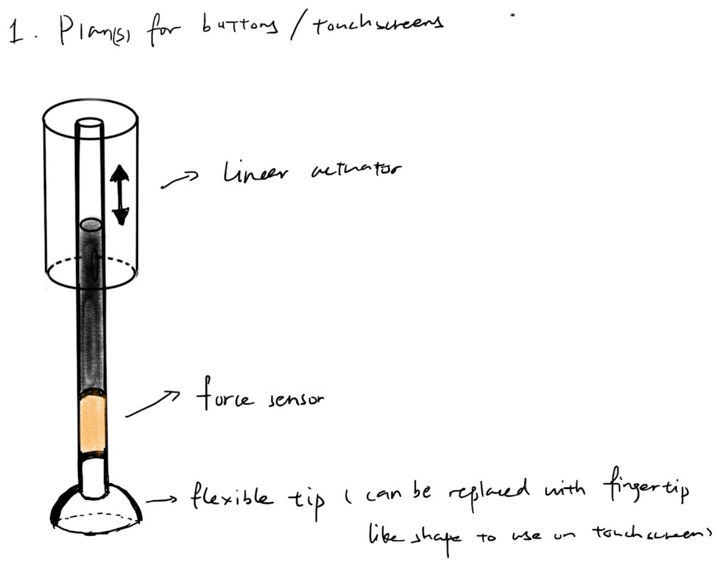
Design Journel

Ideation 1: Single Prong Ball tip pen with force sensor


1. Plan(s) for buttons / touchscreens
Lineer actuator
force sensor
flexible tip (can be replaced with fingertip like shape to use on touchscreens)

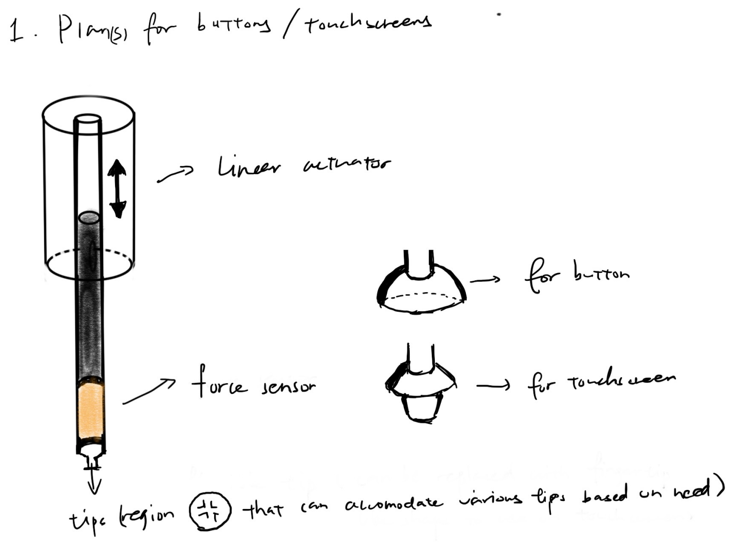
Abstract:
This Design has the specific purpose of pressing buttons in mind. Acuated in 1D with feedback on force exerted.

Deign Feature:
1. Z-direction linear actuation
2. Force sensor incorporation for better feedback on force exerted.
3. Deformable plastic tip for smooth actuation and impact absorption.

Note: Spirng : Passive Force Control Loop. Force Senseor, Active loop./

Score: 35/80

Ideation 1.1 Single finger prong with replacable tip


1. Plan(s) for buttons / touchscreens
linear actuator
force sensor
for button
for touchscreen
tips region (that can accomodate various tips based on need)

Abstract:

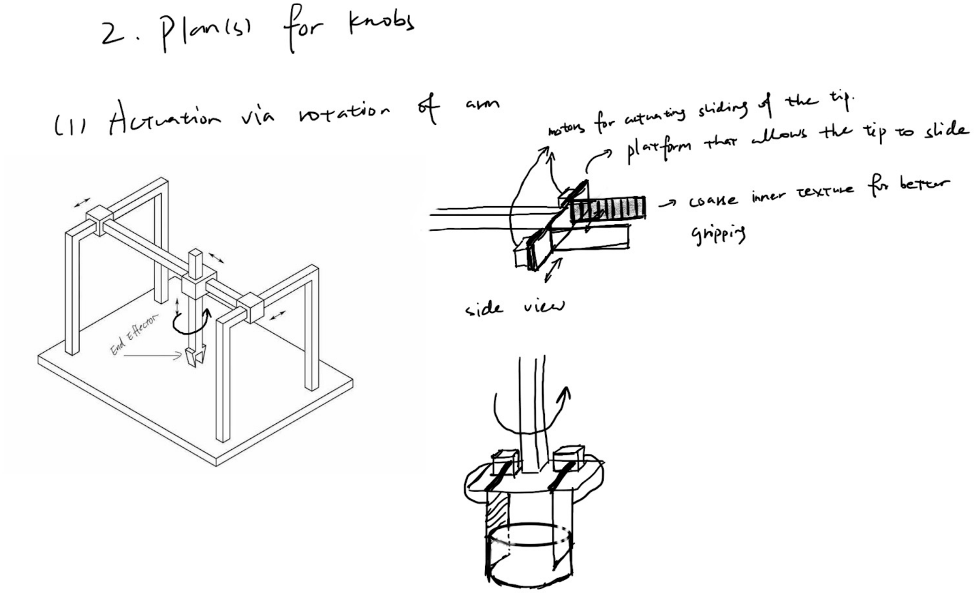
Design is similar to that of ideation 1 except now our tip are replacable with different shape and material to accomate touch screen operation possibility.

