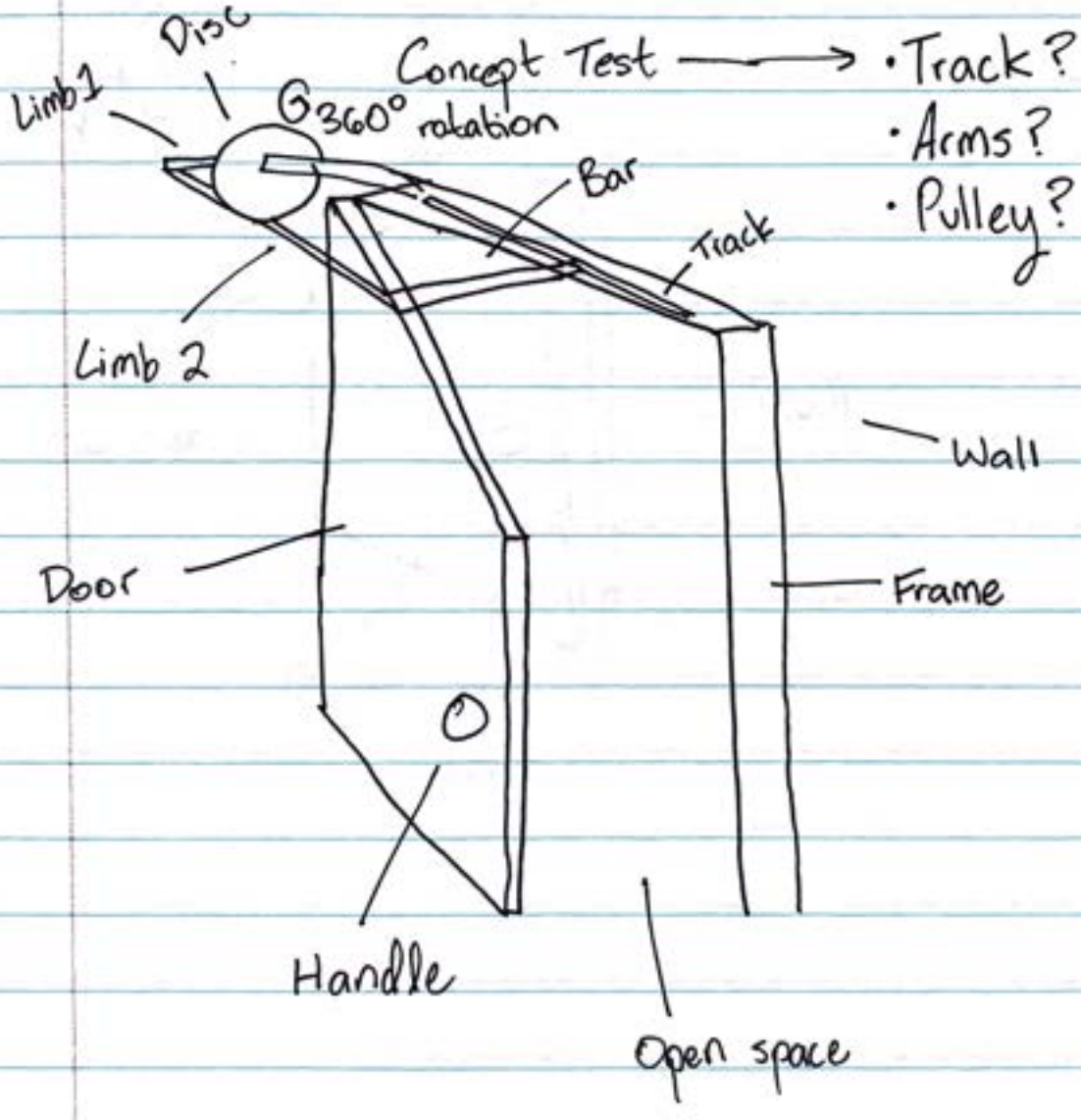
Table of Contents

Justin Atkins

Name:

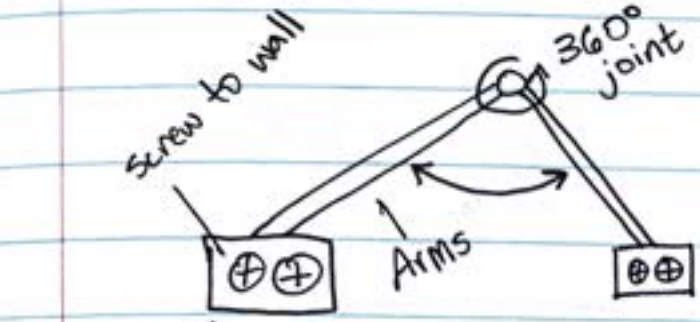
Door Closer Idea #1

02-07-22

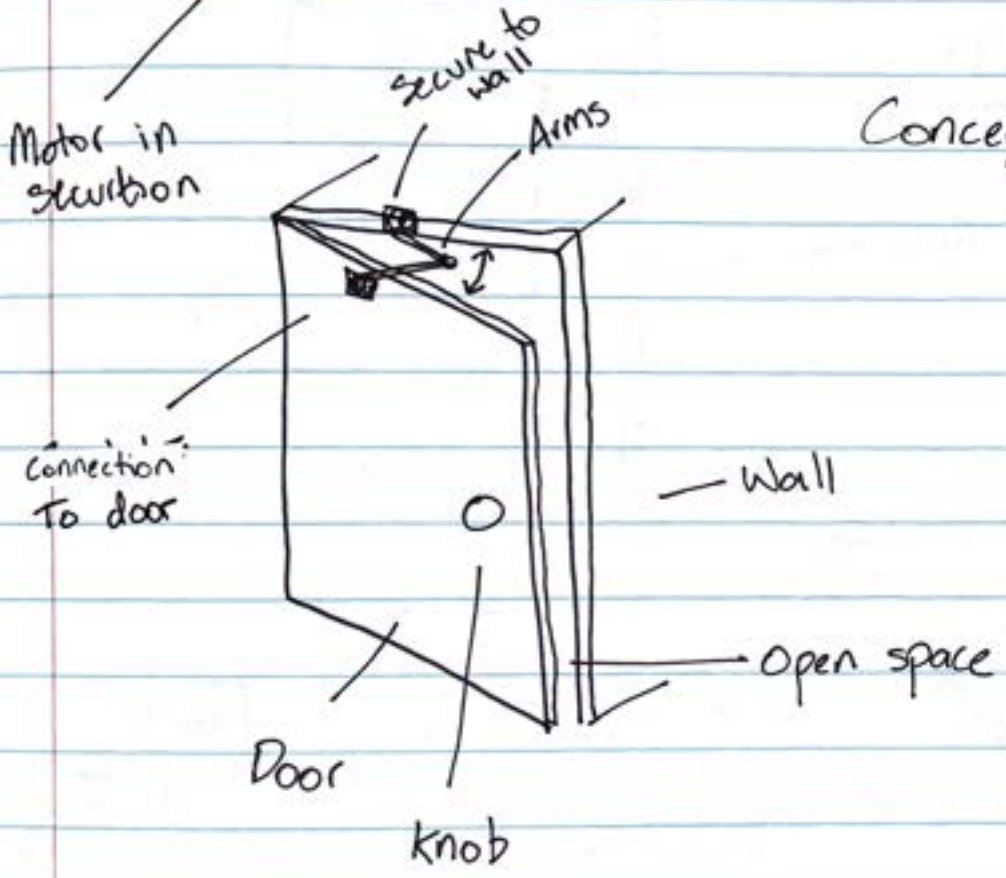


Door Closer Idea #2

02-07-22



→ Concept test: Arms?
~~Pulley?~~ No way to open?

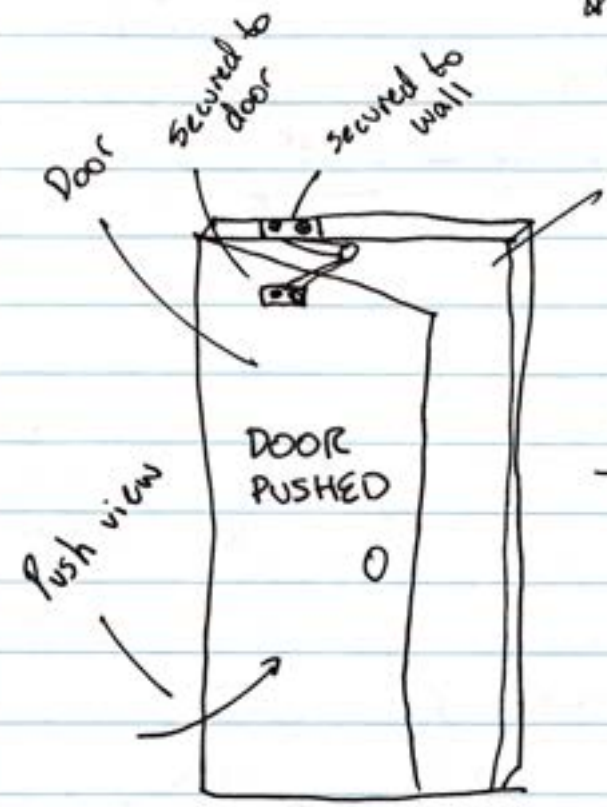


Concept: Arms v. Track

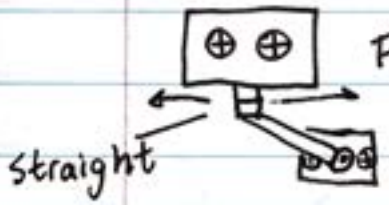
Door Opener Idea #3

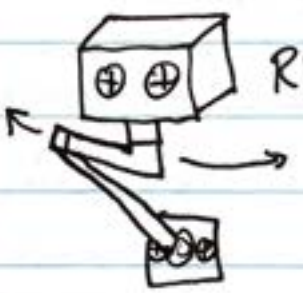
02-08-22

* On inside, more push!

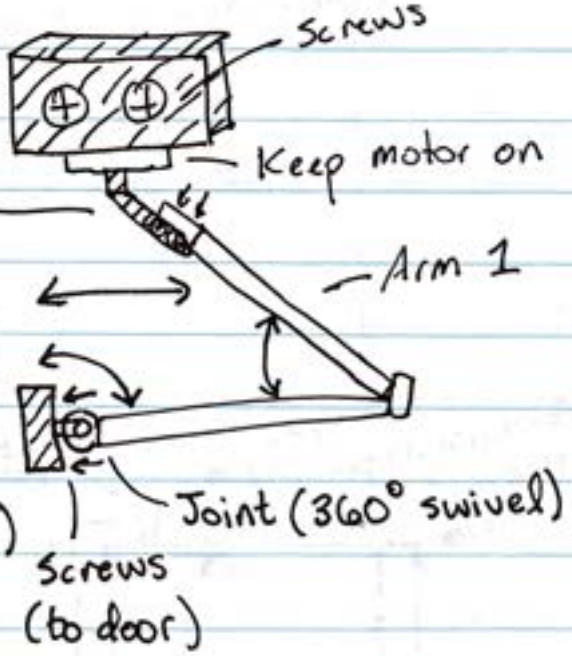


- 20 kg.cm servo
- Design pushes & pulls
- Pull to close
- Push to open
- More powerful & reliable on inside, door.



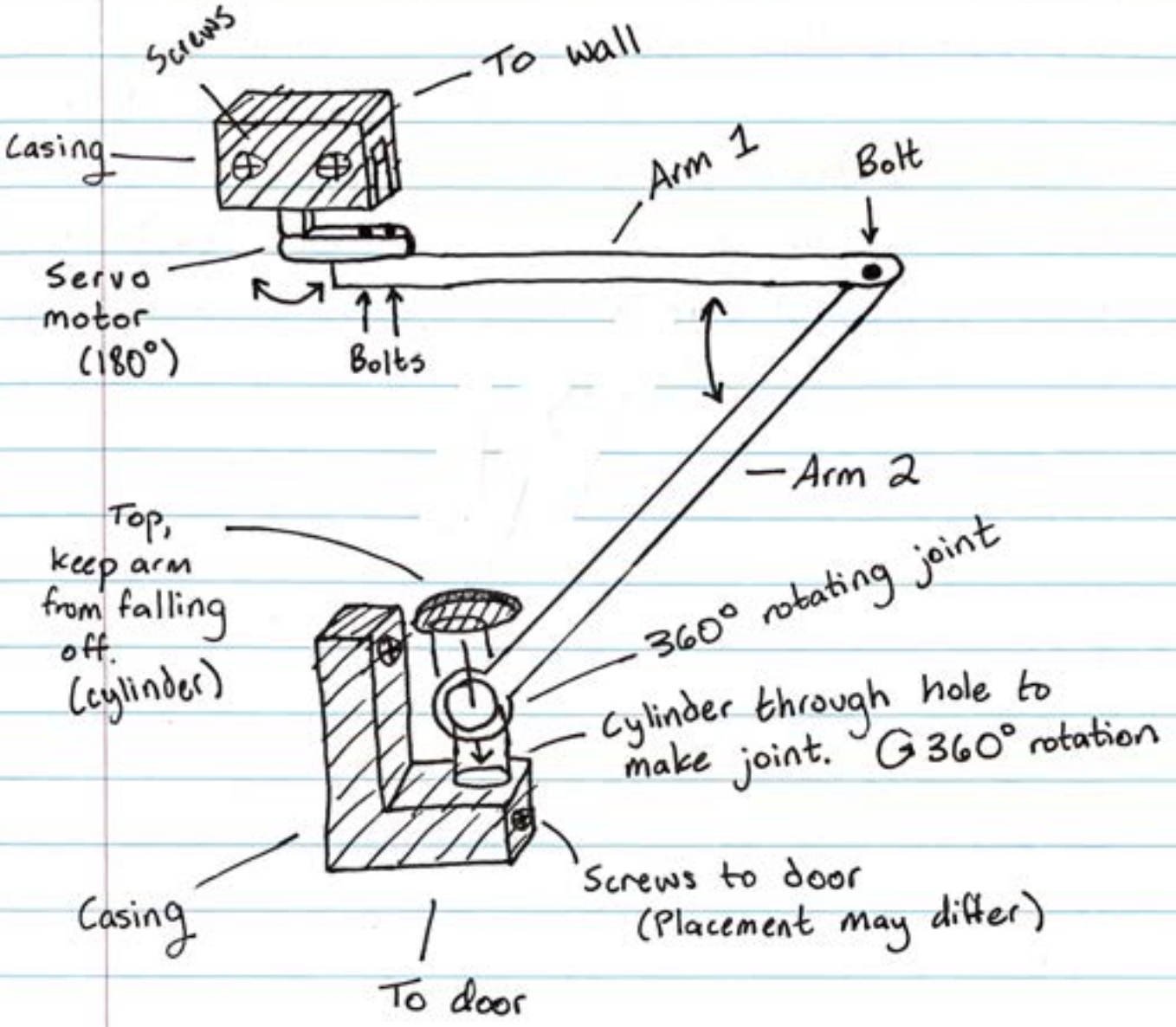


(Servo 180° rotation)
(150° in code)
(±30°)
(16.6% Error)

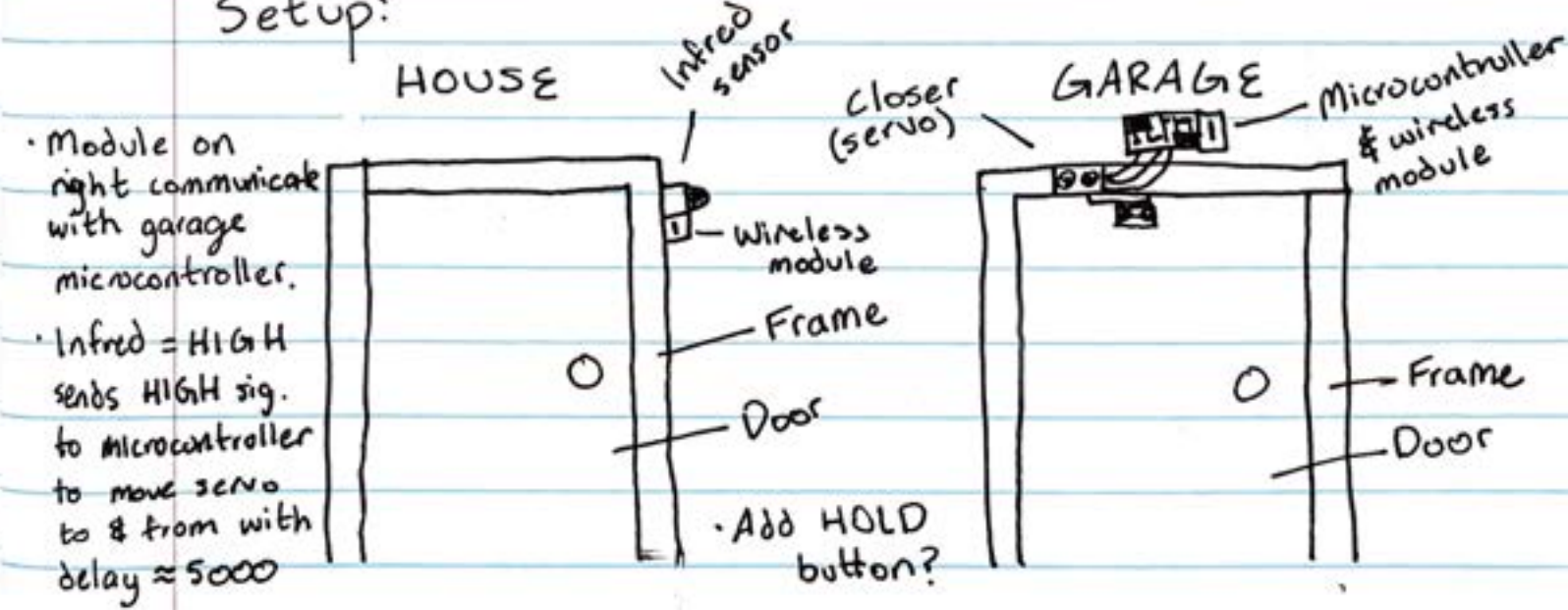


Door Closer #3 Design

02-09-22



Setup:



- Module on right communicate with garage microcontroller.
- Infred = HIGH sends HIGH sig. to microcontroller to move servo to & from with delay ≈ 5000
- Add HOLD button?

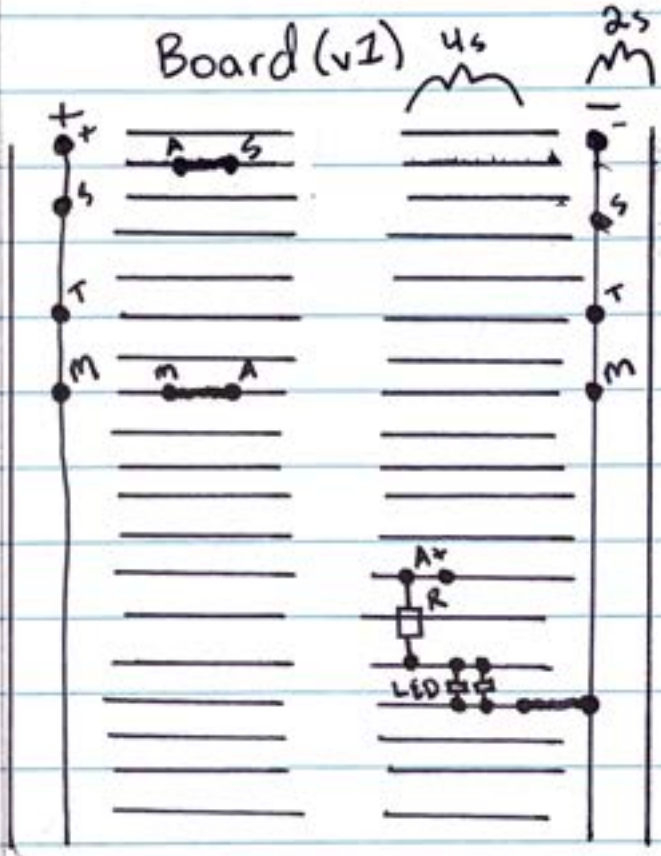
Idea Brainstorming

02-09-22

- Door unlocker (Unlock door with phone)
- Butter Bot (pass the butter)
- Robot that physically writes what you tell it (take notes)
- Turn Alexa into H.U.E. (Heuristic Unified Entity)
- Program H.U.E. voice controls for project automation

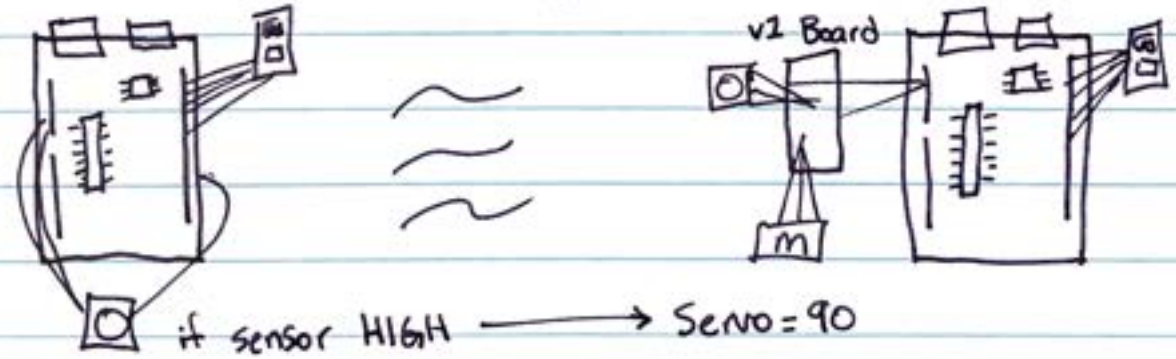
Door Closer #3 Electronics

02-14-22



A - Microcontroller
A+ - Microcontroller (+ out)
S - Infred sensor
T - Transceiver
M - Servo Motor
LED - LED indicator light
+ - Positive charge
- - Negative charge
R - Resistor (∿) (150)
V = IR

Transcieiver pins directly into microcontroller



Problem: Servo signal sometimes sent twice (⎍⎍)
Solutions?: • Create time limit per signal sent.
• Dont use timer for when door closes.

Door Closer #3 Electronics Pt. 2

02-16-22

To transmitter:

All in void loop()

Create time limit per signal sent v1:

```
if (outPin=HIGH) {          // outPin is sig. from sensor
   digitalWrite(pin7, HIGH);
   delay(3000); }    // time limit
else {
   digitalWrite(pin7, LOW); }
```

Variables better? Will delay hold processing?

```
if (pin6 == HIGH) {         // pin6 attached pin7
   inPin_state = HIGH; }
else {
   inPin_state = LOW; }
radio.write(&inPin_state, sizeof(inPin_state)); //send bool
```

Explaination: If the output from the Infrared senor is high (+), then it sets pin7 as a high output & waits 3 seconds. pin6 is attached to pin7 as a input pin. If pin6 is high the boolean variable being sent through transceiver is high, if not it is low.

Incorrect logic! Correct logic:

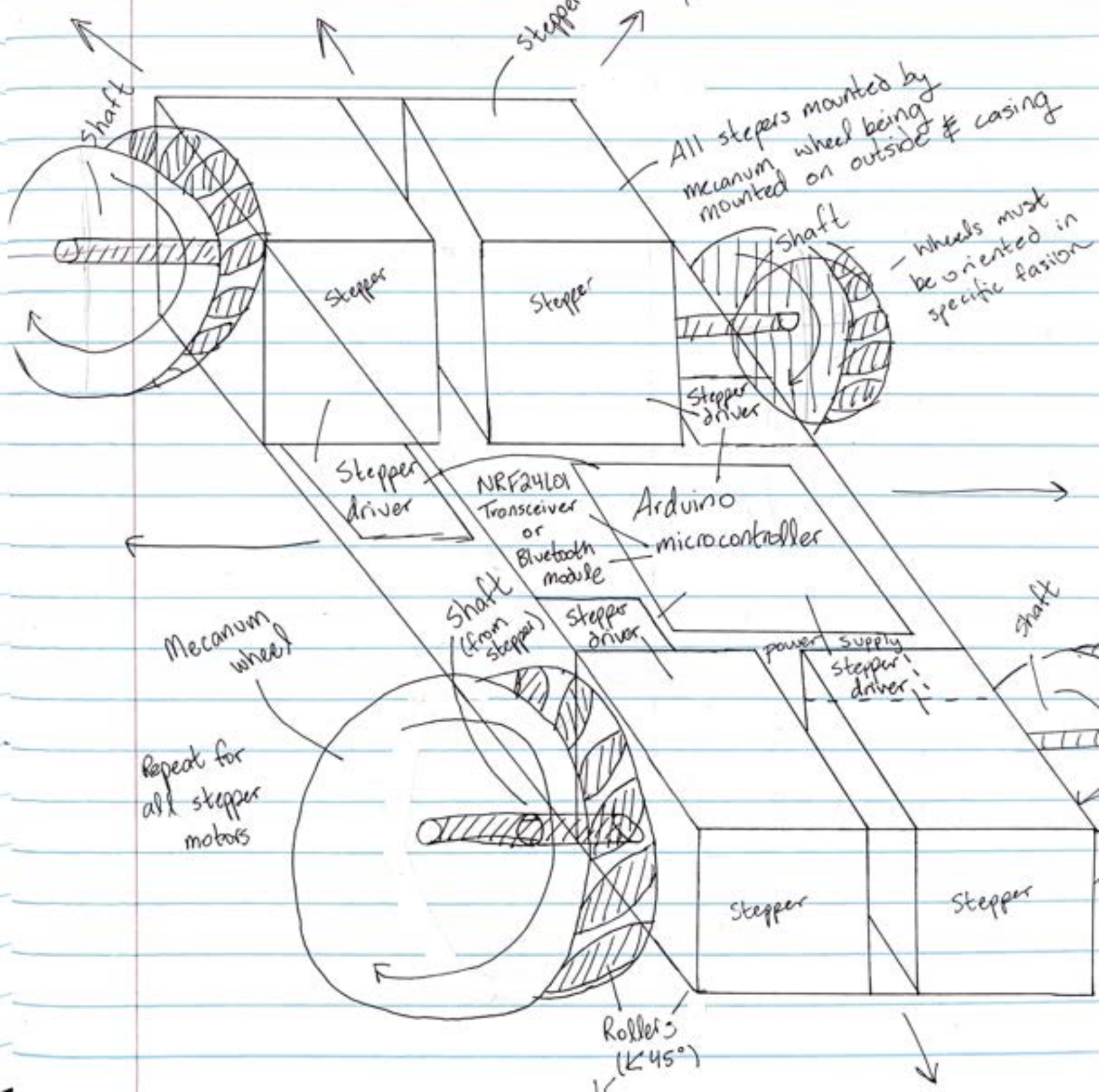
```
val = digitalRead(InPin);          //detects change from + & -
if((val ==HIGH) && (old_val ==LOW)) {
inPin_state = HIGH; }              // sends one signal
else {
inPin_state = LOW; }
old_val = val
```

First time inPin is high, inPin_state is high. inPin_state is low again UNTIL inPin is low, then high again.

Mecanum Wheel Car Design

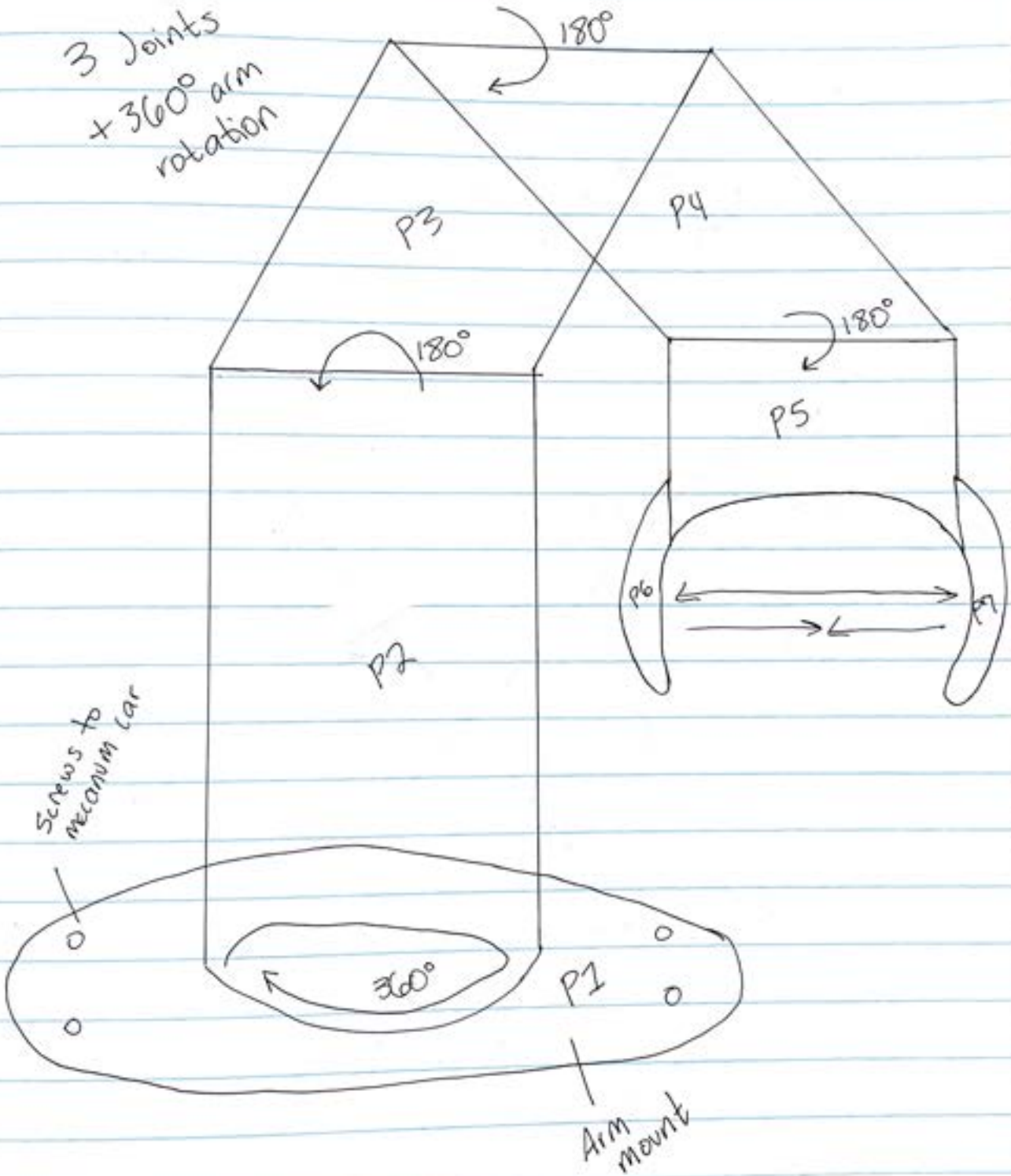
02-23-22

Mecanum Wheel car will be able to move all directions without turning. Commands later. Robotic arm mounted on top.



Robotic Arm Design / Concept

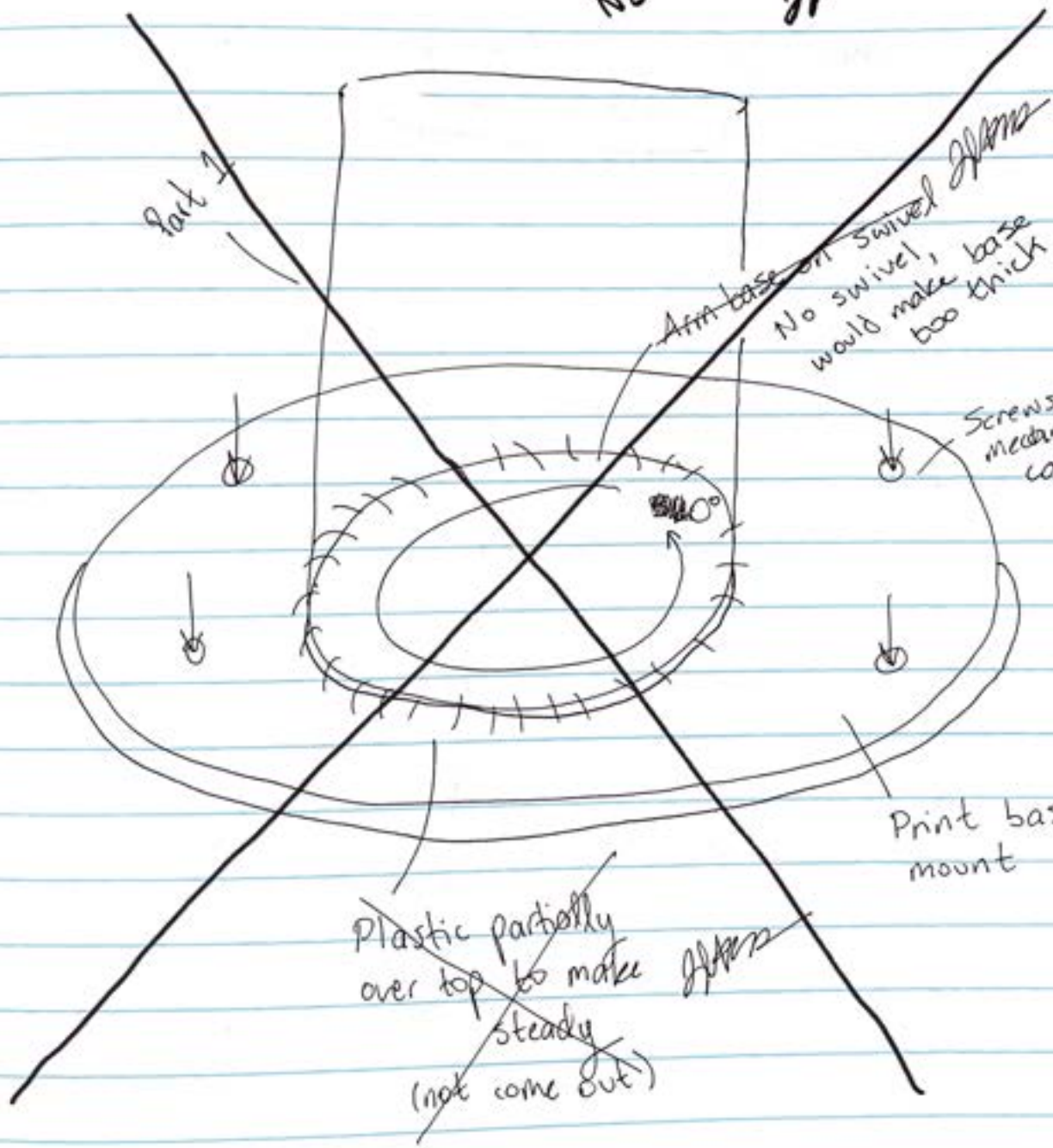
02-23-22



Robotic Arm Design

02-23-22

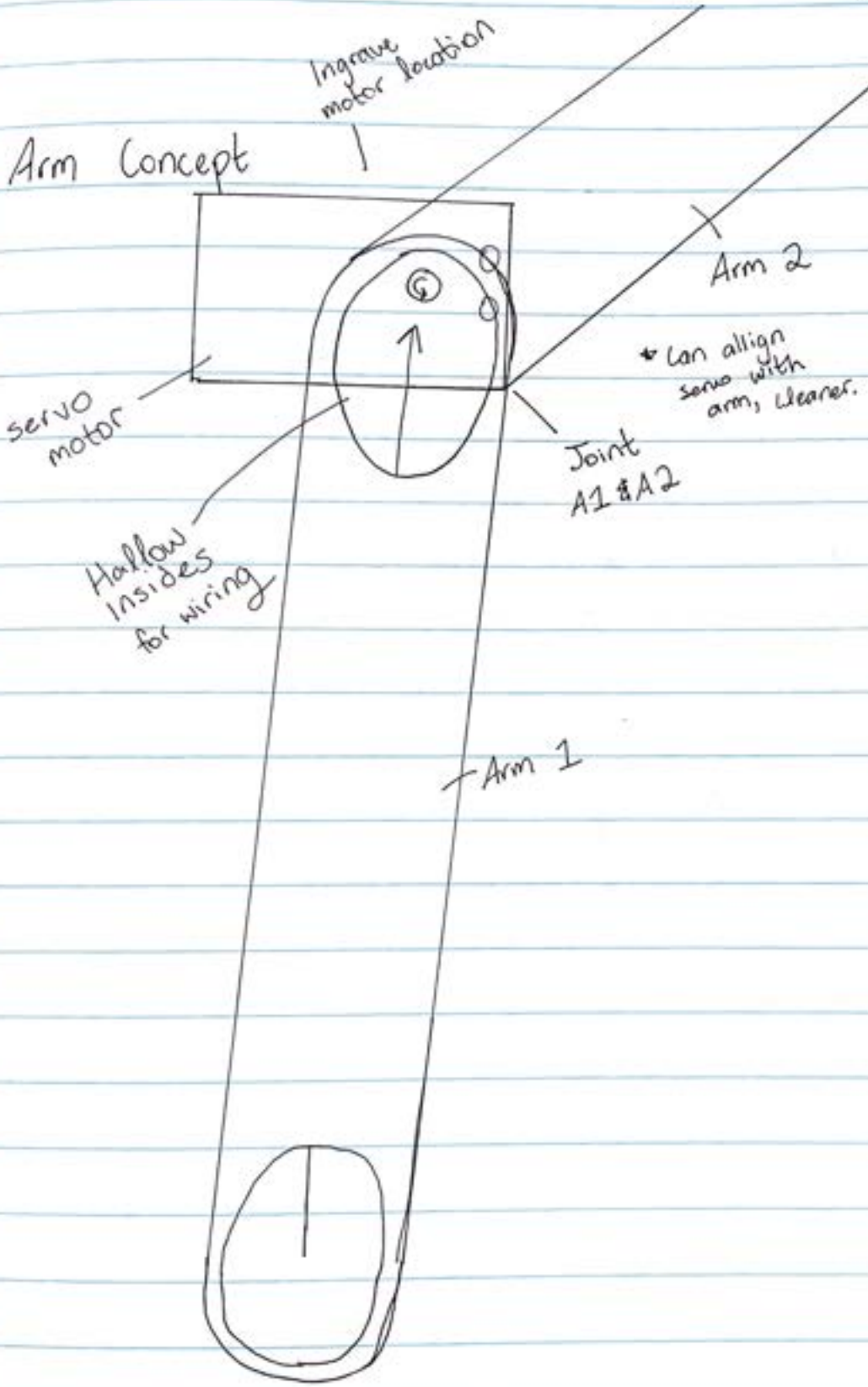
NEXT PAGE



Robotic Arm Design

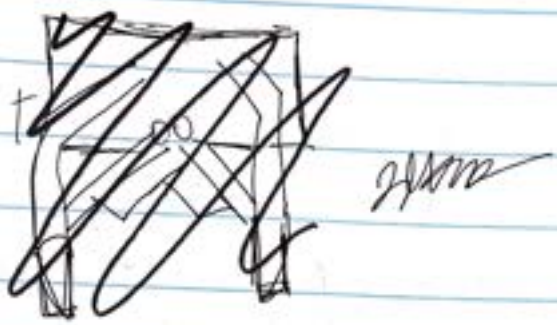
02-24-22

Arm Concept



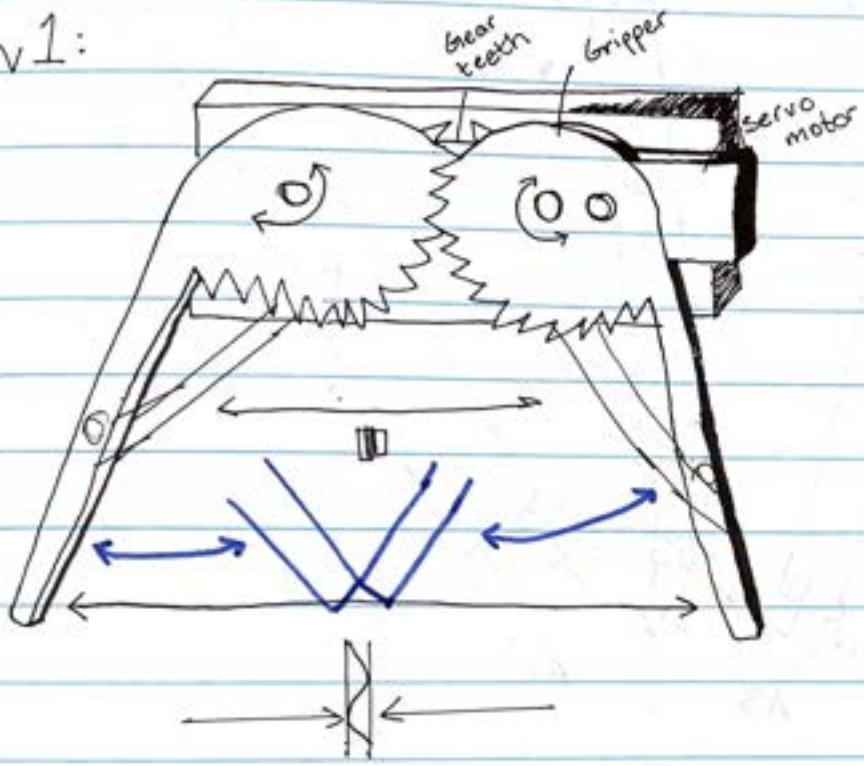
Gripper Design

03-01-22



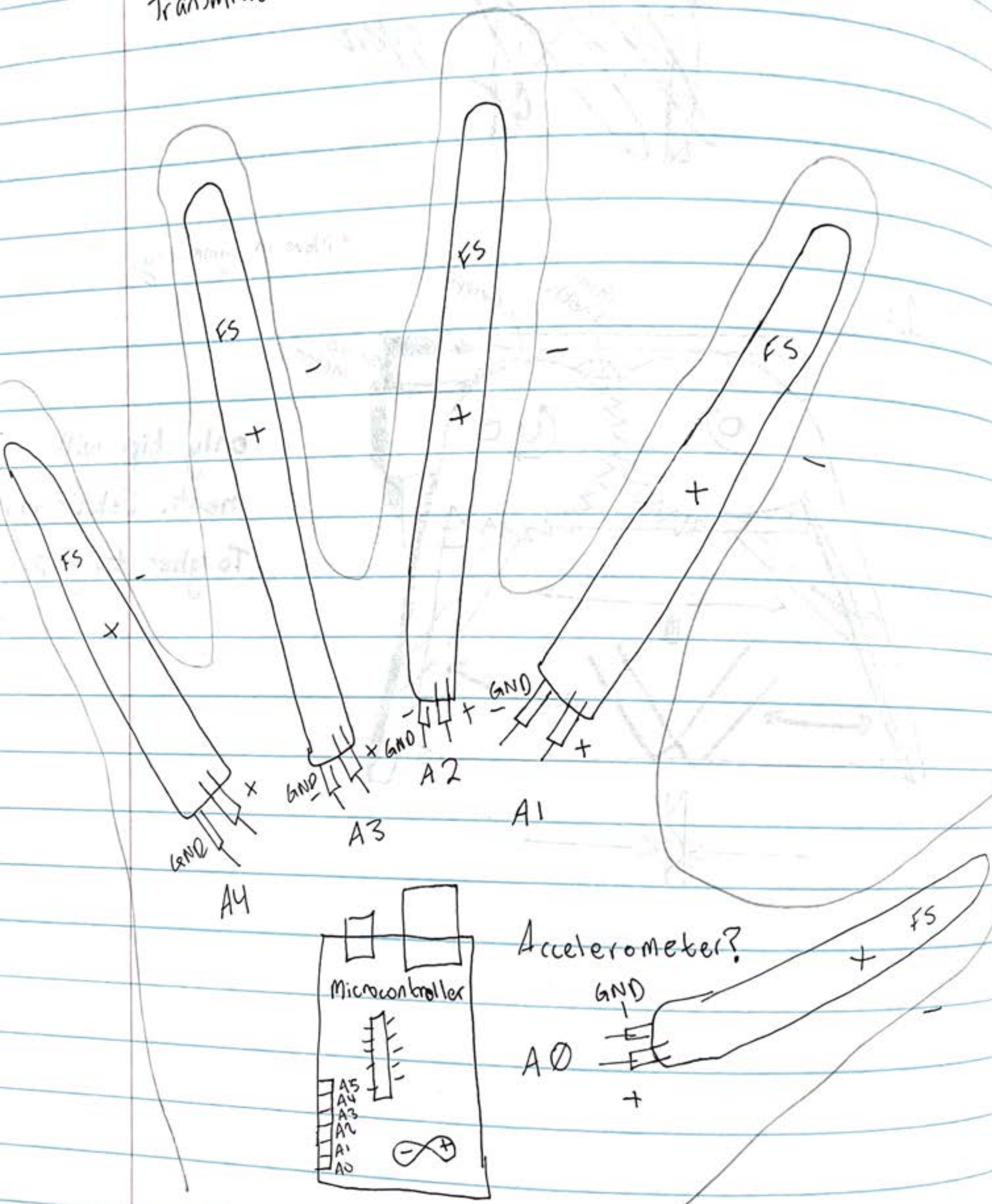
*Move in symmetry

v1:



*only tip will meet. Solutions? Tougher to grip.

Transmitter:



Robot Hand Concept

03-10-22

Transmitter: Add accelerometer?

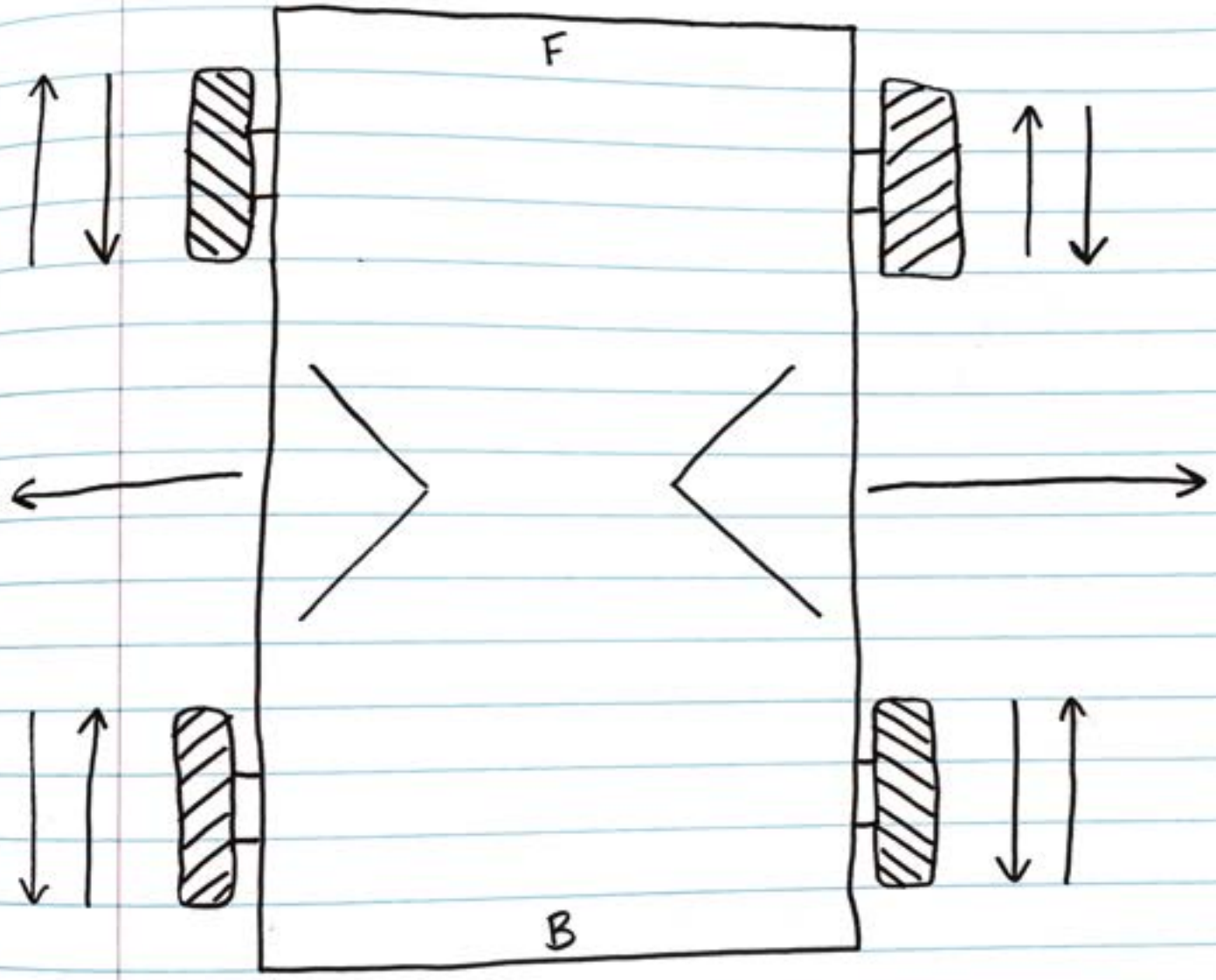
FS - Flex Sensor

Be sure to have a seperate negative & positive pulse to measure resistance value. The more flex in the sensors, the more spread apart the conductive particles will be & therefore will have a greater resistance value which can be transmitted & programmed in the reciever.

Reciever

Mecanum Wheel Concept

03-14-22

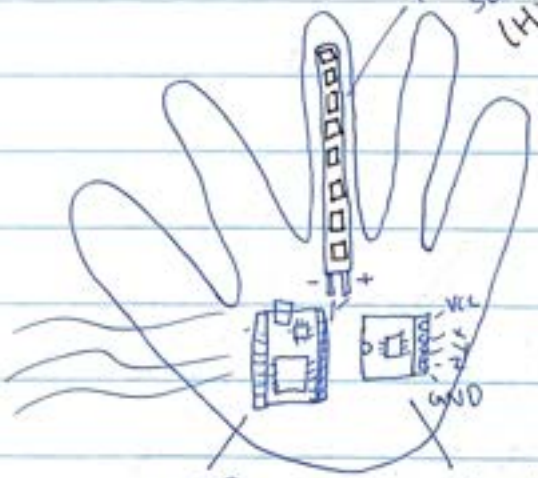


Possessed Arm Concept

03-19-22

- Robot Arm will mimic controller

Transmitter:

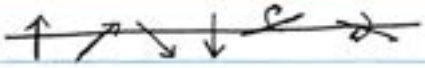


- Flex sensor will control gripper.
- Accelerometer will control all other arm axis.

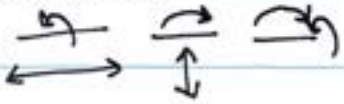
Reciever:

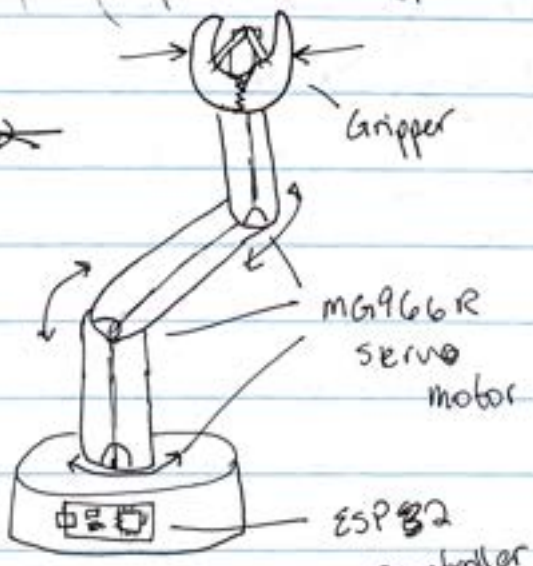
— Wireless data via ESP-Now (private connection)

Gestures:



MPU6050 only measures

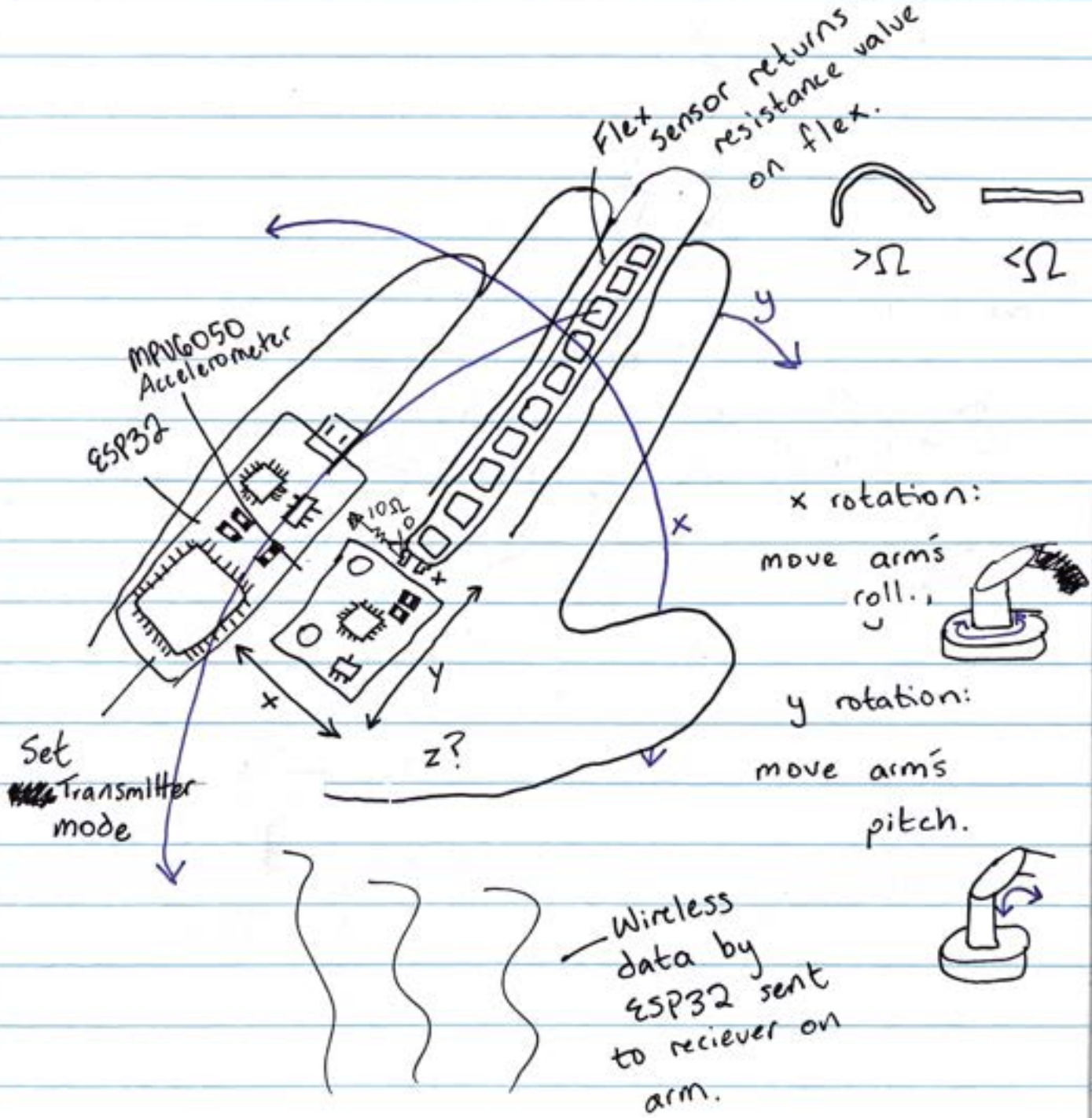




- Servos move based on hand transmitter values.

Possessed Arm Guestures

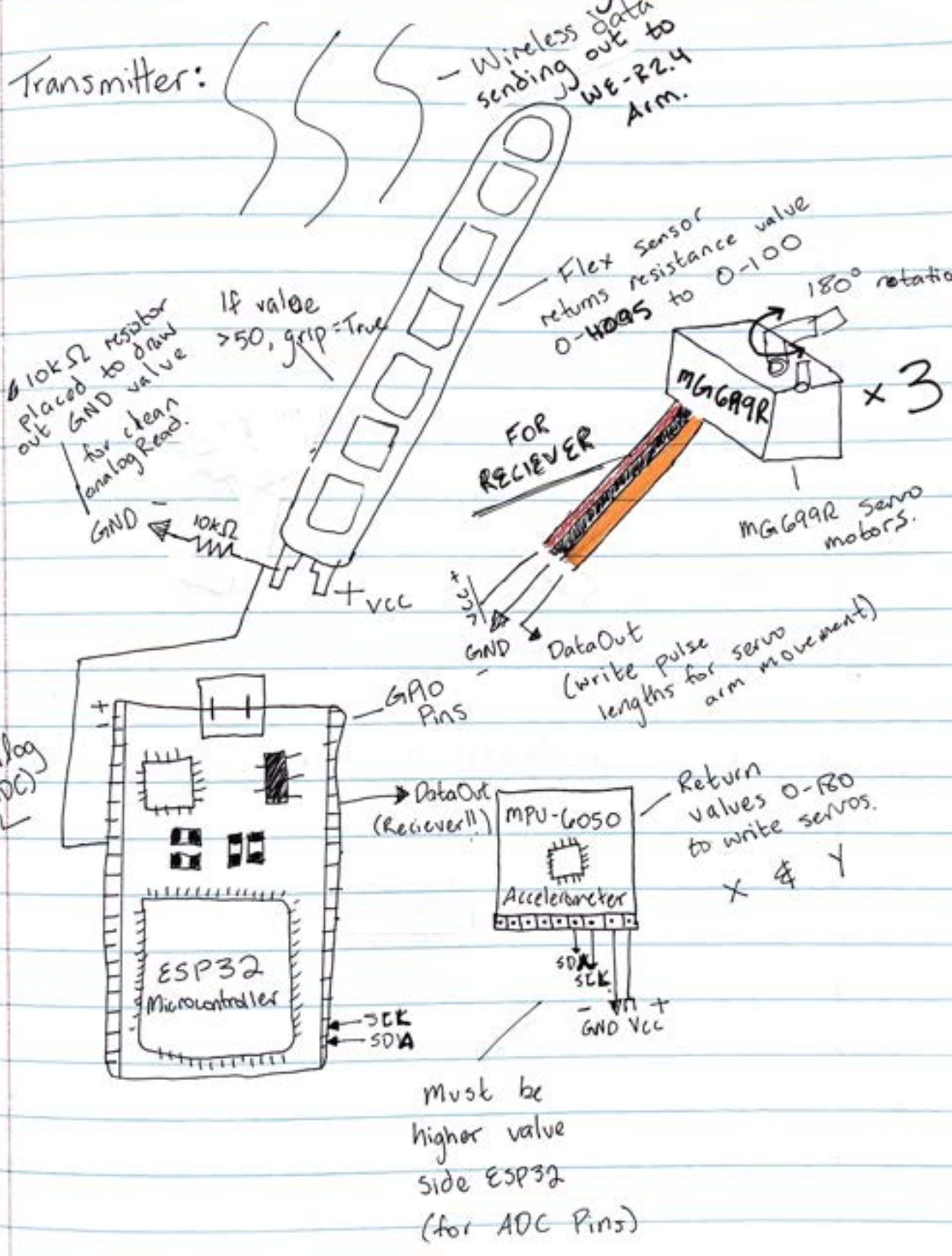
03-22-22



Possessed Arm (WE-R2.4 (Reciever)) + Transmitter

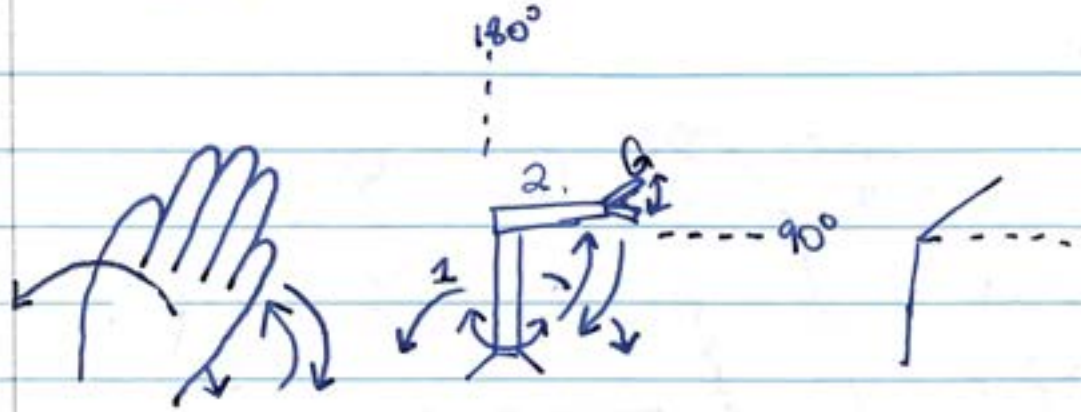
Circuit Analysis

03-24-22



Gesture Interface

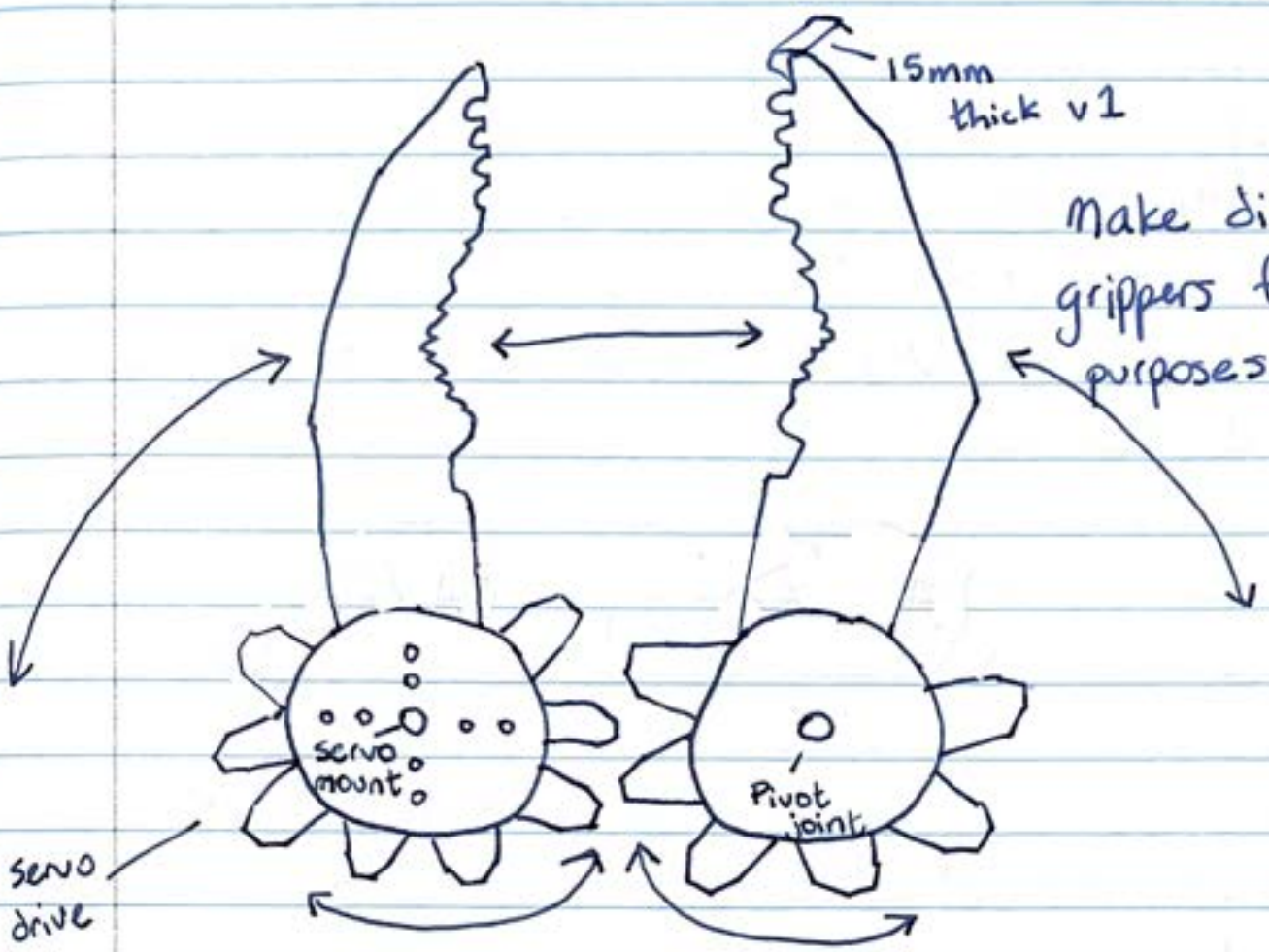
03-29-22

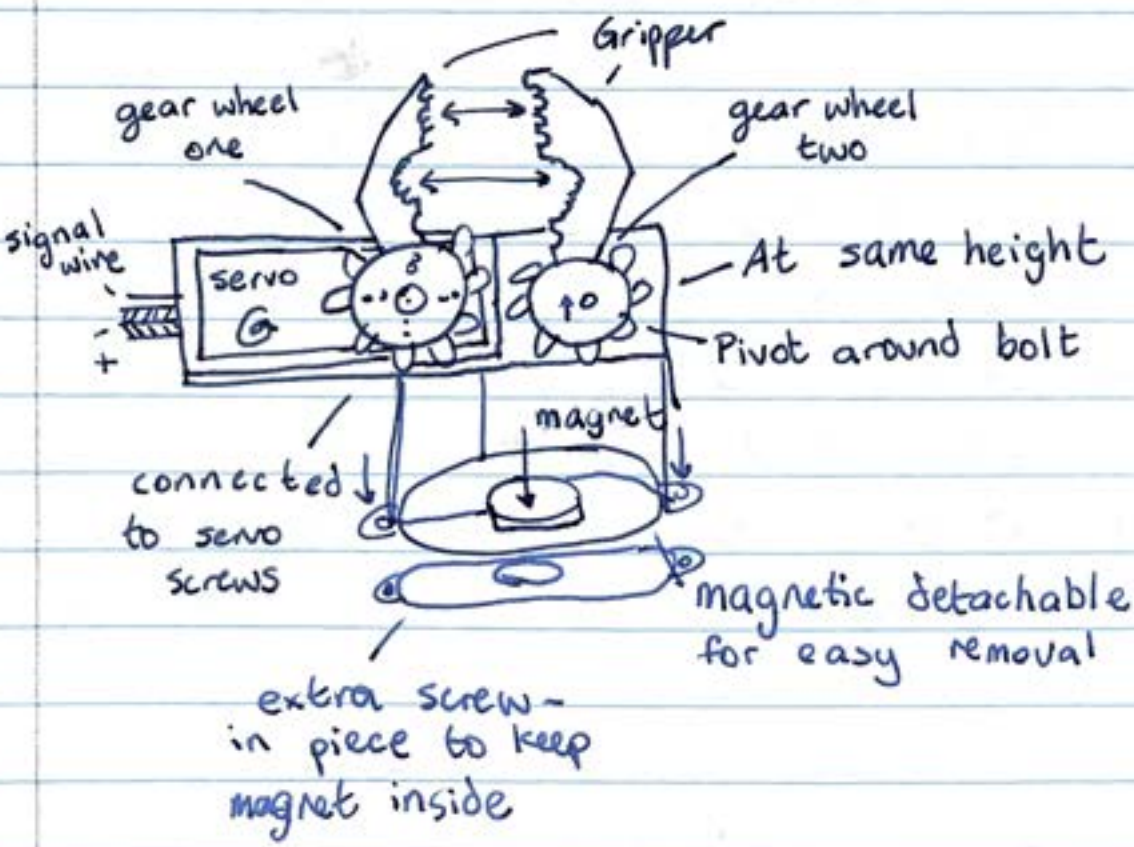


- Roll hand right/left
  - Yaw arm right/left
- Pitch hand up/down
  - Pitch arm joint 1 up/down. (Not <90°)
- Pitch hand up/down, joint 1 = 90°
  - Pitch joint 2 up/down
- Hand grip = true
  - Grip gripper, & rotate end joint 2

Gripper Design Pt. 2

04-04-22





Arm Issues & Improvements

04-11-22

Issues:

- Gripper offset ~5mm
- Unable to grab objects unless at tip (less area^2)
- Transmitter only senses rotation, not location, so its more difficult to gesture control.

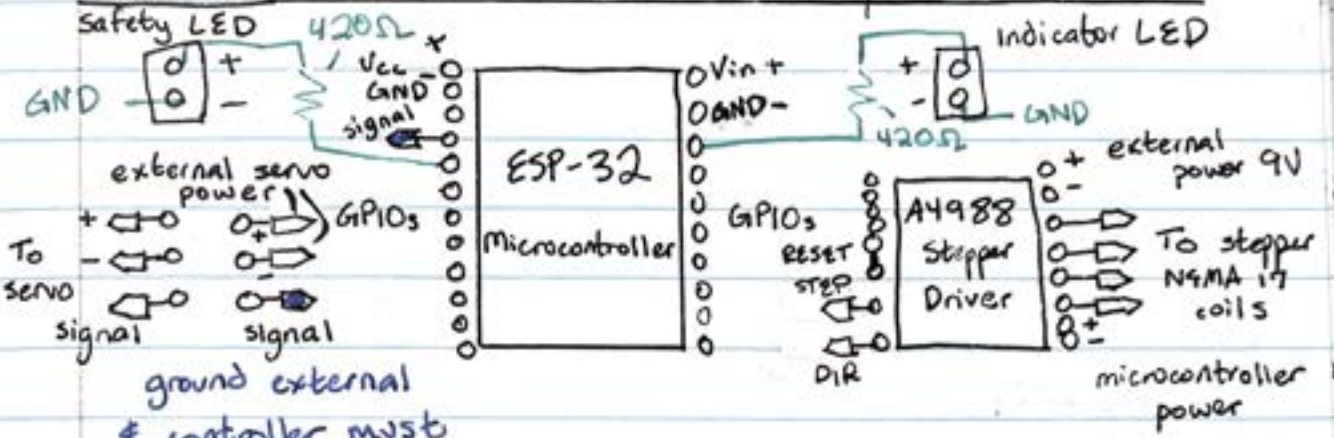
Ideas for improvement:

- Longer screw & spacer nuts to reduce offset
- Add extra hinges to make it open/close in vision.
- Could add pixy cam/infred sensors to locate position for easier control.
- Could add camera/esp32 cam to control from distance & complete tasks while away.
- Could add wheels base for movement.
- Change comminication from ESP-NOW to WiFi for better ranged communication.

Possessed Arm PCB Design

04-12-22

RECIEVER Concept

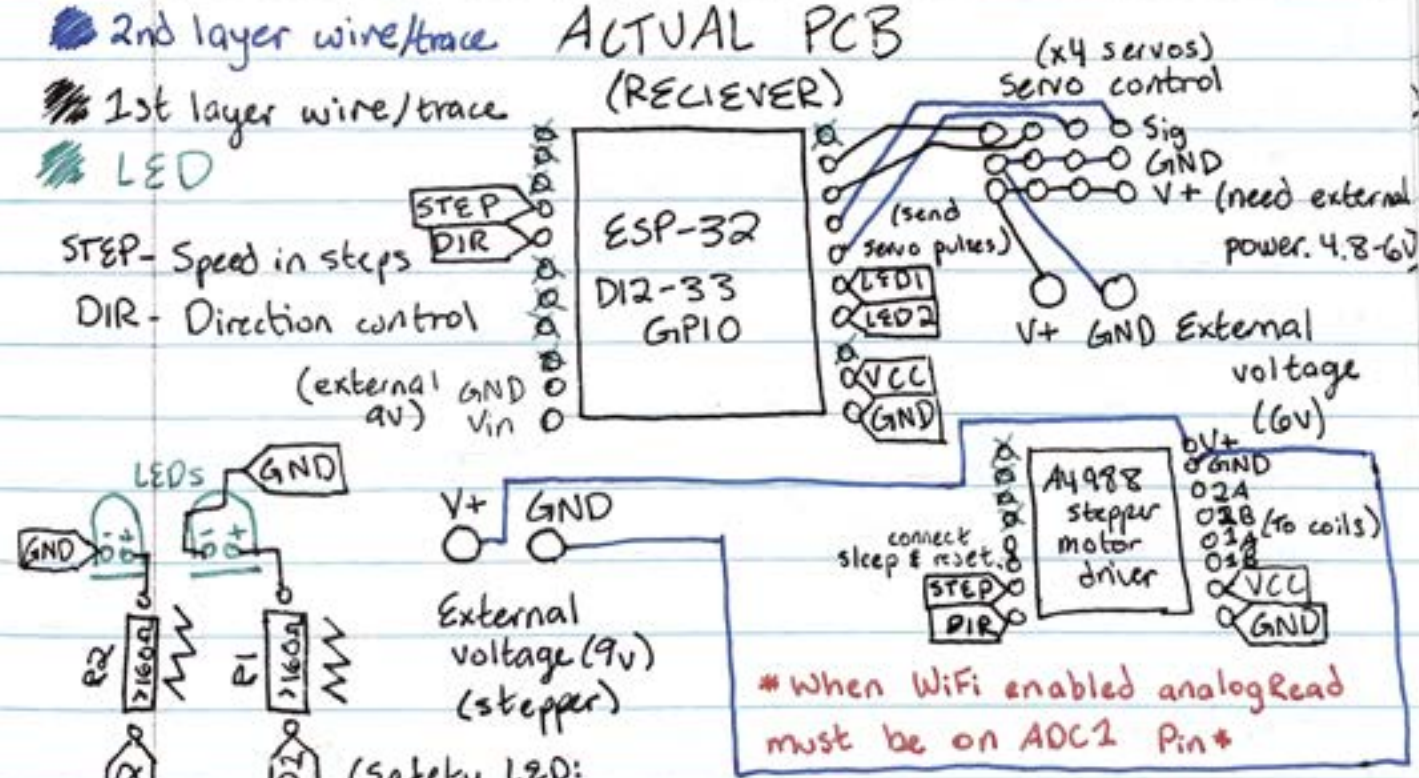


2nd layer wire/trace

1st layer wire/trace

LED

ACTUAL PCB (RECIEVER)



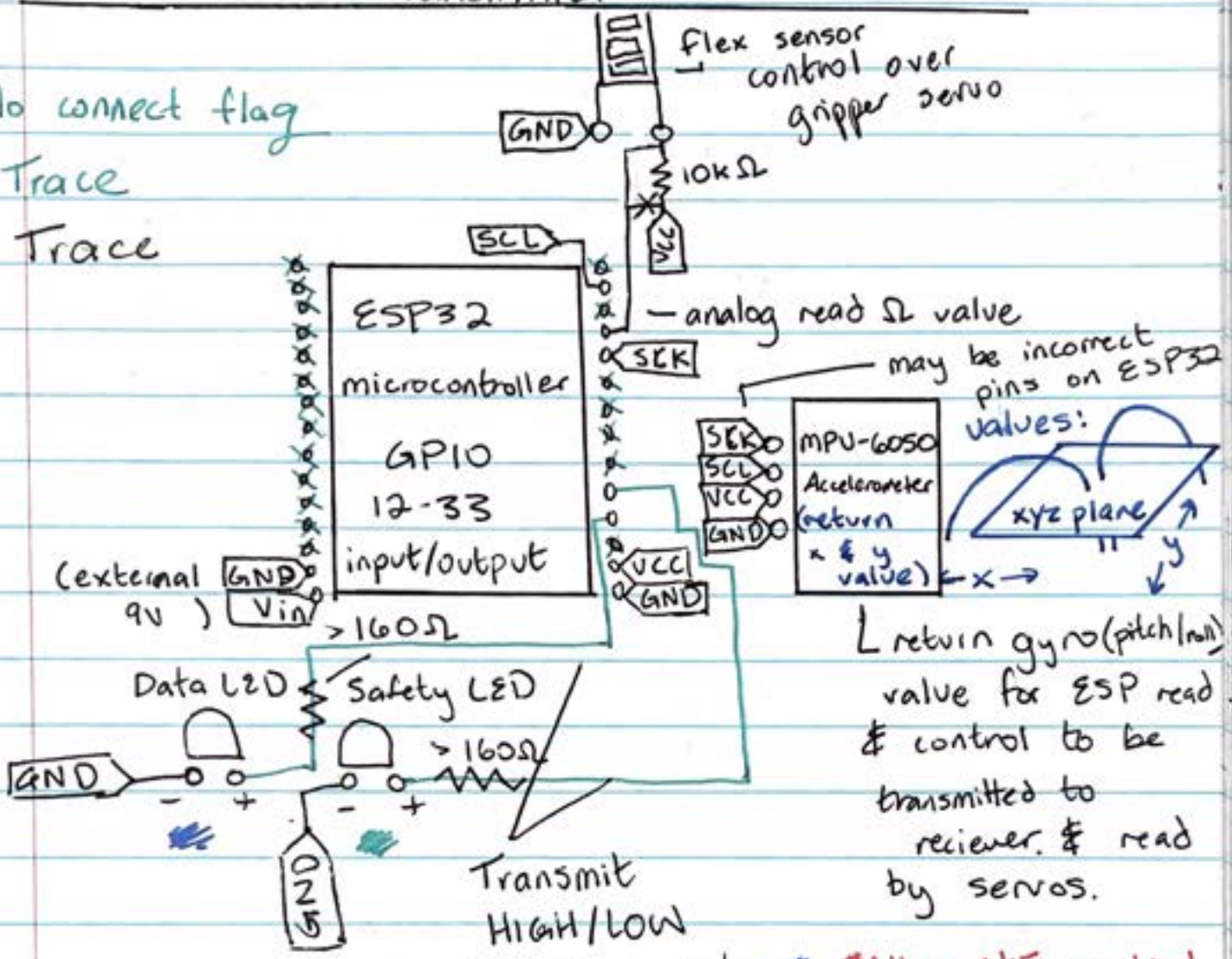
RECIEVER SCHEMATIC

→ (To be updated with 11.1V Lipo & voltage regulators!

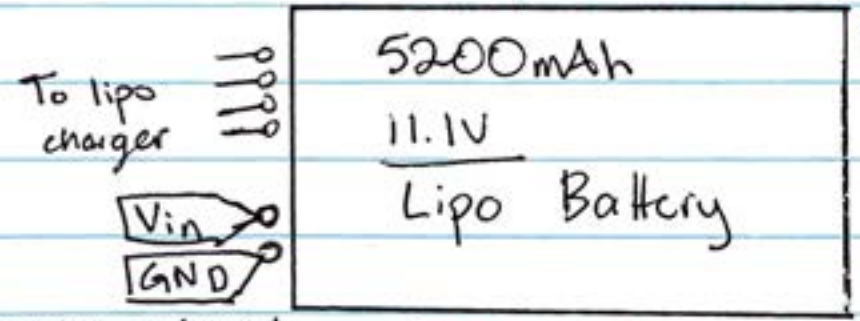
Transmitter Glove PCB Design

04-27-22

Transmitter

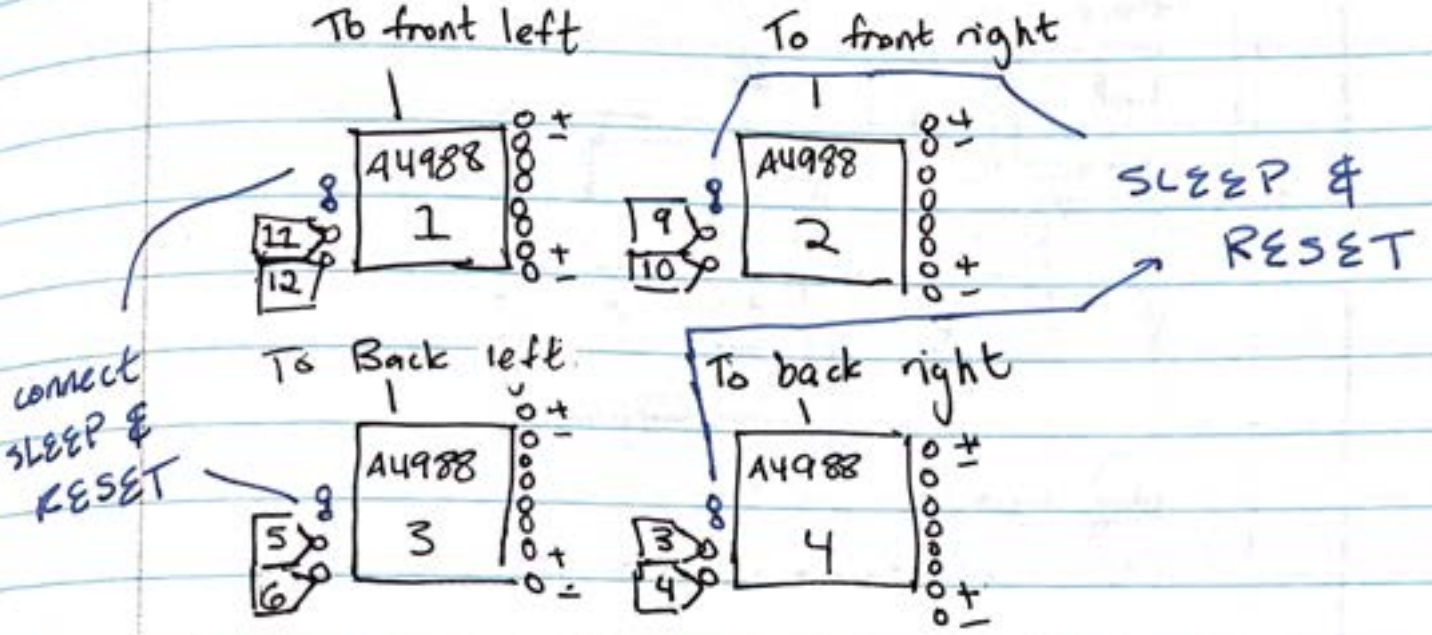


(To be updated with voltage regulators!)



Bluetooth Car Pinout

04-27-22



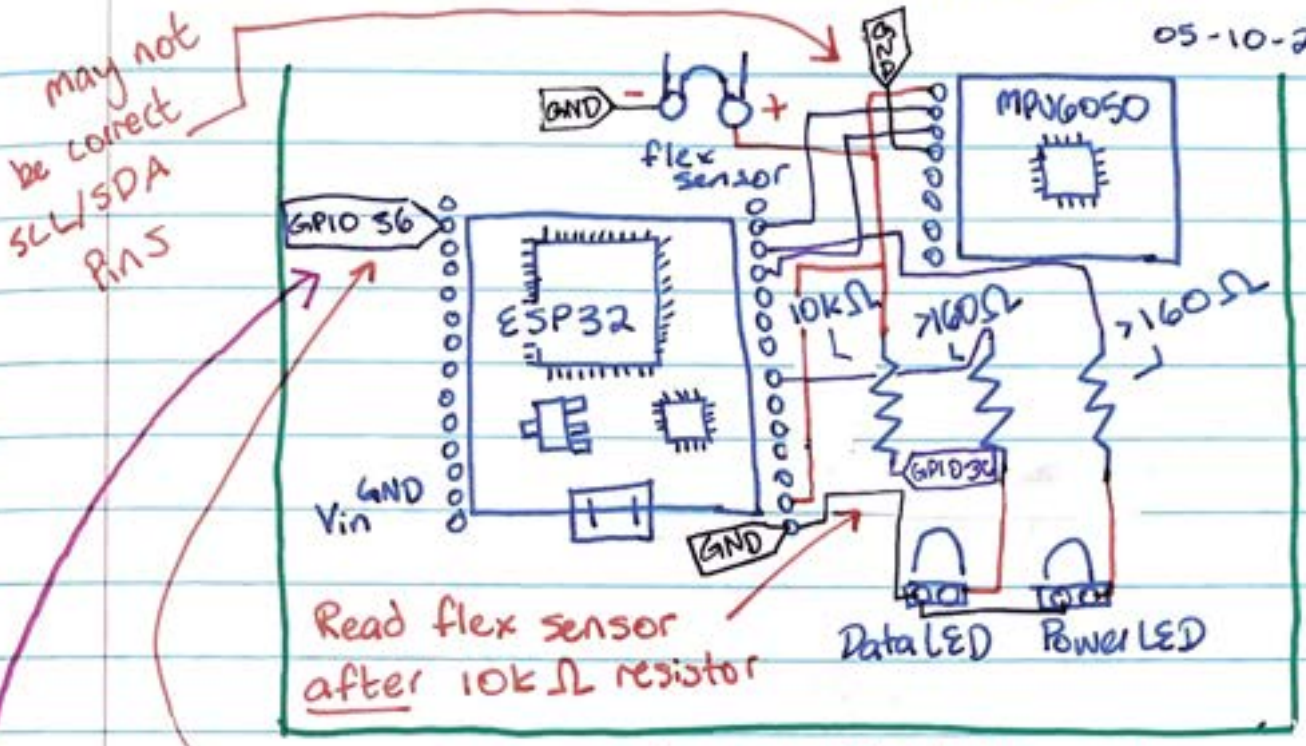
A4988 - Stepper Drivers for NEMA 17

White - 7

orange - 8

Transmitter Glove PCB Corrections

05-10-22



To send analogRead() values over WiFi, they must be connected to a ADC1 pins.

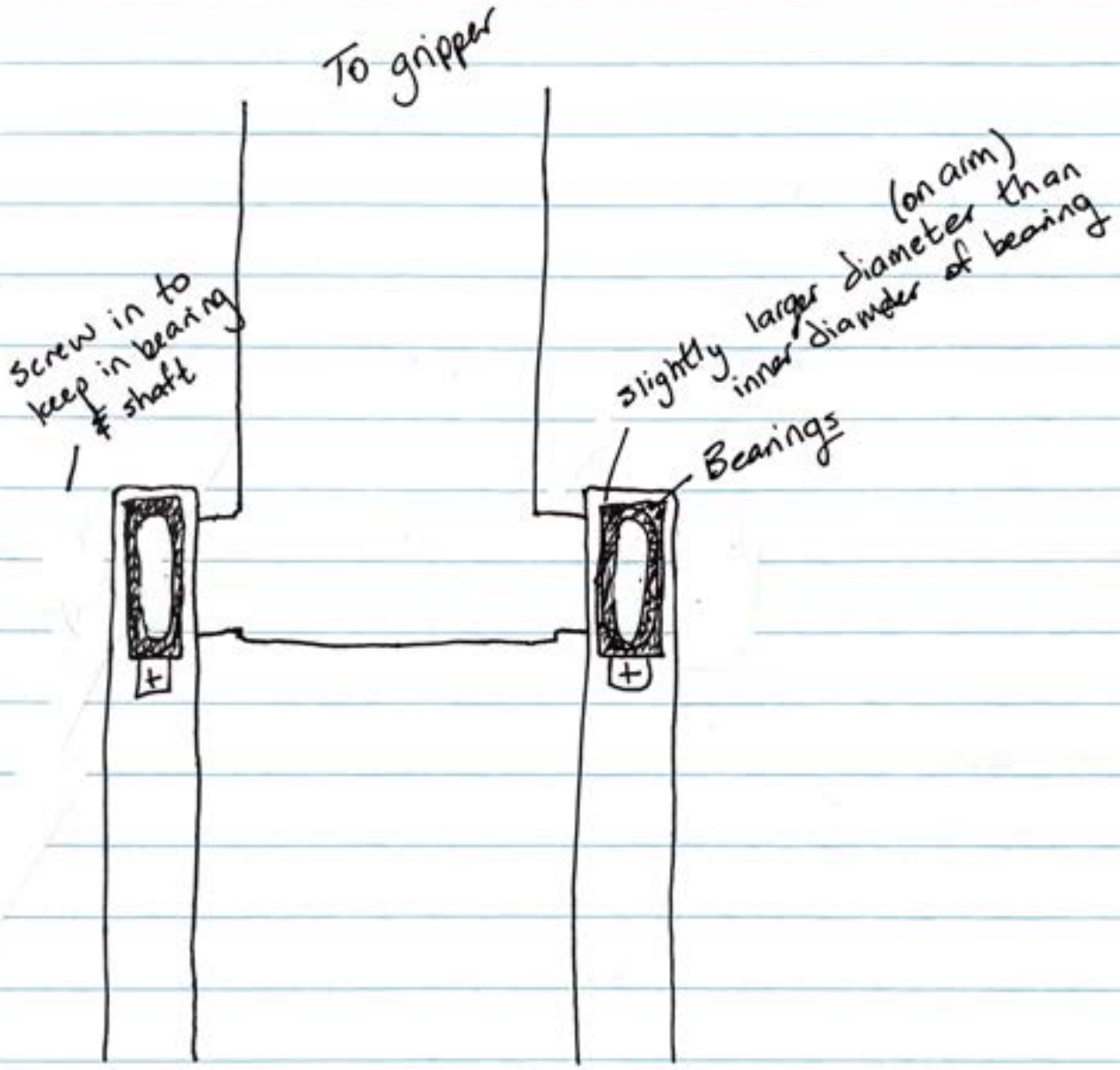
BOARD WILL NEED REDESIGN TO AVOID ERROR WIRES

In PCB, error wires connecting resisted current from 10kΩ resistor to ADC1 pin. (rogue connection above ESP32)

WILL AISO NEED EXCESS BOARD FOR POWER SUPPLY IF <9V NEEDED

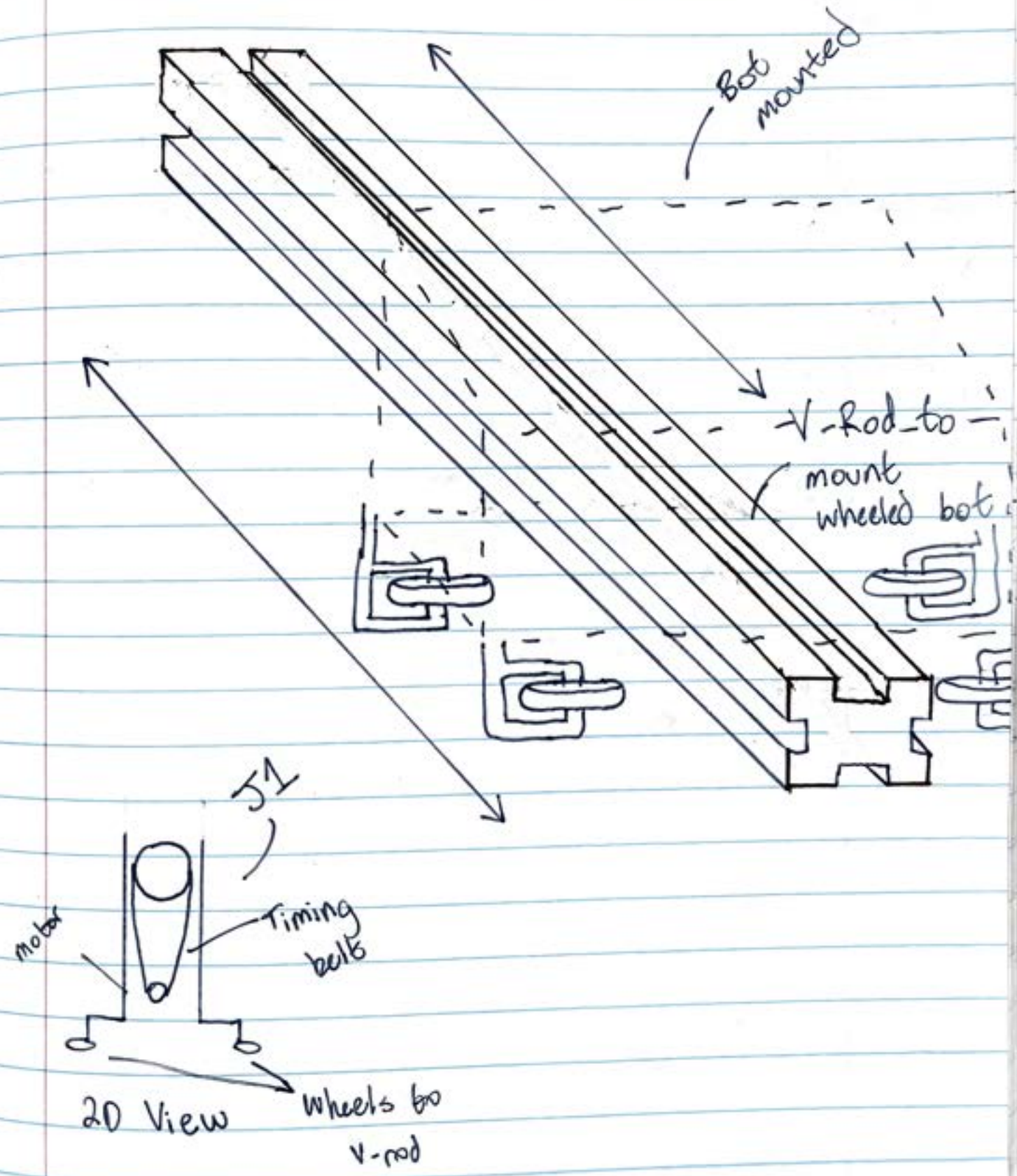
Robotic Arm Redesign

06-08-22



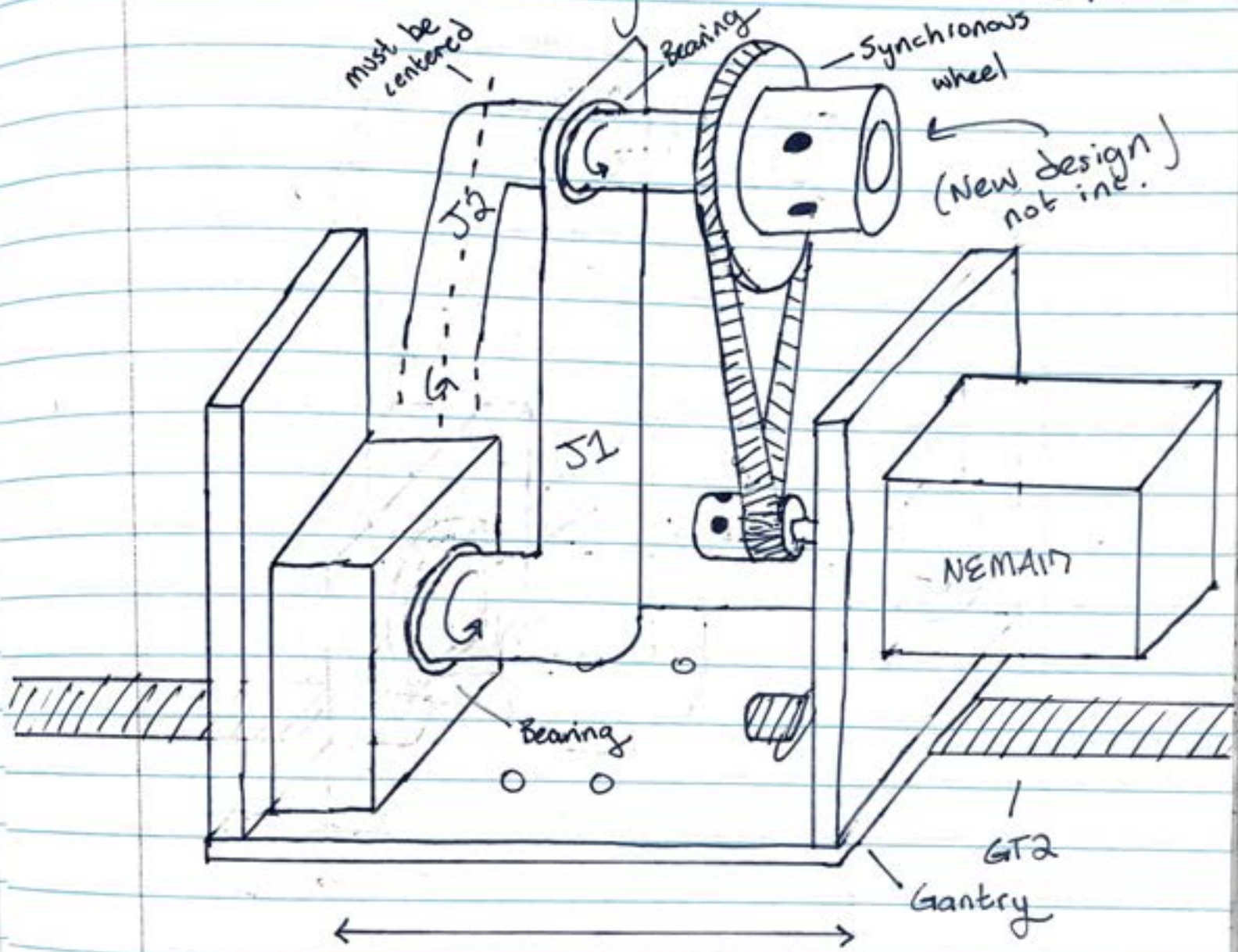
Belted Robotic Arm Concept

09-02-22.



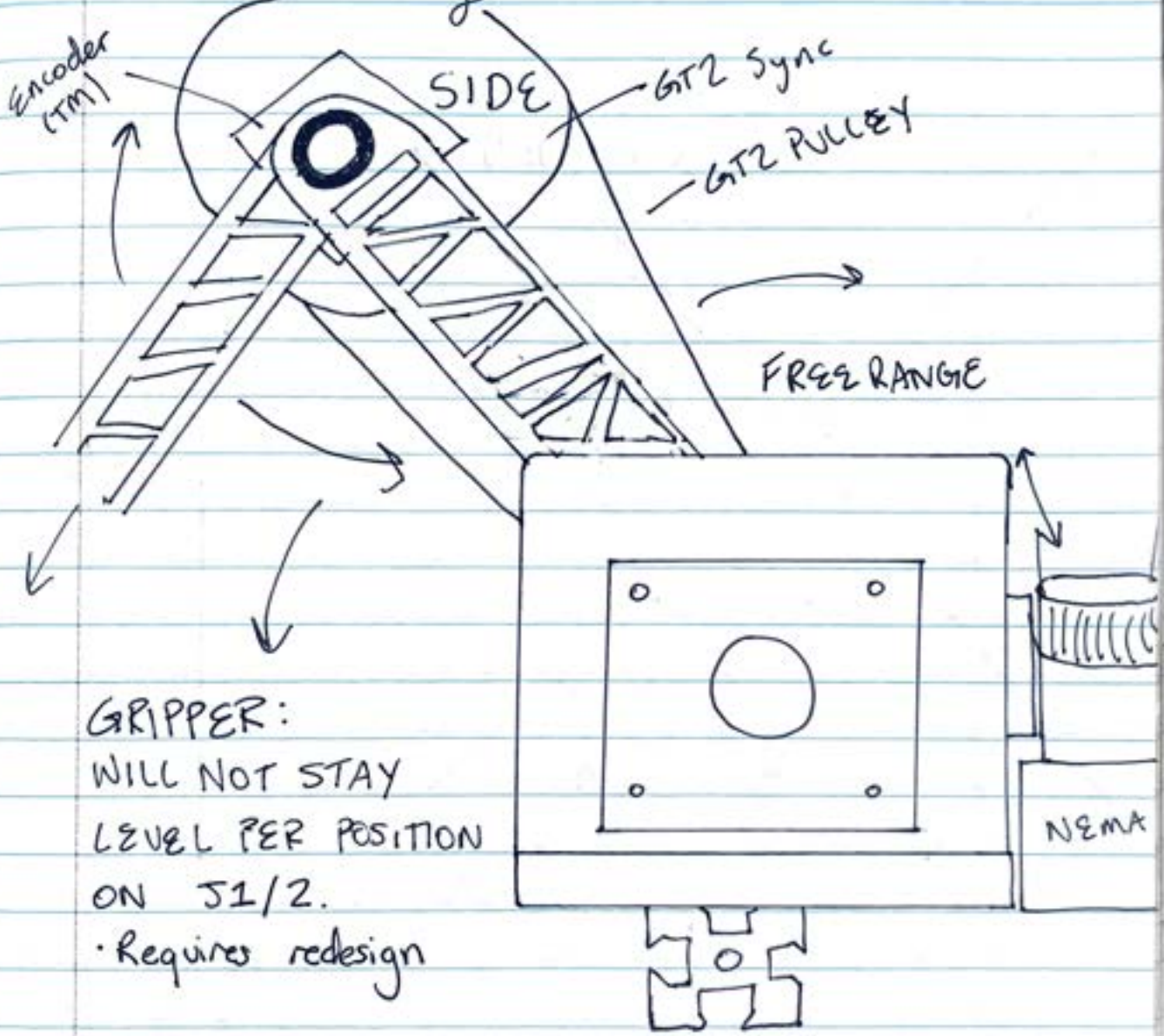
Robotic Arm v4 Layout

09-08-22



09-12-22

J2 Redesign

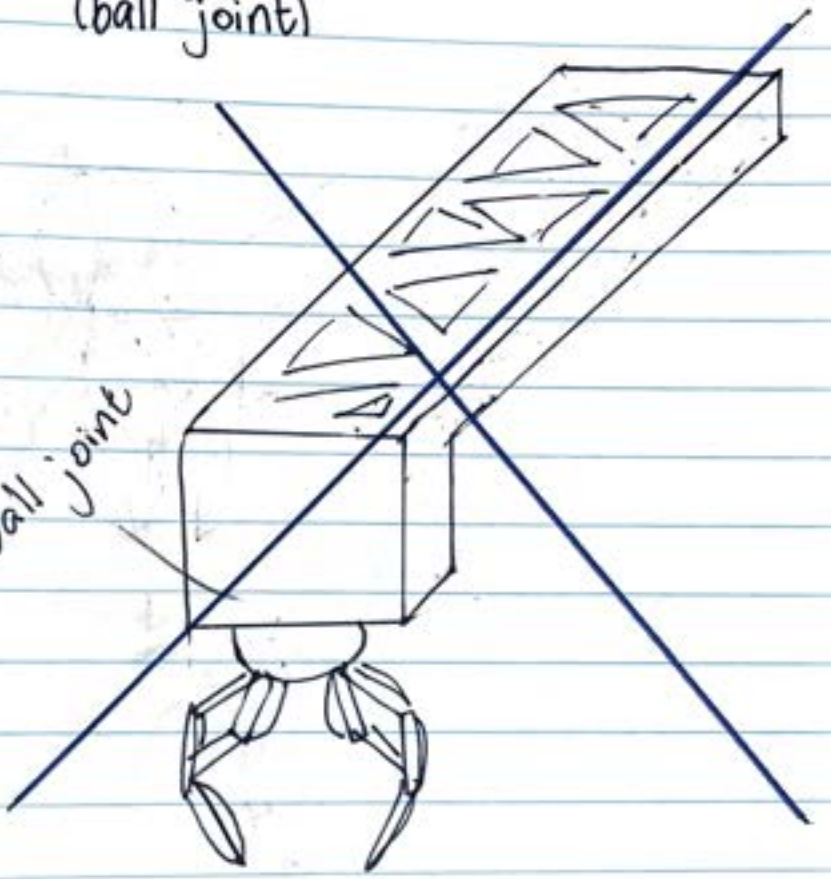


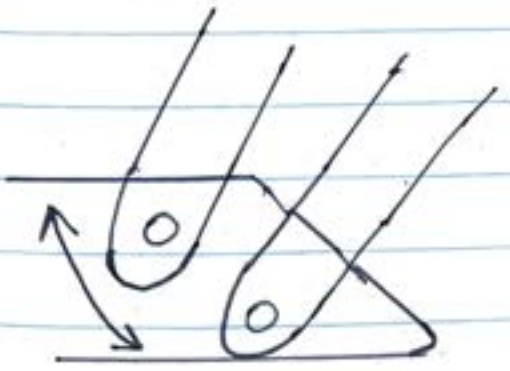
GRIPPER:
WILL NOT STAY LEVEL PER POSITION ON J1/2.
- Requires redesign

Grippers

09-12-22

Gravity-based
(ball joint)

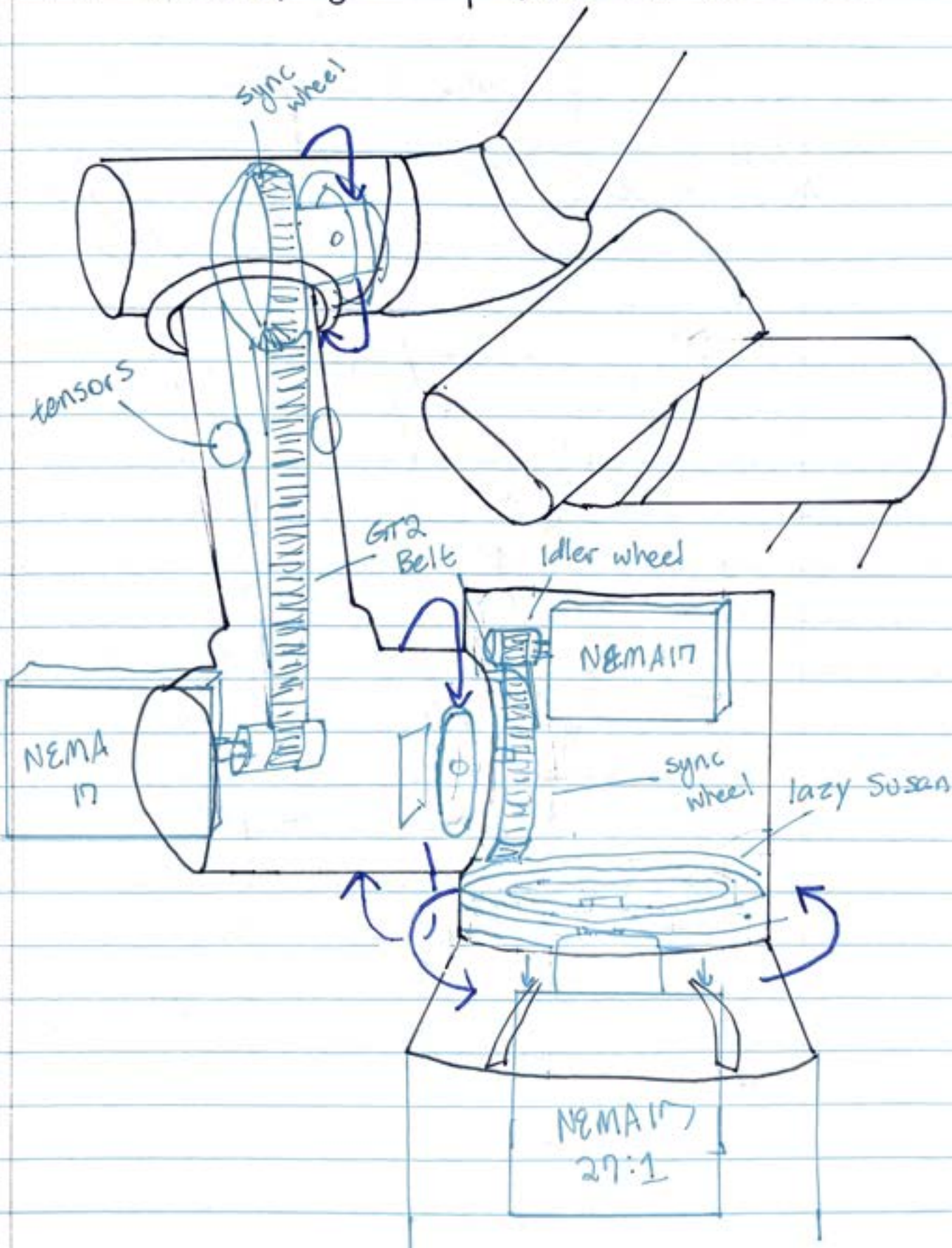




Arm v5 New Concept

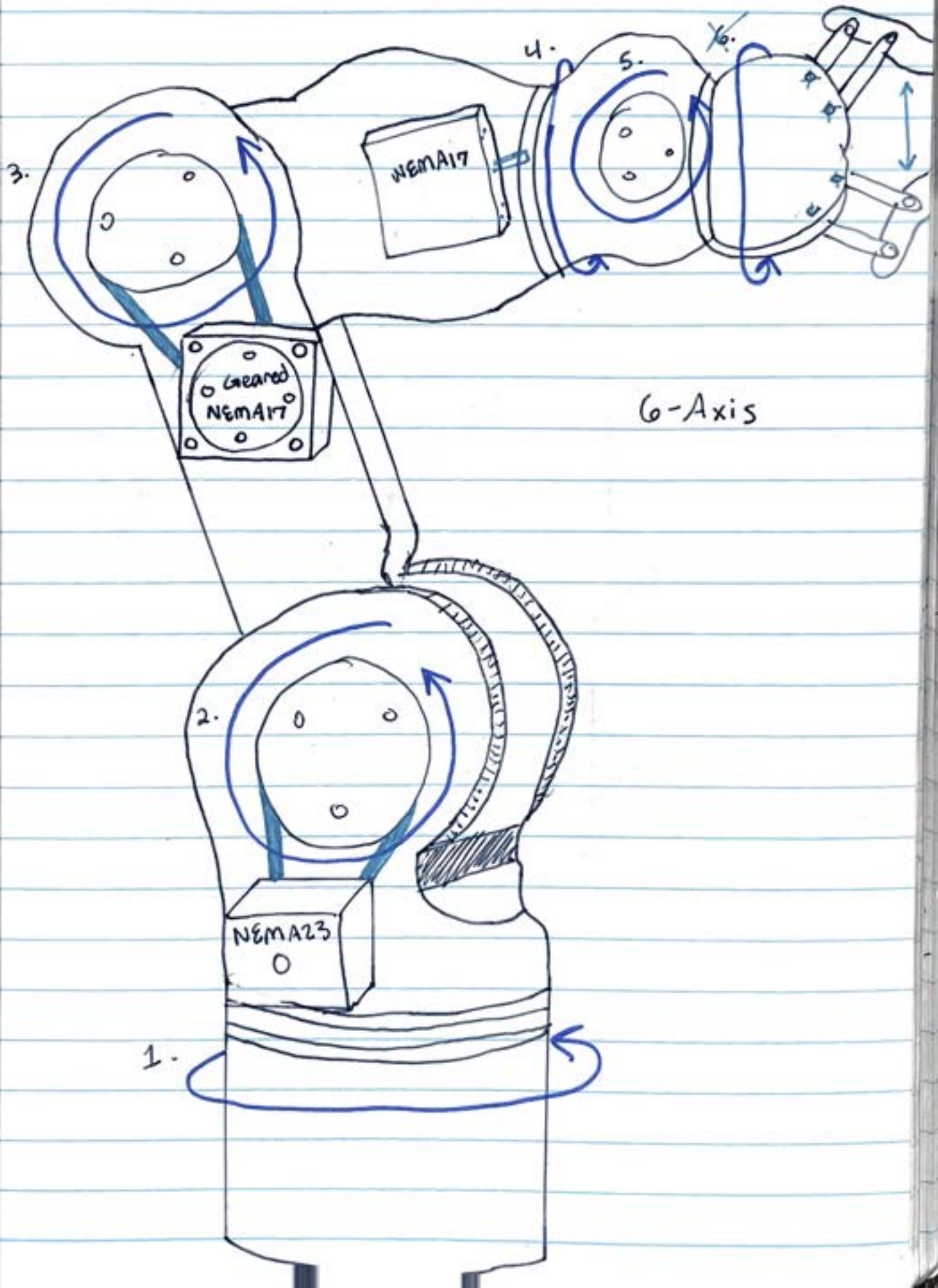
09-13-22

- Add encoders, figure torque, add new electronics



Arm v5 Concept v2

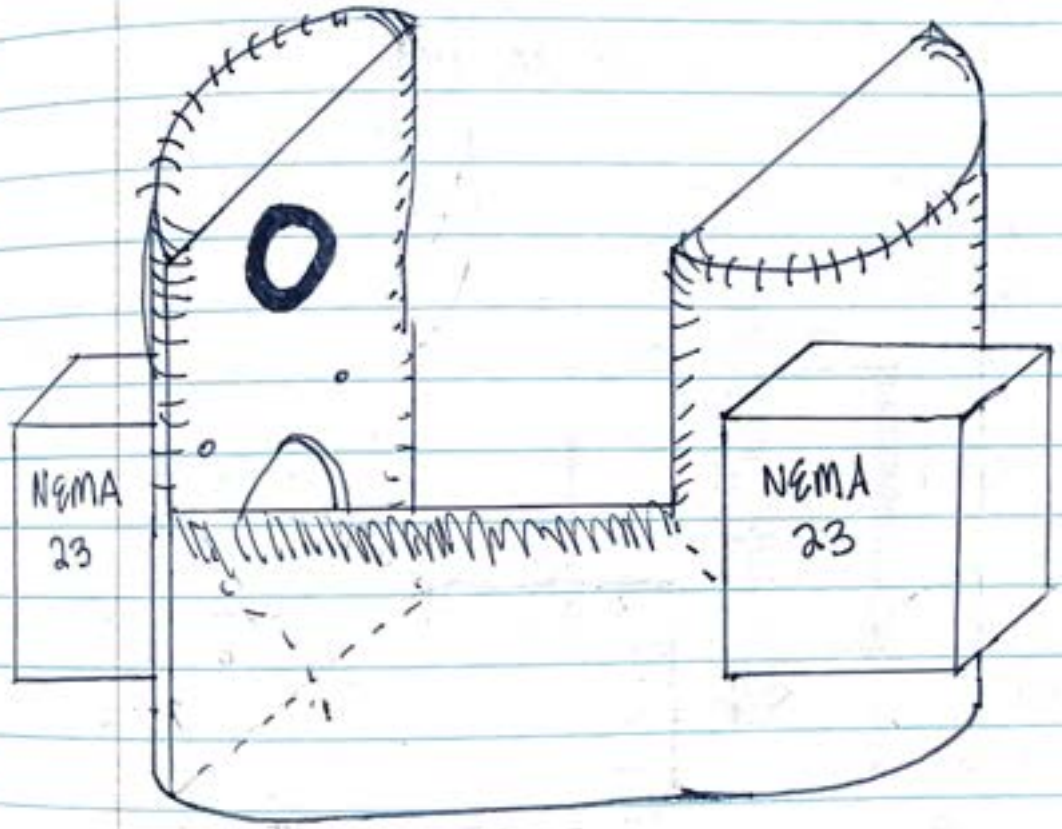
09-14-22



(v5)

Casing Design

09-19-22



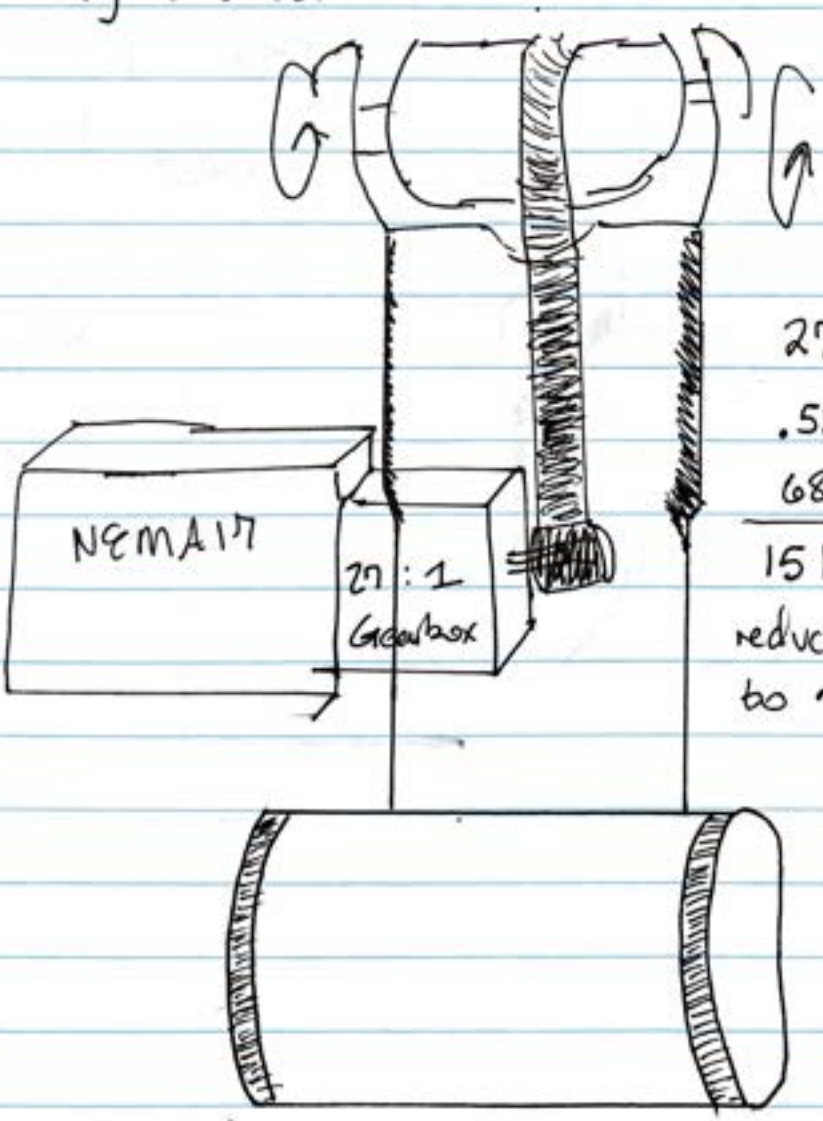
v5 Componets

09-20-22

Belt coupler

Couple 5 teeth / 200

- Also work as tensioner for belt using teeth adjustments.



$27 \cdot 5 = 135 GR$

$.52(132) \approx 68 Nm$

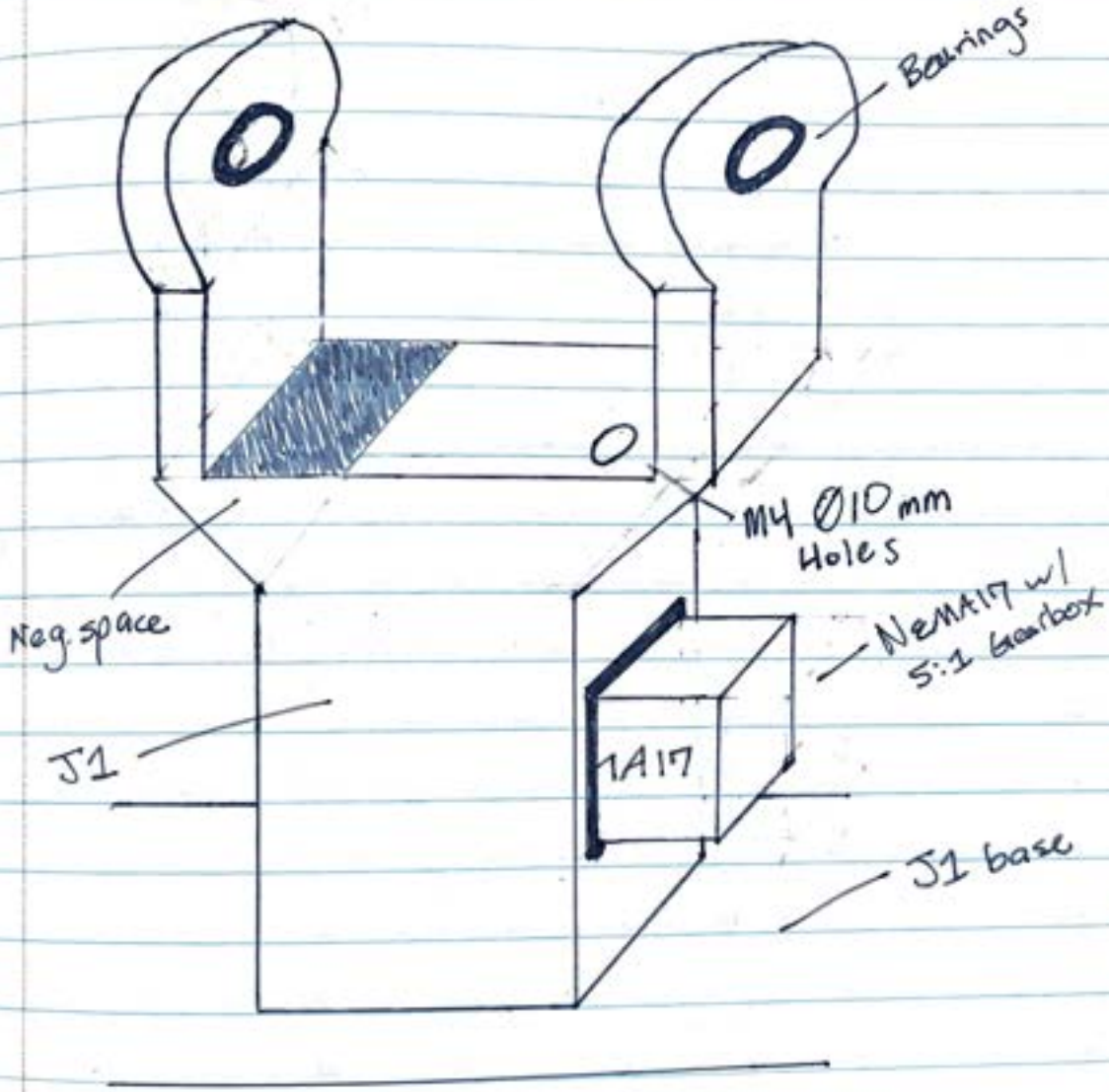
$68/4.4 \approx 15 lbsm$

15 lbsm overkill, reduce NEMA Gearbox to ~10 (26Nm)

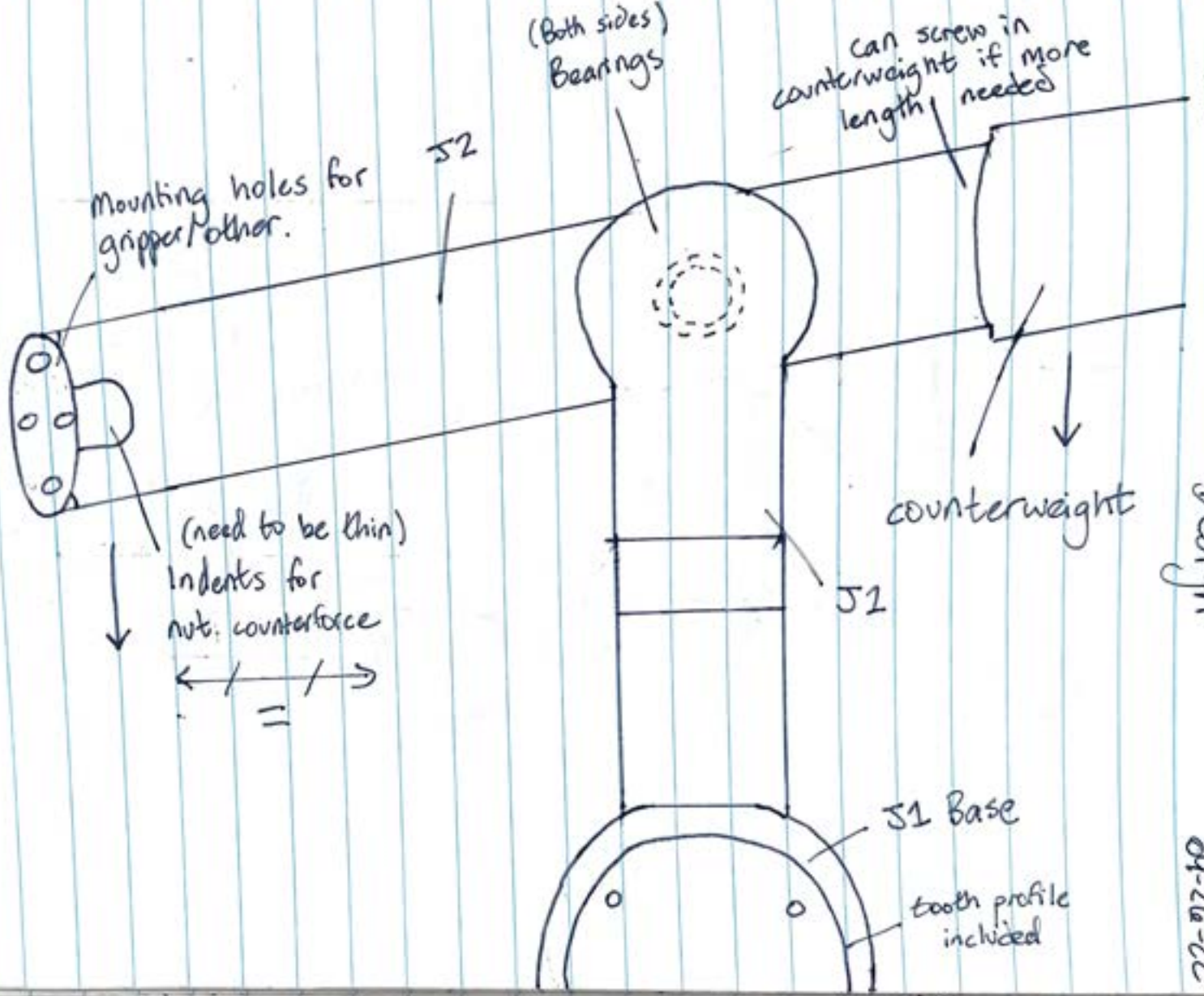
v5 J1 Design

09-26-22

- Will need 9mm bore GT2 idler wheel for coupler

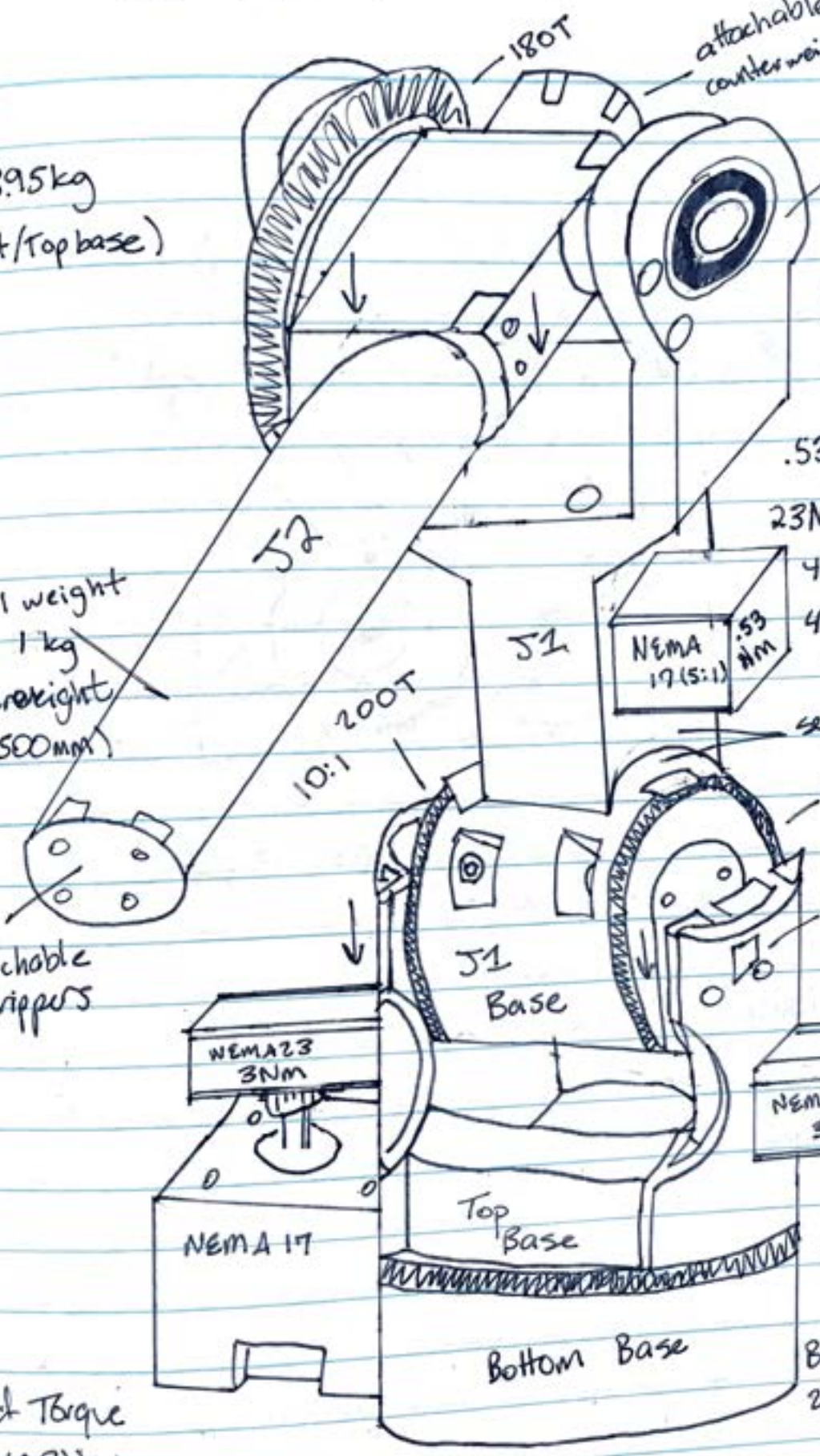


SIDE


(Both sides)
Bearings
can screw in
counterweight if more
length needed
v5 J2 Design
J2
Mounting holes for
gripper/other.
(need to be thin)
Indents for
nut. counterforce
=
counterweight
J1
J1 Base
tooth profile
included

v5 Full (No G)

