# APSC 101
# CAFETERIA CLAW – TEAM G2

**Team Members**

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Sneha Das
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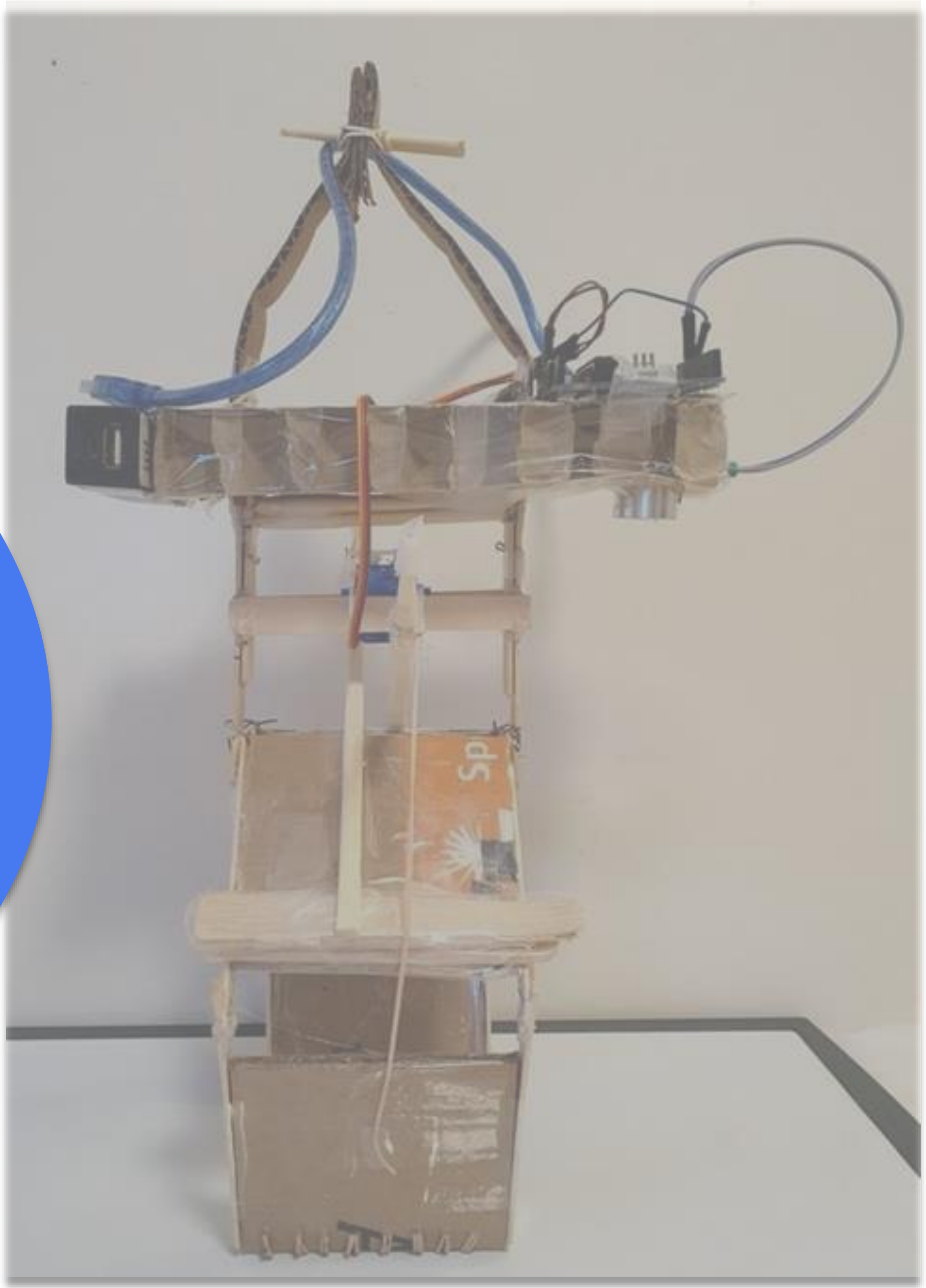
Effie Fang
Joe Bhachu

# DESIGN CHALLENGE

CONSTRUCT AND PROGRAM A FULLY AUTONOMOUS CLAW RETRIEVAL SYSTEM THAT CAN PICK UP A VARIETY OF DESIGNATED OBJECTS FROM SPECIFIED LOCATIONS



## REQUIREMENTS

1. Can pick up commonly found materials
2. One electronic kit component for each claw-Arduino board, servo motor and SONAR sensor
3. Only interact with claw through crane

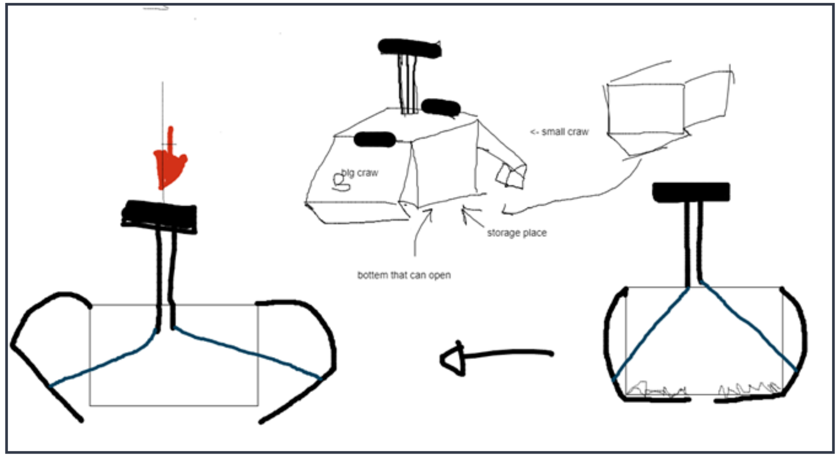
## EVALUATION CRITERIA

1. Pick up maximum number of objects of several sizes (from 1mm to 10mm in width)
2. Pick up object quickly (delay time <2 seconds)
3. Pick up objects of different weights

# TEAM STRATEGY

- Explore a variety of prototypes to design a claw which can pick up objects of different sizes and shapes.
- Follow the APSC design process model
- Focus on getting best results from the competition.
- Since it is strongly focused on time, and the objects are not too heavy we want to focus on making it lighter and more efficient

# CONCEPT SKETCHES




## 01

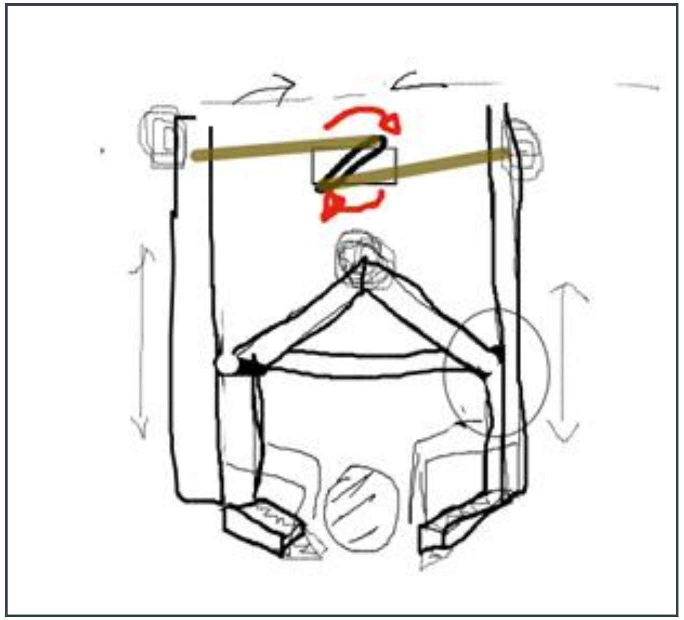
### *The Box*

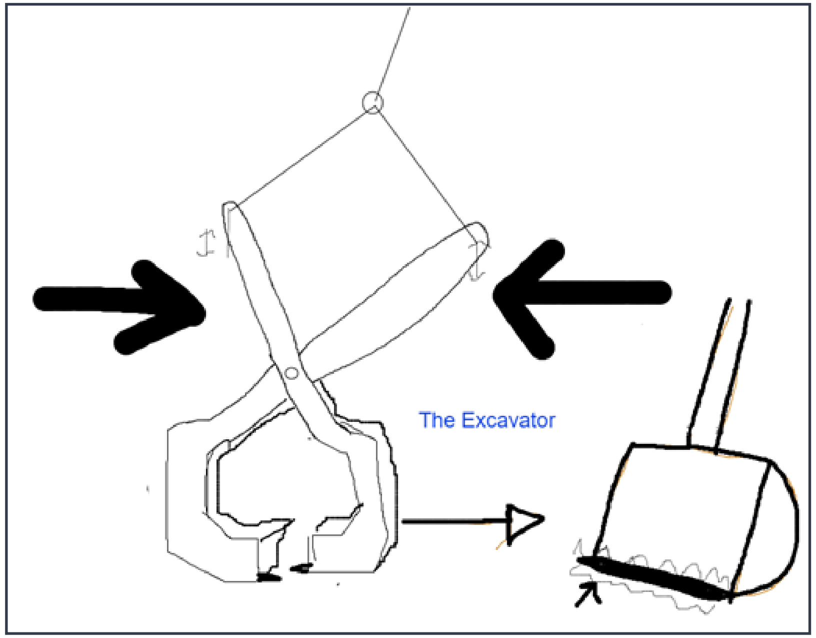
A box in place of the traditional claw, this design encloses the object completely.

## 02

### *Pick It Up*

This design uses torque to generate compressional and tension forces.



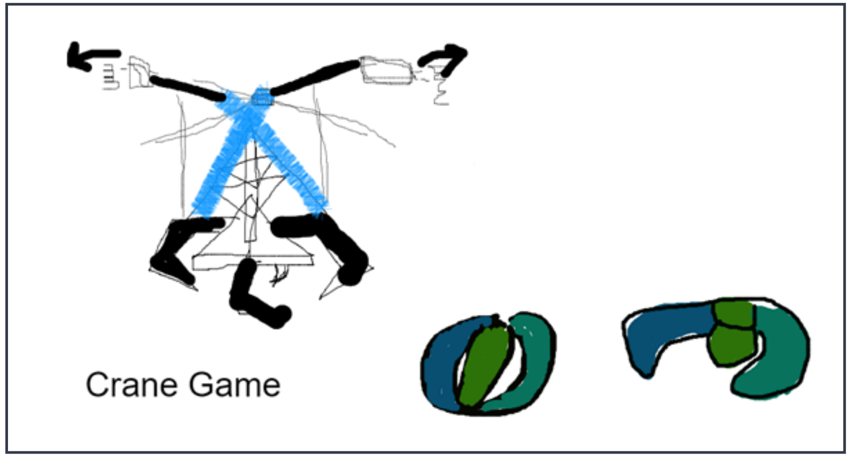



## 03

### *The Excavator*

Inspired by the cross-sectional design of scissors and the bucket of the excavator.

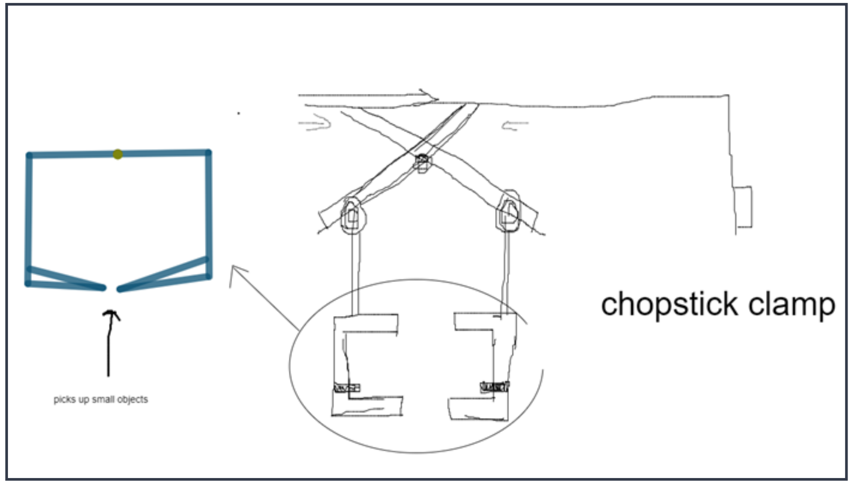
# CONCEPT SKETCHES




04

***Crane Game***

Makes use of the concept of a force couple, with three hands.




05

***Chopstick Clamp***

Based off the working of chopsticks, it has a pointed end to pinch smaller objects.

# PROTOTYPES


*1*

The Box

*2*

Pick it Up

*3*

The Excavator

# PROTOTYPES

4
Chopstick Clamp

5
Crane Game

# RISK ANALYSIS – TECHNICAL RISKS

| *RISK ID* | *DESCRIPTION OF RISK* | *LIKELIHOOD* | *SEVERITY* | *RATING* | *ACTION* |
|---|---|---|---|---|---|
| 1 | MATERIAL FAILURE | 2 | 5 | 10 | REPLACE WITH ANOTHER CLAW, DOUBLE CHECK BEFORE COMPETITION DAY |
| 2 | LOOSE CONNECTION | 4 | 5 | 20 | PROPERLY SECURE WIRES, LEAVE ROOM FOR MOVEMENT |
| 3 | BUG IN CODE | 1 | 5 | 5 | CHECK CODE BEFORE COMPETITION DAY, TEST OUT CODE |
| 4 | ARDUINO PART FAILURE | 2 | 4 | 8 | PROPER HANDLING AND CARE OF ARDUINO PARTS |

# EXPERIMENT 1 – MATERIAL TEST

***Goal: To achieve the strongest force the servo motor can exert.***

***Why?***

There are several objects being picked up during competition, so we wanted to make sure our claw had enough force to pick everything.

***How was this done?***

A combination of materials was used to maximize servo strength.

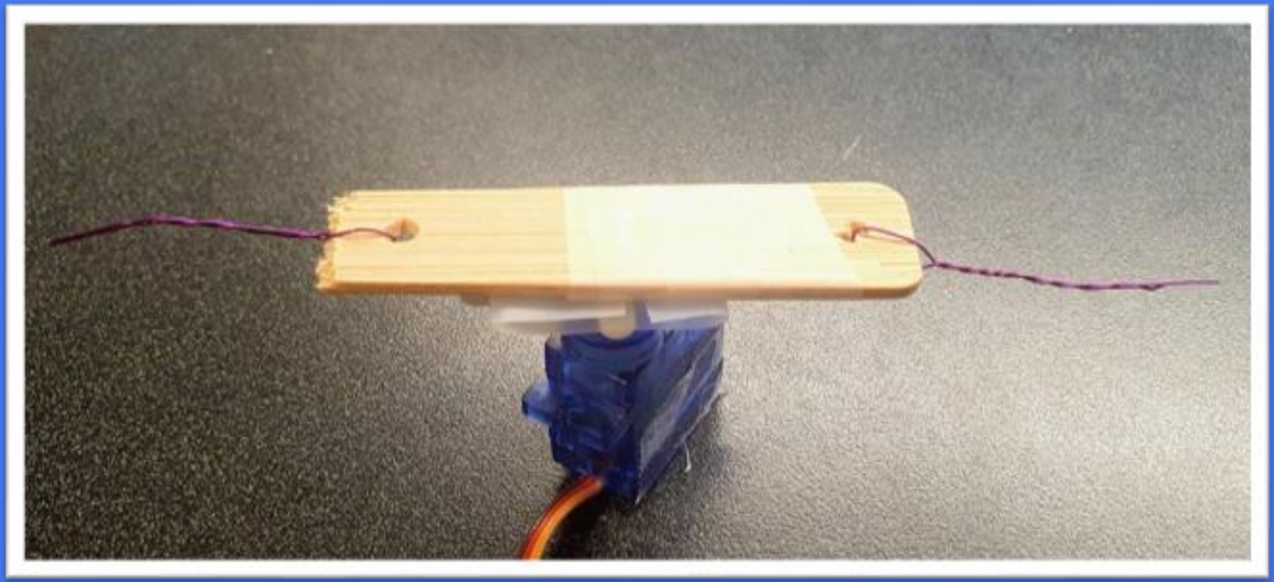
The claw was then tested with similar objects being picked up on competition day.

***Trial 1: Thin Metal Wire + Wooden Board***

Metal wire was connected to a wooden board on top of the servo motor.

Result – It was able to pick up everything only after one try and resetting.

Con: The wire deforms after each movement, thus decreasing torque after each use. Wooden stick caused connection issues on servo.



