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Professor Peter Jansen

ISTA-303: Introduction to Creative Coding

7 November 2018

ISTA 303: Assignment 3

MeArm Robotic Arm and Application

Documentation

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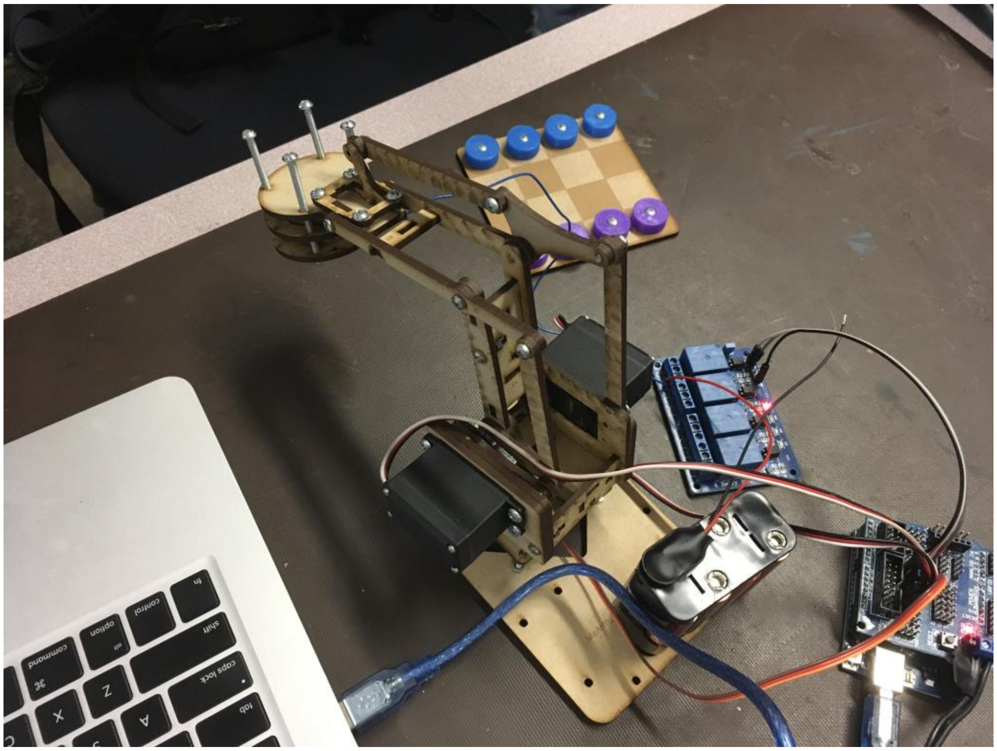
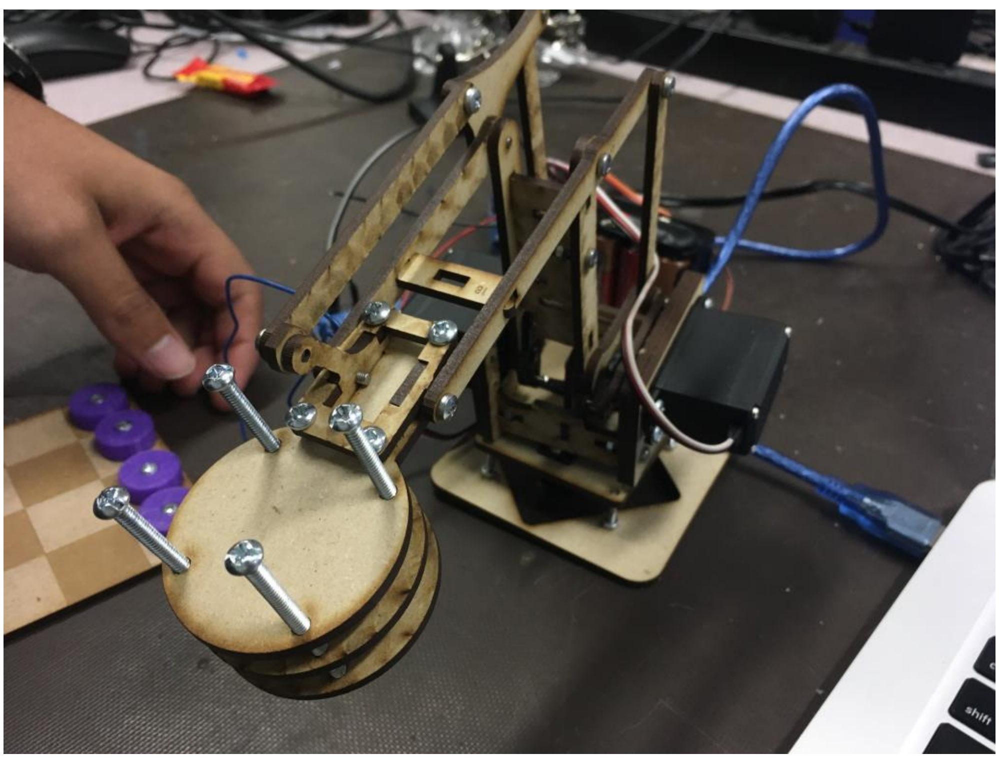
ISTA-303 Assignment 3: MeArm Robotic Arm and Application

