

Designed By  
**Harrison Hsieh**

Electronics Major Work  
Robotic Arm

# RIVET GEN 1



# JET INDUSTRIES

**Accelerating Technology**



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# ABOUT

Rivet is an affordable 5 axis robotic arm with a modular system that allows it to be equipped with different effectors to perform different tasks. Rivet Gen 1 is a proof of concept for a much more capable robotic arm that will be equipped for more complex controls and automation. The aim of Rivet is to provide an affordable but powerful desk robotic arm that can be used to develop products or automate processes.

Currently the Gen 1 series uses an Arduino Uno R3 Microcontroller combined with a servo driver capable of controlling up to 16 servos. In this current configuration the Arduino controls 7 Servos in an inverse kinematic model that currently allows for 3 Degrees of Freedom although the arm is capable of 4 DOF. The inverse kinematic model uses a series of formulas derived from trigonometry to convert cartesian coordinates into angles for the servo motors. The advantage of an inverse kinematic mode is that it removes the need to control the servos individually and instead moves the end effector exclusively in the x, y and z directions. This results in a robotic arm that only requires two joysticks to control.

The current model comes equipped with a simple gripper that can clamp onto objects horizontally. The foam padding provides additional grip although the small size of the servo limits its grip strength.

# COMPONENTS + COST

## Robotic Arm

	Cost (\$)
-1kg Bambu Lab PLA Basic Spool*	30.99
-6x MG996R Servo Motors	26.47
-SG90 Servo Motor*	1.50
-PCA9685PW 16 Channel Servo Driver	3.73
-Bolts and Nuts	8.84
-4x 608 Bearings	5.21
-Mini Breadboard*	2.75
-Foam*	----
Sub-Total:	79.49

## Controller

-Arduino Uno*	27.60
-Breadboard*	9.95
-2x Joysticks	3.98
-Wires	4.62
Sub-Total:	46.15

## Power Supply

-30V Power Supply*	80
-9V Battery	7
Sub-Total:	87

**TOTAL: 212.64**

\*these items were provided by the school

# INVOICES

Rivet  
Gen 1

				Date of issue	Notice no.
				2024/04/02	B1020240402049169
Transaction	Quantity	Price exclusive of GST (CNY)	GST Rate	GST Amount (CNY)	Price inclusive of GST (CNY)
4pcs 13kg 15kg Metal Servos Digital M6995 M6996 M6996R Servo Metal Gear Motor for Futaba JR Car RC Helicopter Boat Diy toys	1	55.55	10.0 %	5.55	61.07
Total amount inclusive of GST in CNY				5.55	61.07

				Date of issue	Notice no.
				2024/10/02	B1020241002065358
Transaction	Quantity	Price exclusive of GST (CNY)	GST Rate	GST Amount (CNY)	Price inclusive of GST (CNY)
4pcs 180° 13kg 15kg Metal Servos Digital M6995 M6996 M6996R Servo Metal Gear Motor for Futaba JR Car RC Helicopter Boat Diy toys	1	102.87	10.0 %	10.29	113.16
Total amount inclusive of GST in CNY				10.29	113.16

				Date of issue	Notice no.
				2024/10/02	B1020241002065358
Transaction	Quantity	Price exclusive of GST (CNY)	GST Rate	GST Amount (CNY)	Price inclusive of GST (CNY)
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Total amount inclusive of GST in CNY				10.29	113.16

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Total amount inclusive of GST in CNY				10.29	113.16