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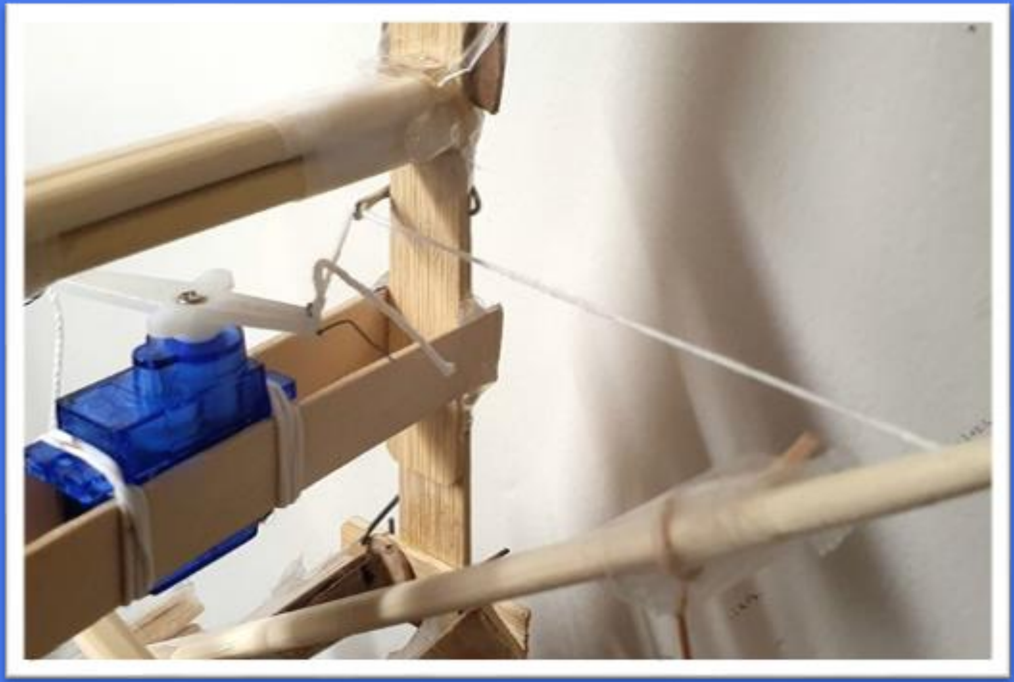
***Trial 2: Paper Clip Pulley***

On each side of claw, a pulley was created to replicate the extension strength the wooden stick gave. We tried the pulley with kite string.

Result: The force ended up being weaker than trial 1. It was only able to pick up 2 small objects.

Metal Wire: Deformation was worse. New added friction decreased strength.



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***Trial 3: Kite String***

Metal wire was clearly causing issues. Therefore, we changed material.

Wasn't considered before because the string did not fit through the servo motor hole.

Solution: tie the metal wire that could fit through motor to kite string to be attached.

Result: The kite string did great. It was able to pick up everything one after another without malfunctioning.

Therefore, this was part of our final design.

# EXPERIMENT 2 – STABILITY TEST

***Goal: Withstand movement without disconnection issues.***

***Why?***

The claw will be on a crane, we want to prevent disconnection happening to maximize time.

***How was this done?***

Focus on keeping wires and sensor not moving using materials, and methods.

Replicated the movement of crane to test if it worked.

***Trial 1: Cardboard Cut Out***

To stabilize the sensor without getting in the way of the claw mechanism, a cut out of a platform was made.

Pro: The cut out was able to stabilize the sensor from moving left and right

Con: The material was too flimsy, the strength of the motor caused platform to bend. The sensor started moving up and down.

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Replicated the movement of crane to test if it worked.

***Trial 2: Cardboard Cut Out***

First, the thin carboard is changed into a thicker ones for it allow other material to be easier to attach to it.

Second, we added hot glue to stabilize the platform so when it is connected to the rest of the claw it will not slide or move. It is located  where it and the stick of the lower section is connected.

Third, attach another stick to it to increase the surface area that the platform will be attach to for the glue to work better in this case.

Con: the hot glue wasn't enough to secure platform, after replicating crane movement, the platform was moving again, along with sensor.

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***Goal: Withstand movement without disconnection issues.***

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***How was this done?***

Focus on keeping wires and sensor not moving using materials, and methods.

Replicated the movement of crane to test if it worked.

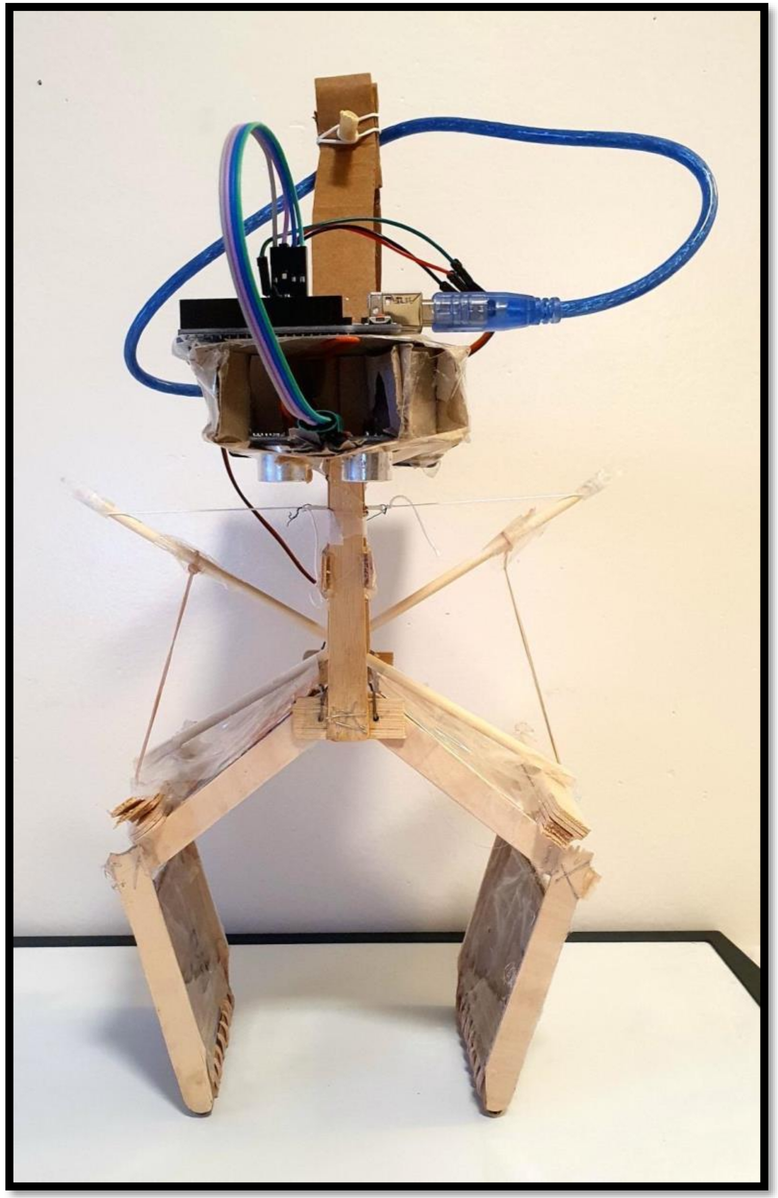
***Trial 3:***

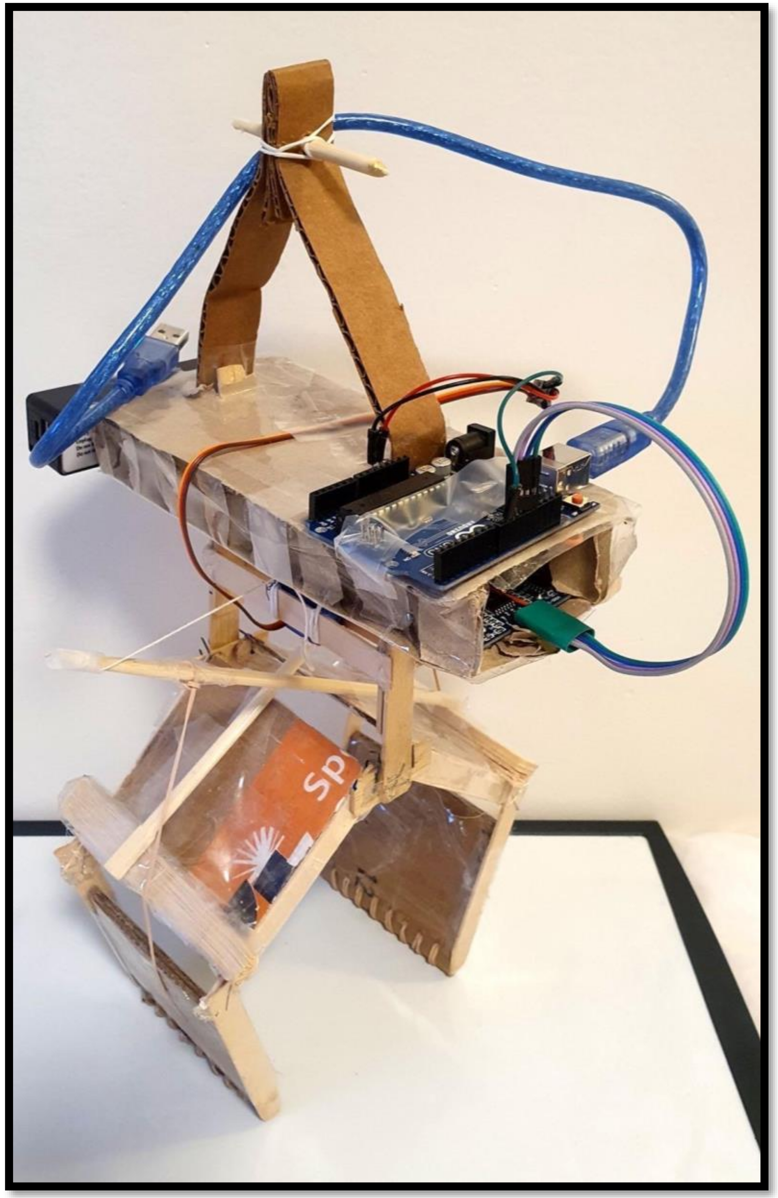
We created another platform below it for support, as hot glue alone wasn't enough.