Design Feature:

Replacable Tip for specific button pressing and specific touchscreen operation.

Score: 43/80

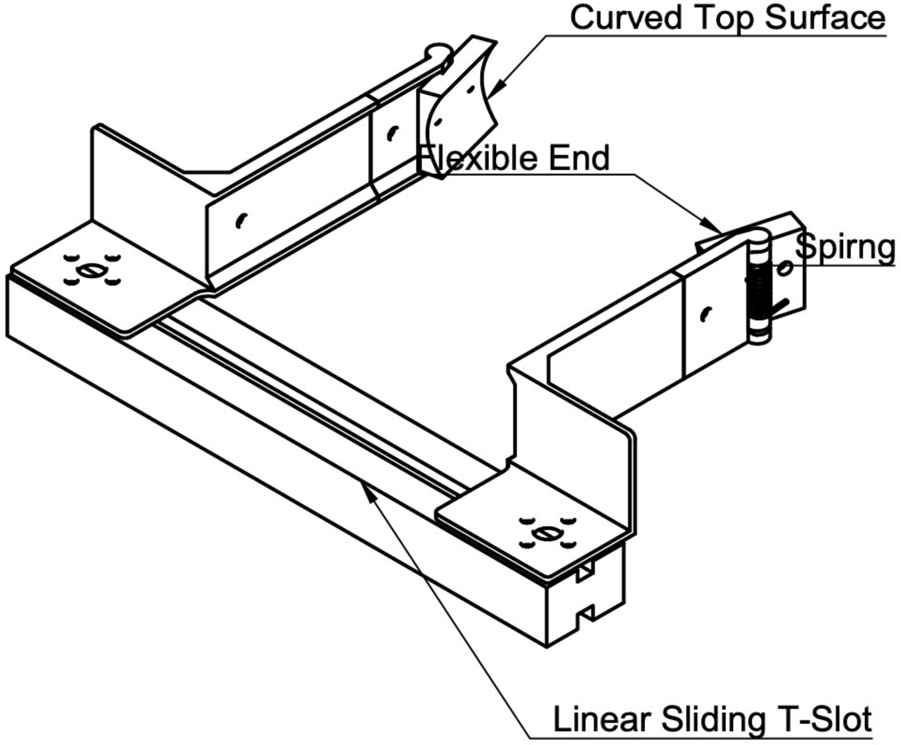
Ideation 2: Two Slab Finger for knob control

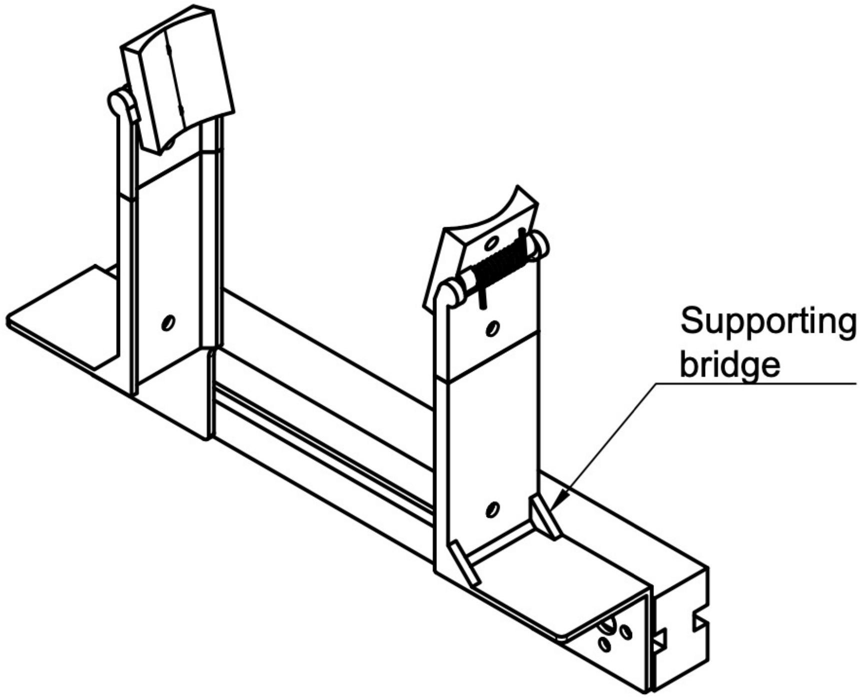

2. Plan(s) for knobs
(1) Actuation via rotation of arm
End Effector
motors for actuating sliding of the tip.
platform that allows the tip to slide
coarse inner texture for better gripping
side view

Abtract:
This design is intended to target knob turning modality, with two parallel moving finger interacting with the knob using friction