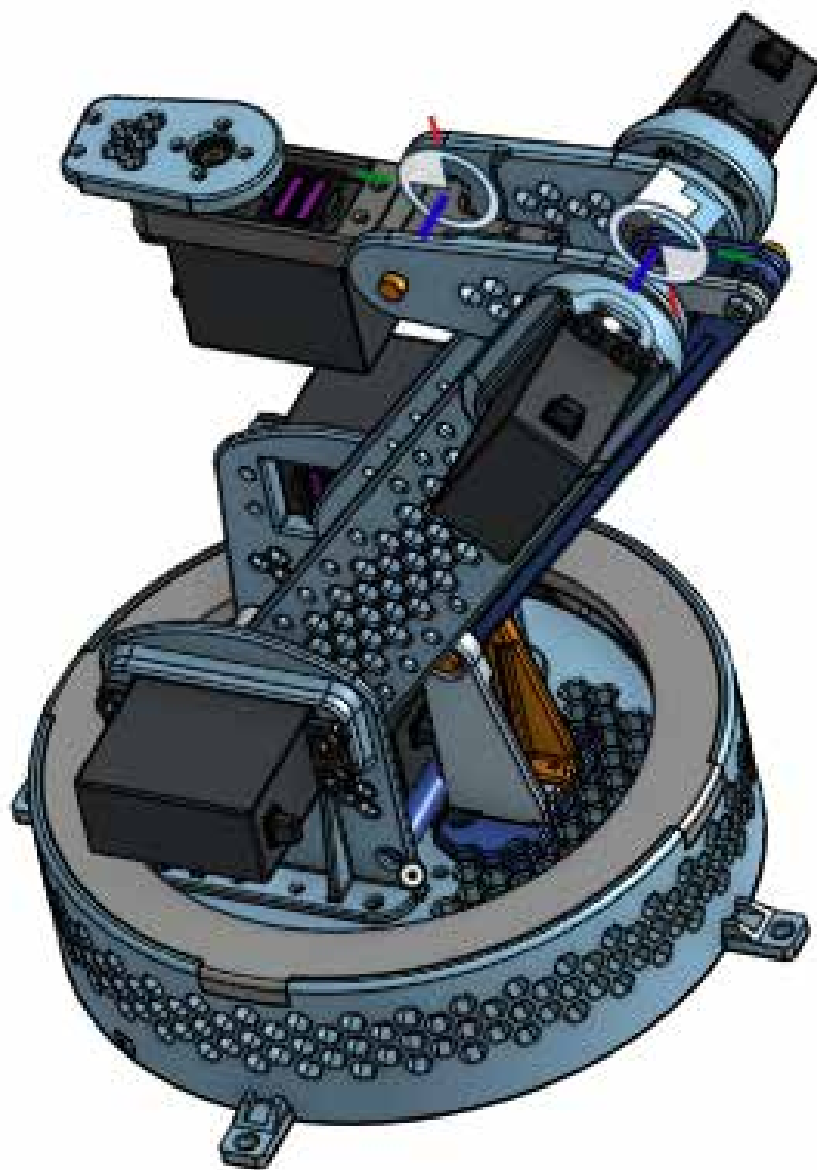
				Date of issue	Notice no.
				2024/10/02	B1020241002065358
Transaction	Quantity	Price exclusive of GST (USD)	GST Rate	GST Amount (USD)	Price inclusive of GST (USD)
20-120pcs Dupont Wire 20CM Male to Male + Female to Female and Male to Female Cable DIY Electronic Wire breadboard Jumper Wire	1	2.85	10.0 %	0.29	3.14
Total amount inclusive of GST in USD				0.29	3.14

				Date of issue	Notice no.
				2024/06/24	B1020240624059993
Transaction	Quantity	Price exclusive of GST (CNY)	GST Rate	GST Amount (CNY)	Price inclusive of GST (CNY)
10pcs 608ZZ 608RS Deep Groove Ball Bearing 8*22*7 MM Double Shielded Miniature High-carbon Steel Single Row 608ZZ ABEC-7	1	22.56	10.0 %	2.26	24.82
Total amount inclusive of GST in CNY				2.26	24.82