Part 1: Assembled MeArm





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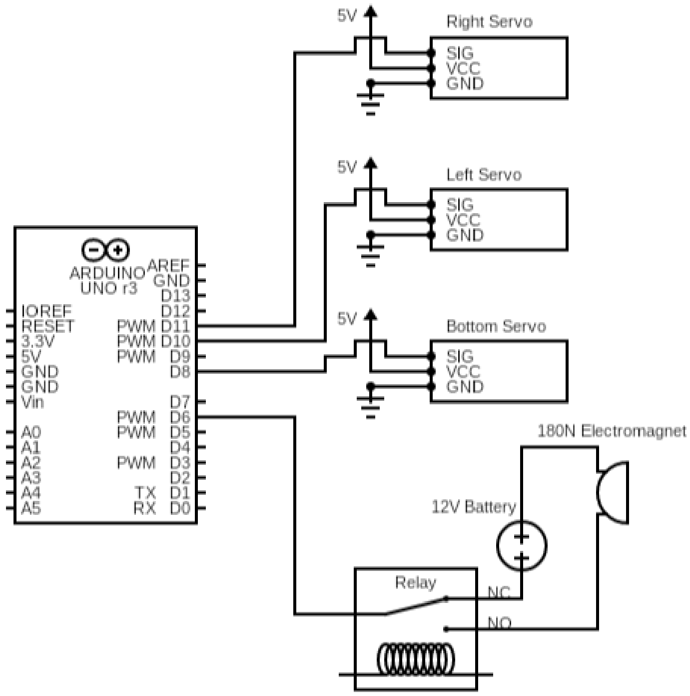
Part 2: Circuit Schematic



Part 3: Kinematic Code

We started from the simplified geometry graph. Instead of the given method, we found another way to calculate **W** and **K** angle.

K= acos(r/c) or atan(z/r)	**W** = A – K

And here shows our progress to get the Kinematic code:

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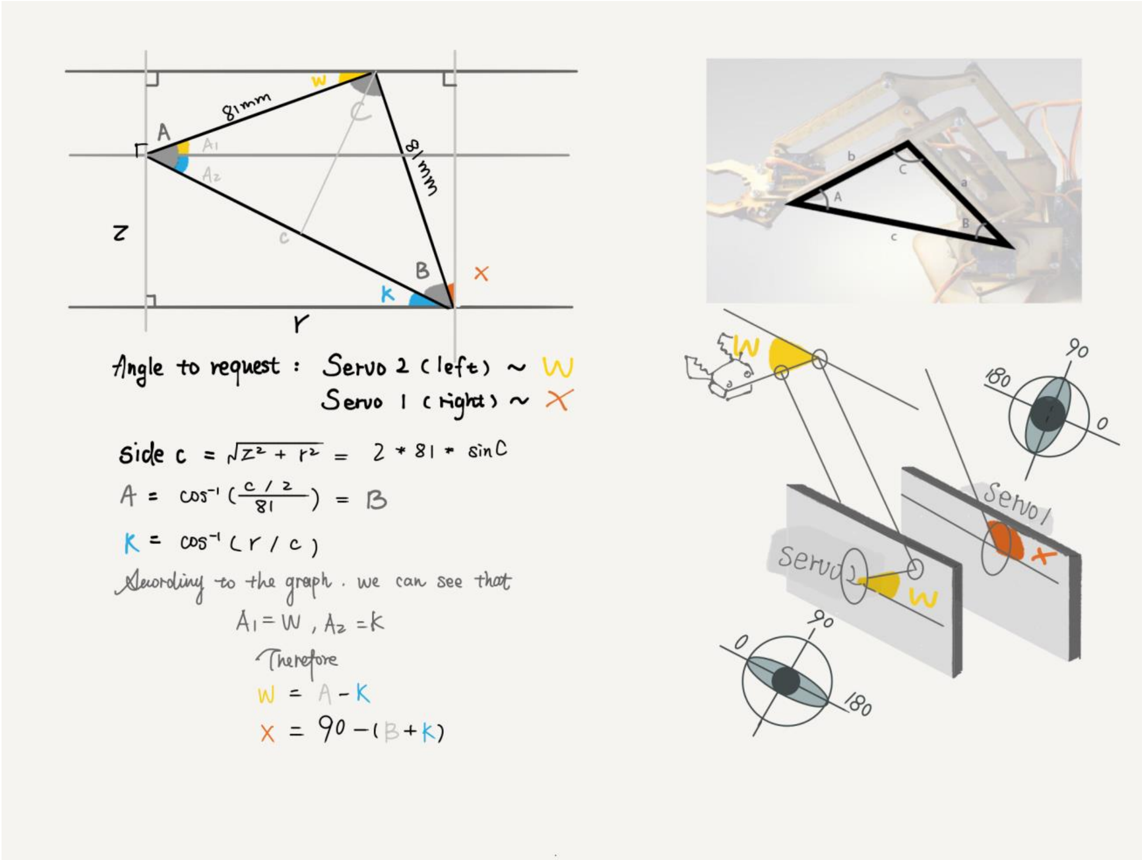
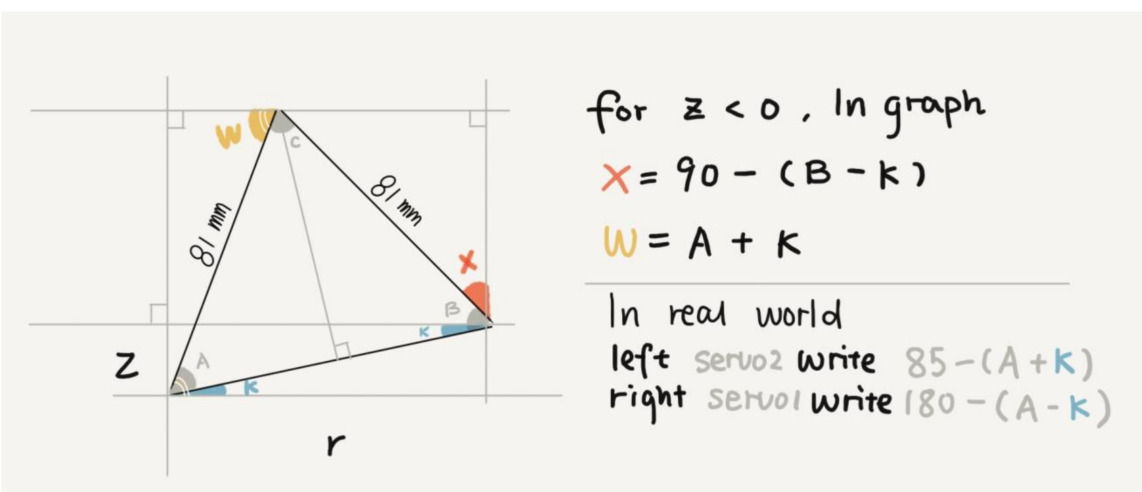
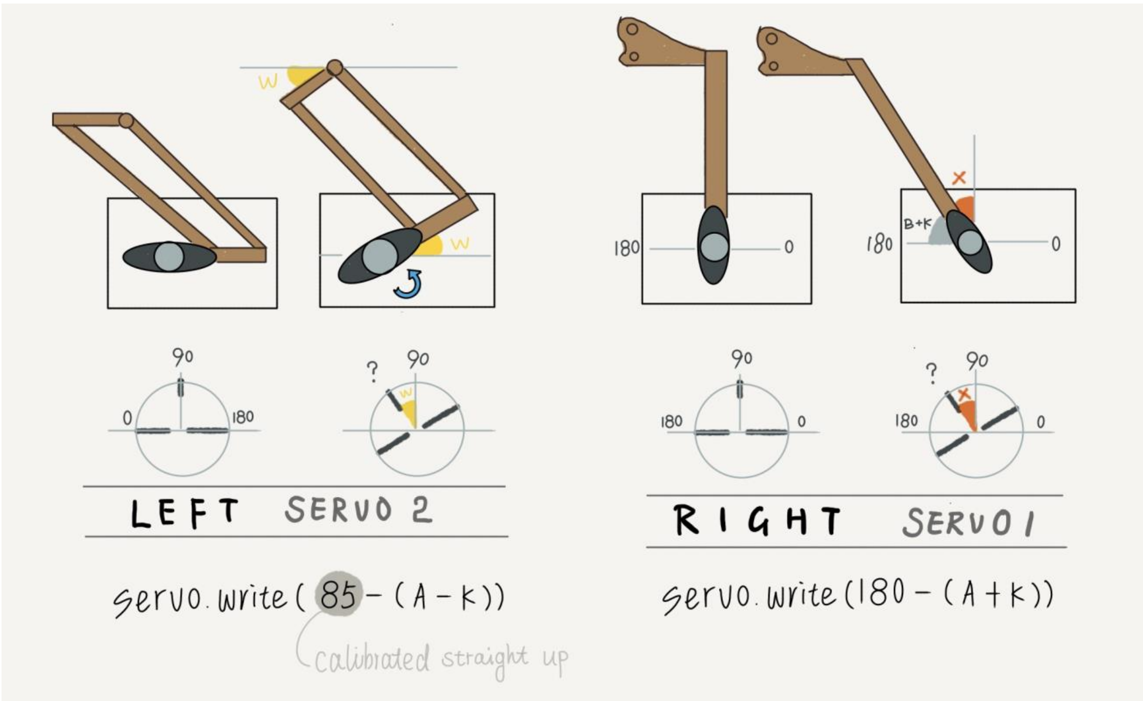