Four chopsticks were glued together right above the motor to secure the platform on top.

To counteract sensor movement within the thicker cardboard, we used a paper clip to hold down the sensor.

Result: During replication of crane test, the platform stayed secured, the sensor wasn't moving within the thicker cardboard, therefore it was our final design.



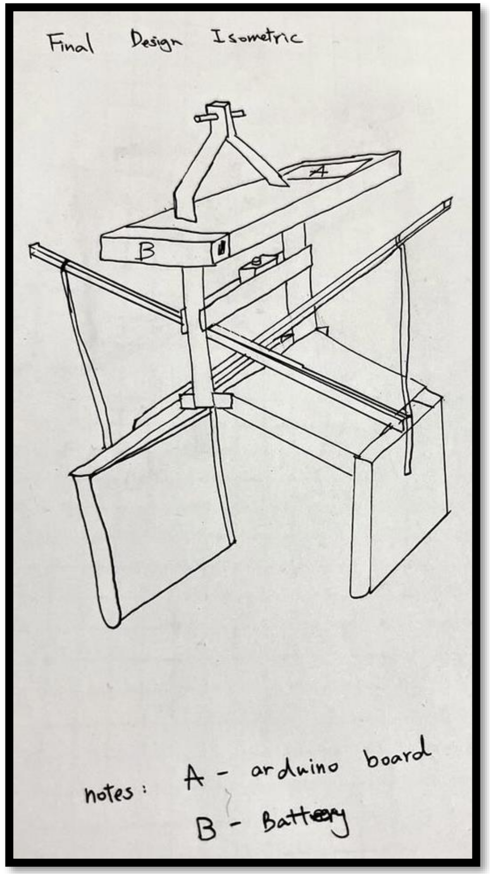


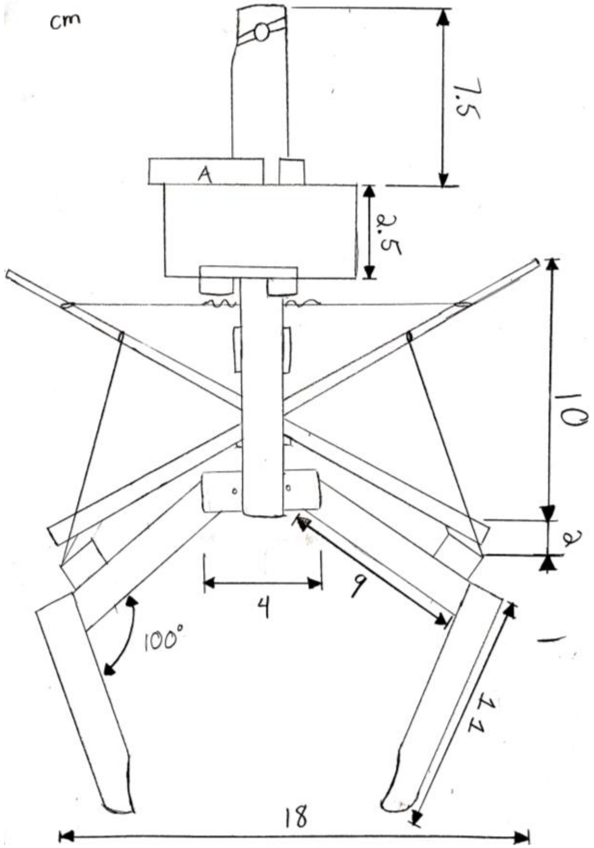
# FINAL DESIGN

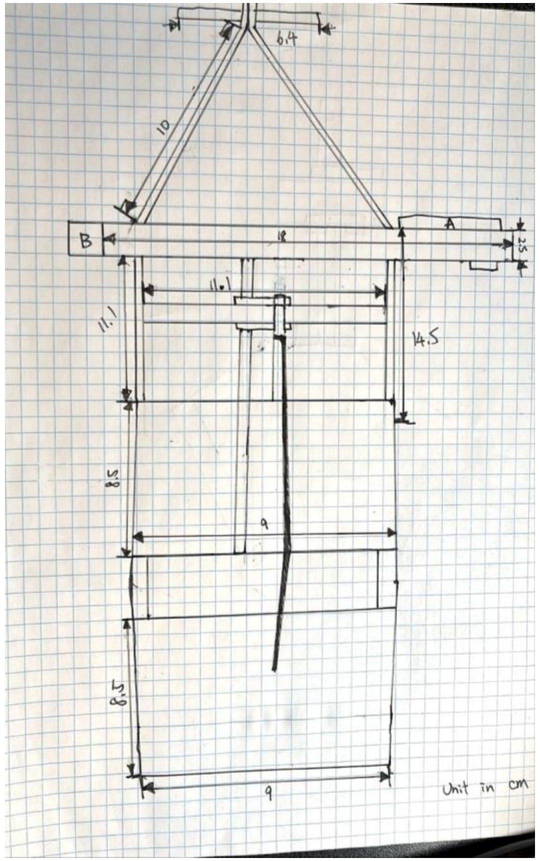
Reasons for finalizing this design:

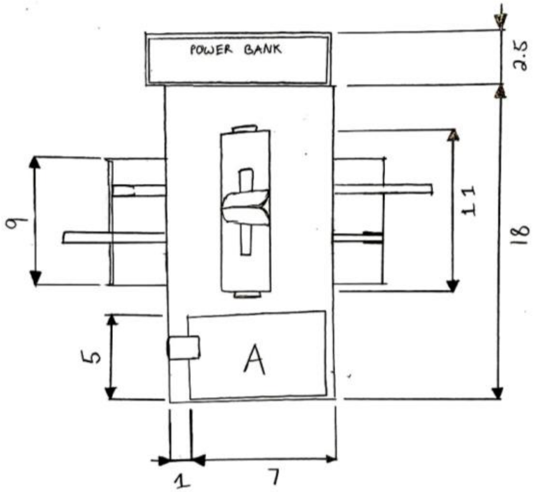
- ❑ Was able to pick up a variety of objects of different sizes
- ❑ Was lightweight and well-balanced
- ❑ Simple to build
- ❑ Strong, used multiple layers of wood and cardboard for fortification
- ❑ Connections were tight

