

## Supplies

### I4 Fuse

Lm339an comparators  
Battery locator w/ leads  
Oscilloscope  
Resistors

### Breadboards

## Project Specs

Make I motor:

↳ Spin Both ways

↳ With Variable speed

↳ Control speed w/ switches 0-7 on BASYS Board

Have 2 failsafes to turn motor off

↳ 1 through lock

↳ 1 Hardware (Fuse/Breaker)

Use Basys Board shunt resistors to detect current direction

↳ Display Direction + Current threshold

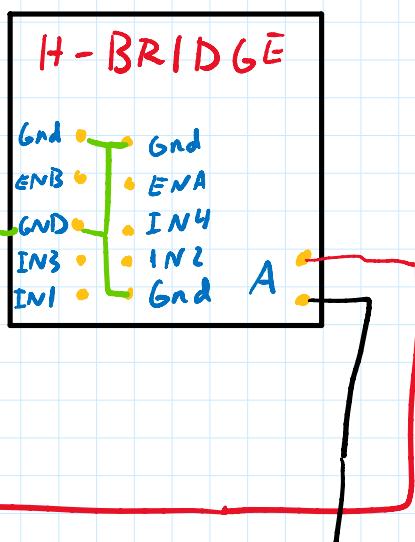
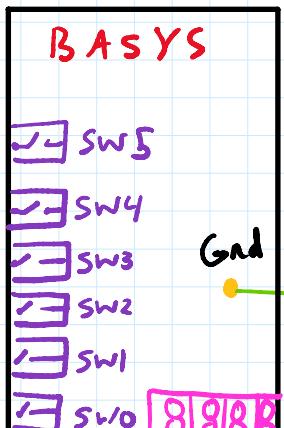
## Switch Debounce

Use 5; 3 for a 3-bit binary #, 000 - 111

↳ 1 for direction

↳ 1 for Enable

## CIRCUIT DIAGRAM

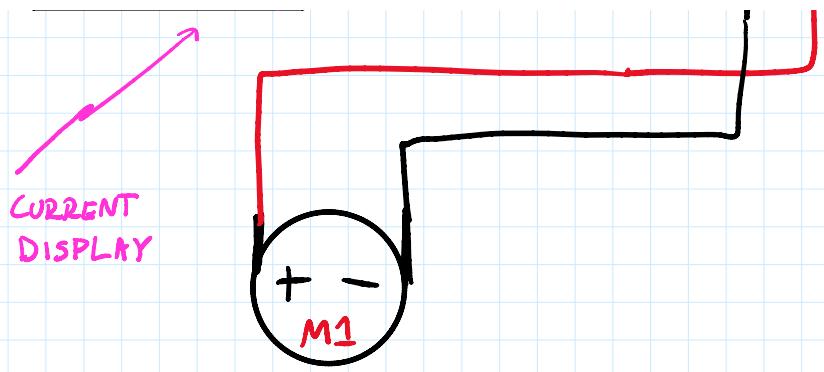


## DISCUSSED DIFFERENT METHODS OF CONTROL

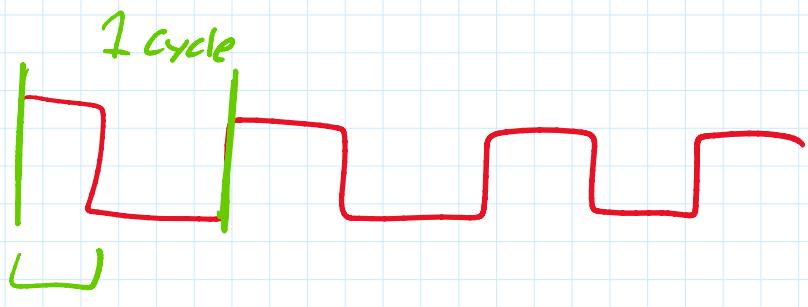
• 7 switches for speed +

1 for direction

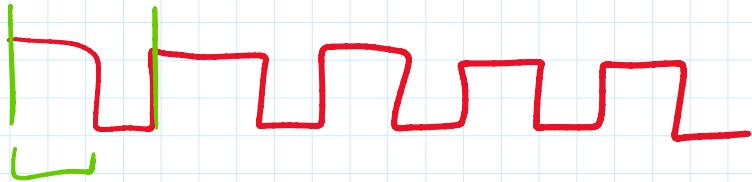
• 4 bits for speed, 1 for  
\* direction, 1 for enable \*



## PWM FUNCTIONALITY



$$50\% \cdot 7.2V = 3.6V$$

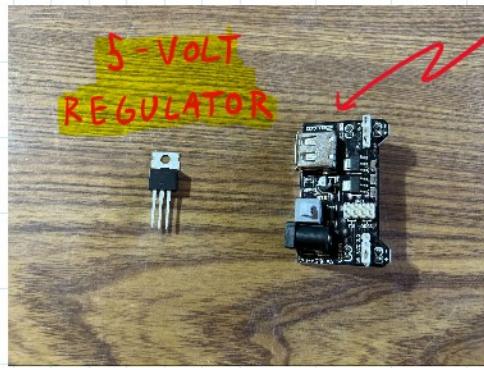
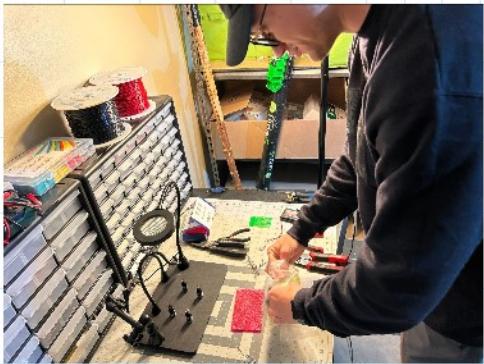


$$75\% \cdot 7.2V = 5.4V$$



$$100\% \cdot 7.2V = 7.2V$$

## REPLACING BATTERY CONNECTORS



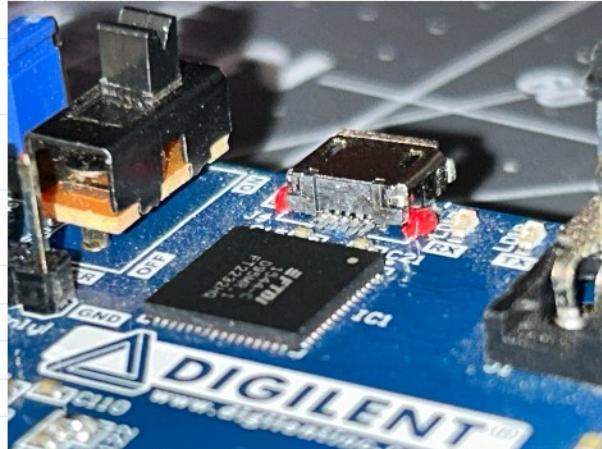
ELEGOO  
5V BREADBOARD  
REGULATOR PCB  
(UNSURE ABOUT \*  
LEGALITY FOR THIS  
PROJECT) \*



FOR THE FIRST WEEK, WE'VE  
DECIDED TO MOUNT ON  
CARDBOARD. IN THE FUTURE,  
WE WILL 3D PRINT A  
MOUNTING STRUCTURE

## CODING THE BASYS BOARD:

- Upon watching a tutorial and writing simple code in Vivado to link the switches and LED's, it was discovered that our micro USB connector on the BASYS board is not connected to the PCB. We will need to attain a replacement in order to program the board

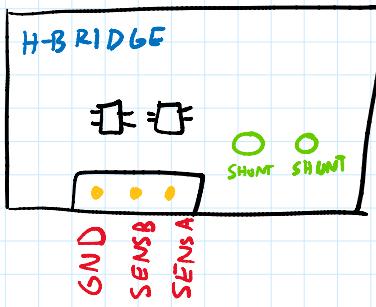


# BASYS Board Beginner Notes

Friday, January 27, 2023 1:05 PM

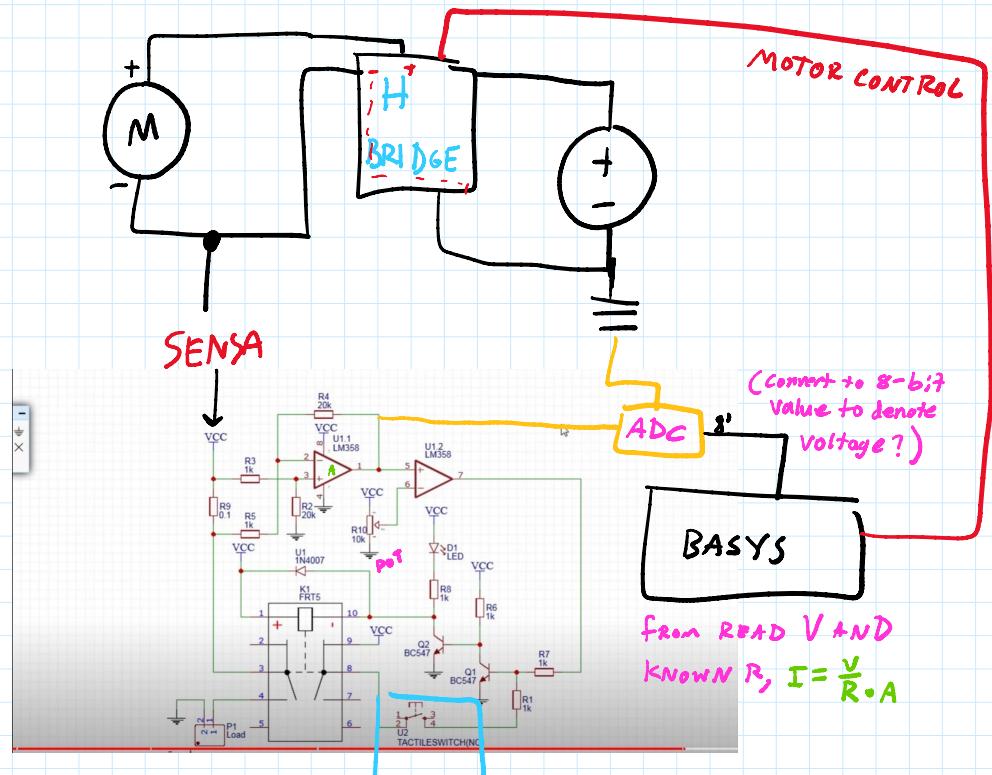
From BASYS Board Reference Manual:

- Operates on 5V power supply through USB port @ top of board (11) on the reference manual
  - o Jumper JP3 determines which source is used
- For more power, can use an external power supply:
  - o Plug into external power header (J6) and set jumper JP2 to "EXT" for external power source (allows it to receive power instead of using any on-board source)
- External battery pack use:
  - o Connect the battery's positive terminal to the "EXT" pin on J6 (external power header), and the negative terminal to the "GND" pin on J6.
    - Limit maximum voltage to 5.5V DC.
    - Minimum of 3.6V for most cases
      - If the USB Host function is used (J2), minimum increases to 4.6V.
- Programming & Configuration
  - o Code can be transferred from a USB memory stick attached to the USB HID port

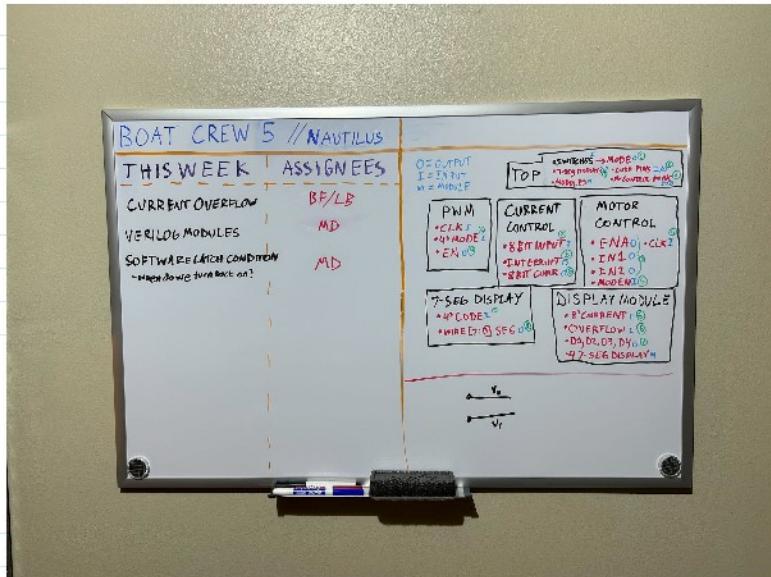
1/30/2023

- CURRENTLY TRYING TO DETERMINE WHY THE BOARD HAS SHUNT RESISTORS AND OPTOCOUPLERS

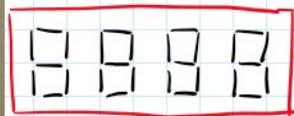
SENZA IS IN LINE AFTER THE LOAD



BUTTON IN CASE OF H-OVERCURR



DISPLAY NEEDS TO  
TAKE 20' DATA



OF

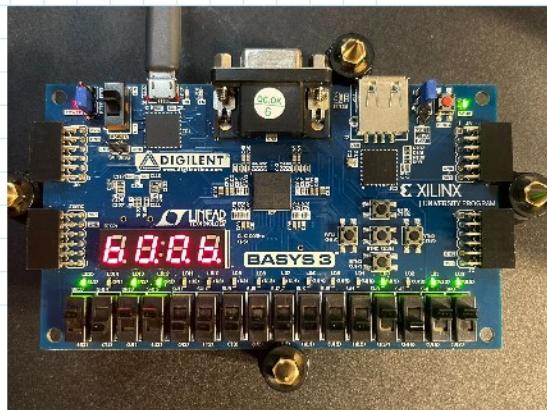
1' FOR HEX CODE

4' FOR ENABLE

6' DECIMAL/colon ENABLE

## 1/31 Tasks

- SET UP EACH MODULE ✓
- COMPLETE DISPLAY MODULES ✓
- COMPLETE CURRENT CONTROL MODULE
  - USE ADC TO READ CURRENT



USING ONBOARD ADC: <https://sites.google.com/a/umn.edu/mxp-fpga/home/vivado-notes/basys3-analog-to-digital-converter-xadc?pli=1>

### ADC Operating Modes

#### Trigger Mode:

The ADC trigger mode specifies the specific time at which data is acquired and converted; it can be configured for a continuous or an event mode.

- In the **continuous mode**, data is acquired continuously (unless configured otherwise) at the maximum sample rate, 1 MSPS.
- In the **event trigger mode**, data is acquired and converted only when the CONVST or CONVSTCLK input initiates it on a rising clock edge.

See page 71 of the user guide linked above.

#### (Startup) Channel Selection:

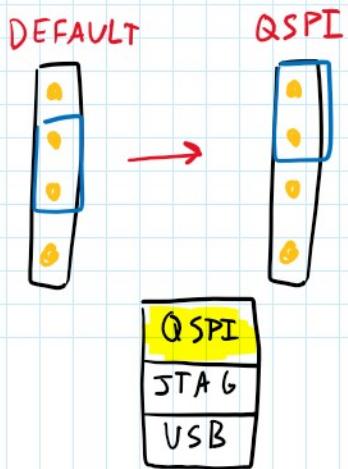
- In the simplest case, a single channel can be read by in the **Single Channel Mode**.
- Multiple channels can be read in either the **Independent** or the **Sequencer Mode**.
- Finally, in the **Simultaneous Mode**, two ADC channels are read at the same time. The two channels must be offset by 8, i.e., for example AUX channel 4 and 12 can be sampled simultaneously with the two on board ADCs in the FPGA.

<https://sites.google.com/a/umn.edu/mxp-fpga/home/vivado-notes/programming-the-basys3-boards-non-volatile-flash-memory-through-vivado>

Had not realized that memory on BASYS is volatile.

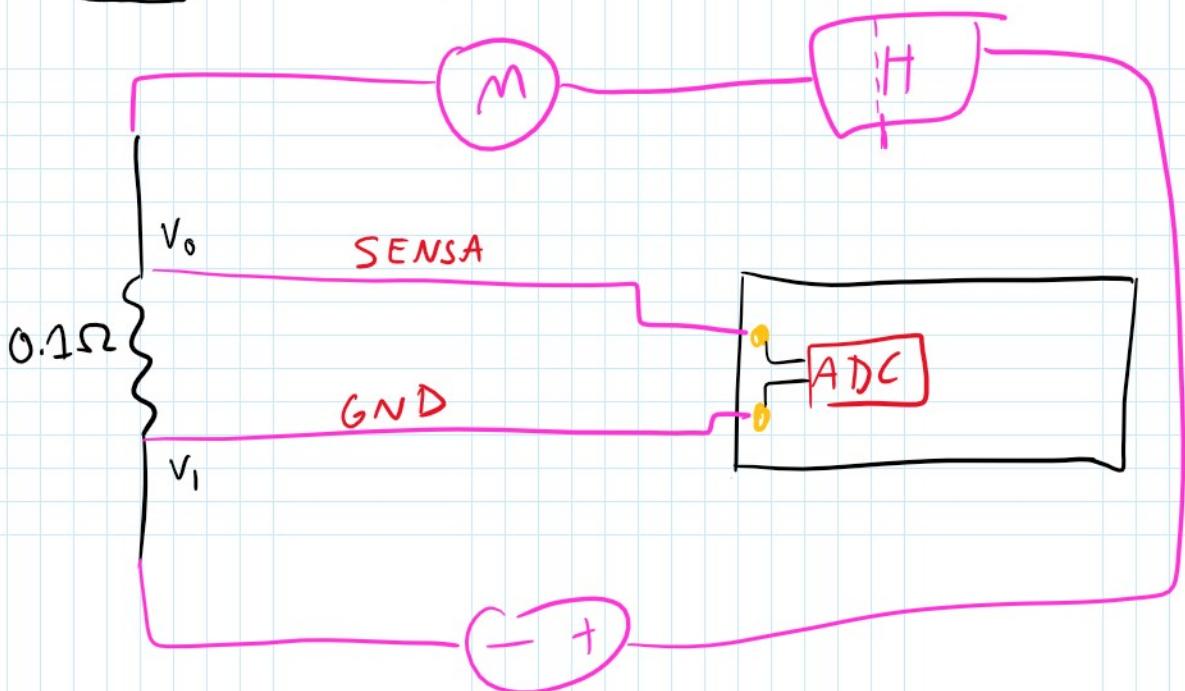
Had not realized that memory on BASYS is volatile.