We also found out the method to reach negative **Z**. This allows us to grab things lower than the platform.



Also, we calibrated the formulas to make it work in the real world by filling out the Inverse Kinematics Worksheet. And here is the way we “translate” from geometry to real servo angles.



Finally, here is the actual code for moving to specific **R** and **Z** position.

```
  Serial.begin(9600);
  left.attach(LEFT_ARM);
  right.attach(RIGHT_ARM);

  float c = sqrt(sq(z)+ sq(r));
  float angleA = acos(c/2/armLength);
  float angleK = acos(r/c);

  if(z < 0) {
    left.write(85 - (angleA + angleK) * RAD_TO_DEG);
    right.write(180 + (angleK - angleA) * RAD_TO_DEG);
  } else {
    left.write(85 - (angleA - angleK) * RAD_TO_DEG);
    right.write(180 - (angleA + angleK) * RAD_TO_DEG);
  }
}
```

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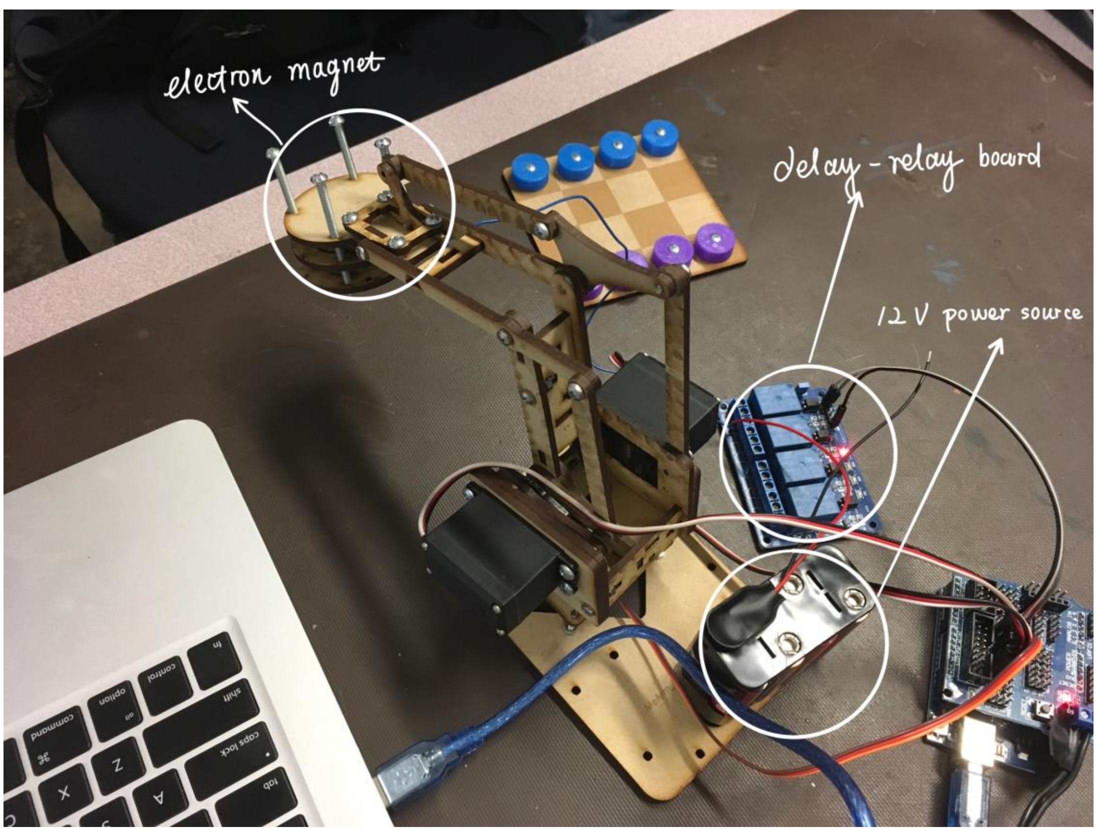
Part 4: Extensions

