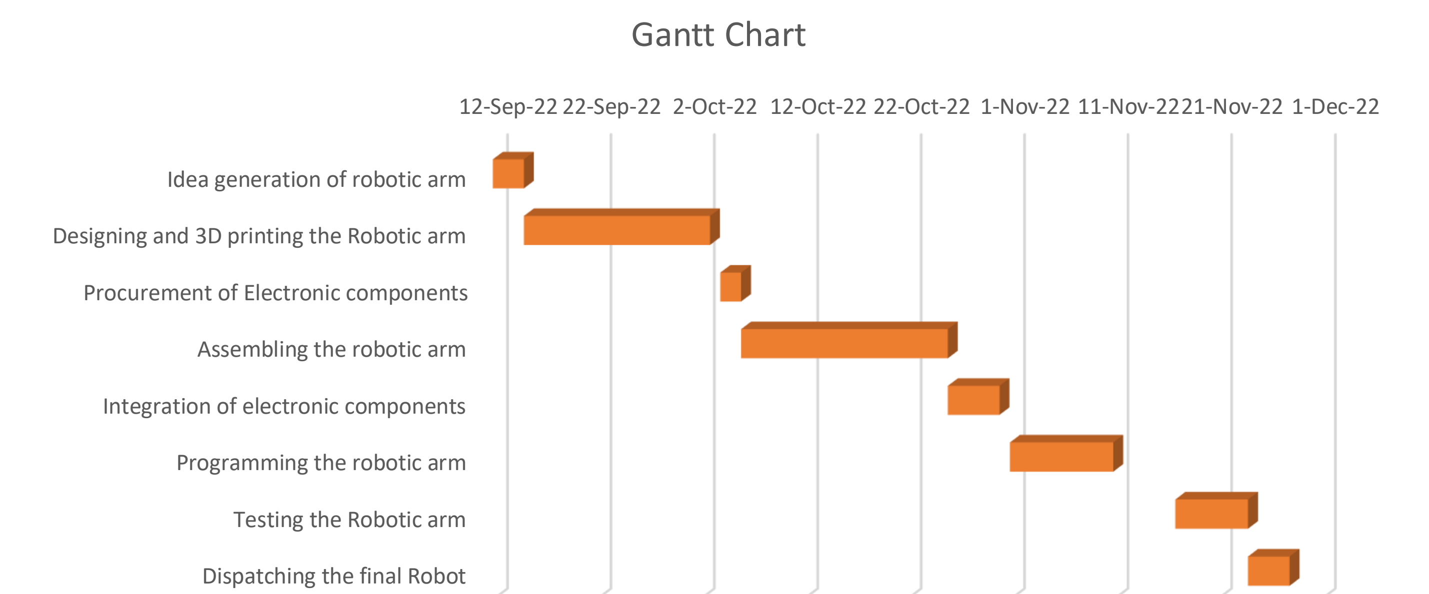
| | |
|---|---|
| Constraints | The 3D printer being occupied or malfunctioned<br>Code not working properly<br>Not being able to procure the required parts or equipment |
| Assumptions | Being able to get the required parts<br>Proper Availability of working code |
| Risks and Dependencies | The code that is procured may not work properly as required which may delay the delivery of the project. |

**Approval Signatures**

| | | |
|---|---|---|
| **Symbiosis** institute of Technology<br>Technology<br>[Name], Project Client Manager | **Symbiosis** institute of Technology<br>[Name], Project Sponsor | **Symbiosis** institute of<br>[Name], Project |

# Gantt Chart

| Sr. No. | Task | Start Date | Days to complete |
|---|---|---|---|
| 1 | Idea generation of robotic arm | 12-Sep-22 | 3 |
| 2 | Designing and 3D printing the Robotic arm | 15-Sep-22 | 18 |
| 3 | Procurement of Electronic components | 4-Oct-22 | 2 |
| 4 | Assembling the robotic arm | 6-Oct-22 | 20 |
| 5 | Integration of electronic components | 26-Oct-22 | 5 |
| 6 | Programming the robotic arm | 1-Nov-22 | 10 |
| 7 | Testing the Robotic arm | 17-Nov-22 | 7 |
| 8 | Dispatching the final Robot | 24-Nov-22 | 4 |




| | Dispatching the final Robot | Testing the Robotic arm | Programming the robotic arm | Integration of electronic components | Assembling the robotic arm | Procurement of Electronic components | Designing and 3D printing the Robotic arm | Idea generation of robotic arm |
|---|---|---|---|---|---|---|---|---|
| Start Date | 24-Nov-22 | 17-Nov-22 | 1-Nov-22 | 26-Oct-22 | 6-Oct-22 | 4-Oct-22 | 15-Sep-22 | 12-Sep-22 |
| Days to complete | 4 | 7 | 10 | 5 | 20 | 2 | 18 | 3 |

Work Breakdown Structure: