**Week 9**

**TEAM MEETING**

***Cameron,*** *Diogo, Jose, Samuel, Yujui, Lio*

## Notes from meetings throughout the week

| **No.** | **Agenda and Minutes** | **Actions needed** |
| --- | --- | --- |
| 2/21 | Meeting on Monday with Profs. Notes below. Most priority tasks:   * Updating design of mechanism   + Sam * Design Frame   + 80x20 + sheet metal base that can hold the main mechanism and have spots for electronics and stuff   + Tablet holder as well   + Jose * Decide Transmission-gear vs belt reduction   + Sam * Figure out Magnet stuff   + Polymagnet     - Diogo   + Grease coming in     - Diogo   + Air bearing     - Jose     - Diogo if Jose can not * Selecting Motor, order motor and new Odrive   + Ray * Implementing Ascii Protocols on ODrive   + Lio   + Jose will ask about RPi * Do haptic/kinematics/joint math   + Cam |  |
| 2/22 | Ray doing motor selection calcs |  |
| 2/23 | Cam working on the first version of air bearing. |  |
| 2/24 | Sam working on Alpha design throughout the week, Jose is out w/ covid but doing designs and making drawings |  |
| 2/25 | Continued work on Air bearings, showed off results to professors. Will do more math moving forward to understand air bearing problem. Called with Polymagnet people, they may or may not be of huge help but best we can hope for |  |

## General Thoughts

Need to start testing to get numbers to track vs requirements

Probably want to split group into magnet vs non-magnetic

## Notes Before Meeting with Professors

### Big Topic Areas

### Magnet/Friction

Options:

#### Superlube

#### Rollers

Have demo thrust bearings ready [Done]

#### Airbearing

Have small components list design ready

#### Polymagnets

->Going to call them and coordinate with Billy

### Mechanical

Think about the design of base plate

Think about transmissions from motors to the base of the arms

Figure out Dynamics and Kinematics, gear ratios to hit benchmarks

What touchscreen to buy?

-> Screen thickness drives magnets

Thinking about Mounting Scheme

Someone should research for Monday

Think about how to program, interface

think about thickness

### Control

Can we stick with impedance or should we get ready to jump to admittance

## 

<https://www.raspberrypi.com/products/raspberry-pi-touch-display/>

<https://www.amazon.com/Android-Tablet-Display-Quad-Core-Processor/dp/B087BC4DJH/ref=sr_1_8?crid=3NRAIP850AE99&keywords=thin+android+tablet&qid=1645914571&sprefix=thin+android+%2Caps%2C239&sr=8-8>

<https://www.walmart.com/ip/onn-10-1-Tablet-32GB-Storage-2GB-RAM-Android-11-Go-2GHz-Quad-Core-Processor-LCD-Display-Dual-band-Wi-Fi/248528865?athbdg=L1300>

# Meeting with Professors

### Ed’s areas of concerns:

what does the computing environment look like? especially with touch screen

bearings and friction

What are we doing with arms and friction?

Are the magnets going to be able to surpass the other arm?

Thrust bearings can work with poly magnets

Want completed full mechanism by week 2-3. Then can prototype additional mechanical and software in parallel

## Magnets

Repelling fields - can we arrange them to make there be force that pushes up without screwing up the lateral force

Superconductor??->Magnet hovers?

Want to prototype the experience. Okay to have pump or grease.

Possible another idea: electromagnets?->probably bad for edges.

-> Potentially prototype electromagnetic solution?

Start thinking about the actual interface of the user to the magnets

One more thought on thrust bearings-> better for them to ride on metal disc on top, or better with teflon??

## Control

Think about haptic experience.   
Would like to feel rigid planar body moving around in space

would like to feel knob with detents.

2D circular wall, centered somewhere. Now need to figure out which torques to apply to do correct reaction force

also need to think about where these systems live, and how to set up the system

Need someway to put the primitive model of the wall down in the embedded code.

In a circle and can't get out. if get too far out, push him back in. If implement the control law on the Arduino, not looking at the tablet, just render the circle on the tablet. Just make sure to render the tablets obstacles.

Need to develop language of impedance heuristics between devices->arduino can have impedance field?

Need to test magnet on tablet

Start with slider and knob primitives modeled on raspberry pi.

Using tablet->Can catch the user based on position.

If you know the shear force that causes you to lose them, set that to your current limit.

Order 2nd Odrive.

Android vs Raspberry

Run entire program from the android tablet?

Can make whatever look like a finger.

Order raspberry Pi tablet

Tablets

IOIO boards->go from android to raspberry pi

want to make this decision in the next 2 weeks.

Can get a 10 inch raspberry pi touchscreen. L

->Lets get one of those

Need to make decision soon, many other decisions flow down from it.

Want to have damping when against the wall, 1mm/s is probably the lowest you need. if you have 1/10 of a second->.1mm->100 microns is necessary. Maybe need to do a little better than that but okay

Can possibly use hall sensors to commutate and put encoders on the output. Might also be better for knowing where it is when it wakes up

Need to figure out how it will sense position at wake up-> could use absolute encoder or limit swtich?

Can add on Ender3 encoder?

Maybe 5 microns is unneeded?

What could help make the decision is how much inertia can you accept-> inertia of anaheim through 10:1 gear or 100:1 transformation of inertia

48 g-cm^2

Say arm is 50 cm, with 10:1 gear ratio, so 5 centimeters. at the output of gearbox feels like 5000 g cm^2 5000/2500 = 2grams even if 10, not very much. Teaches us that 10:1 gear ratio is no problem. Also means we could use a larger motor and a lower gear ratio. If can get from gearbox to pulleyI

Billie suggests we use ascii protocall on hardware serial port on raspberry pi. Can use arduino with Pi as well

If using NEMA clone from factor, belt driving is easy. Next calculation. WIth continuous numbers

with current motor, our 5:1 gets us a newton meter, plus arm length, can probably get force

so we can move to belt? maybe 5:1 belt gearbox

Reasonably nice way to go.

Pulley transmissions, 5:1 similar design like now.

Do we have a threshold for using pulley vs gearbox?

We are in such a standard class of motors that there are gearbox with low backlash available. Is it an issue? Look into it. Gearbox will add inertia and friction but doesn’t seem to be too many downsides. Trade speed for torque. If can find low backlash gearbox,

Place to start is if anaheim has anything.

See what they have, look at the number, look at inertia, friction, backlash

## Mechanical

thinking about aluminum, potentially could go with heavy plastics

Mostly down in the shafts where we see bending in the prototype. Plastic might be good enough.

Potentially don’t even need to optimize for crossover. Bigger problems to solve right now. Perhaps Just go without weird arm.

Order screens soon.

Gorilla glass screen protector or something

Someone needs to start thinking about math

Need to be able to command a force at the end effector in terms of joint torques. Forward kinematics.

Can compute Jacobian in terms of angles of joints-> find if any weird force areas

Need a division of labor

Most priority tasks:

* Updating design of mechanism
  + Sam
* Design Frame
  + 80x20 + sheet metal base that can hold the main mechanism nd have spots for electronics and stuff
  + Tablet holder as well
  + Jose
* Decide Transmission-gear vs belt reduction
  + Sam
* Figure out Magnet stuff
  + Polymagnet
    - Diogo
  + Grease coming in
    - Diogo
  + Air bearing
    - Jose
    - Diogo if jose can not
* Selecting Motor, order motor and new Odrive
  + Ray
* Implementing Ascii Protocols on ODrive
  + Lio
  + Jose will ask about RPi
* Do haptic/kinematics/joint math
  + Cam