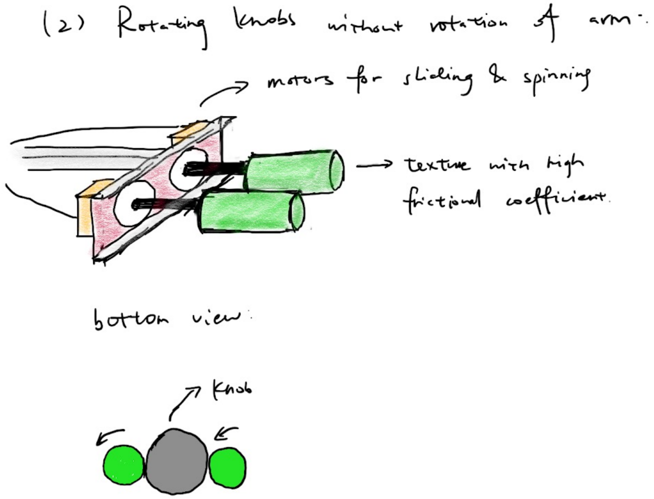
Key features:
1. Parallel slab for manipulation in between small button space
2. Force feedback measured from servo current
3. Flexible far end tip to accomadate different knob geometery
4. Internally layered silicon, maximum grip while easy to clean
5. Detachable slab for future design upgrade.

Score: 55/80


Curved Top Surface
Flexible End
Spirng
Linear Sliding T-Slot


Supporting
bridge

Ideation 2.1 Two Finger Turning Wheel


(2) Rotating knobs without rotation of arm.
motors for sliding & spinning
texture with high frictional coefficient.
botton view.
Knob

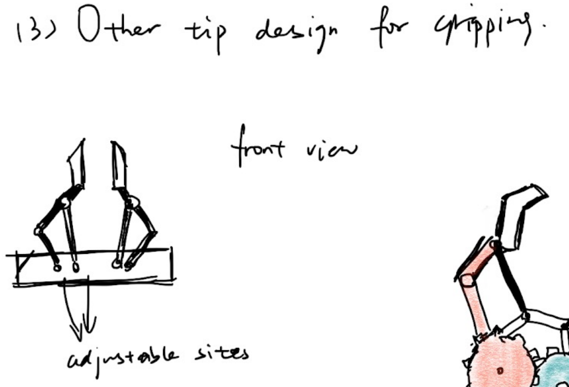
Abstract：
This design is similar to ideation 2 where we utilize 2 finger design. Nonetheless, for more accurate actuation of knob, we utilize spinning wheels instead of slab.

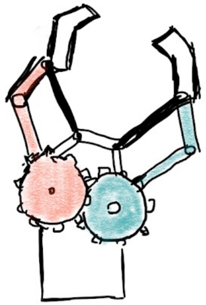
Design feature:

1. two turning wheels for accurate actuation of knobs.
2. Enlarged surface area for better gripping ability
3. Force feedback derived from rotational speed of servo

Score: 36/80

Ideation 2.2 Forceful Gripping two finger





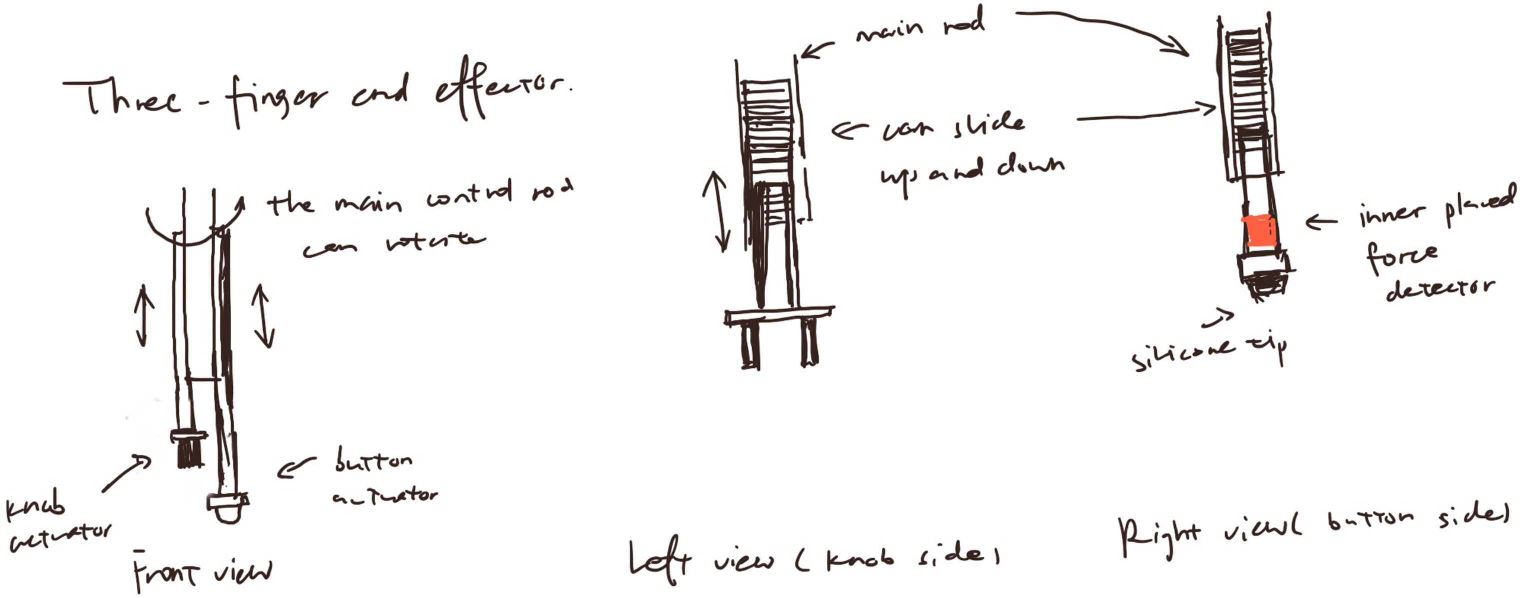
Abstract：
This design is similar to that of ideation 2, but we switched the two slab to more mechanical complex geometry design to amplify the force exerted by servo on knob to ensure better grip.

