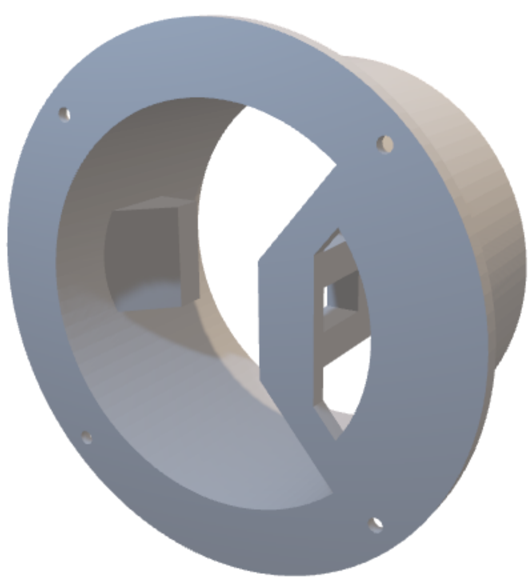
Use of Additive Manufacturing in the Arduino-controlled Robot Arm 3D Model (Sayandip Paul – 22070148010)

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

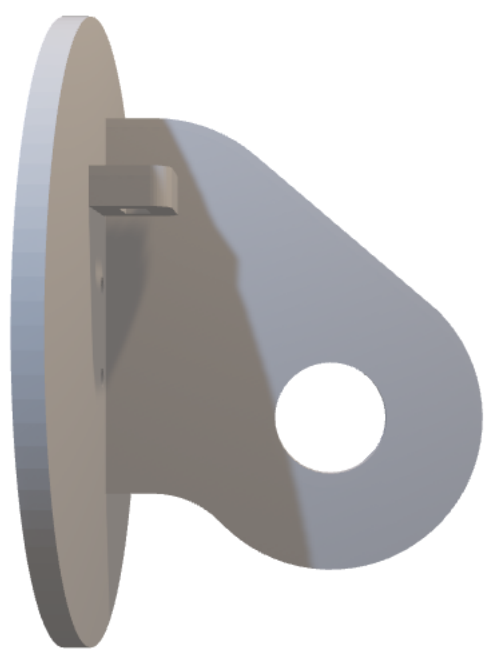
For the first 3 axes, the waist, the shoulder, and the elbow, I used the MG996R servos, and for the other 2 axes, the wrist roll and wrist pitch, as well as the gripper I used the smaller SG90 micro servos.

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.

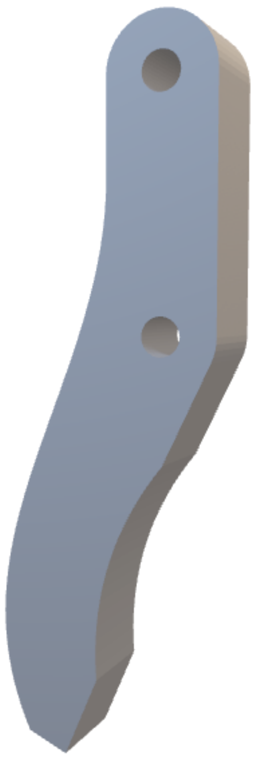
We have set the infill quality to 20% and are printed at Standard quality to print the following parts of the robotic arm.

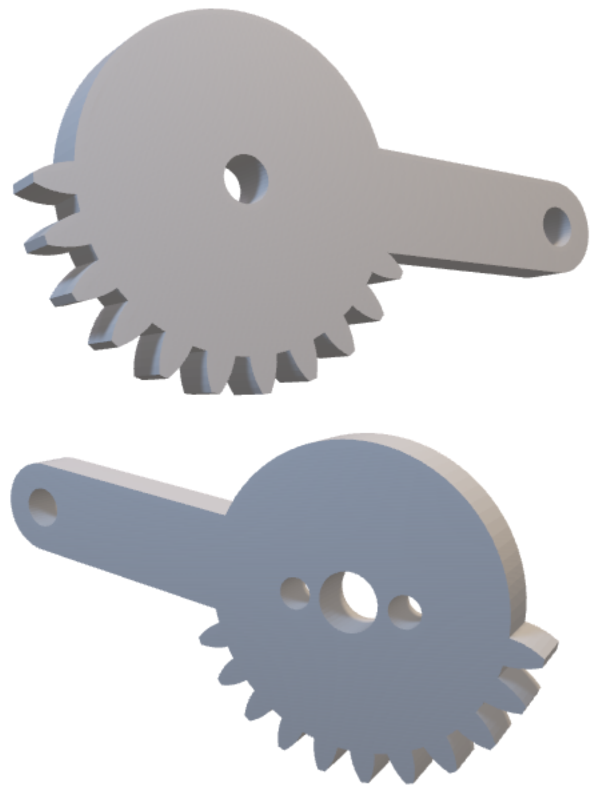


Base



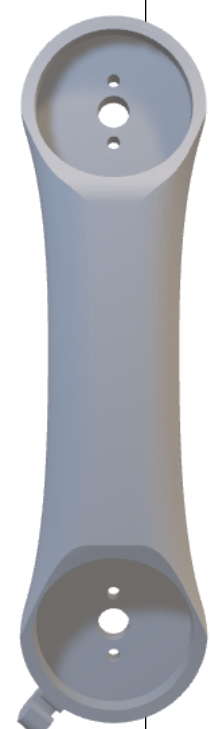
Waist





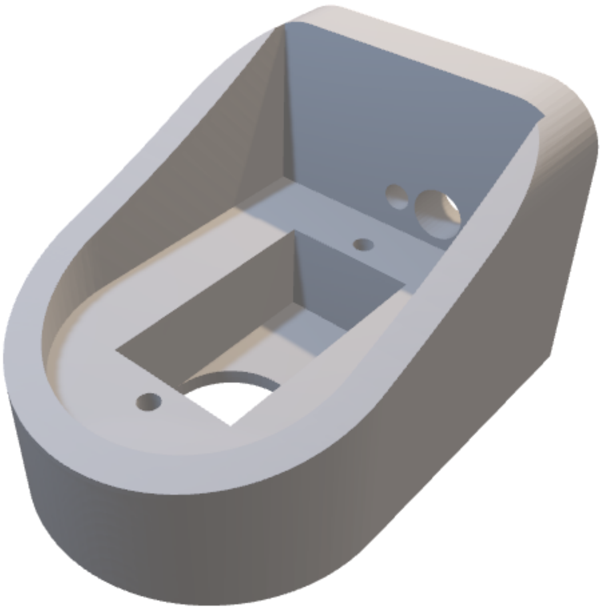
Gripper 1
and 2

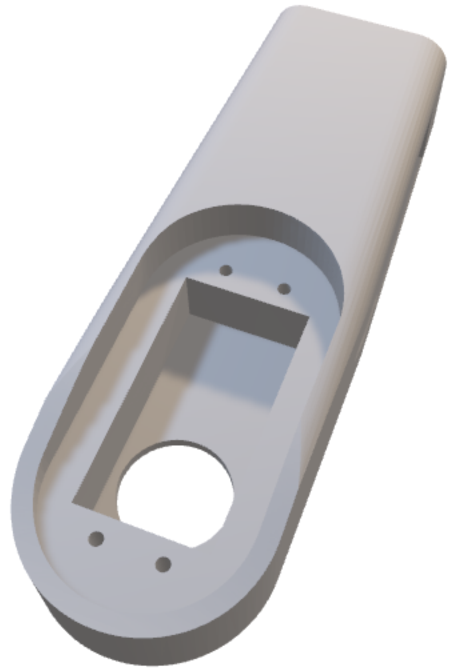
Gear 1 and 2



Grip link 1,2,3 and 4

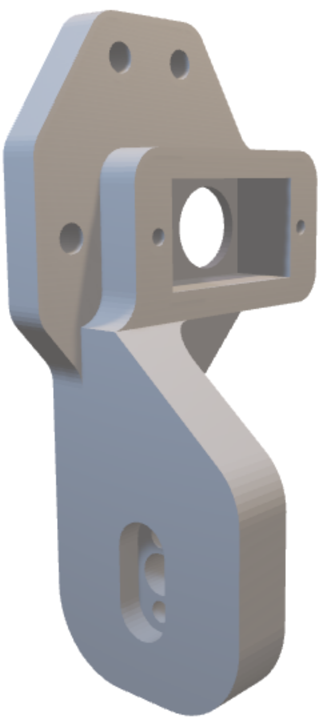
Arm 1





Arm 3

Arm 2



Gripper Base

List of components printed using the 3D printer:

Sr. No.	Name of the 3D-	Quantity

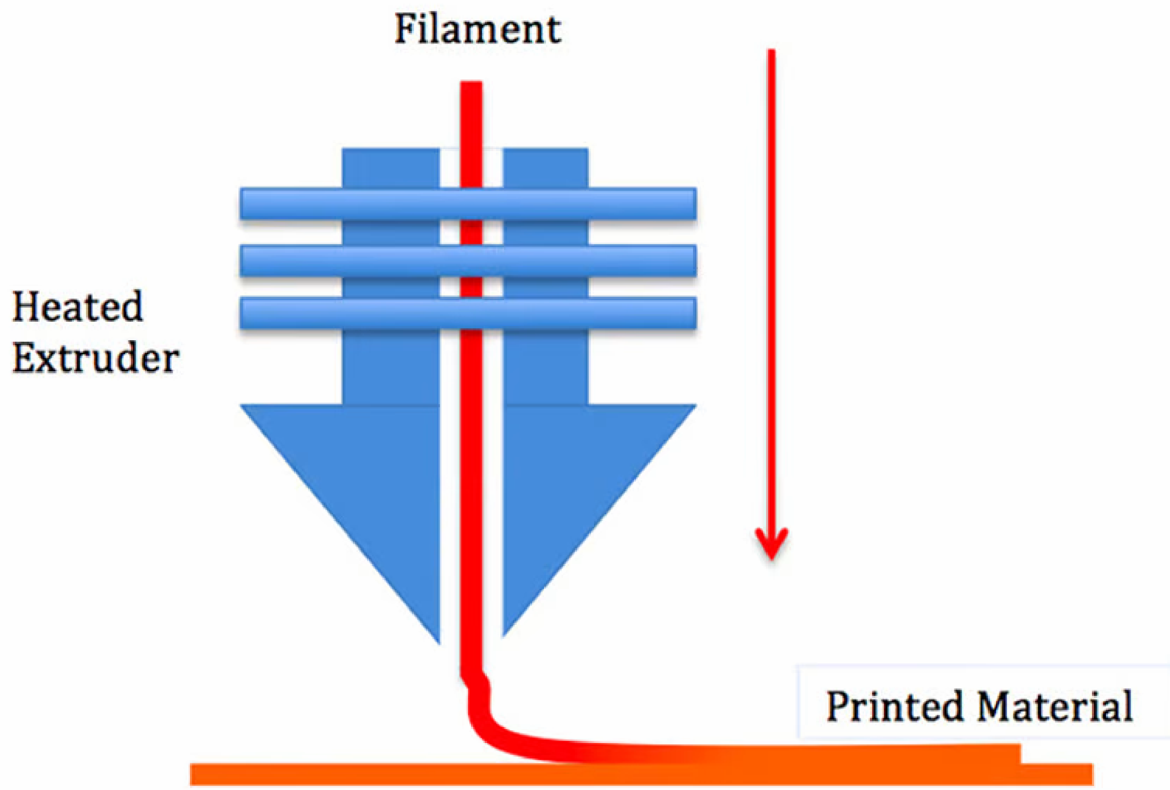
	printed components	
1	Base	1
2	Waist	1
3	Arm 1	1
4	Arm 2	1
5	Arm 3	1
6	Gripper Base	1
7	Grip Links	4
8	Grippers	2
9	Gears	2

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