**Rivet**  
Gen 1

# PRODUCT DESIGN

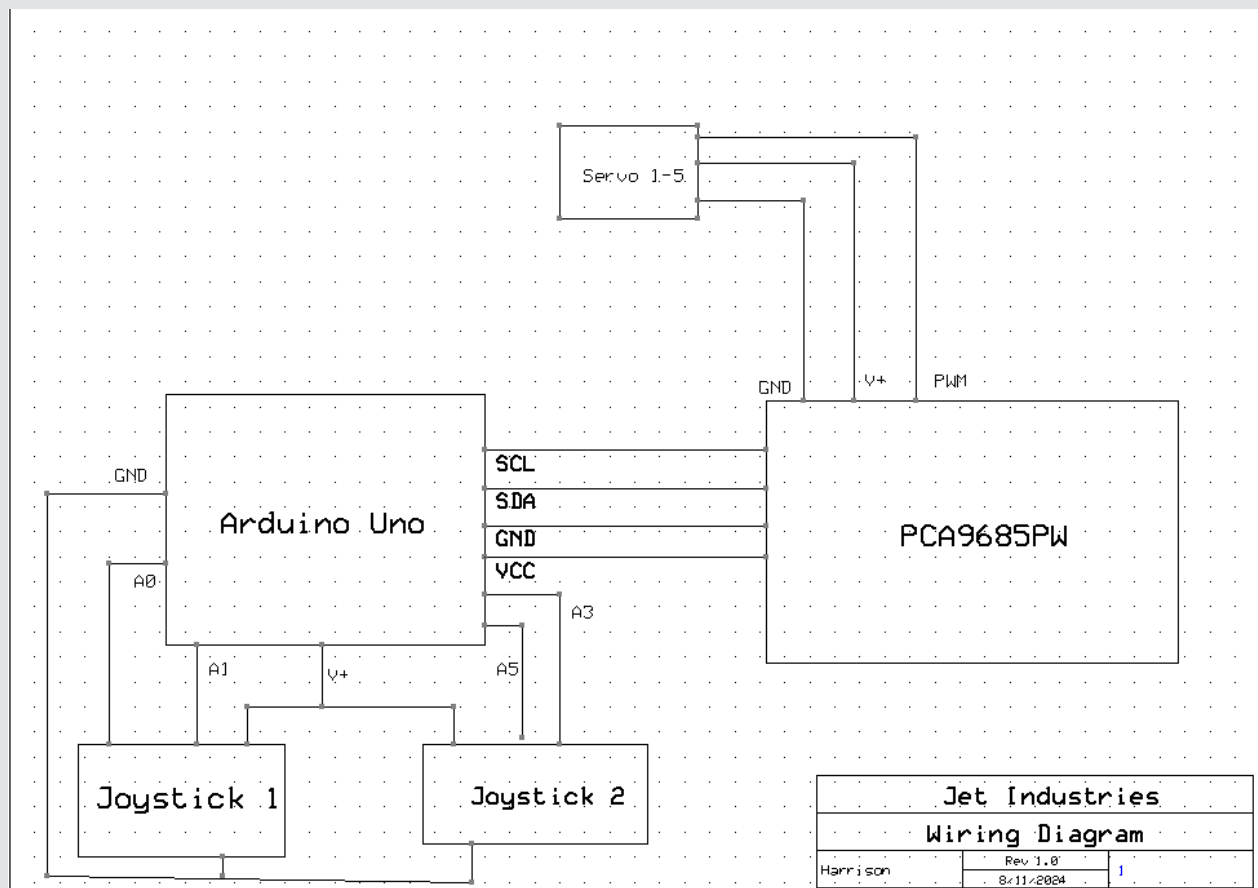
## Final CAD Assembly



# PRODUCT DESIGN

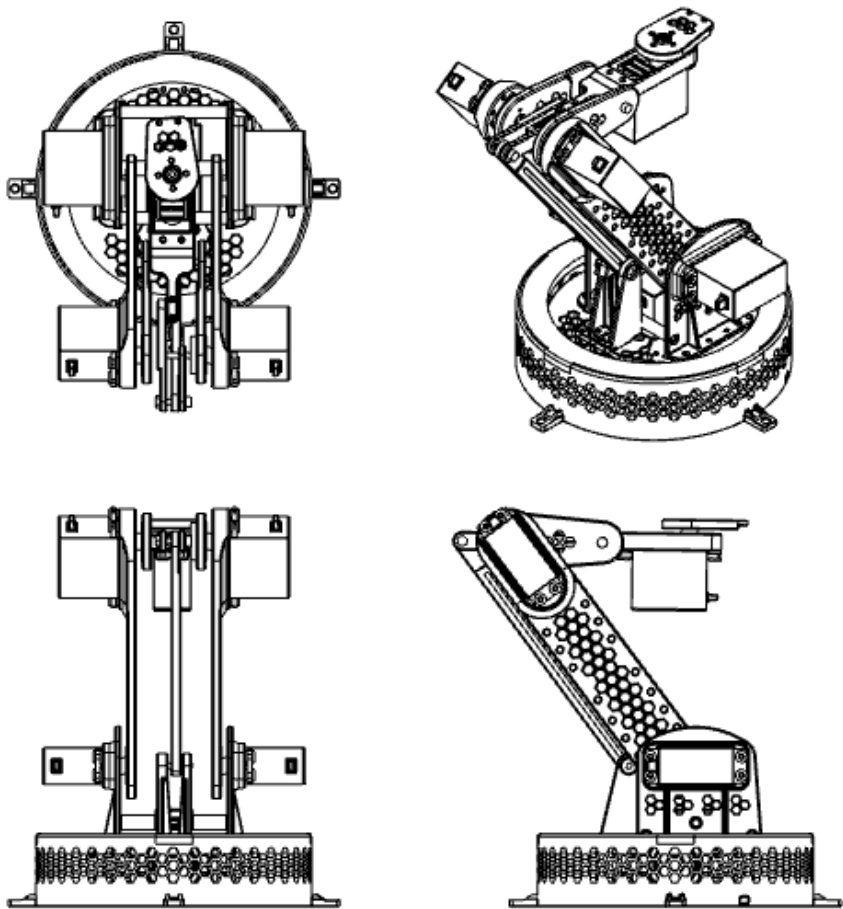
Rivet  
Gen 1

## Wiring Diagram



# PRODUCT DESIGN

## Final CAD Drawing



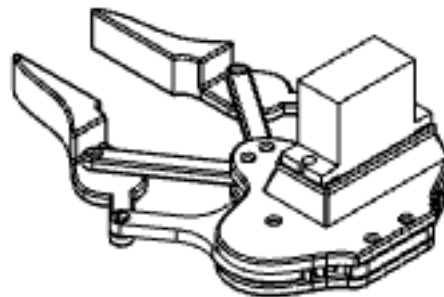
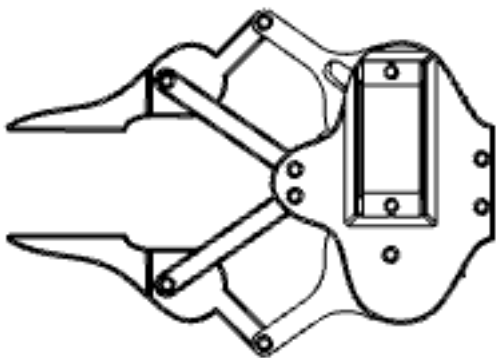
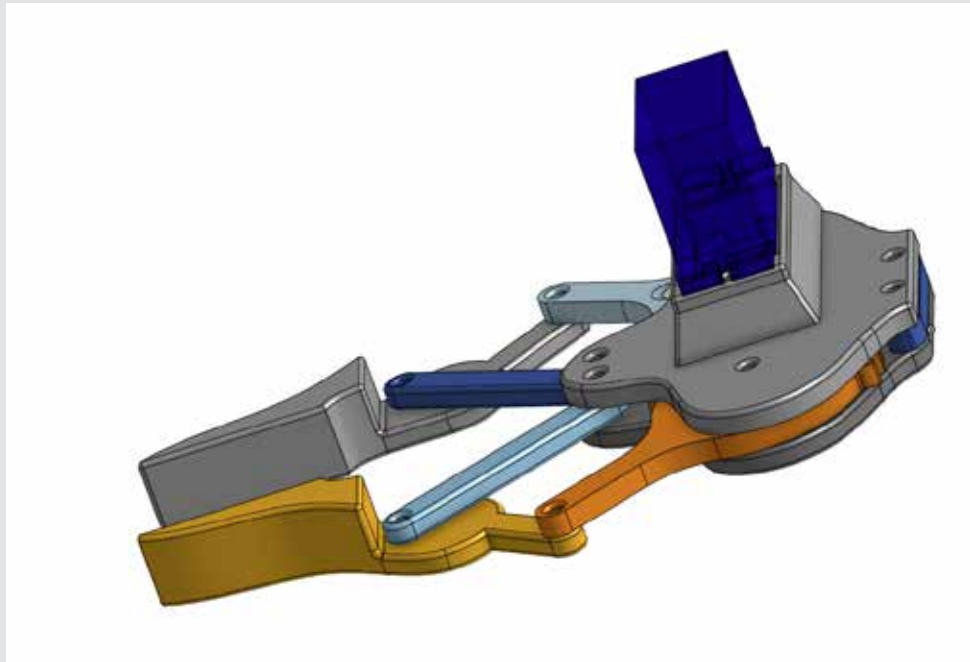
	NAME	DATE				
DRAWN	Harrison	11/07/2024				
			TITLE Full Assembly Drawing			
MATERIAL PLA		FINISH NONE		SIZE A	DWG NO.	REV. -
				SCALE 1:5	WEIGHT	SHEET 1 of 1



# PRODUCT DESIGN

Rivet  
Gen 1

## Gripper CAD Assembly + Drawing



# PRODUCT TIMELINE

## **Term 2 Week 9**

Begin Planning

## **Term 3 Week 1**

Write Code

## **Term 3 Week 2**

Learn 3D Printing & CAD

## **Term 3 Week 3**

Buy Components

## **Term 3 Week 4**

Begin CAD

## **Term 3 Week 7**

3D print and laser cut 1st prototype

## **Term 3 Week 10**

3D print and laser cut 2nd prototype

## **Term 4 Week 2**

3D print final parts

## **Term 4 Week 3-4**

Assemble and test robotic Arm



**Rivet**  
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# FINAL PRODUCT



Rivet  
Gen 1

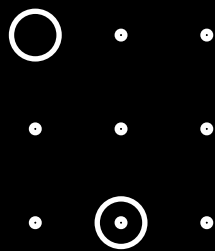
# FINAL PRODUCT



# **EVALUATION**

Overall I have found this an enjoyable experience as I have developed many new skills in CAD and 3D printing. The Inverse Kinematics was difficult at first but I was able to figure it out and get it to work well. I was constantly facing challenges throughout this project such as with 3D printing, tolerances on parts and figuring out how to design the robotic arm itself.

While I have completed the arm, I am not satisfied with construction and design of it as multiple improvements can be made how the servo and linear motion system works. There are also bugs in the arduino that has prevented it from functioning properly as it will sometimes freeze. However in the end the robotic arm has performed as designed and can lift and place items.



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Robotic Arm



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