Design feature:

1. Geometric finger design for better force exertion
2. Reduced number of servo, two finger driven by one servo using gears.

Score: 50/80

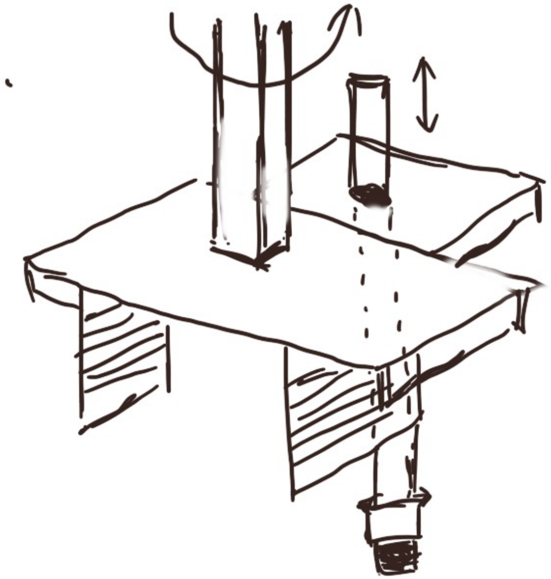
Ideation 3: Three-finger end effector



This design incorporates both the knob turning actuator and the button pressing actuator. The two tools will be attached to the two sides of the main rod and they would be able to slide straight up and down on the sliding track attach to the main rod. Note that the rotation would be achieved through the main rod. The design of the two tools are based on ideation 1.1 and 2.

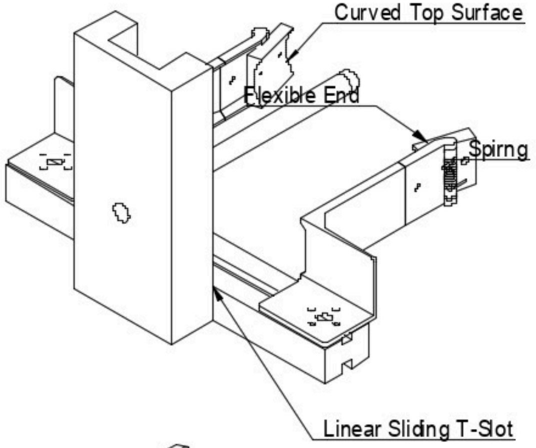
Score: 67/80

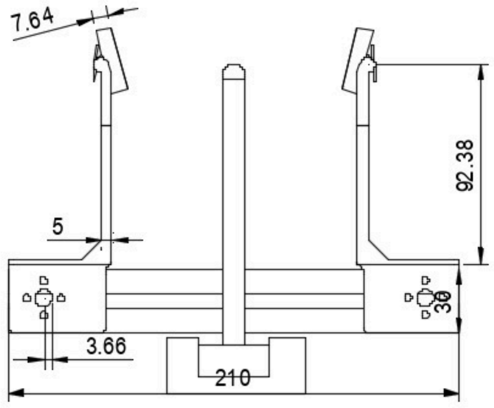
Ideation 3.1

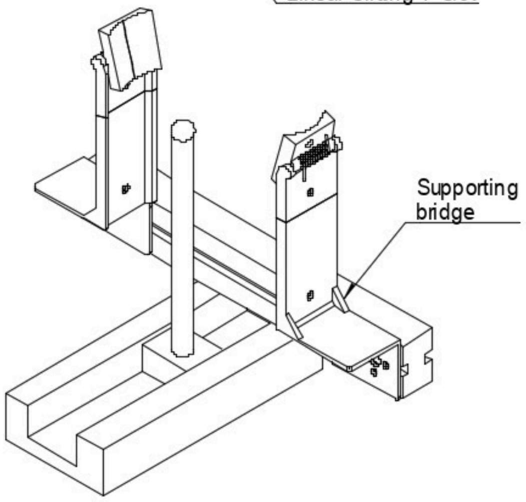


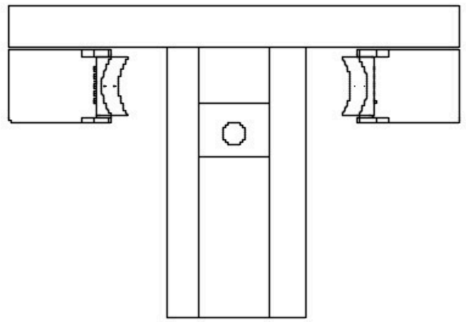
The design is different from ideation 3 in the sense that the button touching actuator is now integrated to the knob turning actuator, and the button touching actuator itself is retractable. In this way, we decrease the material usage as well as less blocking of camera view.