We attempted following extensions:

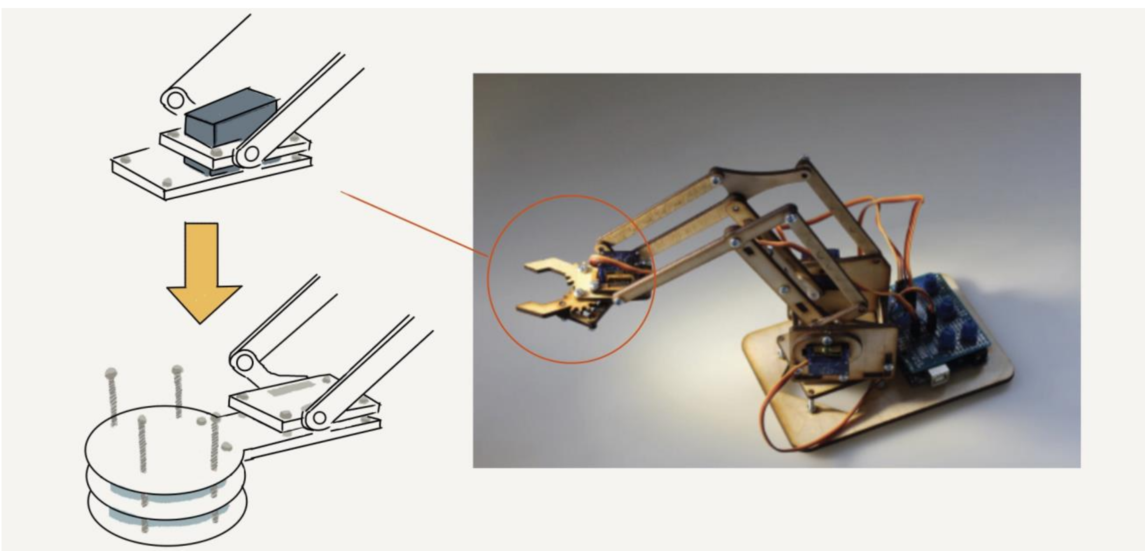
1. An electronic magnet to replace original gripper

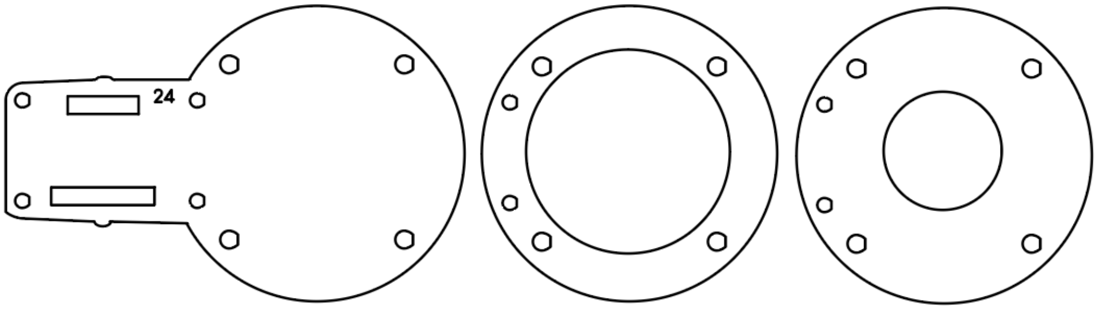


Because the electromagnet works on 12 Volts and the arduino is not capable of providing that, we used a relay and 8 AA batteries (1.5V each) as a DC source to power it but you can use some other battery configuration or DC power supply for the same purpose.