09-27-22

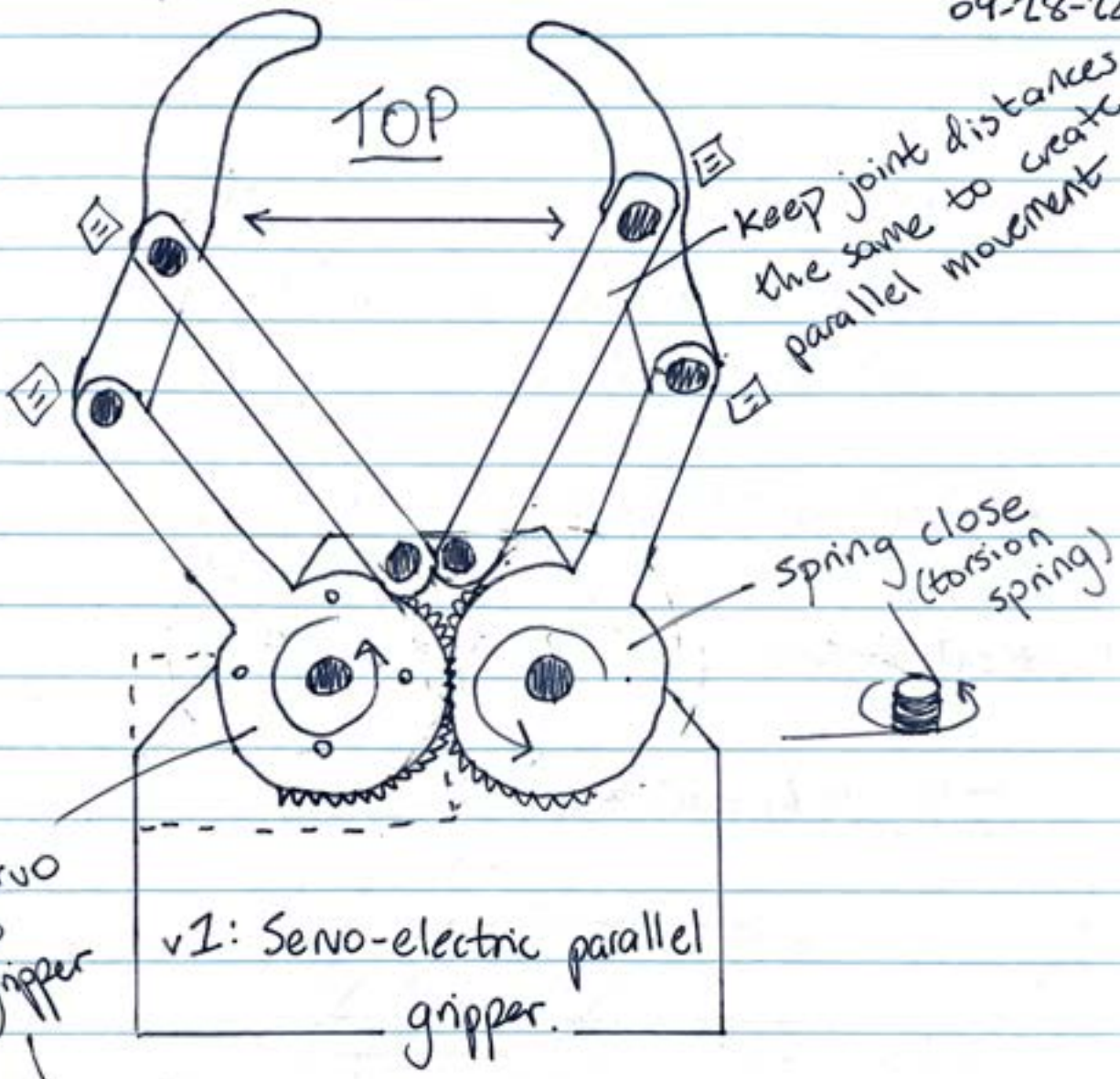


Required Torque
(.1 m)(4)(9.8) N
~ 40Nm

Bot Payload: 60 - 40 = 20 N
20/9.8 ≈ 2 kg

v5 Gripper Design v1

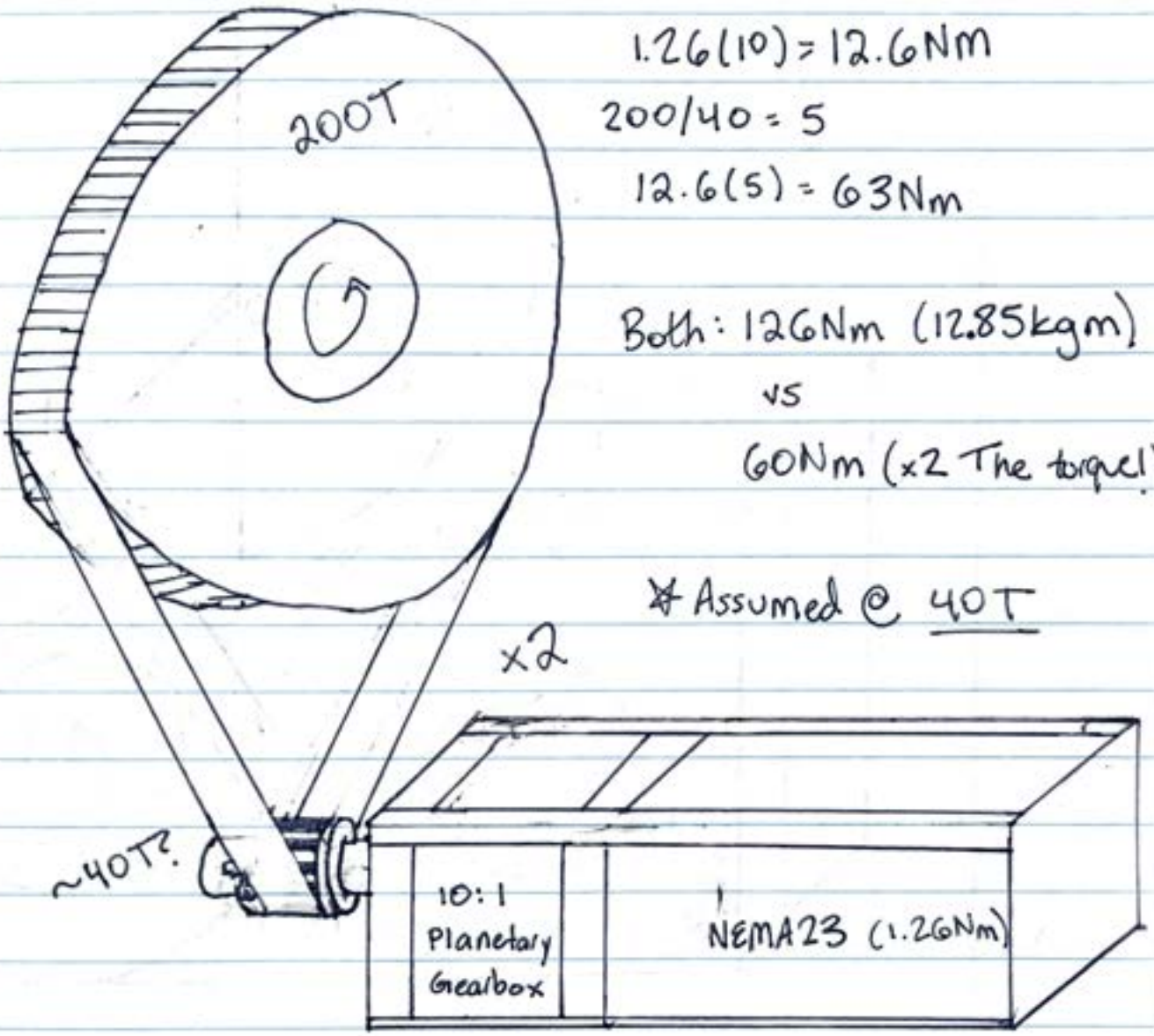
09-28-22



Will limit current spikes to avoid using current/force sensing.

v5 Nema 23 Gearbox Calc.

04-29-22



1.26(10) = 12.6Nm

200/40 = 5

12.6(5) = 63Nm

Both: 126Nm (12.85kgm)

vs

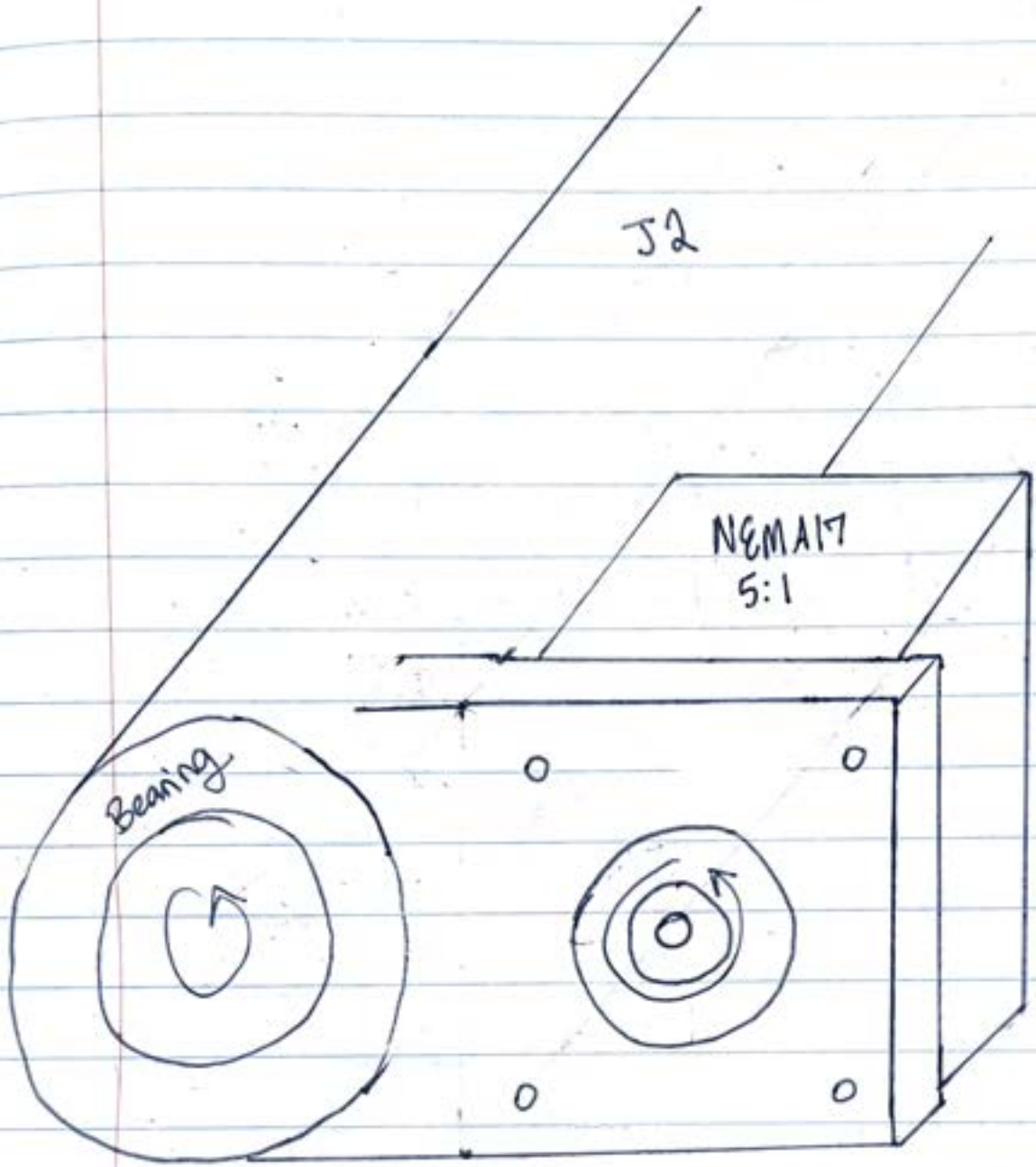
60Nm (x2 The torque!)

* Assumed @ 40T

12.85 kg.cm - 7 = 5.85kg payload!

v5 Rotating Gripper v1

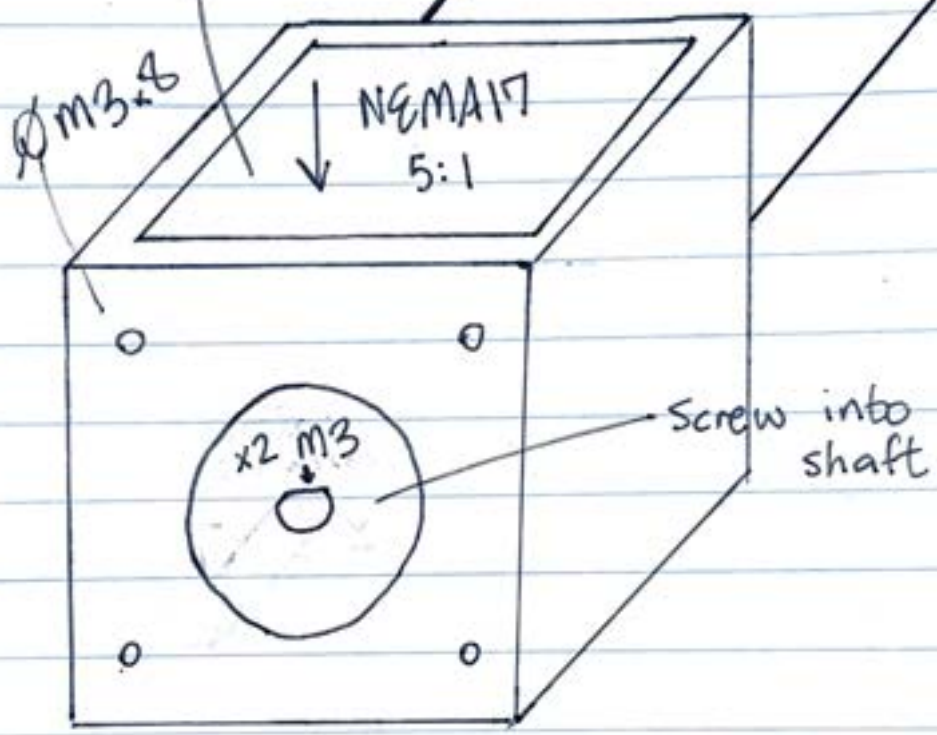
09-30-2



v5 Rotating Gripper v2

09-30-2

52



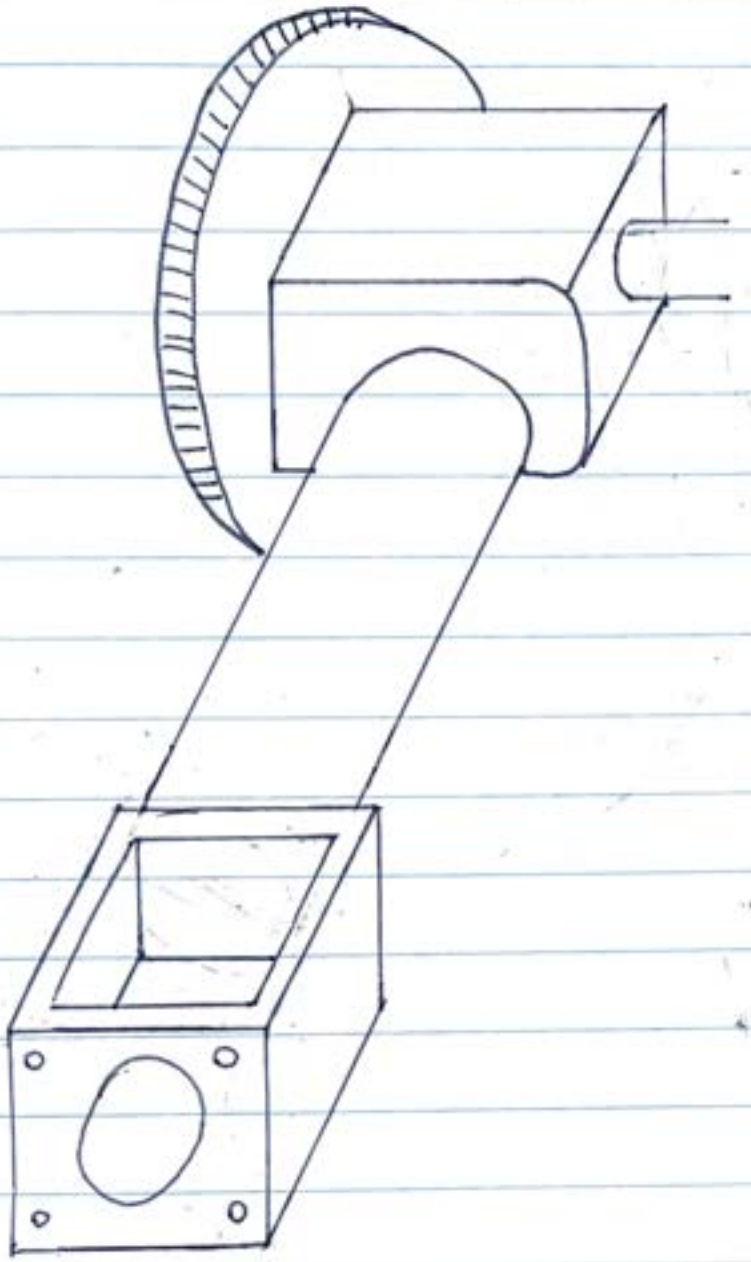
G Torque: .53Nm (5)

Rotational T = 2.65Nm (6.7)

≈ 17.7N (15cm) or 1.8kg (15cm)

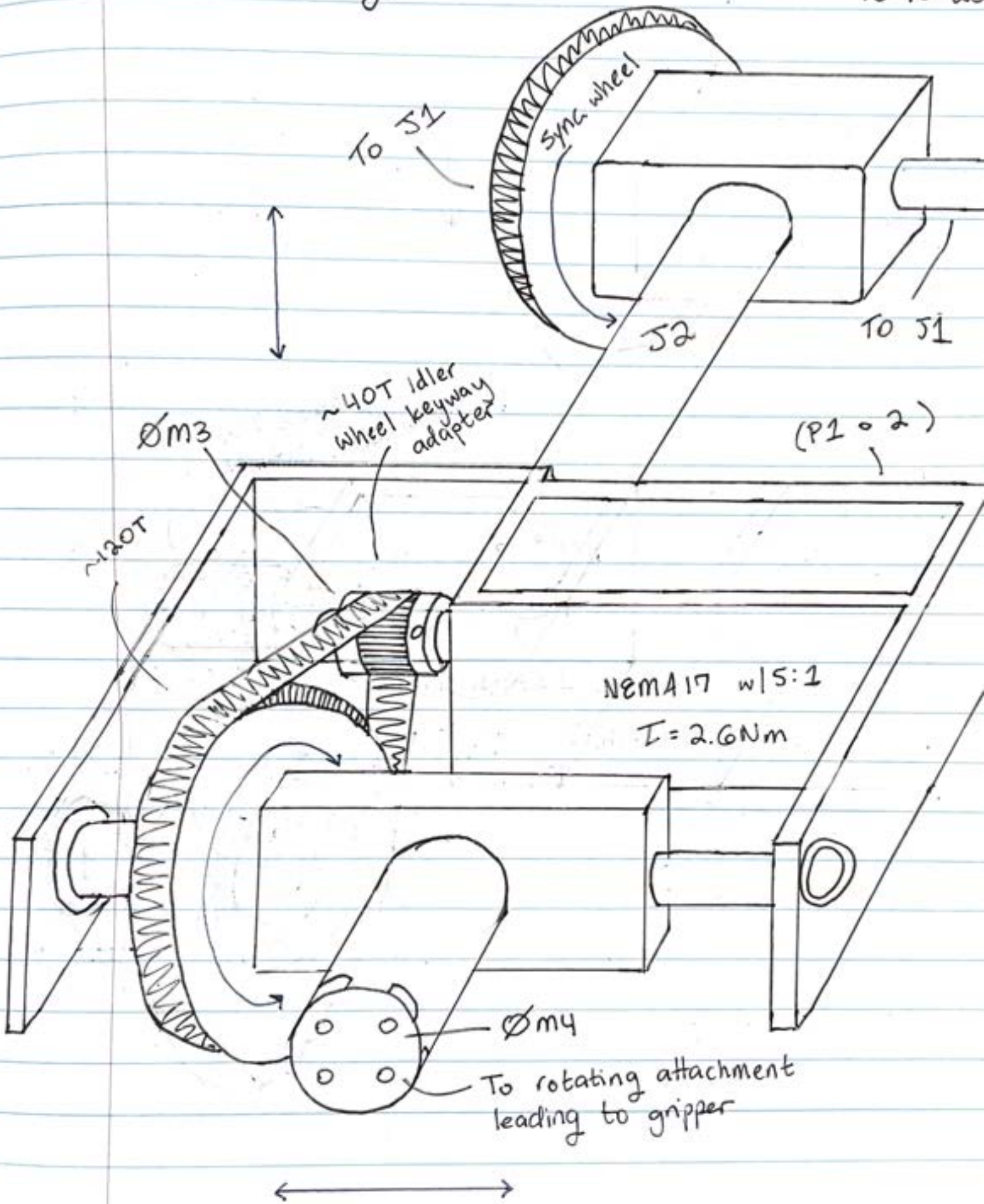
v5 Rotating Gripper v3

10-03-22



10-10-22

v5 Rotating Gripper v4



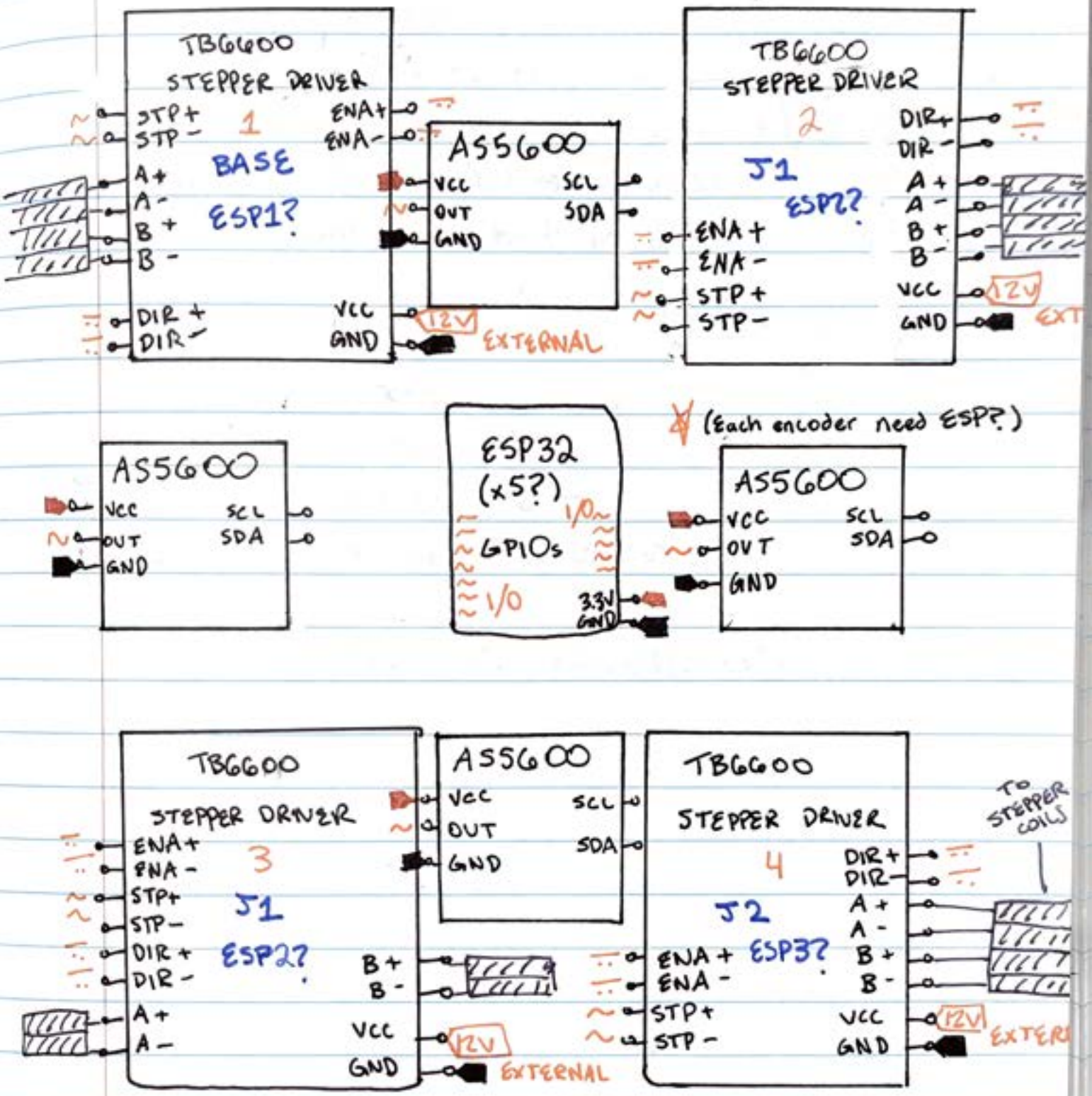
v5 Rotating Gripper v5

10-18-22

NA

v5 Electrical v1

10-18-22



(FIRST FOUR)

v5 Psvedocode v1

10-24-22

Negative acceleration to endpoint concept:

- As position closer to endpoint, slow down proportionally.
- As position farther from endpoint, speed up proportionally.
- Enable / disable TB6600 v.s. apply power against Fgrav.
  - Stationary power hurt motor?

f:

.setmaxspeed(1000)

.setspeed(steps/second)

float(output) = encoder.out

output = output (mapped 0-4095 ⇒ 0-360)

New val. speed (for .setspeed(speed))

ERA Programming Concept

11-21-22

- Log positions in an array list to be replayed []
  - Data set of coordnates:

X Ex: [(180, 40, 97, 35, 10), (198, 46, 122, 37, 46)]

each axis

✓ Ex: Each coord gets own array

P1: [187, 46, 82, 42, 112] (5-Axis)

P2: [220, 346, 12, 49, 302] (5 data points)

0 1 2 3 4

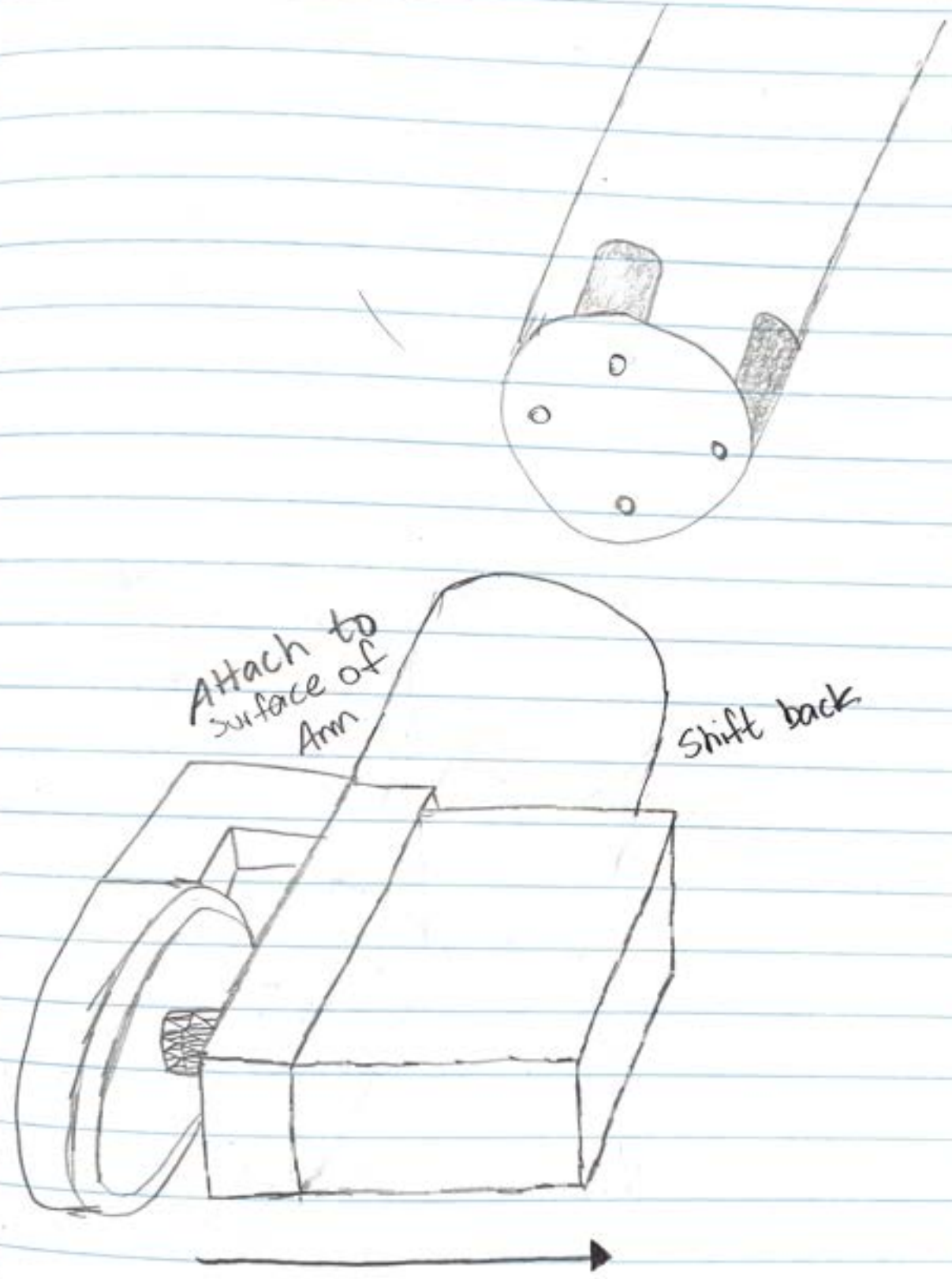
Assign each array valve to log position & move through functions. Test each value for repeat.

- MoveTo [0-4] per motor
  - if (moveTo[0-4] = currentPosition(0-4) {
    atPosition == true

} }

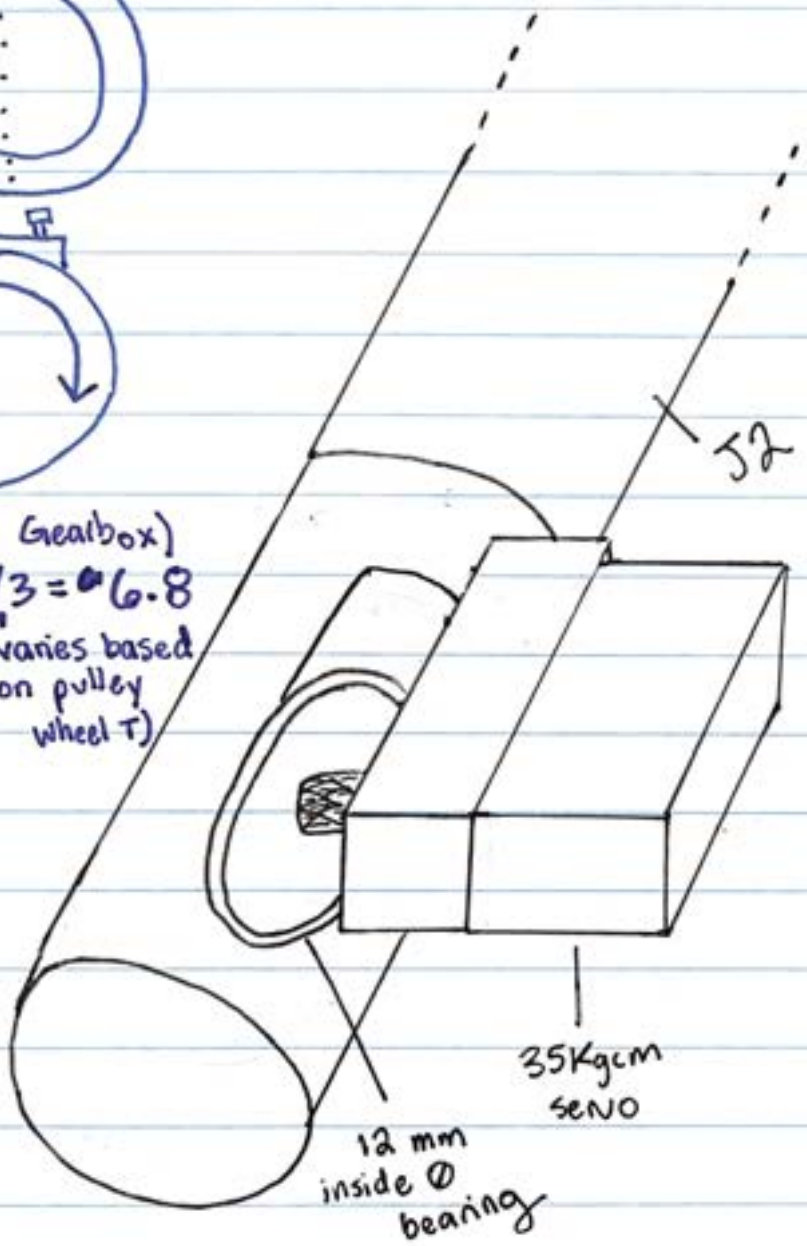
07-29-22

EPA Axis 4-6



ERA Axis 4

07-29-22



Nema 23 (20:1 Gearbox)

400rpm / 20/3 = 6.8

(varies based on pulley wheel T)

$\frac{6.8}{60} = .11$ rps

Nema 23 @ 400rpm (st = steps)

/1333 st/s

400rpm/10 = 40rpm

$\frac{40r}{\cancel{m}} \cdot \frac{\cancel{m}}{60s} = .67$ rps

NEMA 23 No Gearbox:

1.9Nm (10) = 19Nm (2) = 38Nm

38Nm = 3.88kg OR 8.6lbs T

T = 3.88kg @ 1 meter

Acceleration Concept

12-05-22

1. Convert stepper.moveTo() ƒ to degrees.
2. Accelerate to half way between points then slow down.
3. Accelerate to constSpeed then decelerate.

1. Find how many steps to move 1 degree

New solution:

friction between bearings > friction between table.

- Place mat below to increase μ friction, bearings will roll & stop oscillation.

Counting Steps > Encoder?

12-13-22

Gear Ratio - 15:1 (300teeth-20teeth)

$$\begin{array}{r} 200 \\ \cdot\ 15 \\ \hline 1000 \\ +\ 2000 \\ \hline \end{array}$$

3000 steps/base rotation

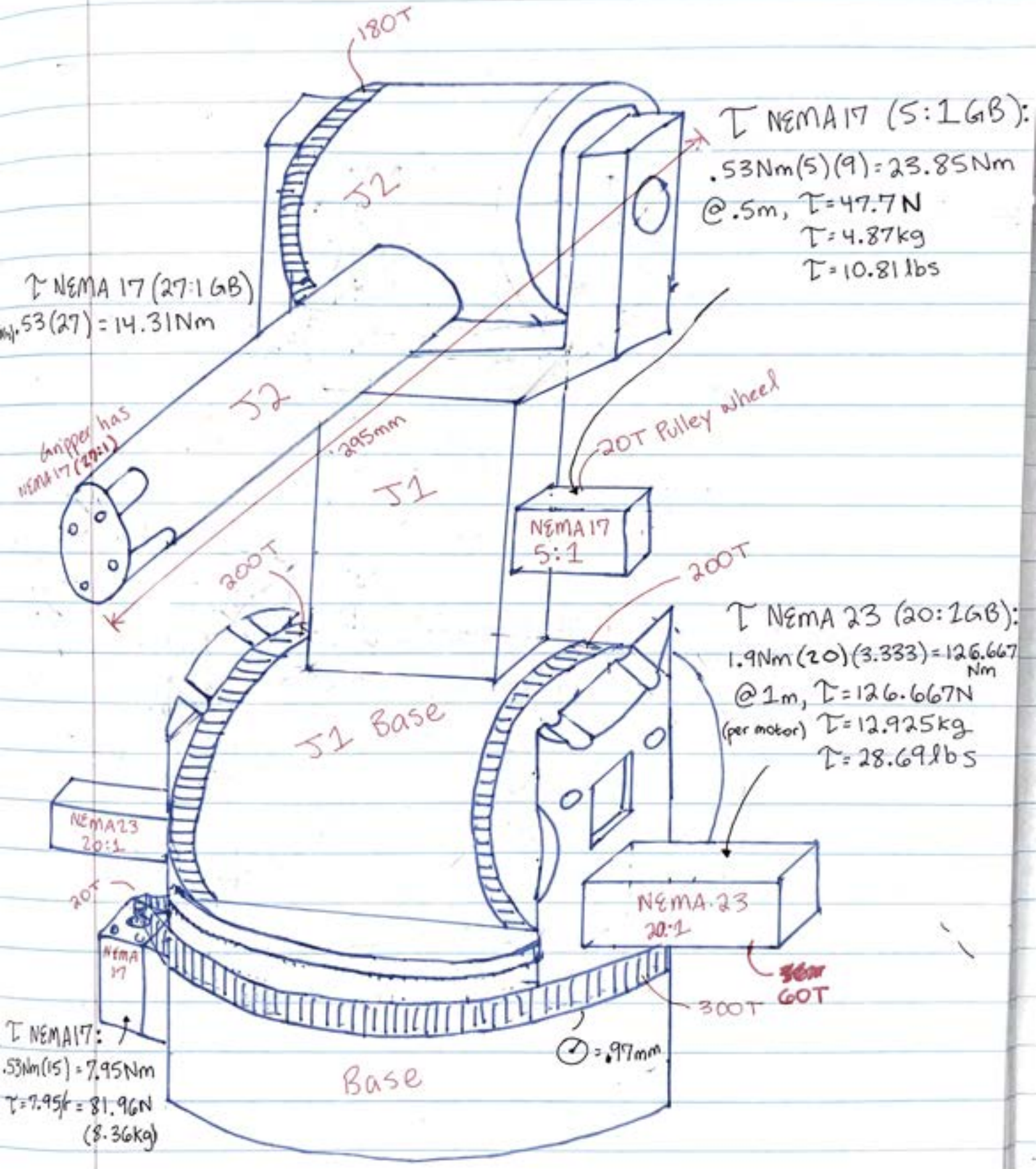
- 3000 steps = 360 degrees
- 1500 steps = 180 degrees
- 7500 steps = 90 degrees
- etc.

ESP32 stalling from inputs from encoder
Solution: Blink without delay encoder values, give more time to output correct stepper pulses.

Accelstepper not seeming true units (steps per second not seeming to actually be steps per second.)
Possible solution: Sync HIGH value pulse with encoder read so no interruption. (Shakes when moving sometimes.) This way it wont matter.

Torque Calc. (All Joints)

12-13-22



τ NEMA 17 (5:1 GB):
.53Nm(5)(9) = 23.85Nm
@.5m, τ = 47.7N
τ = 4.87kg
τ = 10.81 lbs

τ NEMA 17 (27:1 GB)
.53(27) = 14.31Nm

τ NEMA 23 (20:1 GB):
1.9Nm(20)(3.333) = 126.667 Nm
@1m, τ = 126.667N
(per motor) τ = 12.925kg
τ = 28.69 lbs

τ NEMA17:
.53Nm(15) = 7.95Nm
τ = 7.95kg = 81.96N
(8.36kg)

= .97mm

Late Concepts

01-03-23

SERVO:
35kg/cm = .35kg/m ~ assuming 100mm max length ~ τ = 3.5kg
enough? meh.

Logging:
- Use controller to program functions by varying speed.
  - Could use old controller potentiometers.
- logging varys by...
  - Position?
  - Time?
  - User input?
    - Would be good for logging only the most ideal positions. However would still need something for controlling the gripper accurately.
      - Could use a side button for logging. Would also need a reset button, delete last button, & runPositions button. Will test.

ERA Electrical Schematic

01-05-23

USING CLUSTER COMPUTING