This website shows how to reconfigure to program flash



• IT TURNS OUT THAT SOME CONFIGURATION IN VIVADO IS REQUIRED TO PROGRAM TO FLASH MEMORY

USING ADC WITH H-BRIDGE SHUNT



## ADC

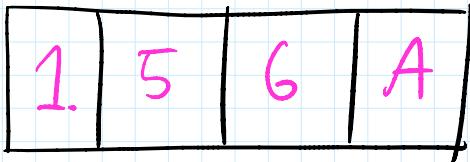
- 12-BIT VALUE

$$\bullet 0xFFFF = 1.0V = 4,095$$

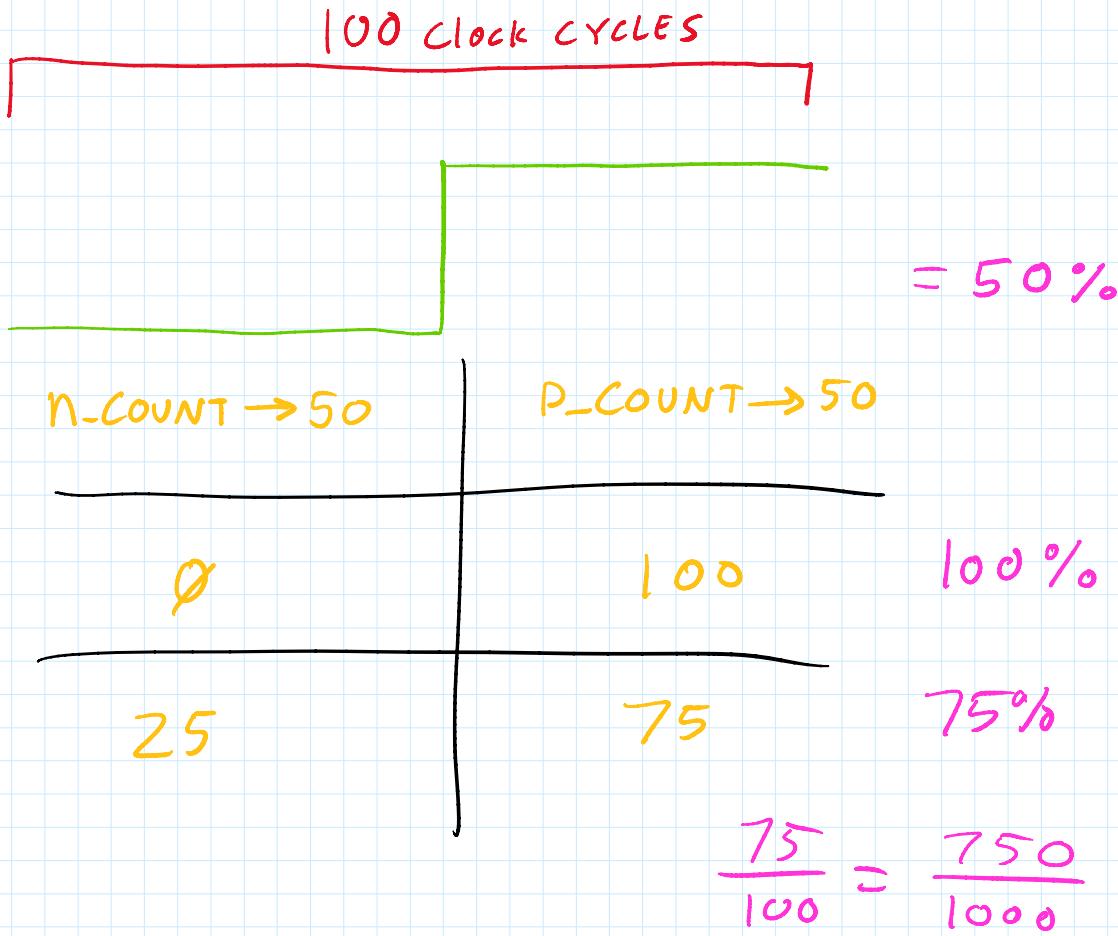
$$\begin{array}{r} 4,095 \\ \times 10^0 \\ \hline 409500 \end{array}$$

$$\frac{4095}{4095} = 100$$

ON DISPLAY:



## PWM MODULE



DESIRED  
100 kHz → 100,000 cycles/sec

SYSTEM CLOCK  
100 MHz → 100,000,000 cycles/sec

↑  
1000 cycles  
CLOCK

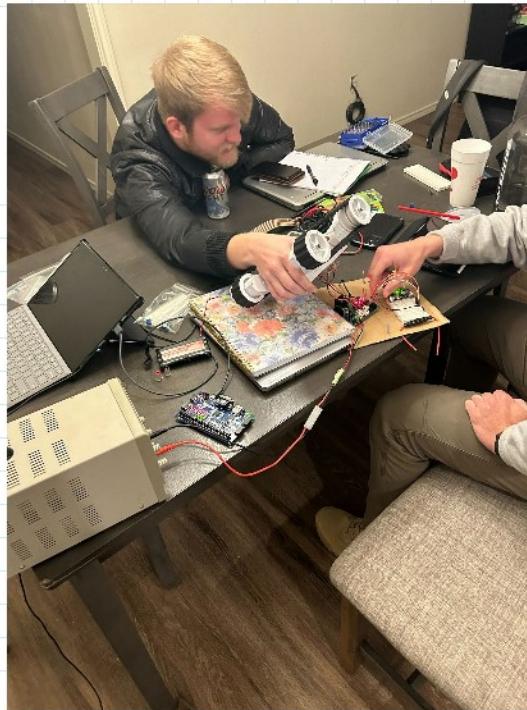
assign pduty = (mode = 0'b0000) ? 60 :  
 (mode = 0'b0001) ? 120 :

...

always @ (posedge clk)  
 begin

```

if pcount < pduty
    pCount = pCount + 1
    PWM_Reg = 1
else if nCount < nduty
    nCount = nCount + 1
    PWM_Reg = 0
else
    pCount = 0
    nCount = 0
end
    
```



### IDEA FOR DISPLAYING CURRENT

VALUE ( $0 \rightarrow 4095$ )

REMAP TO ( $0 \rightarrow 1.0$ )



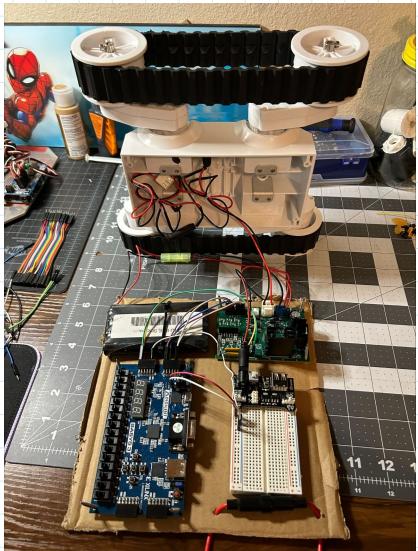
```

D0: COUNT = 0
      loop
          VALUE - 4095 ←
          COUNT ++
          BREAK IF VAL < 0
          COUNT ++
          VALUE += 4095, D0 = COUNT
          VAL → D1
          • REPEAT METHOD WITH 410
          VAL → D2
          • REPEAT METHOD WITH 41
    
```

EX:  $3,000 \rightarrow D1 = 0, VAL = 3,000 \rightarrow D2 = 7, VAL = 130 \rightarrow D2 = 3, VAL = 7$   
 $CNT = 0, \quad CNT = 7, \quad CNT = 3$

$$Ans = 0.73$$

REMAINDER = 7



2/5/2023

- BOARD IS SET UP WITH SOFTWARE CURRENT PROTECTION
- LOGAN HAS BEEN CREATING HARDWARE PROTECTION



\* BATTERY IS OLD  
SO DC GENERATOR  
IS REQUIRED \*

$$100 \text{ MHz} = \frac{100,000,000 \text{ cycles}}{\text{sec}}$$

$$100 \text{ Hz} = \frac{100 \text{ cycles}}{\text{sec}}$$

1,000,000 Clock cycles = 1 PWM cycle

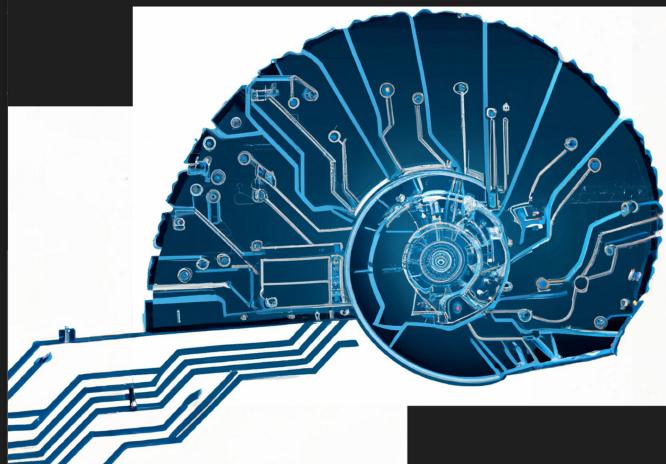
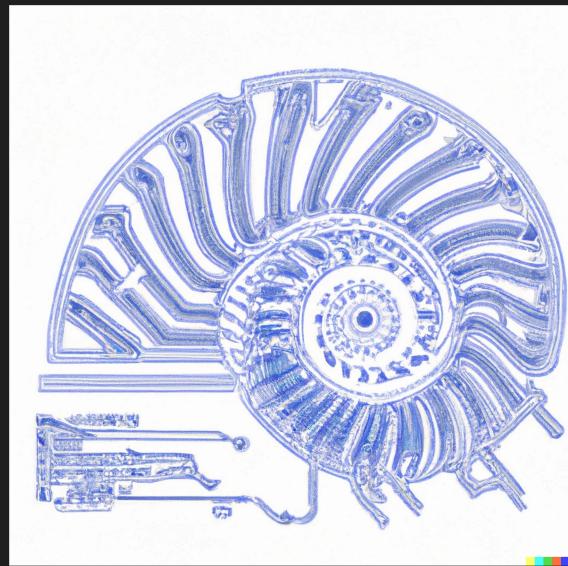
$$100 = 1 \text{ PWM}$$

$$50\% = 50 \cdot 10,000 = \underline{500,000 \text{ clock cycles}}$$

\* OUR PWM HAD AN ERROR

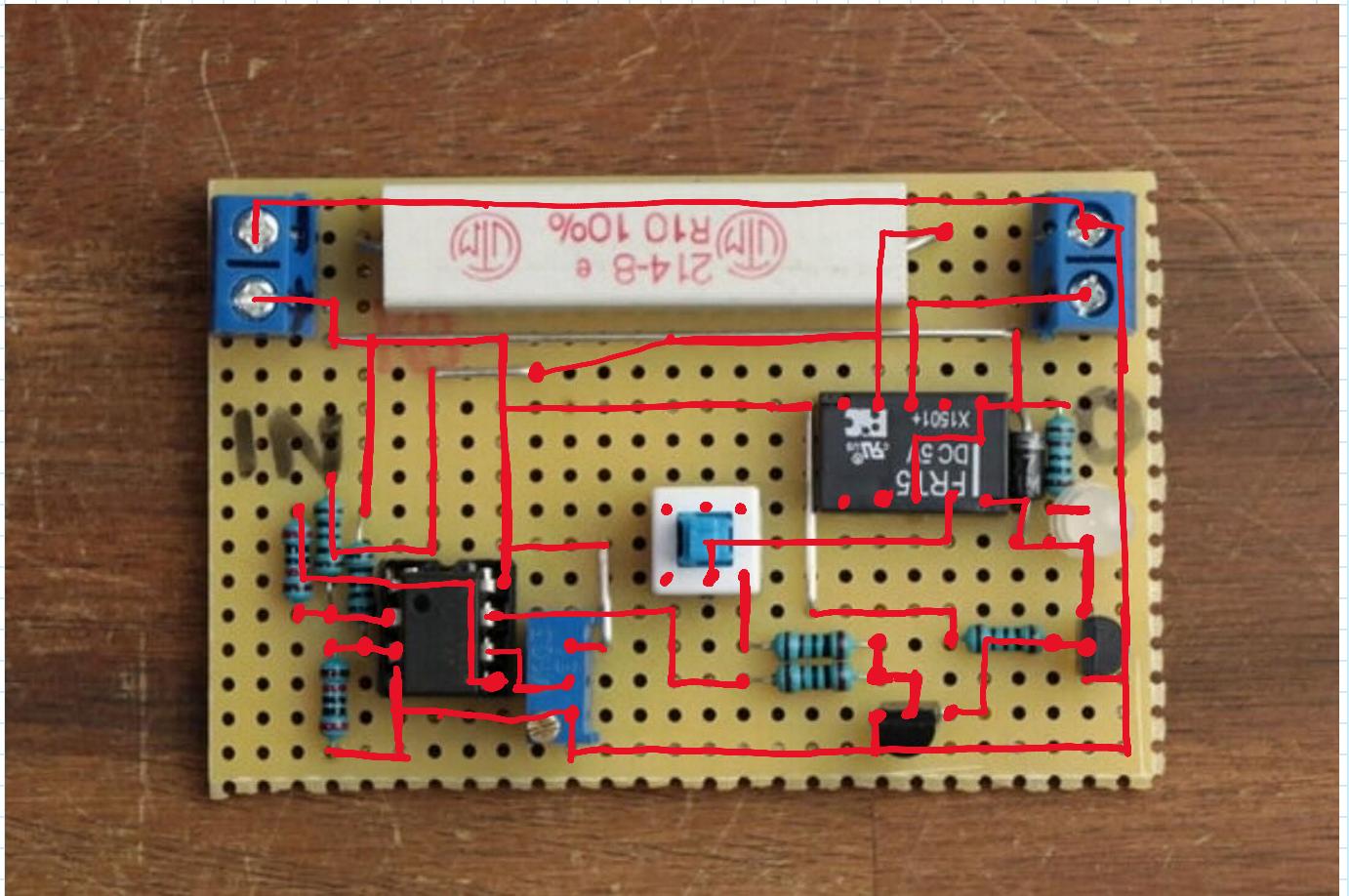
\* OUR PWM HAD AN ERROR

- WE REALIZED THAT OUR COUNTER WAS 12 bits  
AND THE NUMBER IT WAS COUNTING TO WAS 21 bits...



# Overcurrent Protection Ckt Details

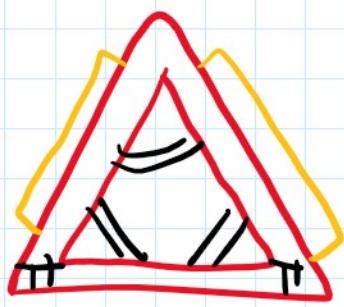
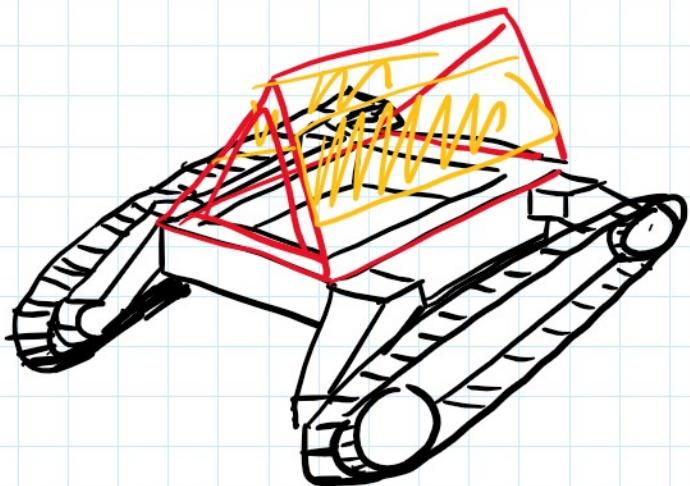
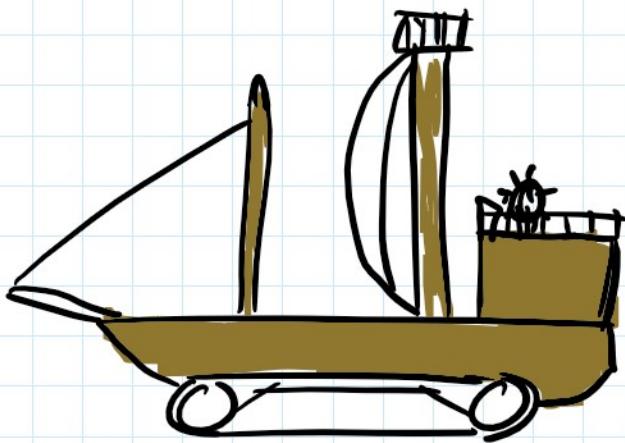
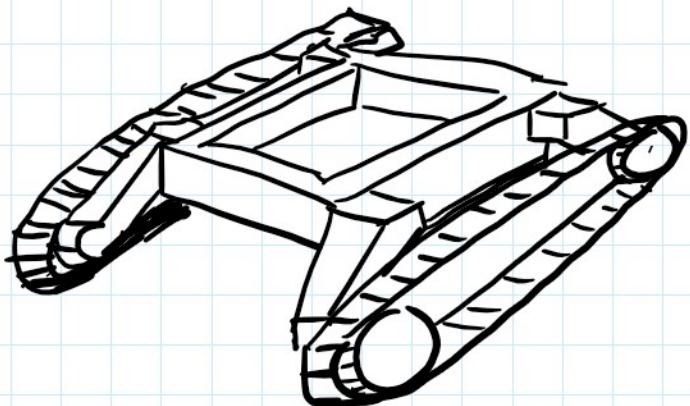
Monday, January 30, 2023 10:05 PM



# Rover Chassis

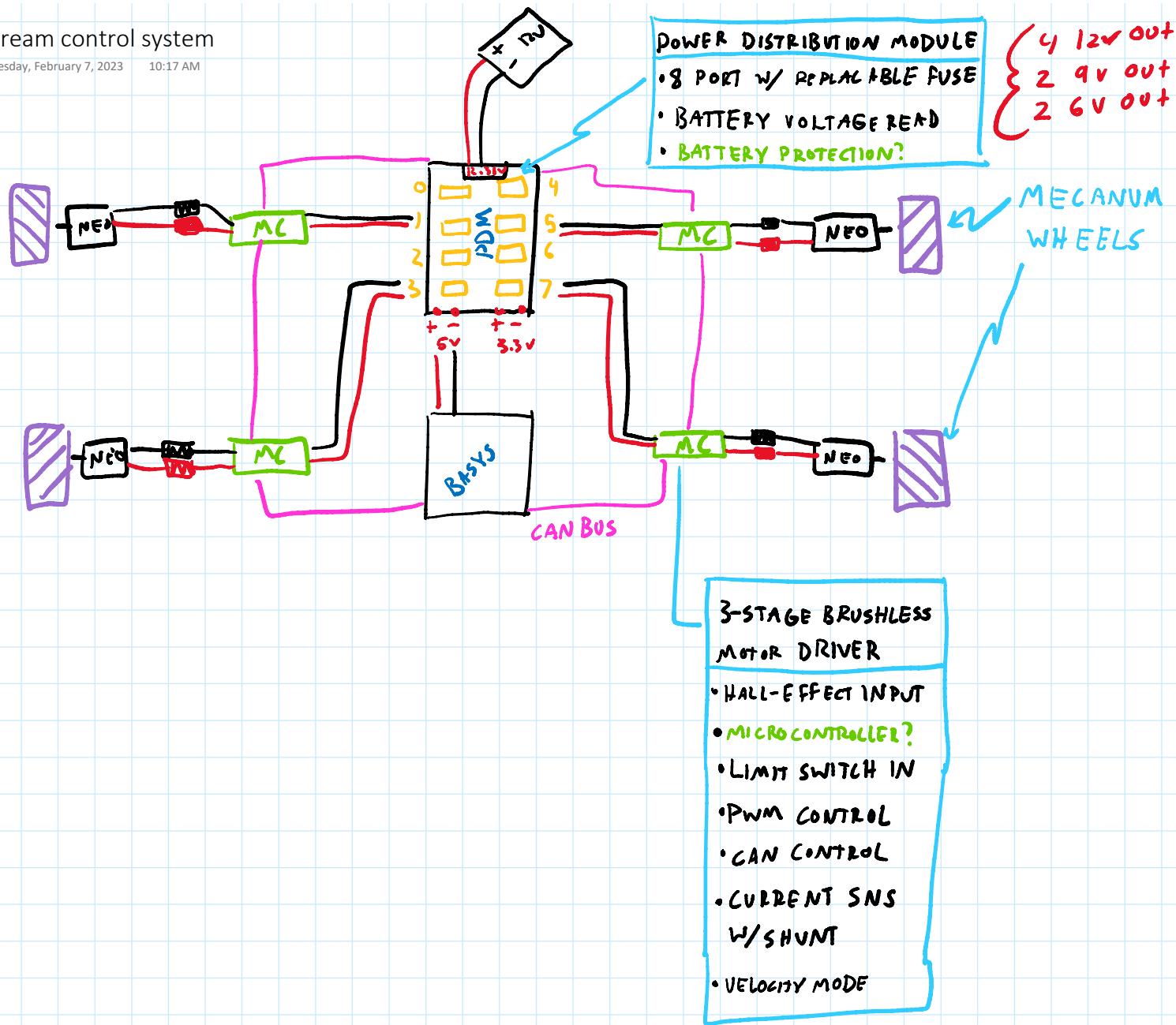
Monday, January 30, 2023 4:57 PM

## BOAT CONCEPT



# Dream control system

Tuesday, February 7, 2023 10:17 AM

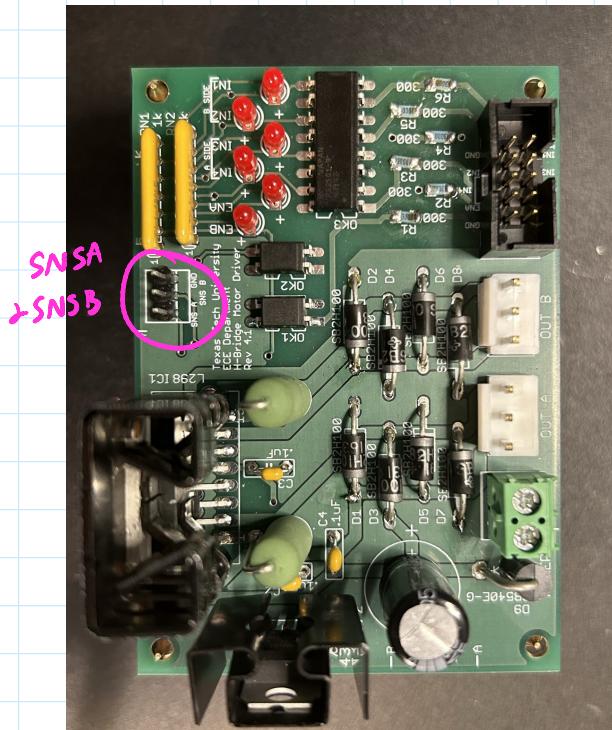
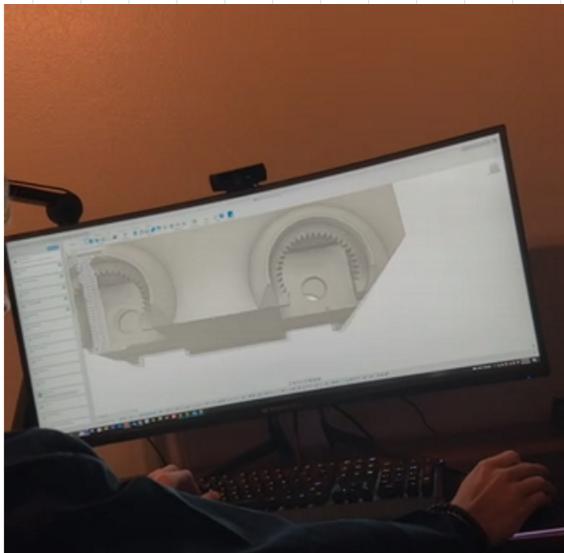


Week 3 (2/8/2023)

Wednesday, February 8, 2023 8:36 PM

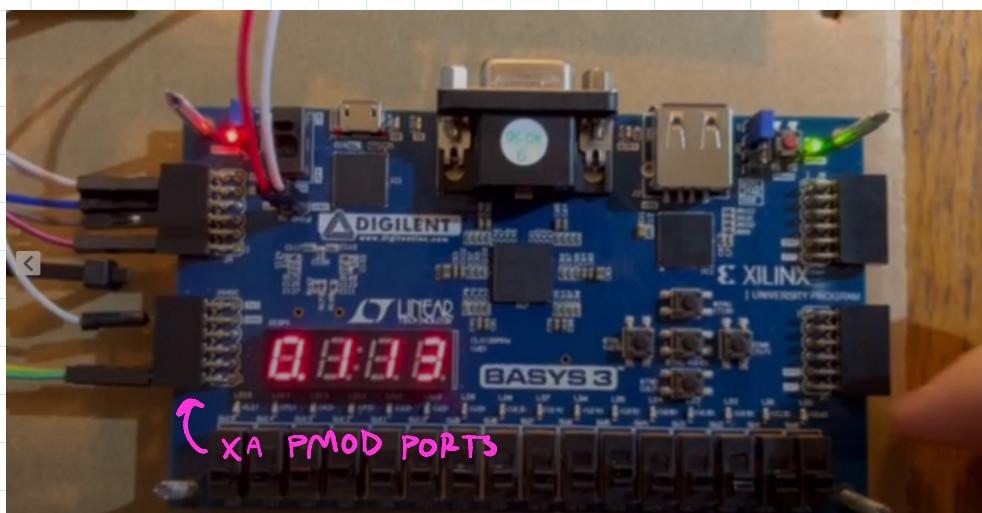
2/8/2022

- FIXING OUTPUT OF ADC
- DISCOVERED THAT SNSA ONLY OUTPUTS POSITIVE (WHICH IS OKAY!!)
- ADJUSTING CODE TO DISPLAY RAW ADC VALUE



• I BEGAN DRAFTING THE DAGU 5 ROVER CHASSIS IN FUSION 360

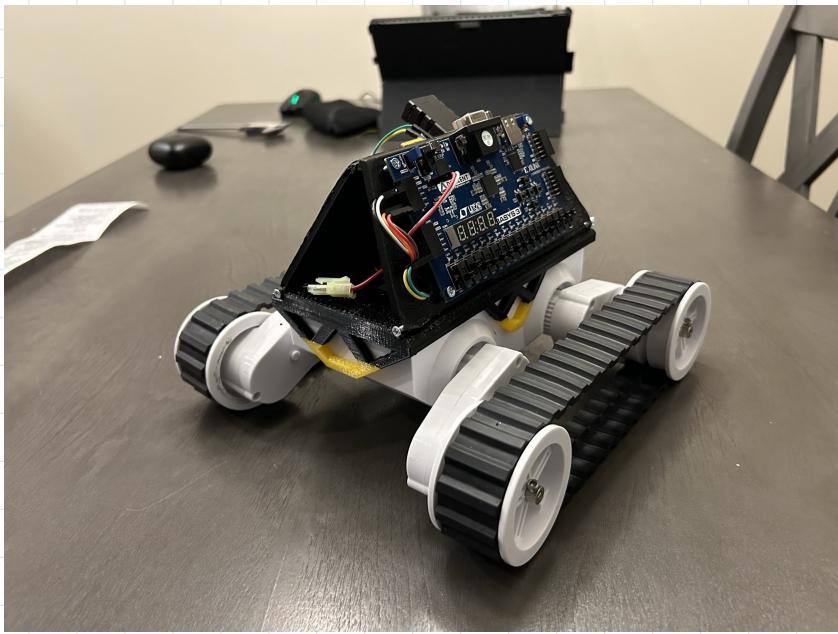
• I WILL USE THIS MODEL TO CREATE A BODY FOR THE DEVICE



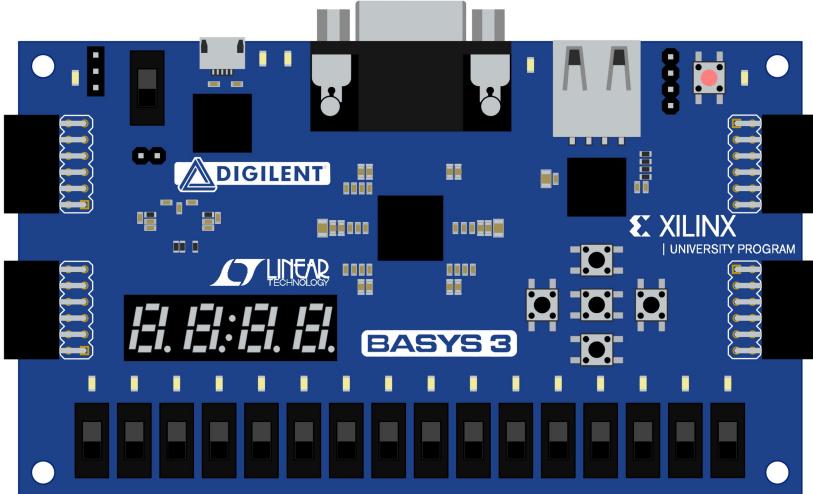
THIS IMAGE SHOWS THE XADC READINGS OFF OF A SINGLE MOTOR



LOGAN HAS BEEN WORKING  
ON A HARDWARE SHUTOFF  
FOR CURRENT OVERFLOW  
BASED ON A DESIGN BY  
THE YOUTUBER  
"GREAT SCOTT"



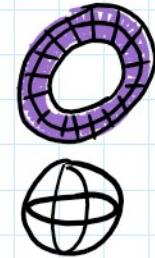
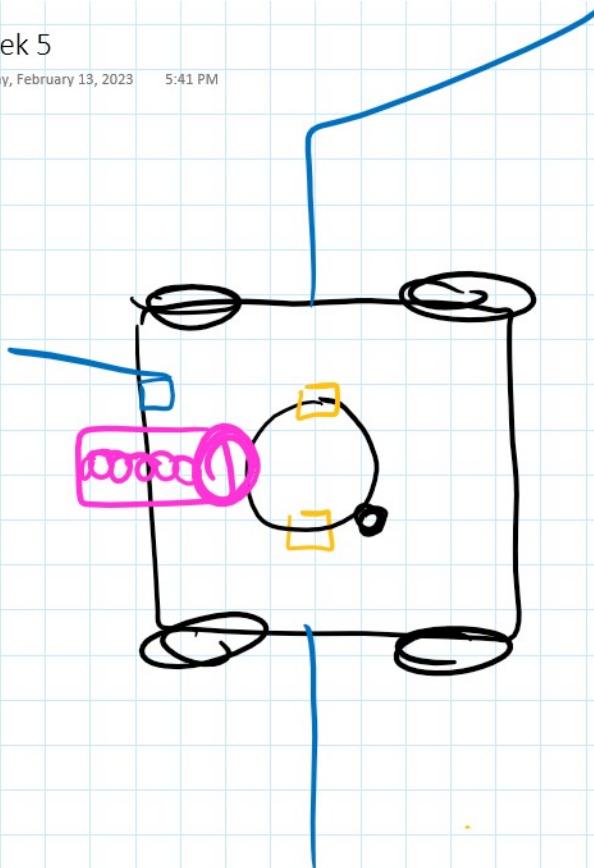
I USED THE MODEL OF  
THE ROVER CHASSIS TO  
PRODUCE THIS BODY  
WHICH HOLDS THE BASYS  
2 H-BRIDGE. IT'S A LITTLE  
SMALL AND CAN BE MADE  
LARGER FOR THE MAIN  
PROJECT



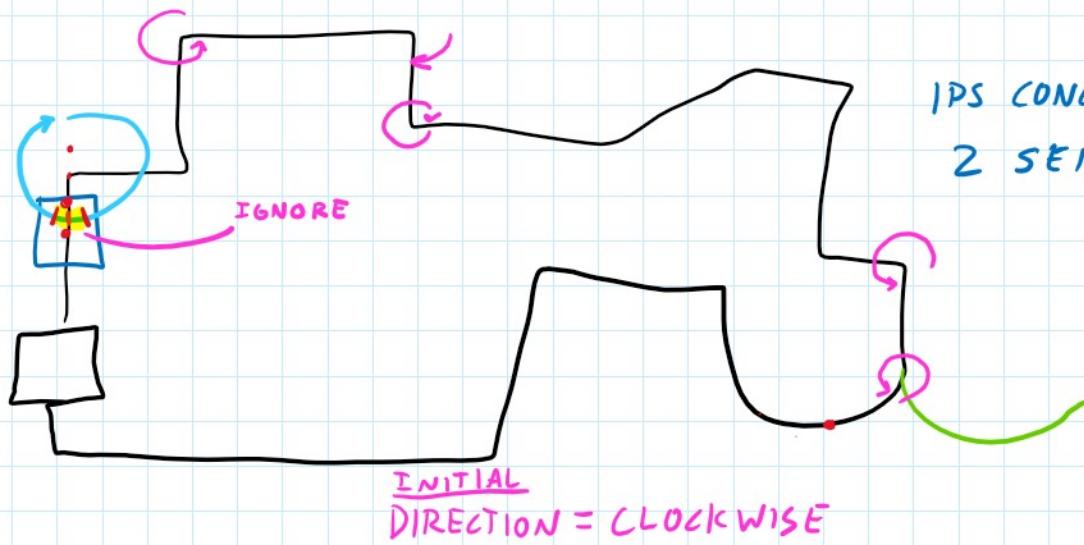
USING AUTOCAD, I'VE MADE THIS RENDER OF THE BASYS BOARD. XILINX DOES NOT HAVE A 2D VECTOR RENDER OF THIS BOARD, WHICH BOTHERED ME

Week 5

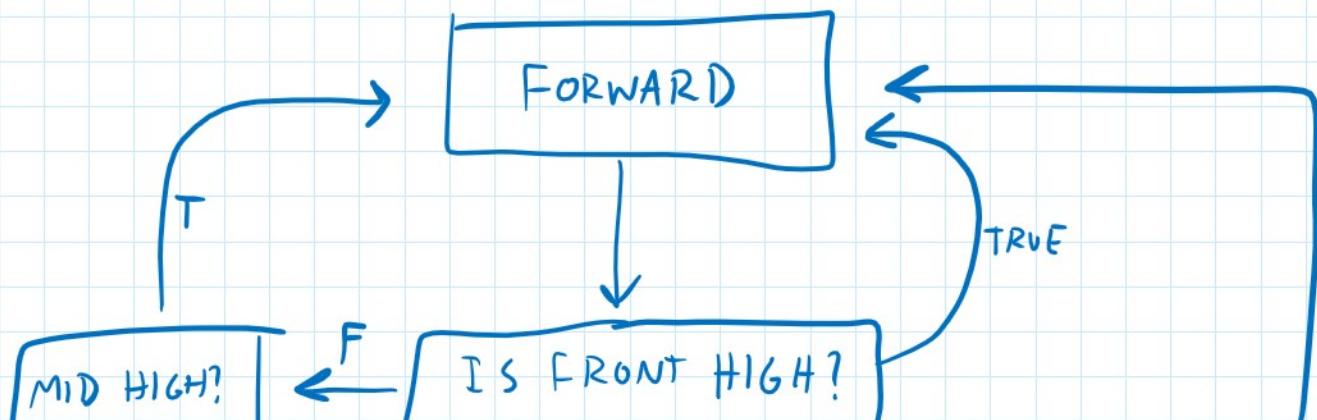
Monday, February 13, 2023 5:41 PM

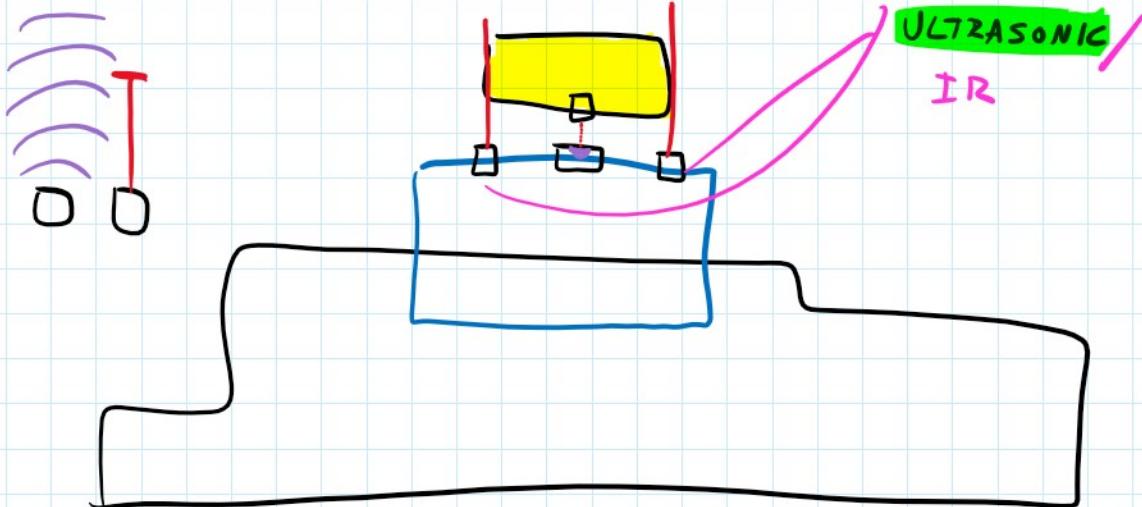
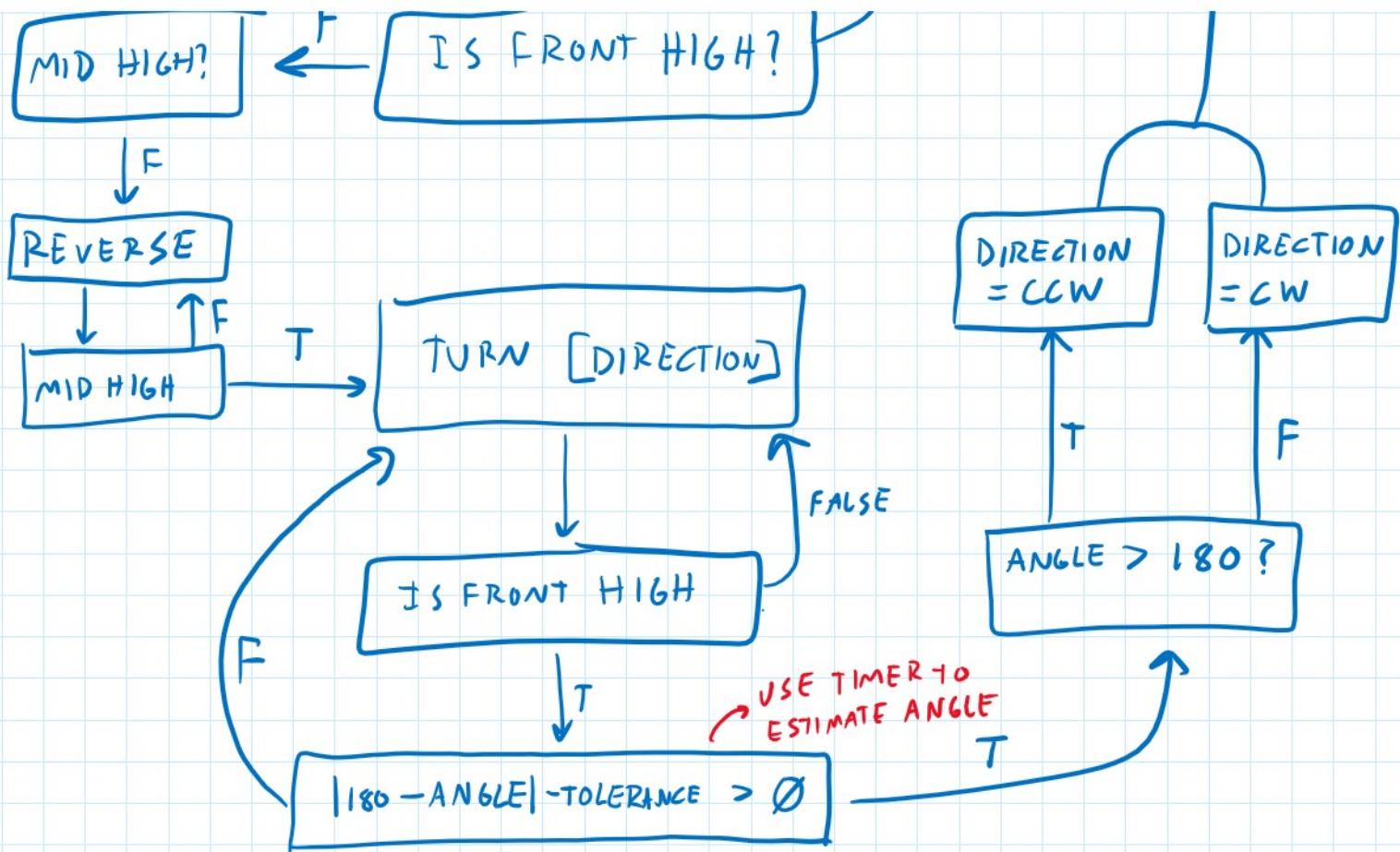


TRACK NAV CONCEPT  
WITH MECANUM WHEELS

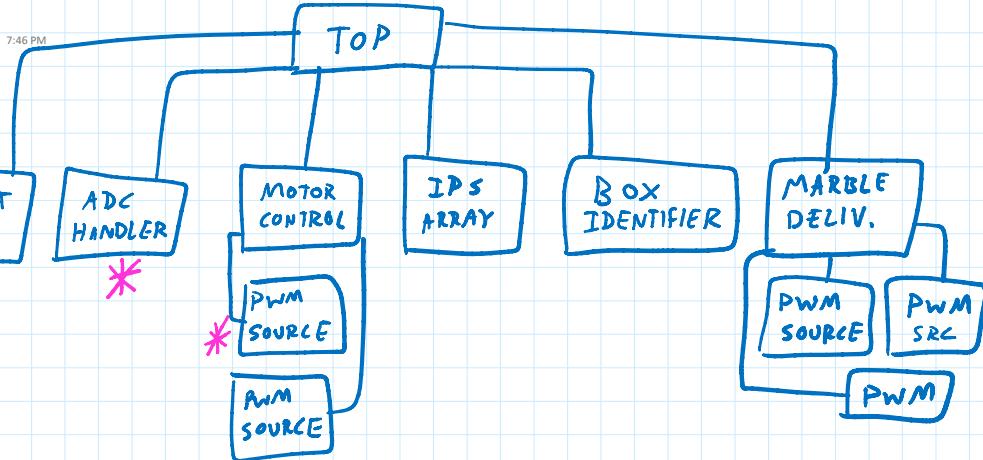
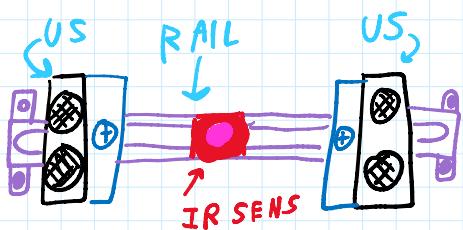