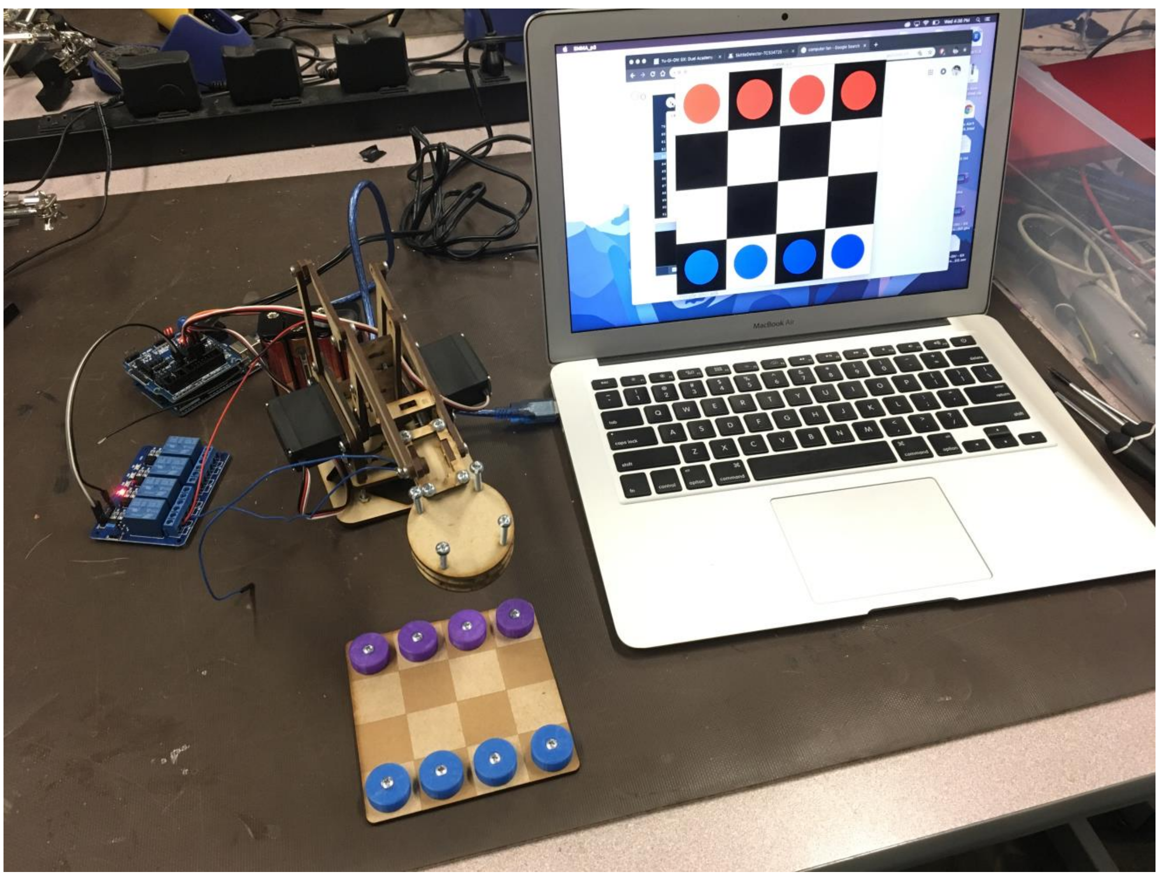
The relay can be used with the arduino in a manner similar to the way you would power an LED in that the signal can be set to high or low using the relay's normally open and common terminals. One thing to note when working with electromagnets is that the lifting force listed in the specs assumes 100% duty cycle and if you leave your magnet on at this setting for too long it will get very hot. This was not much of a problem in our case since moving the chips only requires the magnet to be on for a few seconds but it is something to keep in mind.

2. A 2.5D holder for the magnet.





3. A processing UI that plays chess game on screen and manipulates magnet arm on physical board simultaneously.



The UI system can update physical board according to the remote mouse activity.