# DRAWINGS OF THE CLAW




| UNLESS OTHERWISE SPECIFIED: | | NAME | DATE | APSC 101 TEAM G2 | | |
|---|---|---|---|---|---|---|
| DIMENSIONS ARE IN CENTIMETERS<br>TOLERANCES:<br>FRACTIONAL = ± 1/2<br>ANGULAR = ± 5° | DRAWN | Gabriel Vela<br>Effie Fang | 2022.02.12 | TITLE:<br>AUTONOMOUS RETRIEVAL DEVICE | | |
| | CHECKED | Jessica Chu | 2022.02.13 | | | |
| | ENG. APPR. | | | | | |
| | MFG APPR. | | | | | |
| | Q.A. | | | | | |
| MATERIAL<br>WOOD, TAPE, CARDBOARD | | | | SIZE<br>A | DWG. NO.<br>ASPC-101-M5-G2 | REV<br>A |
| FINISH<br>HANDCRAFTED | | | | | | |
| DO NOT SCALE DRAWING | | | | SCALE: 1:1.75 | WEIGHT: 0.350KG | SHEET 1 OF 1 |

# POSTER CONTRIBUTIONS

- Slides 1-3: Joe Bhachu
- Slides 4-6: Effie Fang
- Slides 7-9: Sneha Das
- Slides 10-12: Gabriel Vela
- Slides 13-15: Jessica Chu
- Slides 16-18: Martin Monaco