IPS CONCEPT USING  
2 SENSORS

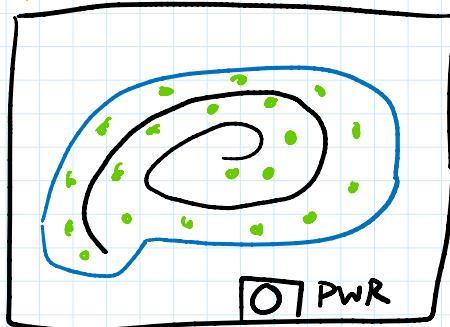




\*IR WOULD PROBABLY INTERFERE WITH Emitter\*

SENSOR ARRAY

## NAUTILUS STATUS BOARD



## ULTRASONIC

time spent in air → emitted by sensor

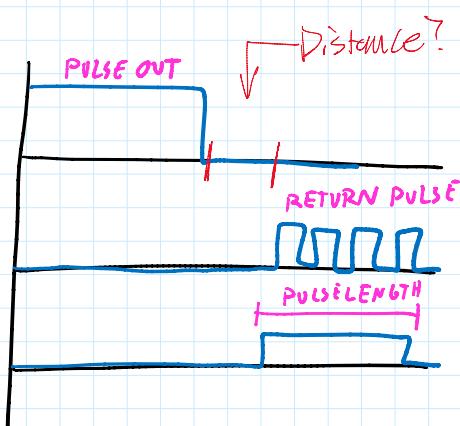
- CLH input }  
Distance Output }
- Trigger width of pulse in CLH cycles
  - ↳ Measure on rising + falling edge
  - ↳ Report # of CLH cycles back to module
  - ↳ Count # of CLH cycles = certain distance away

## MARBLE DISPENSER

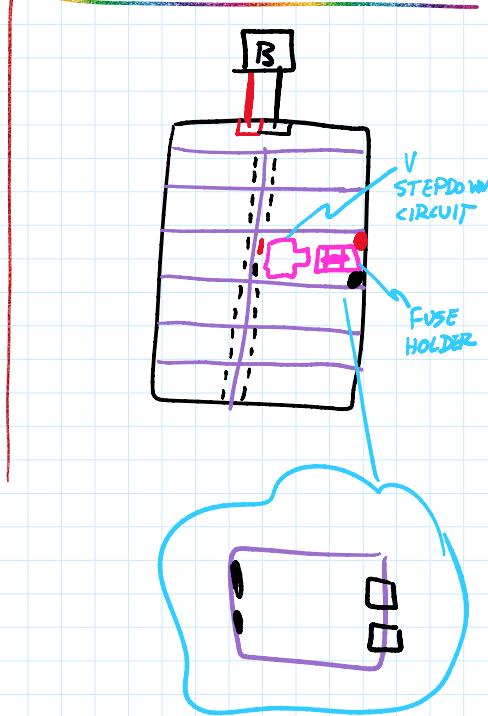
- Detect State from MORSE module  
↳ 3 Diff States,

State 1 = 1 Marble;  
State 2 = 2 Marbles;  
State 3 = 3 Marbles; } use state to determine which pin PWM gets sent to

constants; closed + open Angle

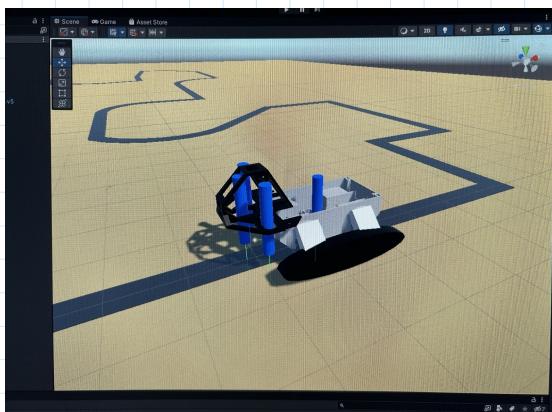


# PWR BREAKOUT BOARD



## DISPLAY IDEA

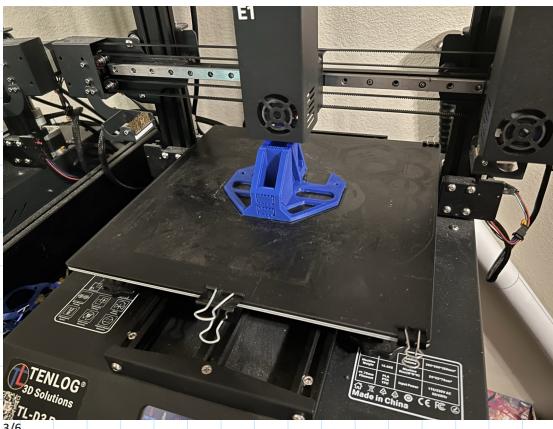
- MULTIPLE INPUT STREAMS MEDIATED BY BASYS BUTTONS
- CURRENT [LEFT + RIGHT]
- IPS ARRAY DATA
- Box ID STATE



3/4/2023

I MODELED AN IPS CARRIER ASSEMBLY AND BEGAN MODELING THE NAVIGATION SYSTEM IN UNITY.

- IT WORKS VERY WELL AND THE ALGORITHM WAS PORTABLE TO VIVADO



MY TENLOG 3D PRINTER

FABBING THE CARRIER



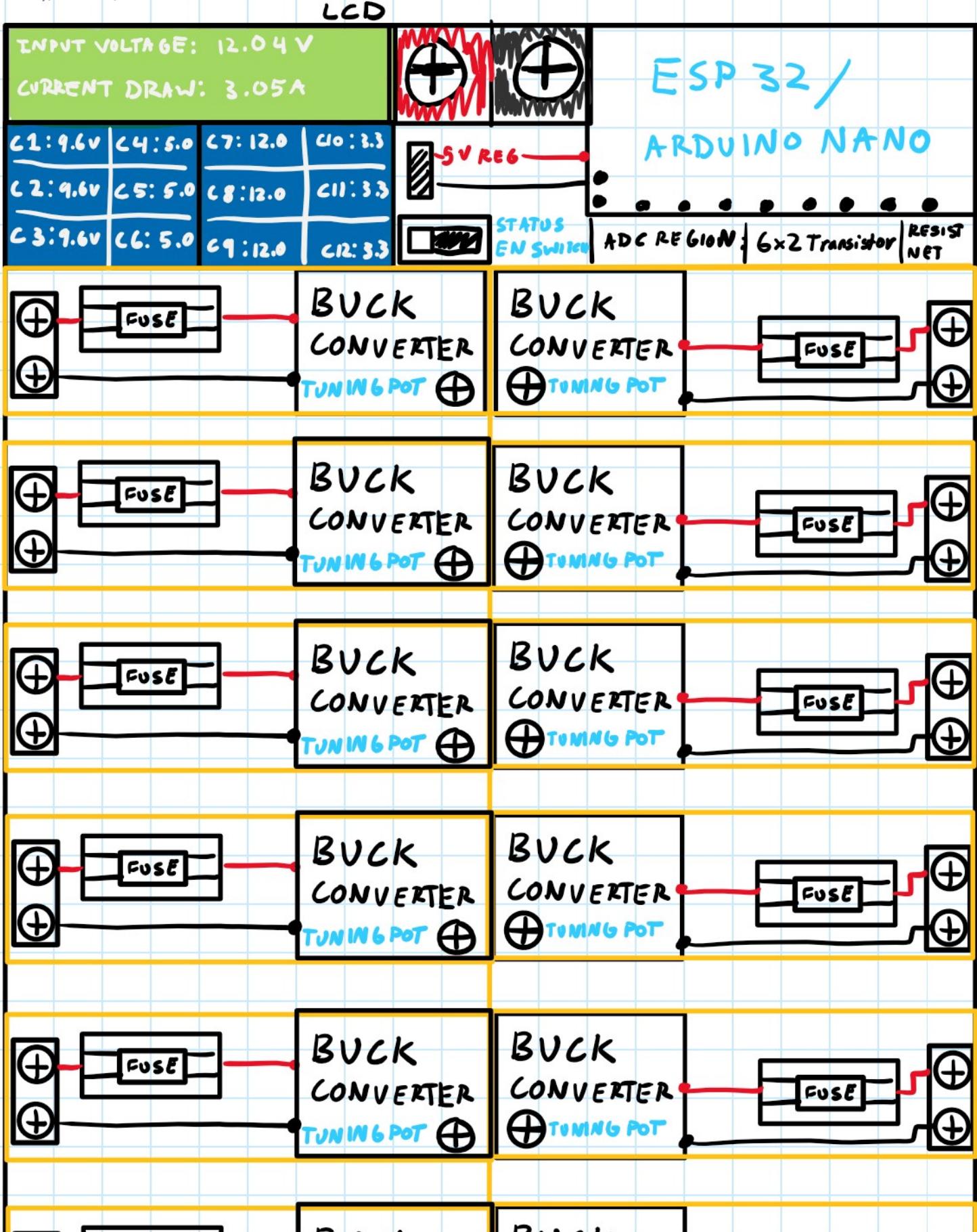
\*UPDATE\*

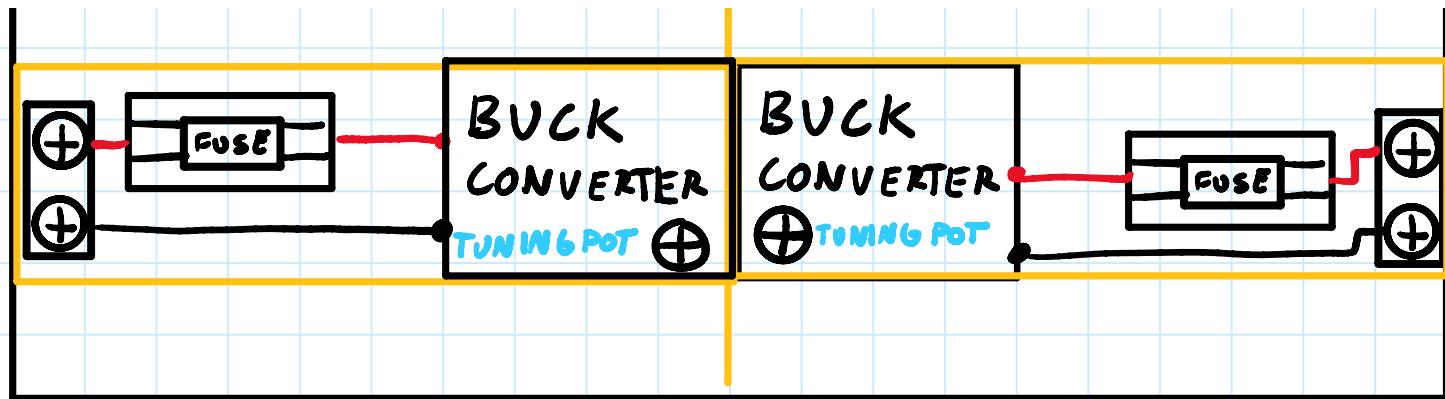
THE ASSEMBLY ABOVE WOULD  
NOT ENABLE THE SENSORS  
TO REACH THE TAPE

→ THIS NEW VERSION IS SIMILAR  
BUT EXTENDS DOWN INSTEAD

# Power Breakout Concept

Friday, March 3, 2023 12:52 PM





Display idea:  
Have multiple channels of data  
Button on Basys cycles channels

Have a switch to enable / disable override function in code  
Basically, the code will auto switch the display if a module raises a flag that there was an important update.

Channels:  
M1 Current  
M2 Current  
IPS State  
Marble Servo Set Positions

## MORSE CODE SPECIFICATIONS:

$$u = \frac{1.2}{c} = \frac{1.2}{20} = 0.06 \text{ s}$$

<u>NUM</u>	<u>MORSE</u>	<u>BINARY</u>	
1	• - - -	1 0 1 1 1 0 1 1 1 0 1 1 1 0 0 0 ...	= 1.2 s/char SPACE CHARACTER
2	• • - -	1 0 1 0 1 1 1 0 1 1 1 0 1 1 0 0 0 ...	= 1.08 s/char SPACE
3	• • • -	1 0 1 0 1 0 1 1 1 0 1 1 1 0 0 0 ...	= 0.96 s/char SPACE

## IDEA:

- ON RISING EDGE OF IR, START SAMPLING

- WAIT FOR SPACE CHARACTER

- SAMPLE BITS

- STOP AT NEXT SPACE

- SEND BITS TO DECRYPTER →

- SAMPLE BITS SECOND TIME

- DECRYPT SECOND BITSTREAM

- IF OUTPUT IS EQ, NUMBER IS FOUND

- OTHERWISE, REPEAT UNTIL " "



## DECRYPTER

- COMPARE BITS BETWEEN SPACES TO 1, 2, & 3

- IF NO MATCH IS FOUND, COMPARE DASHES: 1=4-, 2=3-, 3=2-

- If NO MATCH, COMPARE DOTS:

$$1=1\cdot, 2=2\cdot, 3=3\cdot$$

\* TRY TO SPLIT  
DOTS & DASHES

• OTHERWISE, REPEAT UNTIL  
 MATCH

$$1 = 1\cdot, 2 = 2\cdot, 3 = 3\cdot$$

• IF NO MATCH, NUM =  $\emptyset$  (ERR STATE)

\* SOLUTION YIELDED IN  $\approx 2$  sec

### POTENTIAL ERRORS:

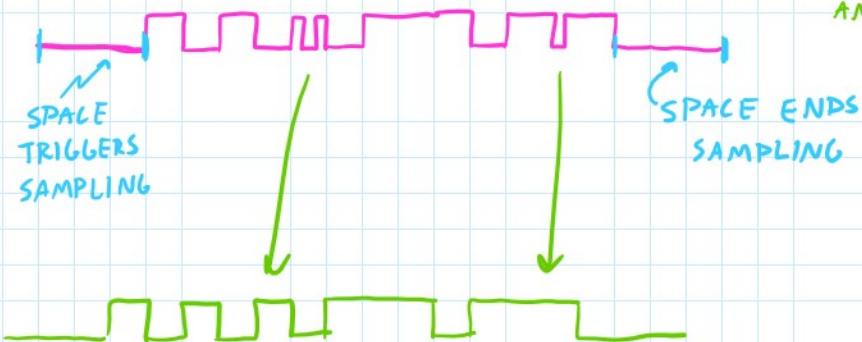
- FAULTY SIGNAL?
  - WHAT IF READING IS NOT 100% CLEAR?
  - THE DEVICE WOULD RECEIVE MORE BITS THAN EXPECTED

\* SPACE CHARACTER SHOULD BE DETERMINED BY "OFF" STATE EXCEEDING 75% OF 3 CYCLES

$$\hookrightarrow 0.06 \cdot 3 = 0.18s$$

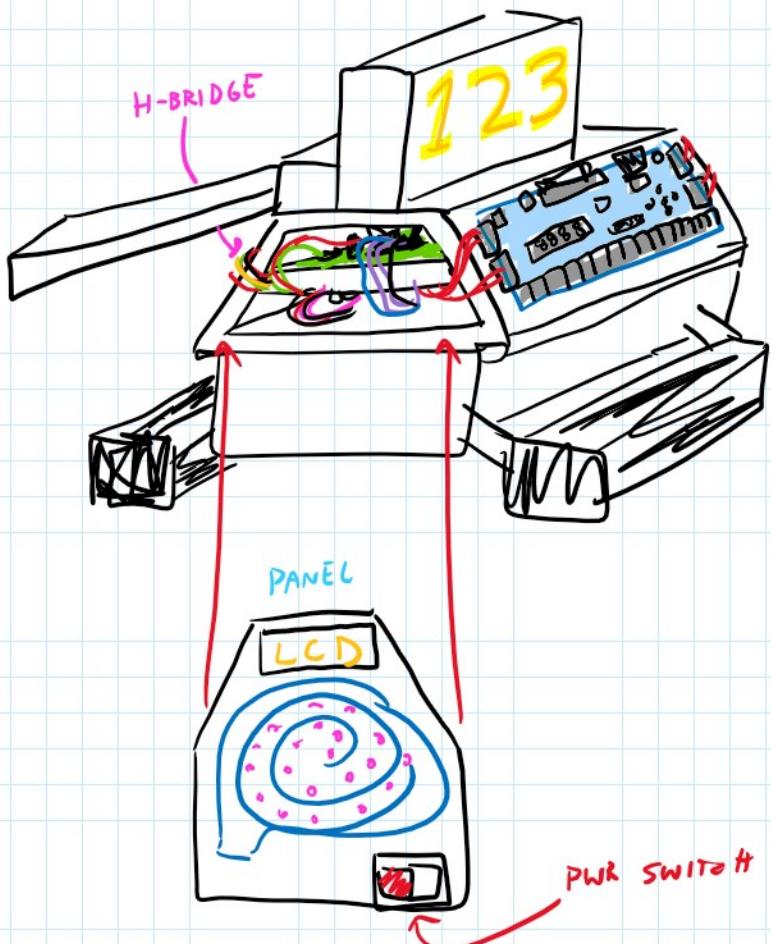
$$\frac{0.75}{0.135s}$$

\*\*\*\*  
 SOLUTION: CREATE A REGISTER OF ON/OFF VALUES WITH A MAXIMUM EXPECTED SIZE. COMBINE 1's & 0's THAT SHARE LOW PERIODS AND ARE ADJACENT

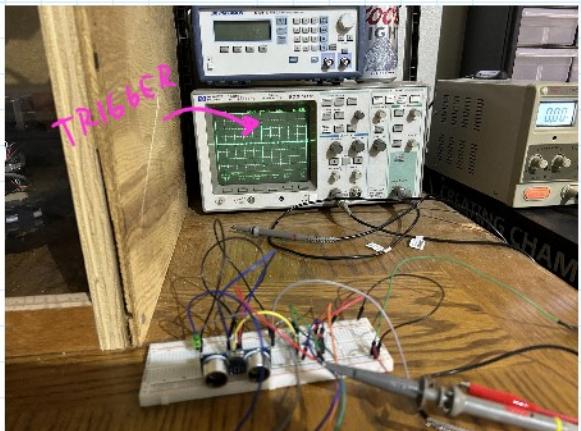


0.000001



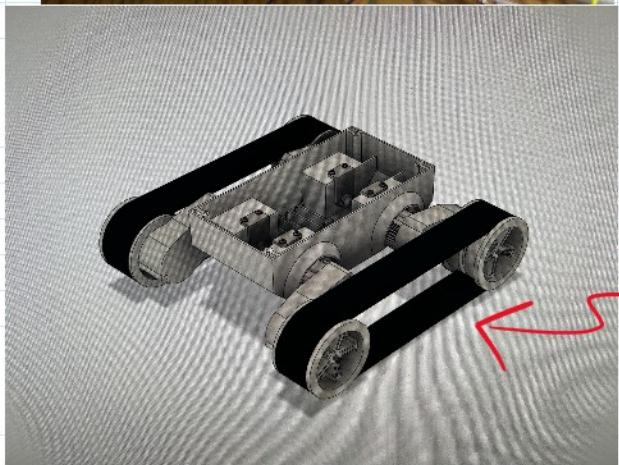


IMAGINING OF  
THE ENTIRE SYSTEM



3/14/2023

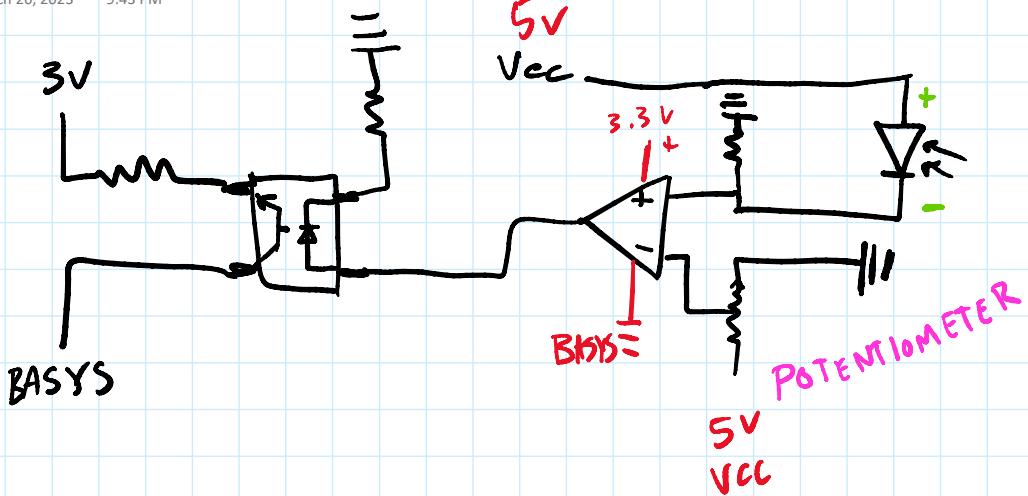
• DEBUGGING THE ULTRASONIC HAS REVEALED THAT THE DISTANCE BETWEEN END OF TRIGGER AND THE START OF ECHO (WHICH IS WHAT WE MEASURED), NEVER CHANGES! MEASURING THE LENGTH OF THE ECHO INSTEAD YIELDS THE ACTUAL DISTANCE.



DAGU 5 CHASSIS IS FULLY MODELED!!

# Week 8

Sunday, March 26, 2023 9:43 PM

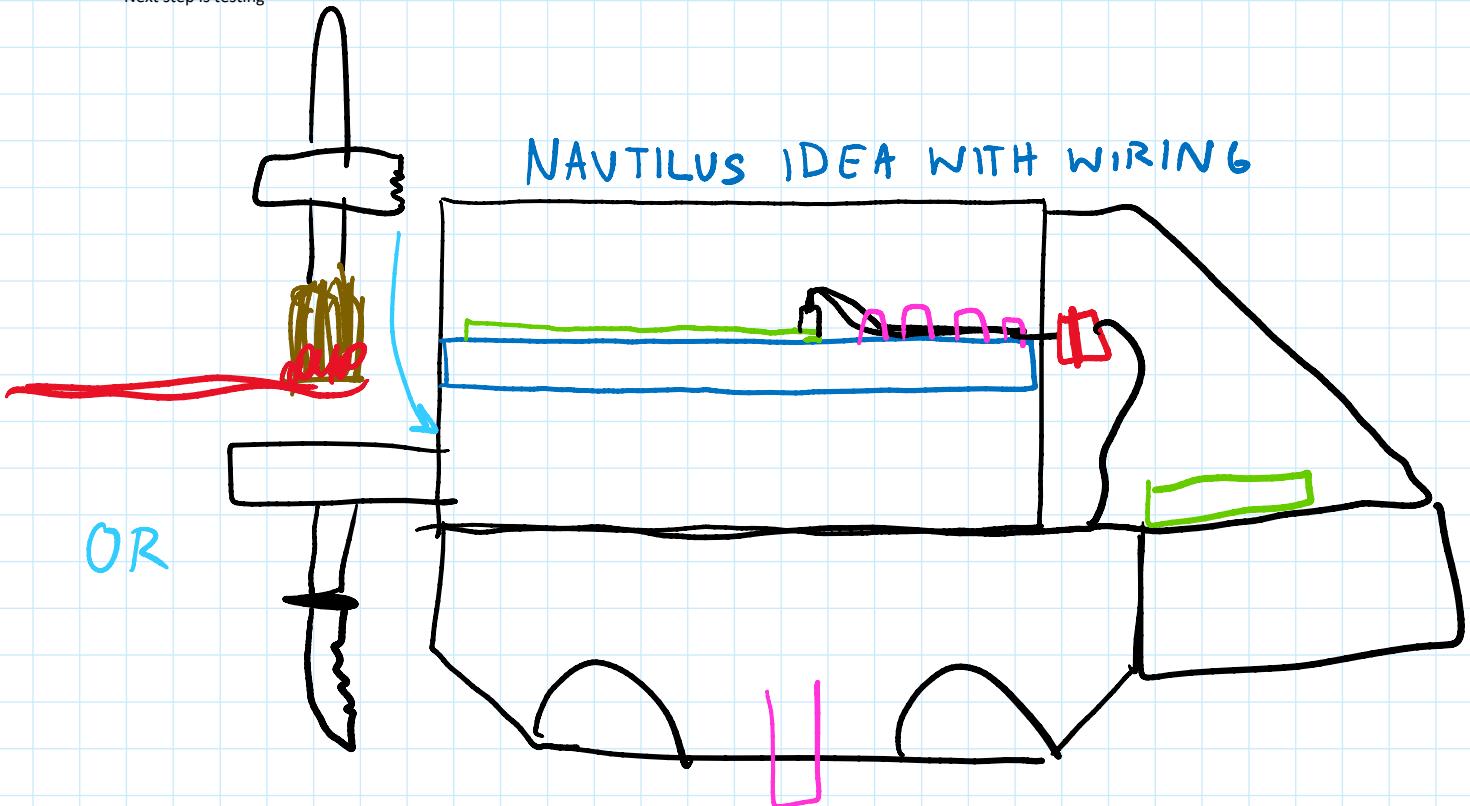


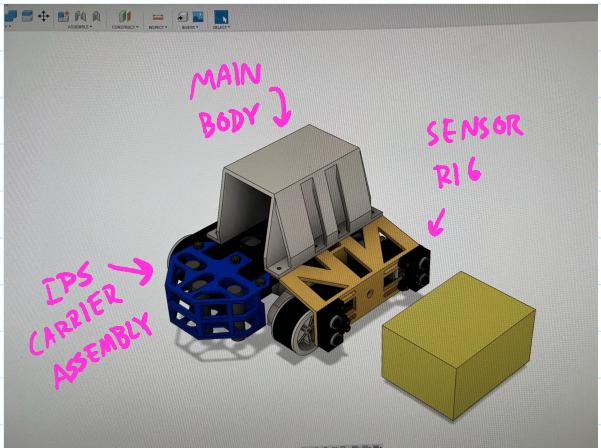
## For Interim report:

- Table on IR emitter distance vs signal strength
- Table for ultrasonic pulse length vs distance (easy)
- Table for PWM duty cycle vs servo position (use signal generator)

## If not due tonight:

- Work on it a little
- IR code fixed and testbench working
- Put together IR circuit with comparator BEFORE ordering pcb
- Fix sensor rig for printing
- Design body
- Attach marble dispenser to body and start printing
- Next step is testing





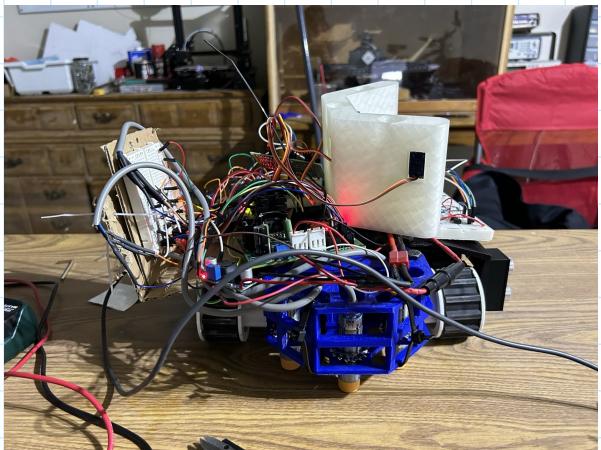
THE DESIGN OF THE MAIN RACK/BODY IS SIMILAR TO THE MINI-PROJECT BUT ALLOWS FOR MORE SPACE AND THE TIERED-STORAGE DESIGN THAT I HAD DREAMED OF BEFORE.



• WE HAVE MADE THE TRACK ON THE RIGHT TO DEBUG OUR NAVIGATION

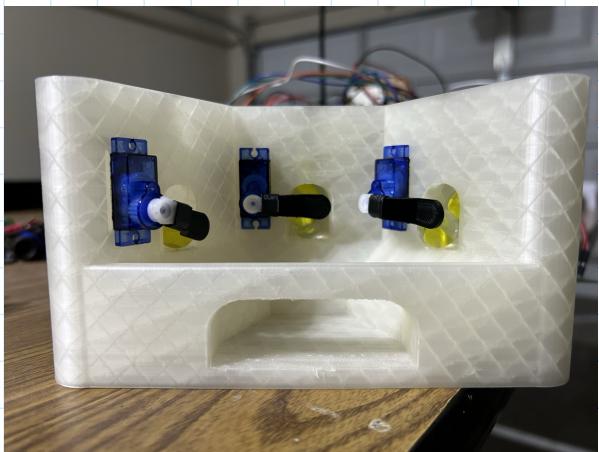
• THE ROVER WORKS REALLY WELL ON THIS TRACK!

JAGGED/STICKING OUT EDGES LIKE THIS ONE CAN BE THE DOWNFALL OF NAUTILUS SINCE IT CAN CAUSE THE SYSTEM TO TURN AROUND



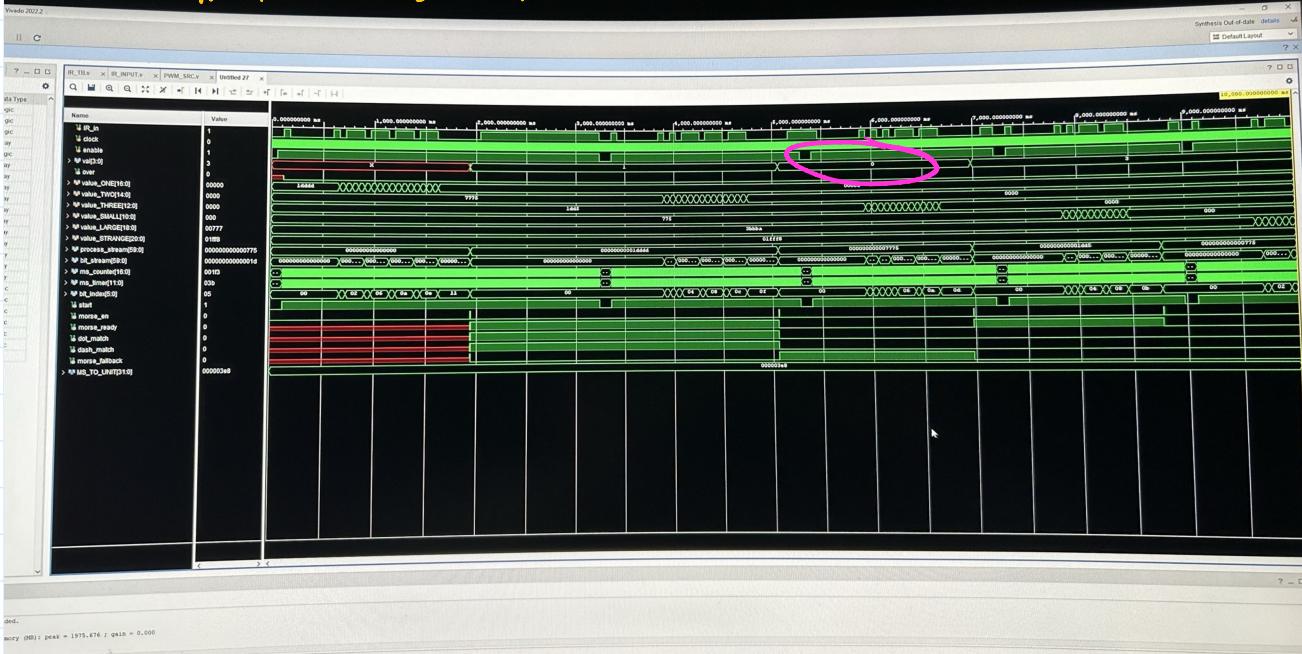
4/1/2023

DOESN'T SHE LOOK SO PRETTY ALL PUT TOGETHER LIKE THAT?



HERE ARE SOME PHOTOS OF OUR FIRST FULL INTER CONNECTING OF EVERY SYSTEM (SEE, DR. CLARK WE DON'T JUST LIVE IN THE CLOUD) EVERYTHING IS IMPLEMENTED ON BREADBOARDS BUT ALL THE SENSORS WILL BE ON PCB'S AND THE MARBLE DISPENSER CIRCUIT WILL BE ON A PROTO-BOARD

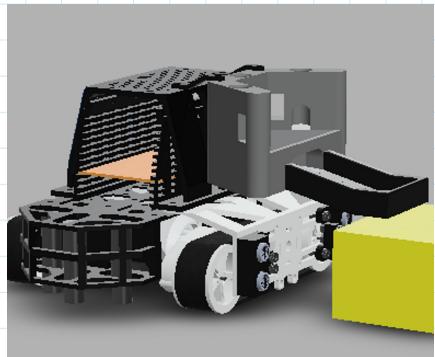
MORSE DECODING IS WORKING EVERY OTHER TIME ON THE TESTBENCH. THE PROBLEM PROBABLY LIES SOMEWHERE IN THE RESETTING OF REGISTERS.



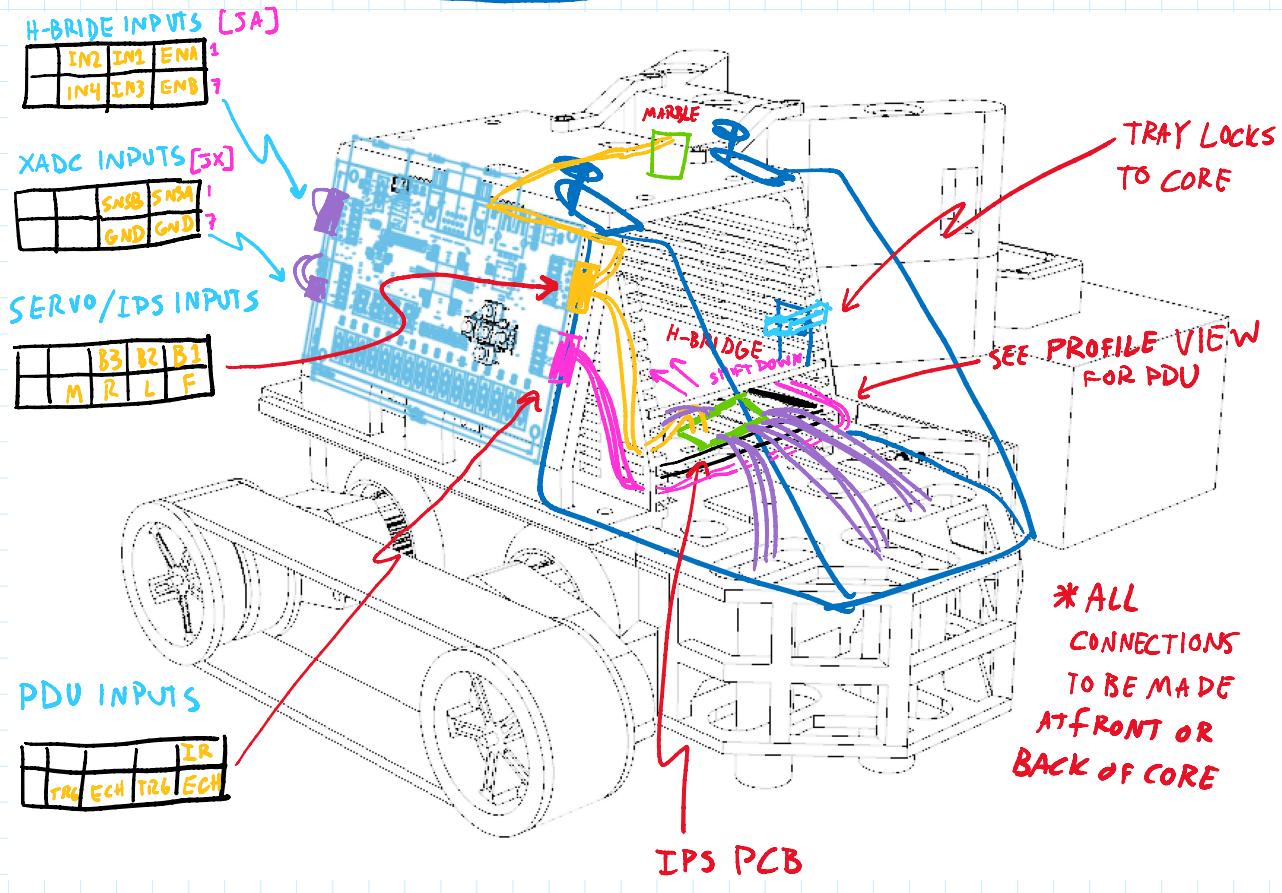


6/6/23

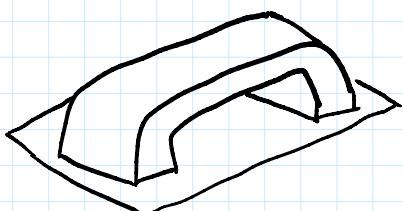
UPDATED THE TIERED-STORAGE SYSTEM & LOGAN  
ADDED THE MARBLE DISPENSER. IT IS A LITTLE  
BIG HANGING OFF OF THE SIDE OF THE ROVER



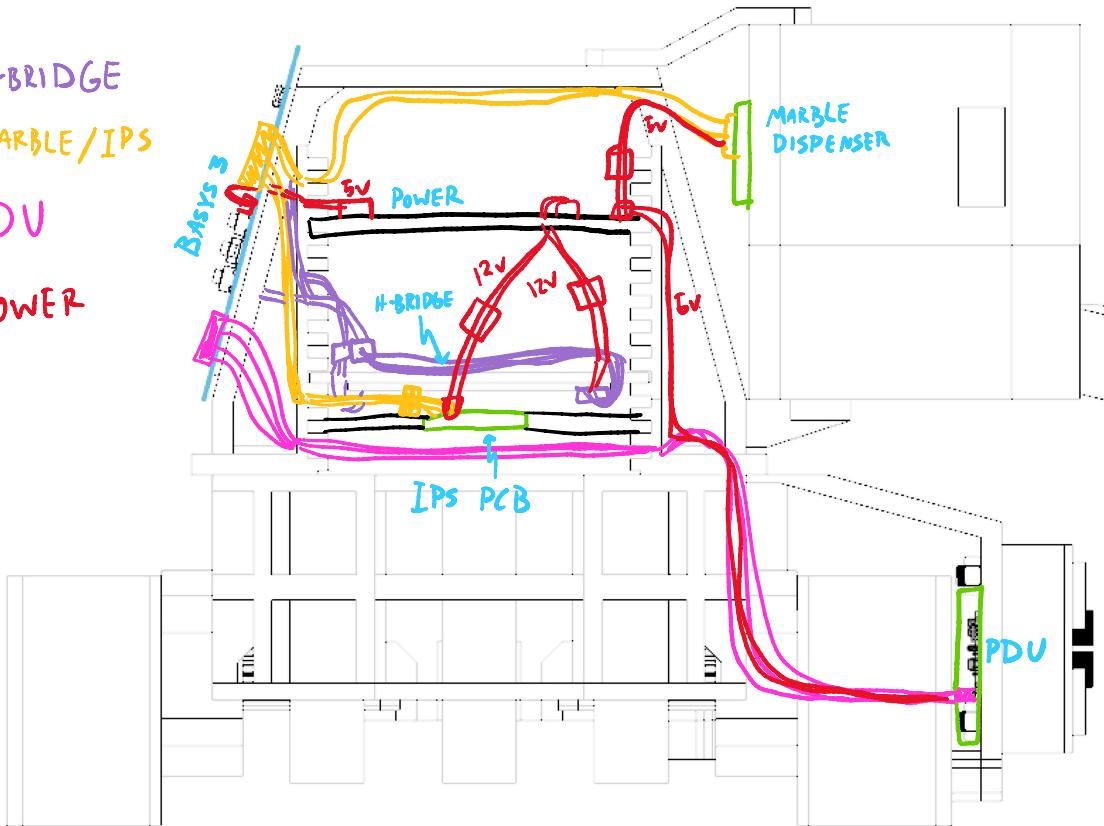
### WIRING DIAGRAM



\*NEED TO DESIGN A  
GLUE-DOWN JUMPER  
ROUTING



- H-BRIDGE
- MARBLE / IPS
- PDU
- POWER



#### Stupid Code Mistakes:

- Made memory states of left and right sensors inverted but then forgot in a different part of code to check their inverted states. So rover always made bad decisions
- Accidentally set trigger pins up as inputs instead of outputs

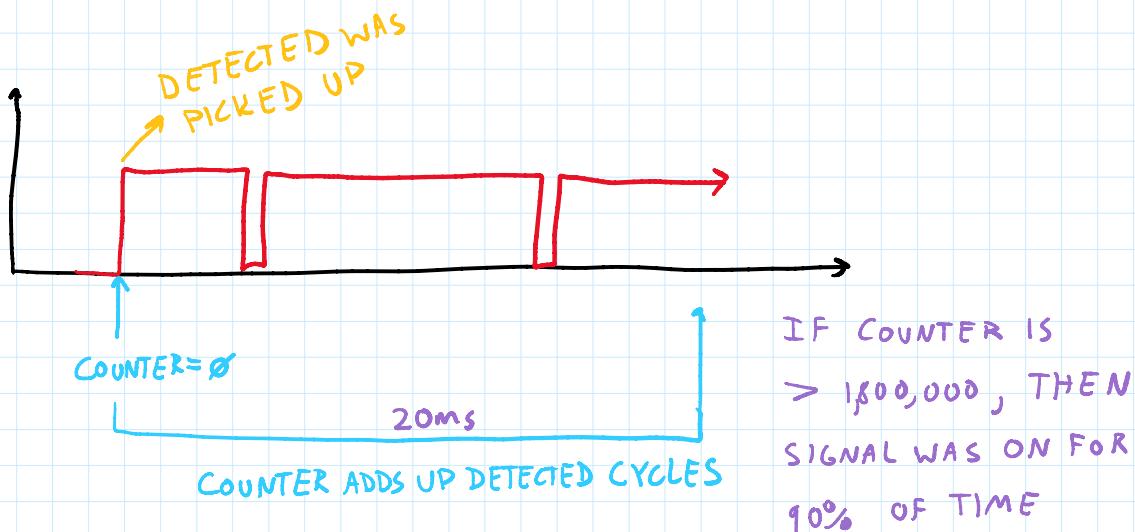
US SENSORS HAD JUST STOPPED WORKING  
AND IT WAS CONFUSING

#### US SENSOR WORKFLOW:

SENSOR IS DETECTING IF:

- SIGNAL IS ON FOR  $\approx 90\%$  OF THE TIME  
OVER A SPECIFIC SAMPLING PERIOD

## EXAMPLE SAMPLING PERIOD OVER 10ms



- SENSOR WILL SAMPLE OVER PERIOD CONTINUOUSLY,  
 AND OUTPUT WILL BE A FILTERED DETECTION SIGNAL!

REQUIRED:

- HIGH-COUNTER
- MS-COUNTER
- SAMPLE\_TIME (ms)
- SAMPLE\_PERCENT

PSEUDO CODE:

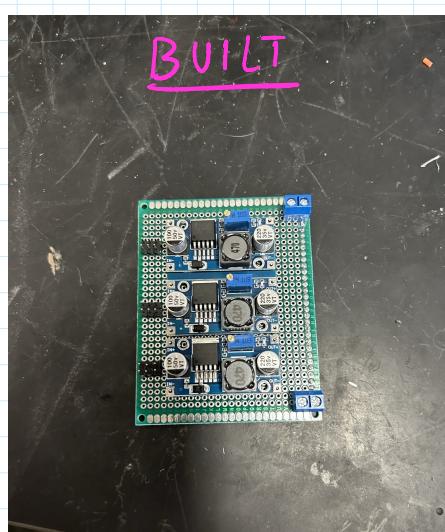
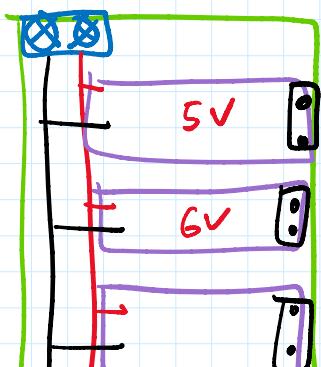
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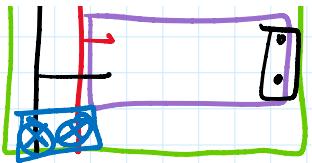
MS-COUNTER += 1
HIGH-COUNTER += DETECTED
IF(MS-COUNTER > SAMPLE_TIME * CLOCK_TO_MS)
    SAMPLED = HIGH-COUNTER > SAMPLE_PERCENT / 100
    MS-COUNTER <= 0
  
```

DESIGNED

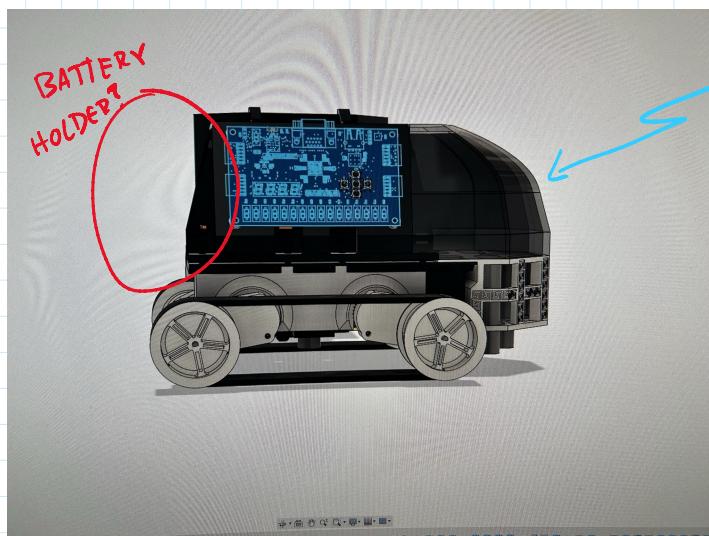
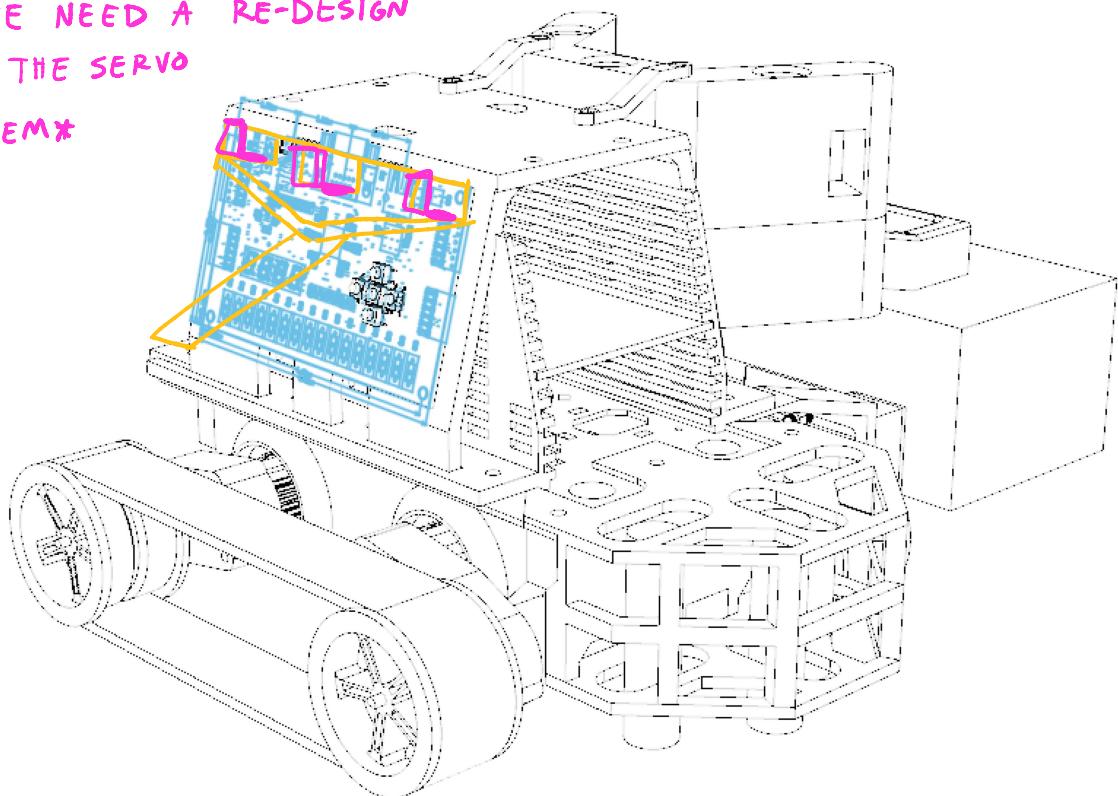
VS

POWER  
BOARD

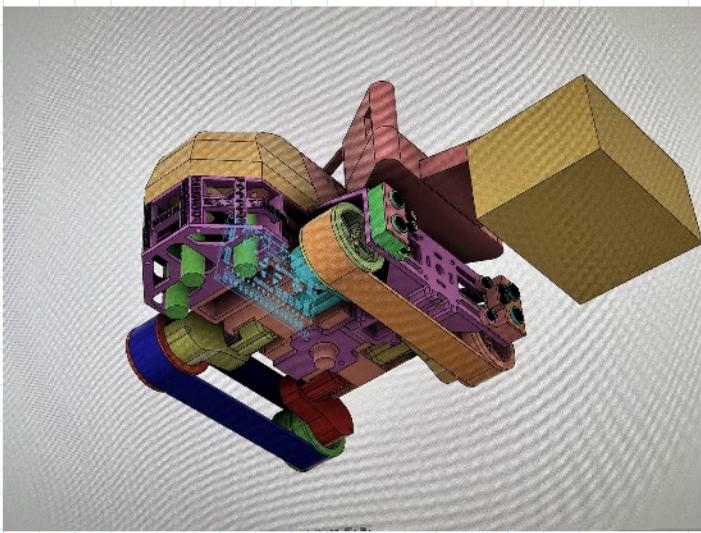




\*WE NEED A RE-DESIGN  
OF THE SERVO  
SYSTEM\*



THE "NAUTILUS SHELL" IS A PIECE  
THAT I DESIGNED TO ROUND OUT THE  
FRONT OF THE BOT AND CONCEAL  
OUR WIRES

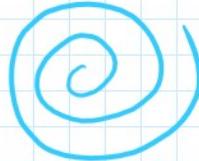


\* JUST DISCOVERED THAT FUSION 360  
HAS A "COLOR BY COMPONENT"  
OPTION \*

4/11/2023    WHAT'S LEFT?

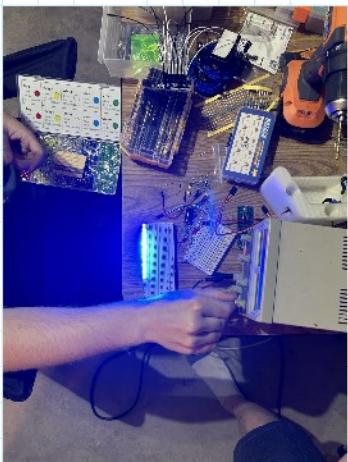
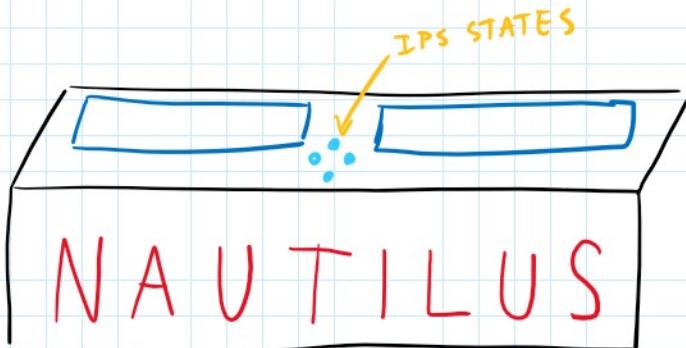
18 DAYS LEFT

- FINISH MORSE DECODING → 1 DAY
- TEST IR PCB → 1 DAY
- TO DESIGN:
  - H-BRIDGE TRAY
  - IPS TRAY
  - POWER BOARD TRAY
  - SENSOR PLATE
  - DISPLAY RIG
  - NEW MARBLE DISPENSER (LOGAN)
  - BACK PLATE (BATTERIES)
- TO PRINT
  - NAUTILUS SHELL
  - IPS UNIT
- UPDATE GITHUB WIKI (LOGAN & BRETT)
- DESIGN CIRCUIT FOR NAUTILUS SHELL LED's
- DESIGN NAUTILUS LOGO → 0.5 DAYS
- ESP - NAUTILUS COMMUNICATION → 2 DAYS
- ESP LCD CODING → 1 DAY



- DISPLAY DATA ON LCD
- SEND DATA THROUGH INTERNET

## DISPLAY PLATE

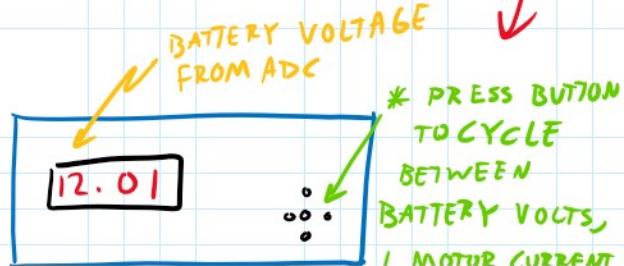


THE OTHER SIDE OF NAUTILUS NEEDS SOMETHING TO MAKE THE ROBOT SYMMETRICAL, SO WHY NOT A COOL LED DISPLAY OF THE LETTERS AND SOME LCD'S TO DISPLAY VARIABLES

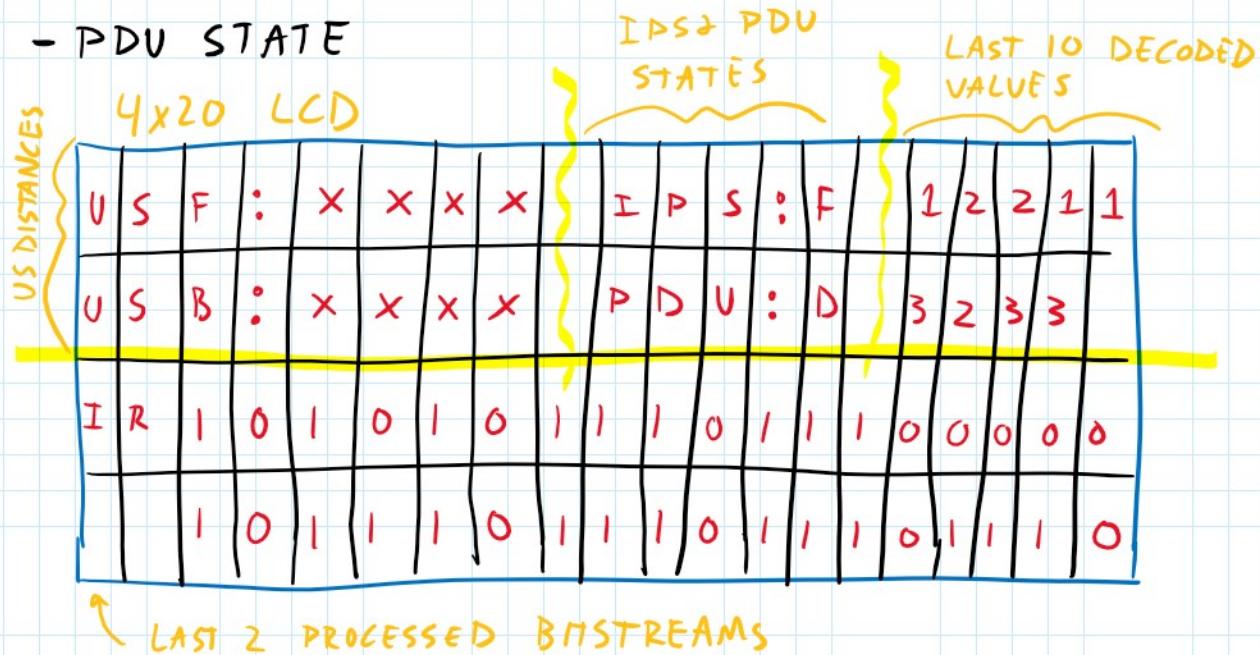
I PUT BRETT ON THE CIRCUIT FOR LED'S WITH A DELAY TO TURN ON/POWER OFF. I HOPE THAT CAPACITORS WORK FOR THIS, BUT 555 TIMERS OR A SEPARATE MICROCONTROLLER IS AN OPTION

## DATA TO DISPLAY:

- VOLTAGE OF BATTERY SUPPLY (ON BASYS)
- CURRENT THROUGH L/R MOTORS
- STATES OF IPS SENSORS (4 LED's)
- US DISTANCES
- IR BITSTREAM



- IR BITSTREAM
- DECODED NUMBERS
- IPS STATE
- PDU STATE



BASYS AND ESP SHALL COMMUNICATE THROUGH  
I2C OR SPI

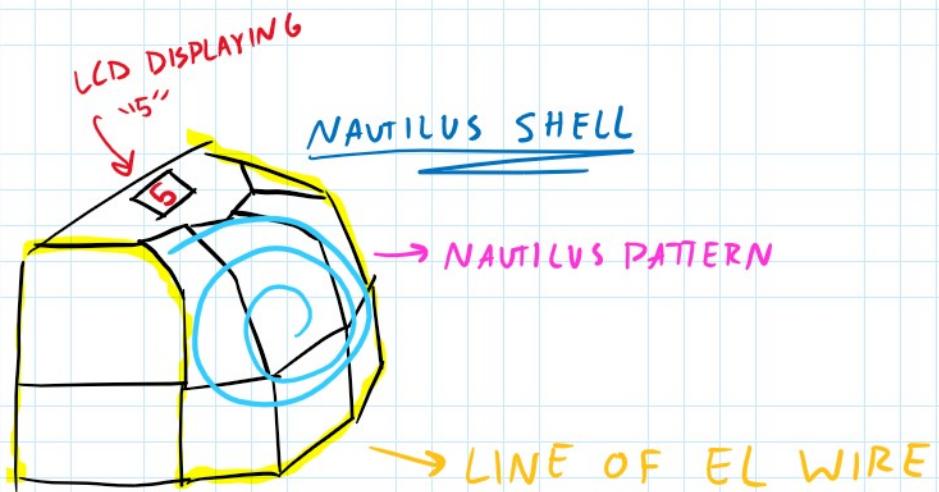
WHICHEVER IS EASIER ON THE BASYS

THE "DISPLAY" VERILOG MODULE SHALL BE OVERHAULED

TO THE "DATA" MODULE

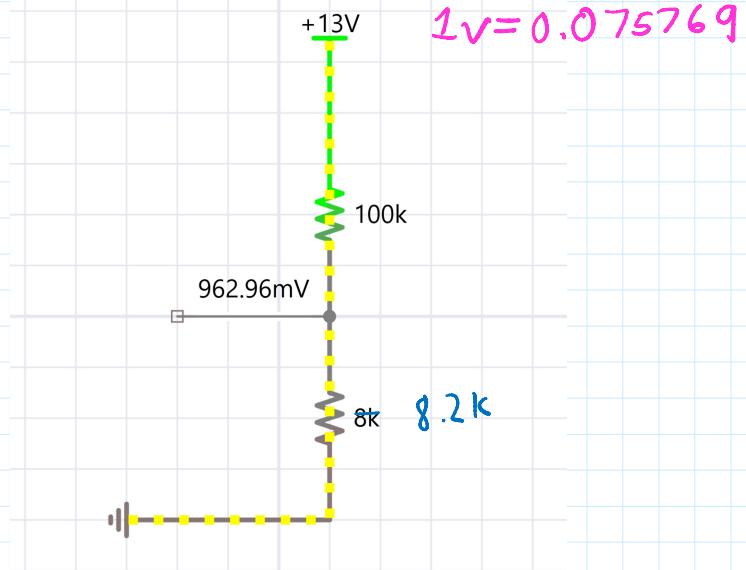
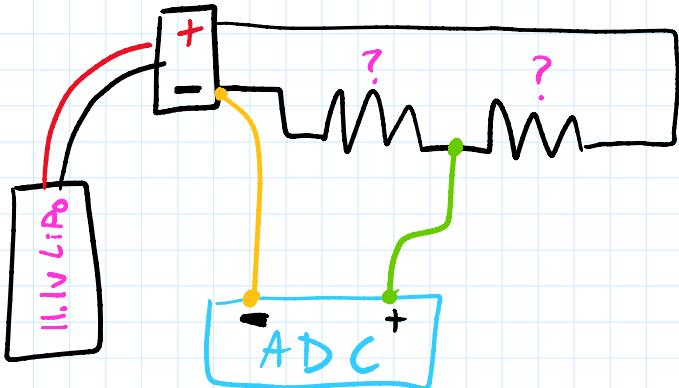
- CONTROL 7-SEGMENT & LED's ON BASYS
- COMMS WITH ESP

- { SEND TIME ELAPSED, BATTERY VOLTAGE, CURRENT THROUGH MOTORS, IPS STATE & SENSOR STATES, US DISTANCES & PDU STATE, IR PROCESSED STREAM, LAST DECODED VALUE }



HOW TO READ BATTERY VOLTAGE WITH ADC

$$13V = 0.985 V_{R2}$$



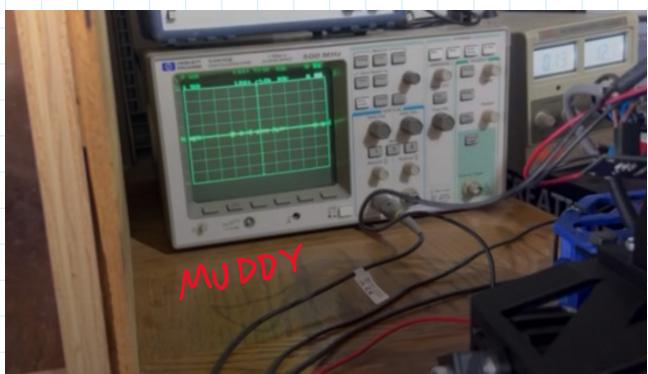
4/16/2023

FOUND THAT INPUTS TO COMPARATOR

MUST BE 2V BELOW V<sub>cc</sub> OF COMPARATOR!

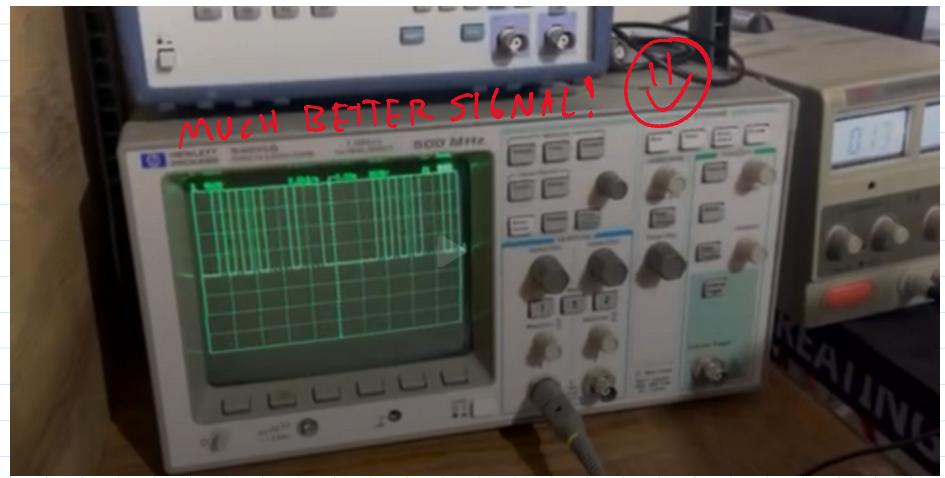
NOT GOOD.