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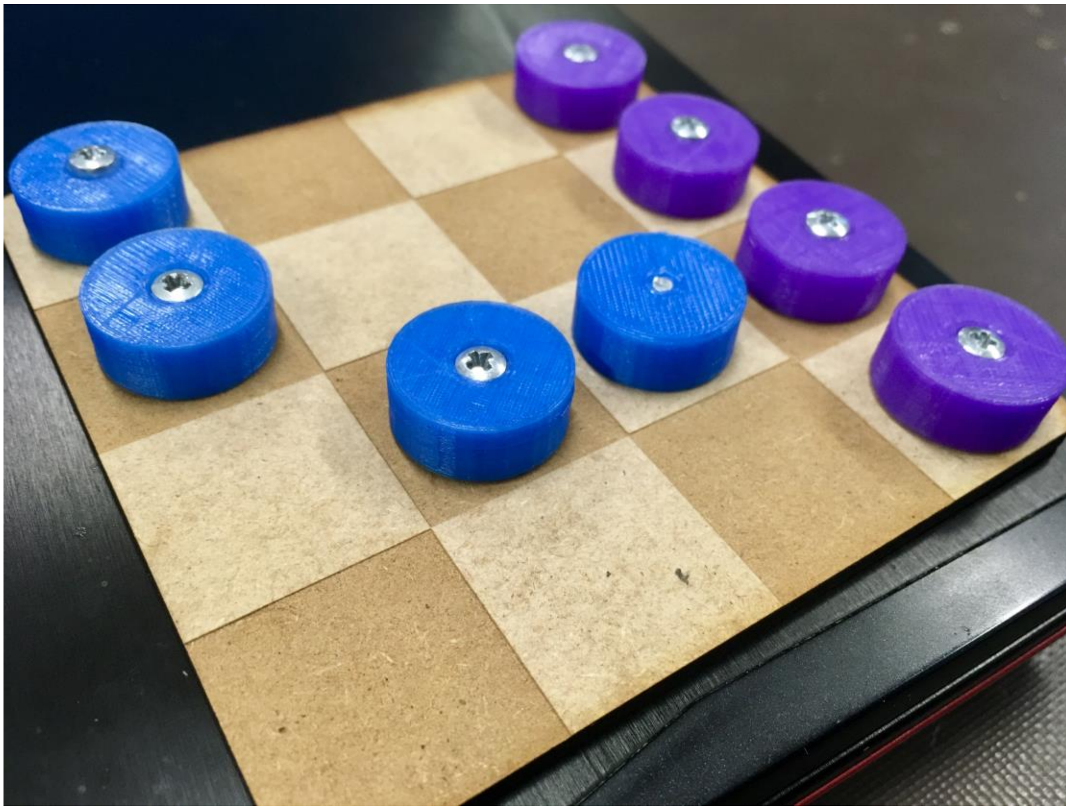
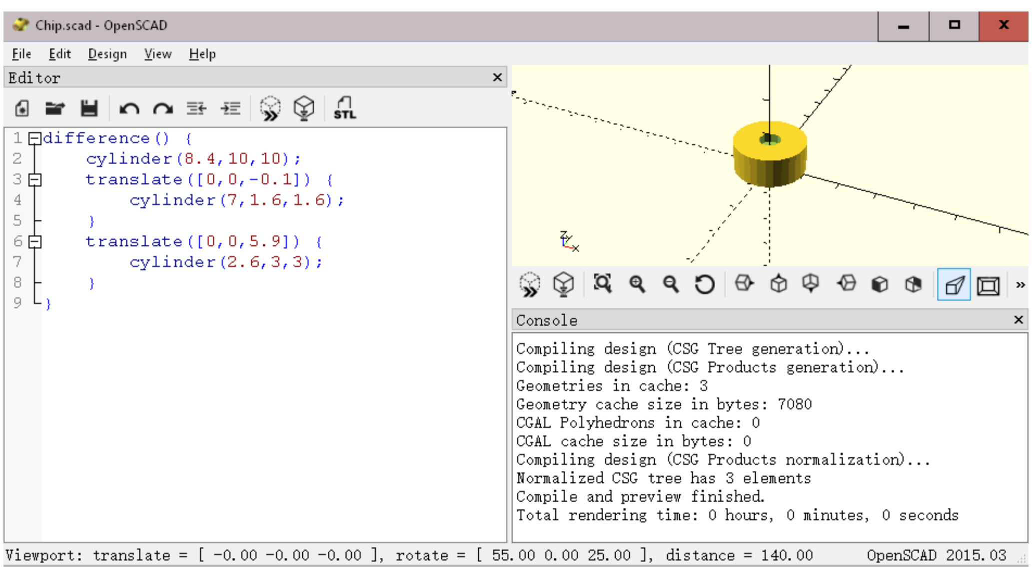
4. A chessboard and some 3D printed chesses with metal heads.



3D model of the chess.



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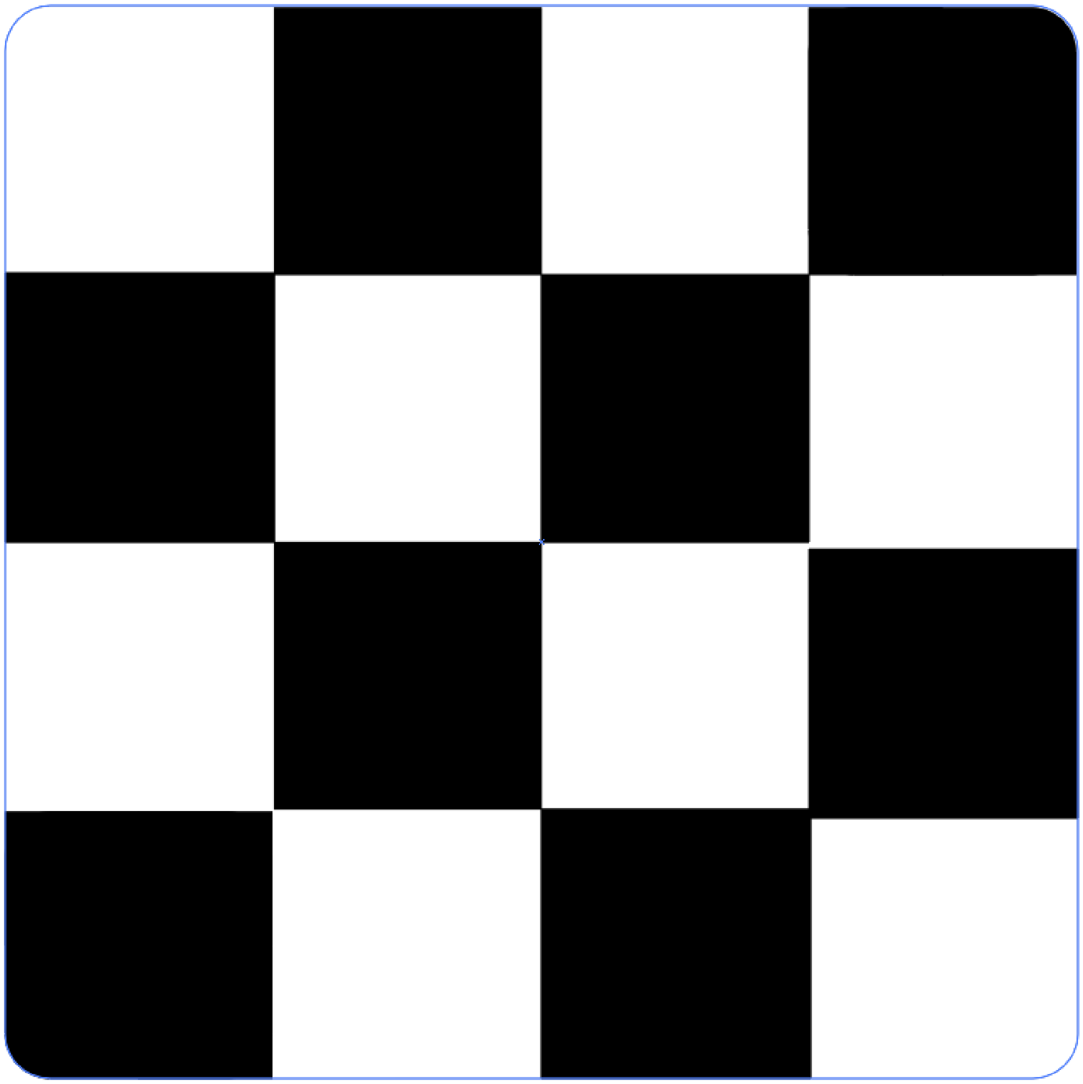
2.5D design of the chessboard.



Part 5: Workload of team members

	Part	Gustavo	Yang
Requirement	Assemble MeArm	√	√
	Geometry Calculation		√
	Calibration	√	√
	Arduino Code (move to r/z)		√
	Write Up	√	√

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	Part	Gustavo	Yang
Extension	Processing Code (chess game)	√	
	Assemble Electronic Magnet	√	
	Magnet Holder		√
	Chess / Board	√	

Part 6: References

Arduino and Processing. *Arduino*, https://playground.arduino.cc/interfacing/processing

Draw arrow in processing. *Processing Foundation Forum*, https://processing.org/discourse/beta/num_1219607845.html