Score: 68/80



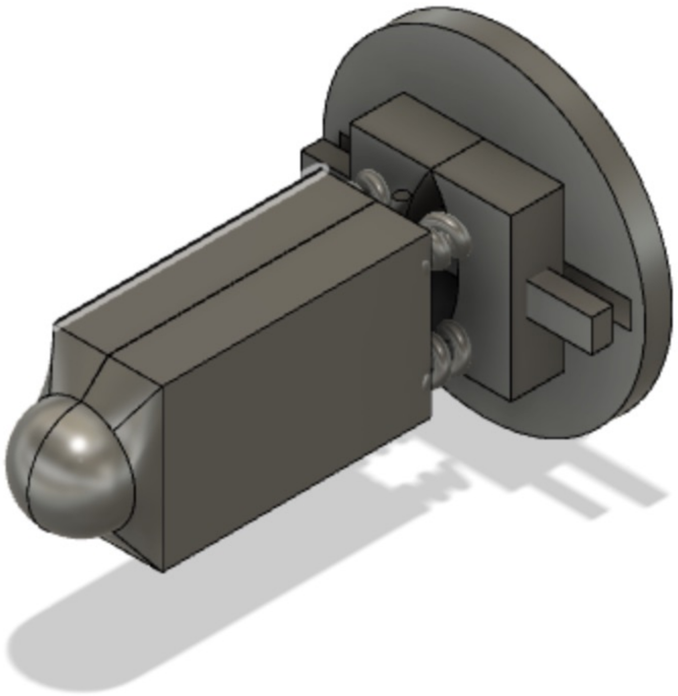






[redacted]	[redacted]	[redacted] Tianyu Wang 3/17/21	[redacted]
		[redacted]	[redacted]
		[redacted] TwoFinger Linear Slide	[redacted]
			[redacted] [redacted] [redacted] 1/1

Final End Effector Design



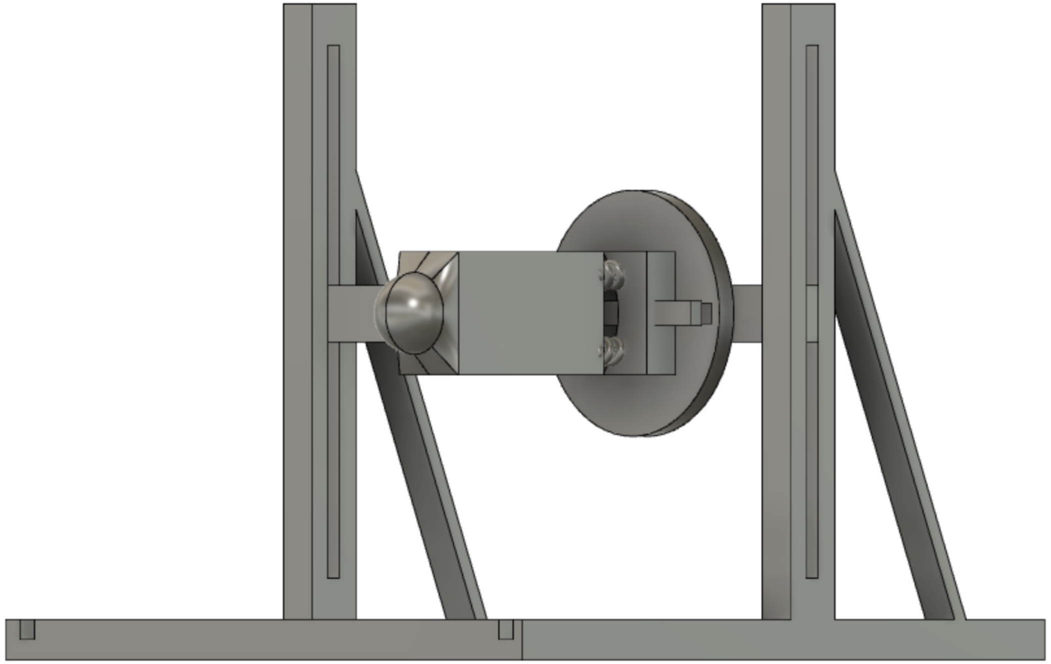
Abstract: Stylus integrated 2 Finger design for end effector

Feature:

1. integrated stylus at the tip
2. integrated spring to absorb impact
3. Potentially replace Spring with actuator to achieve faster movement