It turned out okay! We were simply pulling our output signal down to ground which was causing issues with the IR signal. Removing the resistor solved our problem.



MORE IR PROBLEMS

THE SIGNAL IS MUDDY. I THOUGHT IT WAS A SOFTWARE ISSUE BEFORE SEEING THIS SIGNAL ON THE SCOPE



BRETT SUGGESTED ADDING A PULLUP RESISTOR TO THE CIRCUIT, WHICH IS WHAT HE DID WHEN HE FIRST MADE THE COMPARATOR CIRCUIT ON THE BREADBOARD!

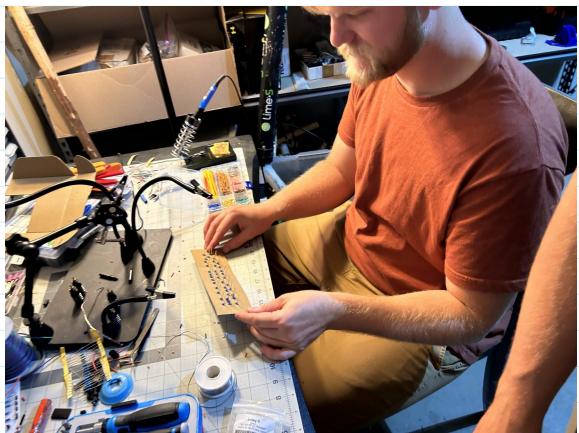


LOGAN AND I HAVE ASSEMBLED THE 3D-PRINTED BODY. ONLY A LITTLE BIT OF DREMELLING WAS REQUIRED, AND IT LOOKS GOOD!

\* WE ARE PRESENTING THE ROVER TO A DONOR TOMORROW \*

THE NAUTILUS LETTERS WERE PRINTED AT 1:1 SCALE SO THAT BRETT CAN POKE HOLES IN THE PAPER AND CREATE THE LED CIRCUIT





IT WORKED VERY WELL!

— BUT HE DID IT ALL BACKWARDS!!

WHOOPS



E C E  
BANQUET

WITH THE GANG

Week 11

Sunday, April 23, 2023 10:43 PM



STARTING THE WEEK OFF RIGHT  
BY WATCHING TIM, BLAKE AND  
ADAM'S ROBOT DISPENSE GUMBALLS  
FROM ITS SHAFT DIRECTLY INTO  
LANDON'S MOUTH!

\*WE NEED TO FINISH PRINTING  
LOGAN'S NEW MARBLE DISPENSER\*

BRETT FINISHED THE  
NAUTILUS  
DISPLAY AND DAMN  
DOES IT DAZZLE!



#### ESP-Nautilus Communication

1. Send data from basys to esp
2. Display data on lcd from esp
3. Display data on console log app on desktop
4. Change constant values from console app to basys for data collection such that testing/tuning can be done without having to push through bitstreams all the time
5. Display rover motion in console app / create map as rover navigates the track

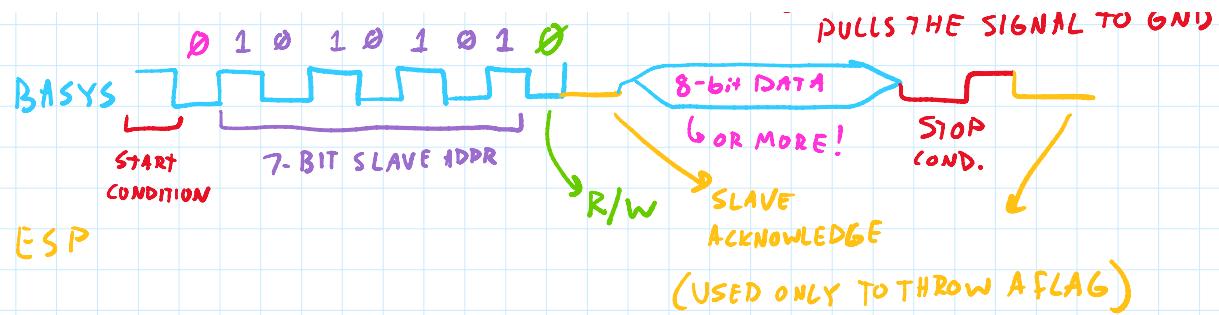
Can we get encoders on the wheels working?

- PID control system between wheels and basys to maintain RMP on left / right side
- Send rotation data to console program to accurately map the entire track
  - o Otherwise, the map will have to be made based on rotation for time and assuming acceleration values

I<sub>2</sub>C FROM BASYS → ESP



\*I<sub>2</sub>C WORKS ON ONE PIN FOR  
DATA AND ANOTHER AS THE CLOCK.  
PULLUP RESISTORS ARE CONNECTED TO  
BOTH DEVICES. THE DEVICE SENDING DATA  
PULLS THE SIGNAL TO GND

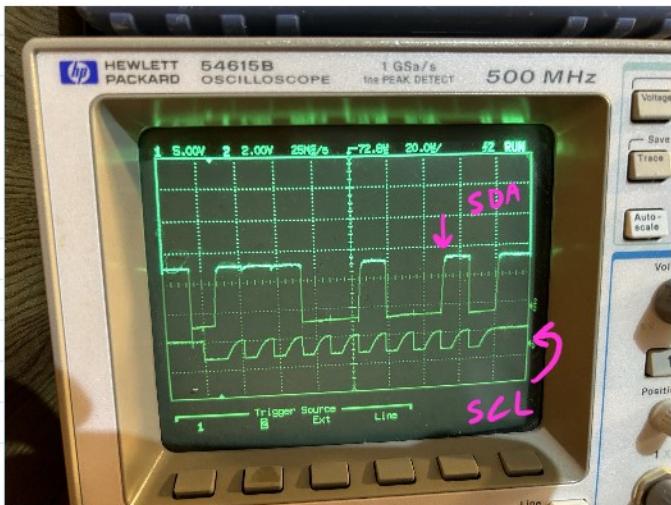


## SCRATCH USING BASYS AS MASTER. ESP NEW MASTER

- CONTROLS LCD ON ADDRESS  $0x3F$
- CONTROLS BASYS ON ADDRESS  $0x72$

### ESP → BASYS

- RESERVE 20 bytes of data for constant values
  - ↳ SPEEDS: FORWARD, REVERSE, ROTATE, SLOW-F, SLOW-R, BOX-DETET
  - ↳ US\_DISTANCE
  - ↳ CHAR\_MIN\_MS
  - ↳ MARBLE OPEN/CLOSE
  - ↳ DISPENSE TIME
  - ↳ XBOX? (ARCADE DRIVE, DISPENSE)



## \* DEBUGGING I<sup>2</sup>C SIGNAL \*

BASYS → ESP

\* DATA WILL BE SENT AS RAW HEX AND DECODED BY ESP \*

- RESERVE 20 bytes of data for display data

- ↳ 1 BATTERY VOLTAGE, CURRENT THROUGH L/R MOTORS
  - ↳ 2 IPS-STATE
  - ↳ 3 PDU STATE
  - ↳ 4 US DISTANCES
  - ↳ 5 & 6 PROCESSED STREAM
  - ↳ 7, 8, 9 LAST DECODED VALUE
  - ↳ 10 FLAGS?
  - ↳ 11 NEW VALUE
  - ↳ IPS TRIPPED
  - ↳ CURR\_OF
  - ↳ VS\_DETECTED × 2
  - ↳ OF ACTIVE
  - ↳ DRIVE ACTIVE
- \* Wake up at 8:00 to speak with Woody → SOURCE ENCODERS IN CASE ✓

TO DO

T-MINUS 4 DAYS

- ESP/BASYS COMMS 1 DAY

- PID LOOP w/ ENCODERS  
??? PROB NOT

- **ESP/BASYS COMMS** 1 DAY
- **CONSOLE** 2 DAYS
- **LOGO**  $\approx$  0.5 DAYS
- **IR CONE DESIGN**  $\approx$  0.25 DAYS

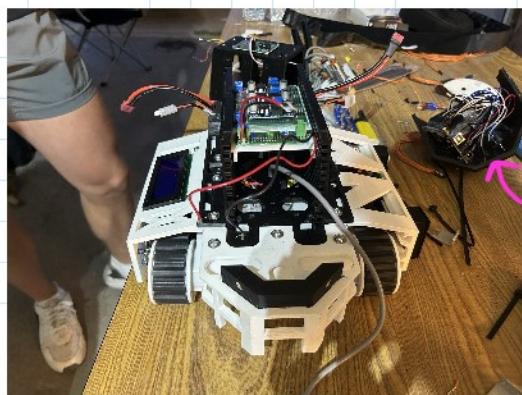
**\*FIT & FINISH\***



- **PID LOOP w/ ENCODERS**

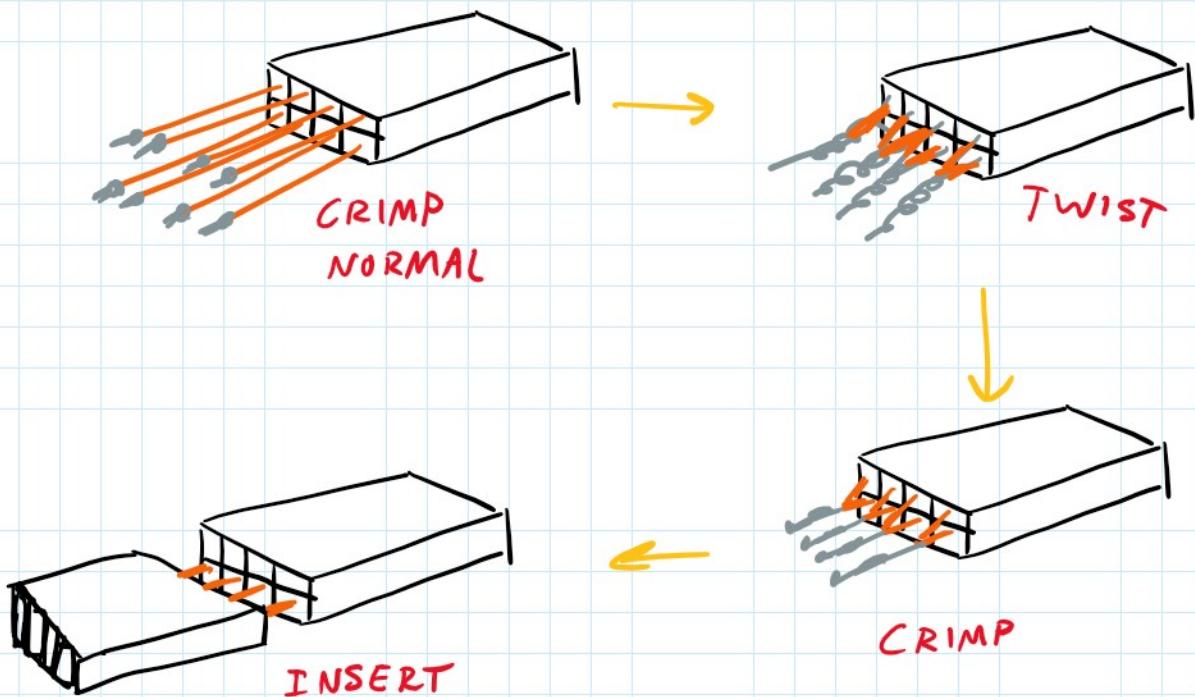
??? PROB NOT

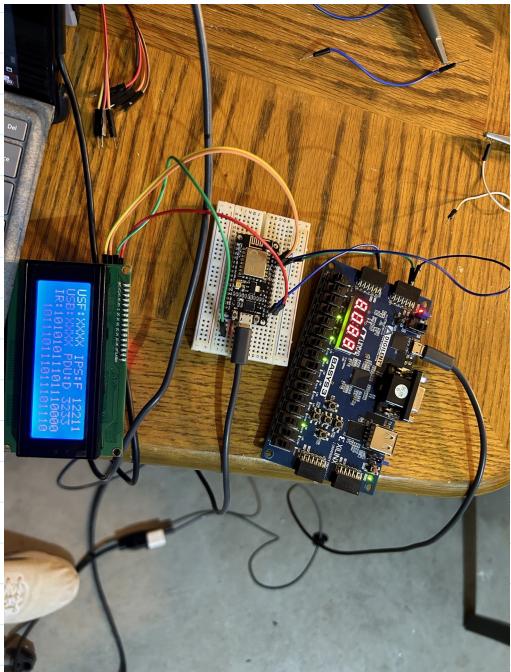
- **FIX GEAR BOXES (LOGAN)**
- **NAUTILUS SHELL (BRETT)**
- **FIX WIRES (BRETT)**
- **PRINT PARTS (LOGAN)**



NAUTILUS  
SHELL w/  
ARDUINO  
CONTROL

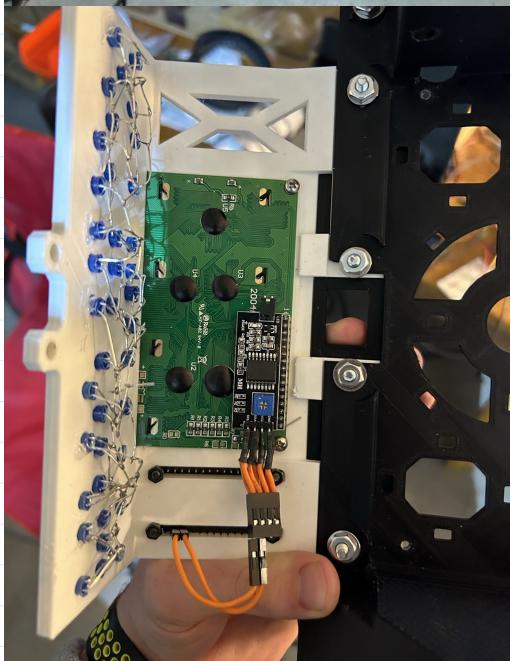
## I<sub>2</sub>C CIRCUIT





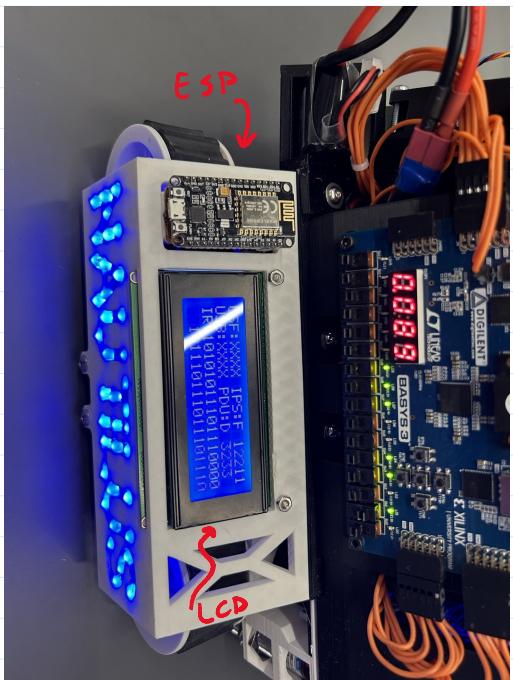
BASYS → ESP → LCD

THE BASYS DOES NOT LIKE TO  
LATCH ONTO SCL FROM ESP,  
HOW TO FIX?



HERE IS THE DISPLAY SYSTEM MOUNTED  
WITH THE SPECIALLY-CRIMPED  
WIRES THAT BRETT PREPARED

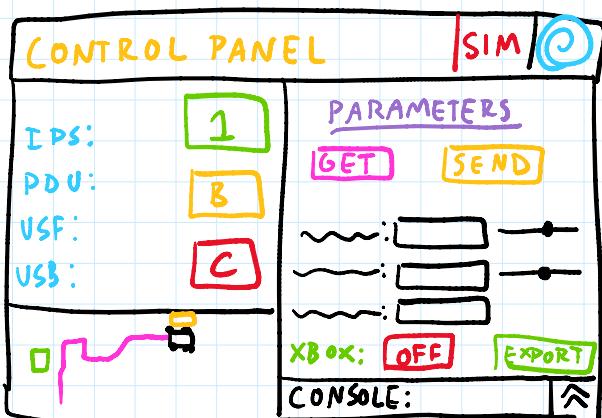
WE ARE SLIGHTLY WORRIED ABOUT  
THE WIRES CATCHING IN THE TREAD



## DISPLAY RIG IN ACTION

- 20 BYTES OF DATA SENT/ RECEIVED FROM BASYS
- CURRENTLY ONLY THE DATA FROM THE BASYS IS USED
- XBOX CONTROL WOULD BE COOL

## UNITY SIM:



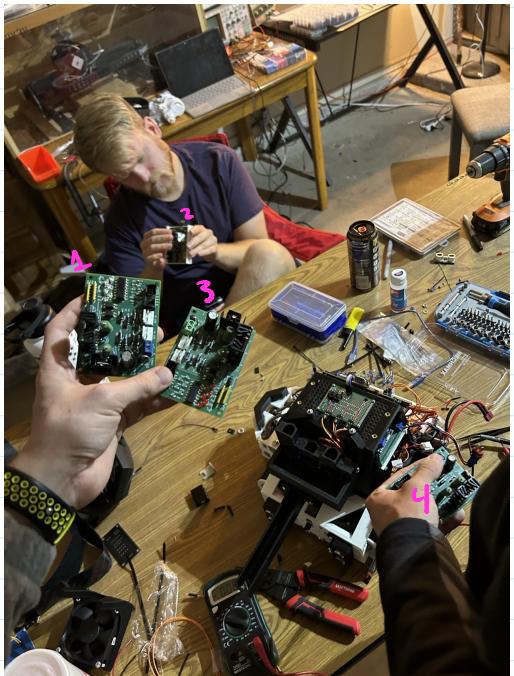
### VALUES TO COLLECT:

- ROVER MOVEMENT SPEEDS
  - FORWARD (SLOW vs FAST)
  - REVERSE
  - TURN



\* ADD A BIT TO MOTOR SPEED \*

↳ MADE 7 BITS TO REPRESENT %



### PROGRAM TO DO:

- BASYS SENDS/RECEIVES H
- BASYS PARAM REWRITE → INPUTS FROM H DATA MODULE
- UDUINO FUNCTION IMPLEMENTED TO SEND UPDATED VALUES E
- UDUINO FUNCTION TO RECEIVE UPDATED VALUES E
- UNITY CONTROL PANEL! E
  - BINS UPDATE TO FINAL VALUES
  - IR VALUES UPDATE USING FLAGS M
  - SAVE TO .TXT FUNCTION M

### H-BRIDGE TROUBLES

- SEVERAL OF OUR H-BRIDGES ARE FAULTY!!
- THE ONE THAT WE WERE USING BROKE
- WE WILL EITHER GET A NEW ONE OR USE LOGAN'S IF IT WORKS

H

### • READ BATTERY VOLTAGE

- BASYS SEND CURRENT PARAMETERS H

—

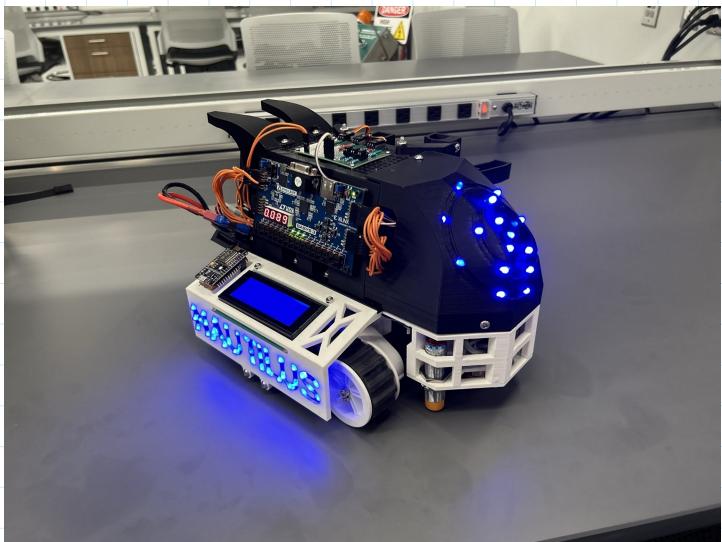
- UDUINO FUNCTION TO RECEIVE BASYS VALUES E

- UDUINO FUNCTION TO SEND CONSOLE STREAM E

- BUTTON TO SWITCH FROM SIM TO CONTROL PANEL E

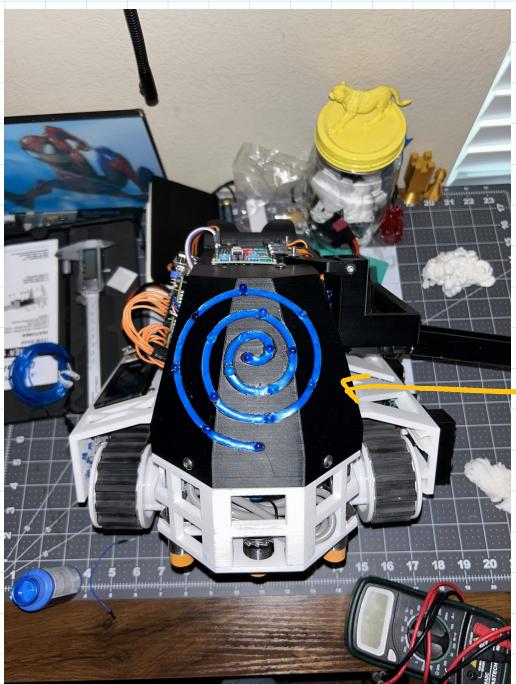


NEW CAD IS IN  
UNITY READY TO  
SHOW TO SPECTATORS



NAUTILUS SHELL IS ALL CONNECTED  
AND ENTIRE SYSTEM IS  
ASSEMBLED.

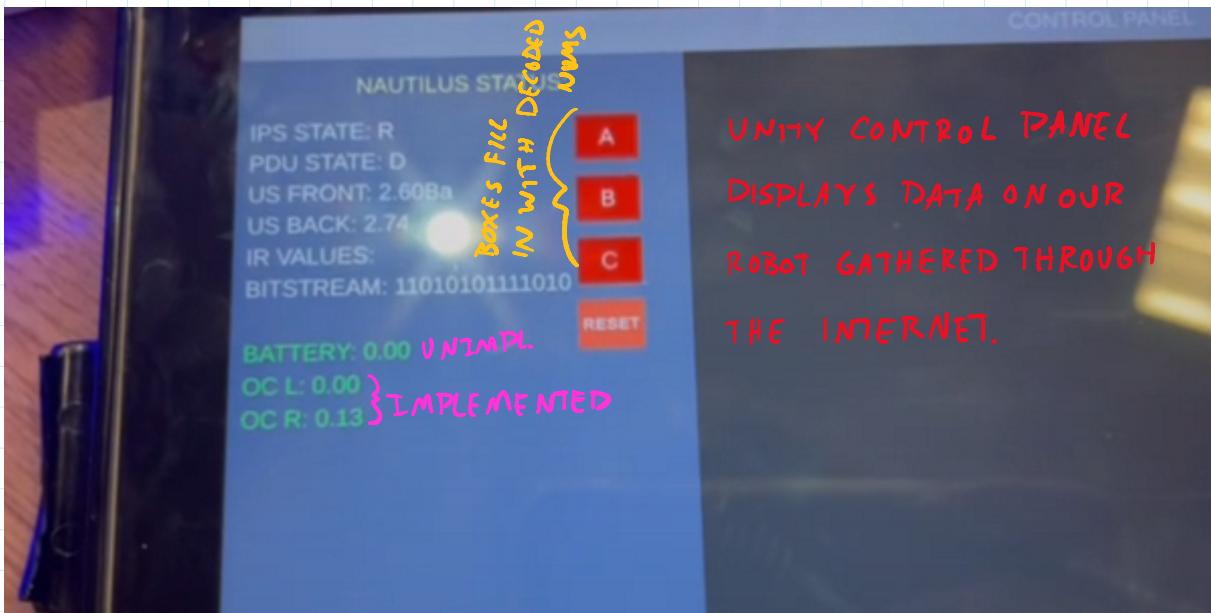
- ↳ DISPLAY RIG
- ↳ NAUTILUS SHELL
- ↳ MARBLE DISPENSER
- ↳ BATTERY HOLDER
- ↳ FAN MOUNT
- ↳ PCB TRAYS

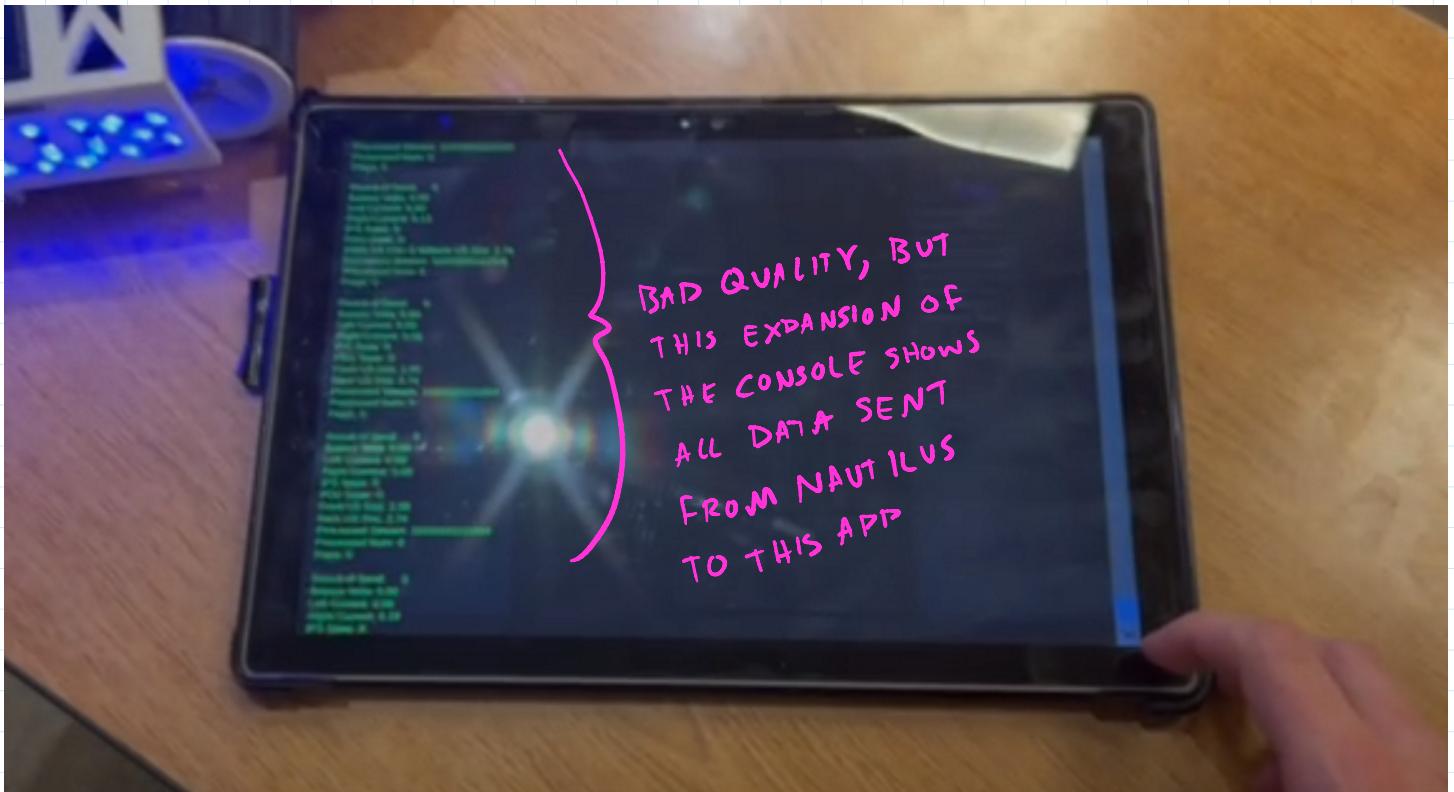
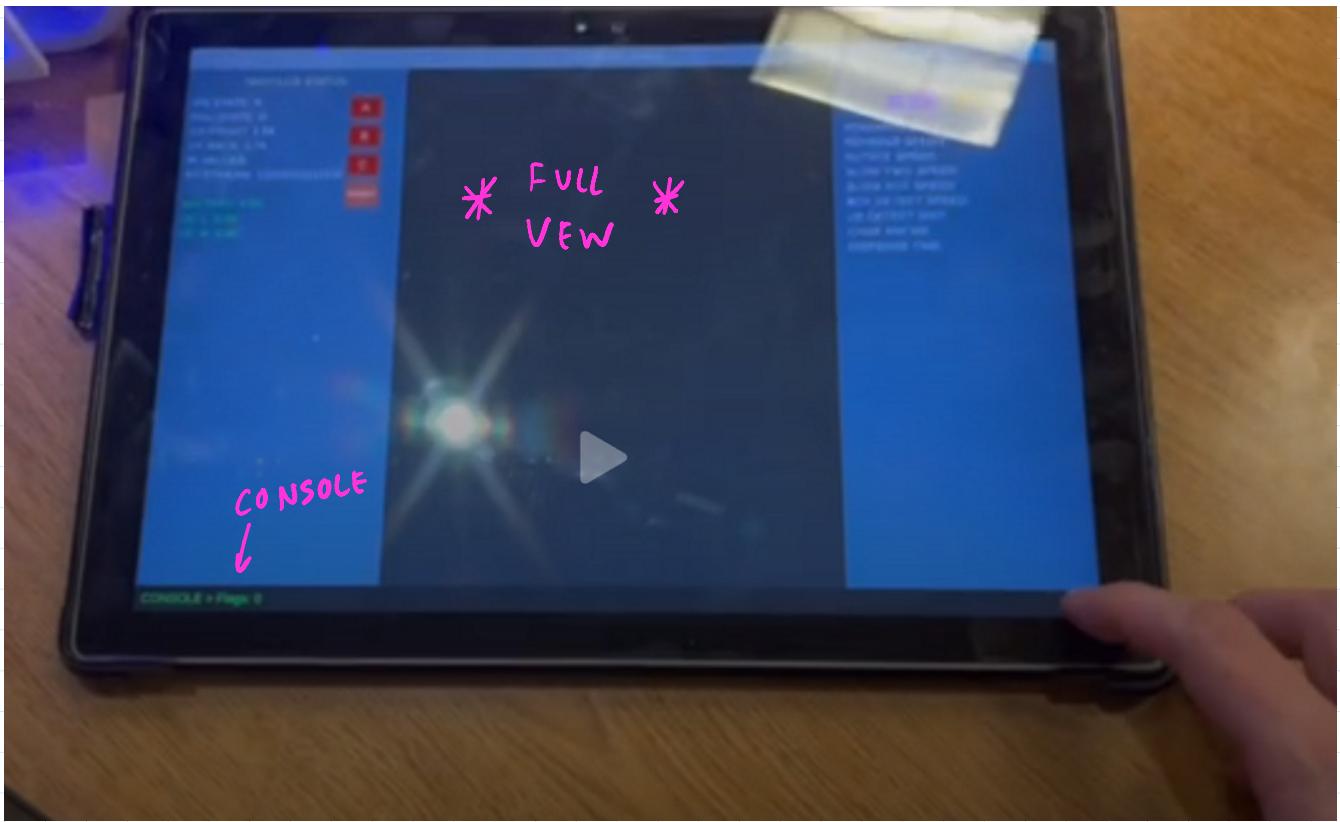


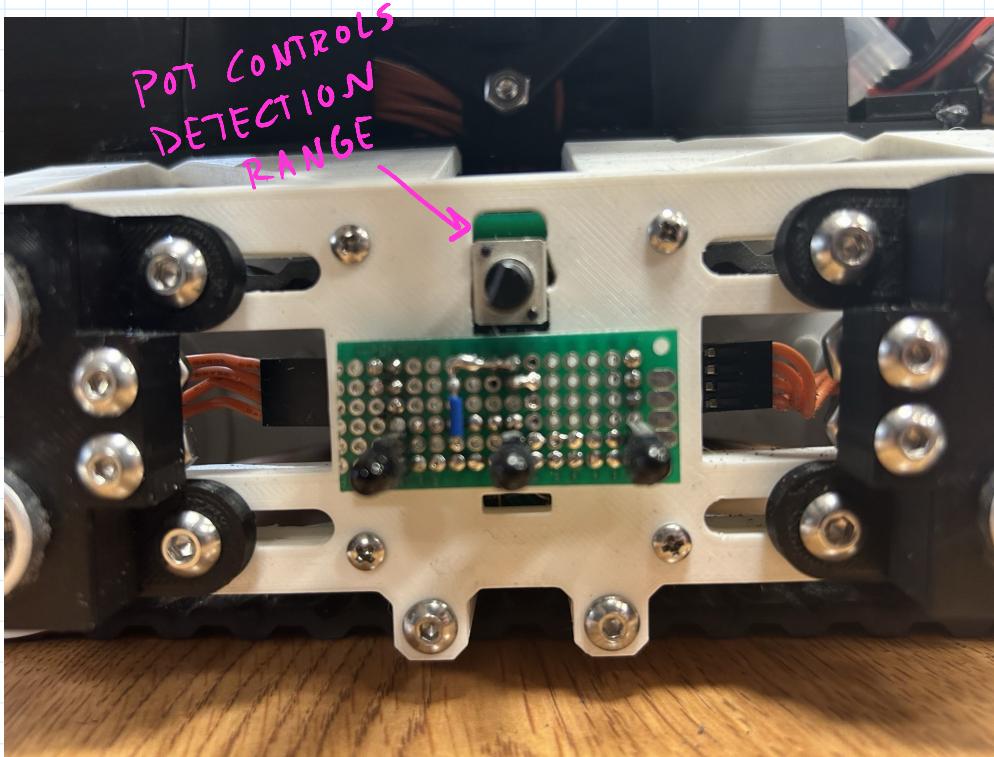
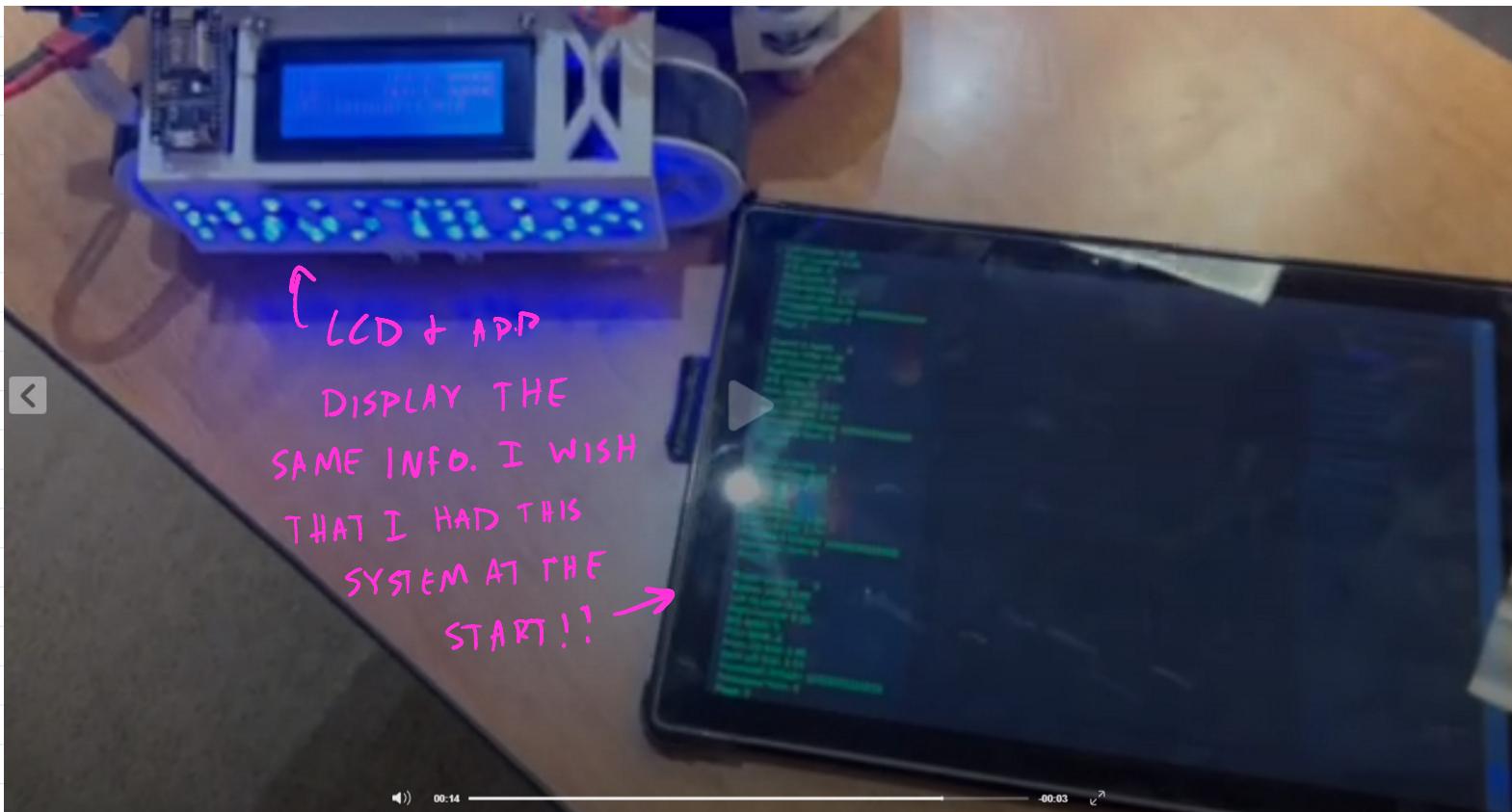
I USED A SYRINGE & ACRYLIC PAINT  
TO COLOR THE SPIRAL



ANOTHER CLOSEUP OF THE  
\*WORKING\* LCD  
DISPLAY







\*LAST MINUTE\*

-WE FOUND THAT THE  
IR TRANSISTORS WORK  
IN PARALLEL  
-LOGAN CREATED THIS  
BOARD TO EXPAND  
OUR IR DETECTION  
HORIZGNTALLY



OFF TO DEMO DAY !!!