Score: 72/80

End effector –Test Bed Assembly



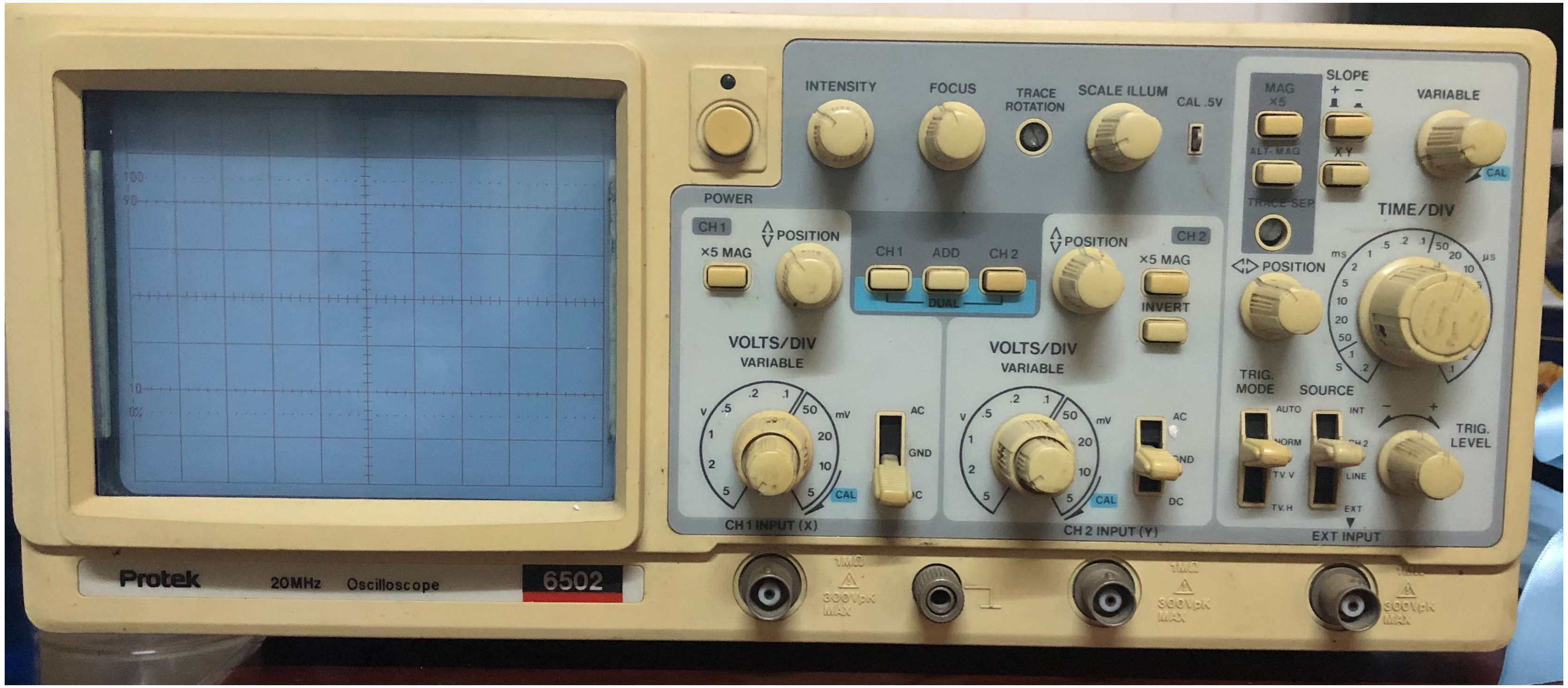
Abstract: This design illustrate a design for the end-effector and our future test bed with 4 DOF

Features:

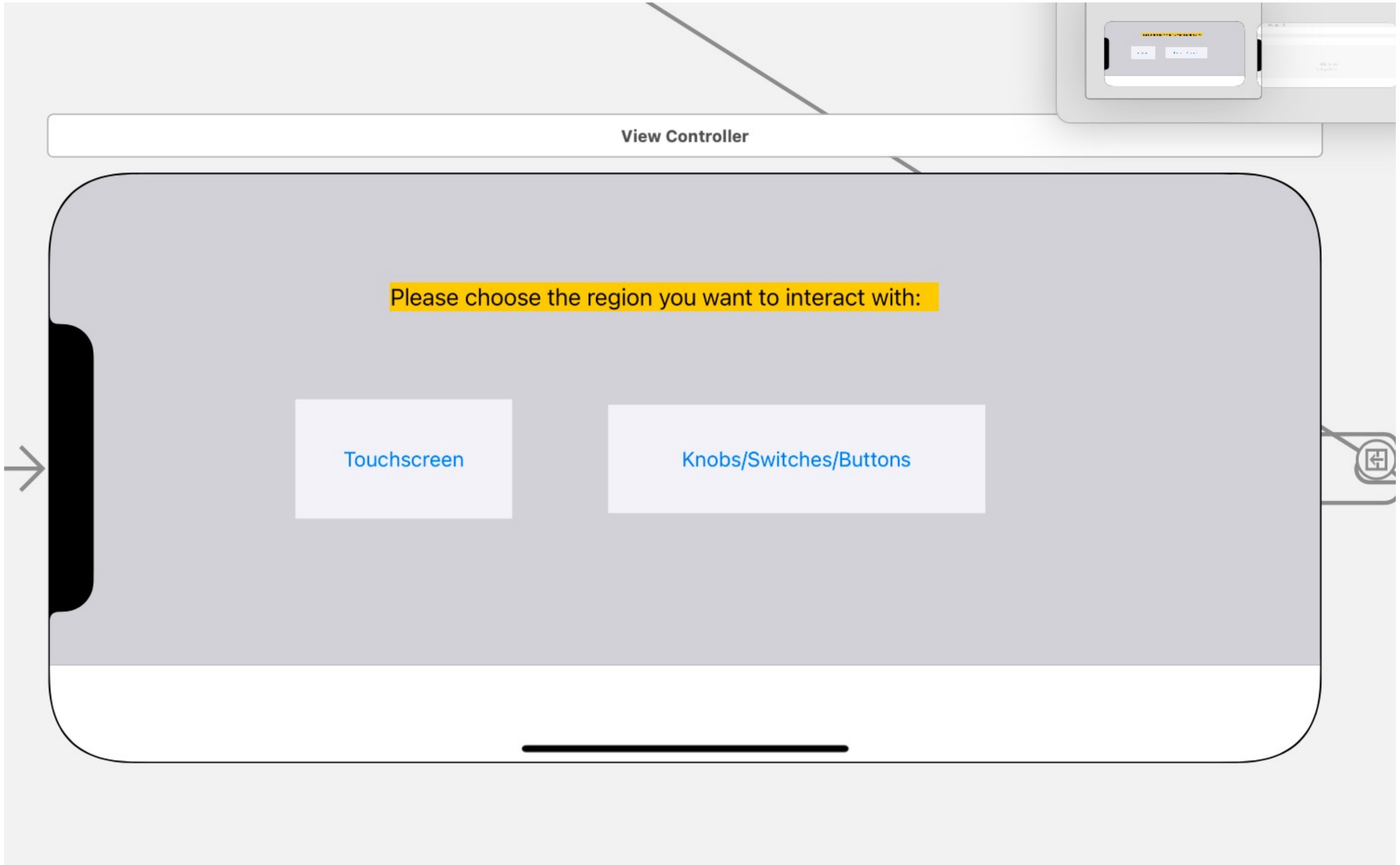
1. Stylus intergrated with end-effector, reduce amount of actuators
2. requires 4 motor and 1 servo to run
3. Spring intergration into end effector for force buffering

User Interface

- Implemented via Swift and Xcode



Two regions, for oscilloscope (only), iphone version



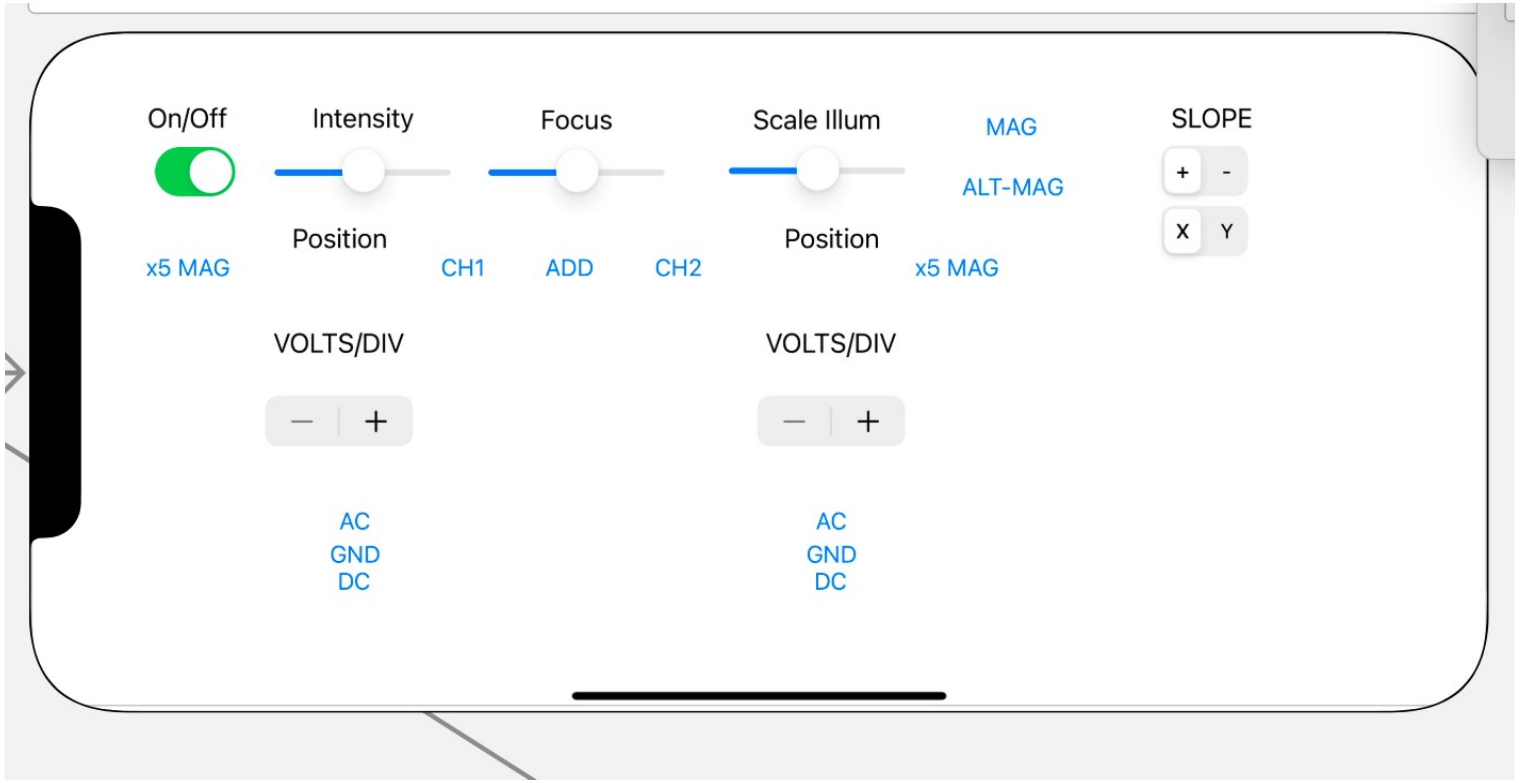
Please choose the region you want to interact with:

Touchscreen

- Background set as the live, zoomed-in camera view (not yet implemented, still learning)
- Record the touch position of users and use the robot to touch accordingly;
- Assumption: we have the desired position (in the 2D cartesian robot case it is settled)

Buttons

- No machine learning model for switch/button recognition available for now, so the positions of the buttons are fixed manually;
- Mimic the position of real buttons;
- Scrolls replaced with sliders;

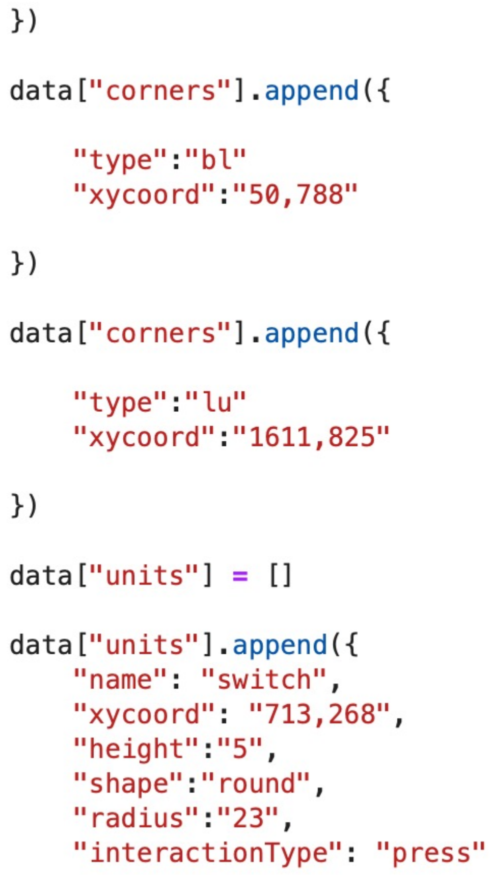


Next step

- Work with David in late April after he finishes construction of the robot and finish all the action parts related with functional parts;
- Algorithm design/object design
- Question: when using the robot in real ICU (with 6DOF), might need preregistration of equipment;
- Not for current project: recognizing buttons might be crucial; or we can give the user with the control power: after the correct pose is achieved, based on the camera input the user decides the action (turning, pressing, dragging) so that no recognition of button type is required- press long and choose from rotation (degree specified in text block), pressing and dragging.

4.1 Meeting

Configuration json file



```
})

data["corners"].append({

    "type":"bl"
    "xycoord":"50,788"

})

data["corners"].append({

    "type":"lu"
    "xycoord":"1611,825"

})

data["units"] = []

data["units"].append({
    "name": "switch",
    "xycoord": "713,268",
    "height":"5",
    "shape":"round",
    "radius":"23",
    "interactionType": "press"
```

Logistics:

1. Record the position of the 4 corners;

2. After the robot enters the right place, the 4 corners in the camera view will be found via corner detection;

3. Match the 4 corners with the calibration data accordingly

4. The position of the center of the unit can be found proportionally;

5. Note that current xy coordinates is based on resolution of the screen. Will change according to the precision that the robot can reach);

6. Various shapes of units;
Circular: center and radius (via real measurement);
Rectangular: center, length and width;
Double circle?: the real radius that the robot gonna make is according to the height and the radius can be calculated accordingly;

Object Recognition via openCV

- Recognize the oscilloscope in random environment;
- Expected output:
- (pictures will later be replaced with live camera input)
- Dataset prepared;
- Work in progress, expect to wrap up this weekend

Next step

- VM is already set up. Still learning how to use ROS.
- Distance recognition? How to decide the path of the robot?
- For the purpose of the project, will work on UI for the next two weeks and work with Tianyu afterwards, wrapping up the whole project;