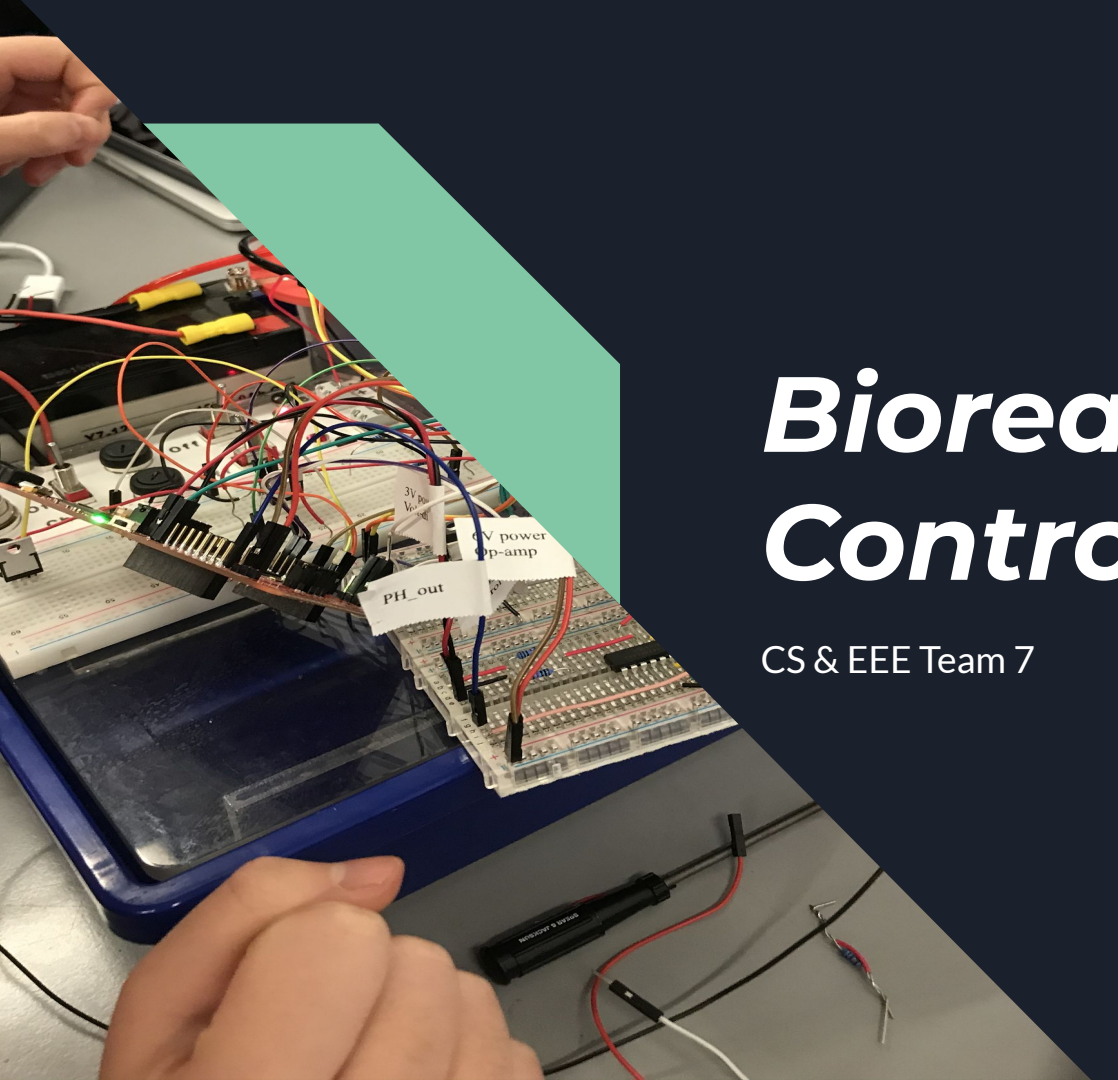
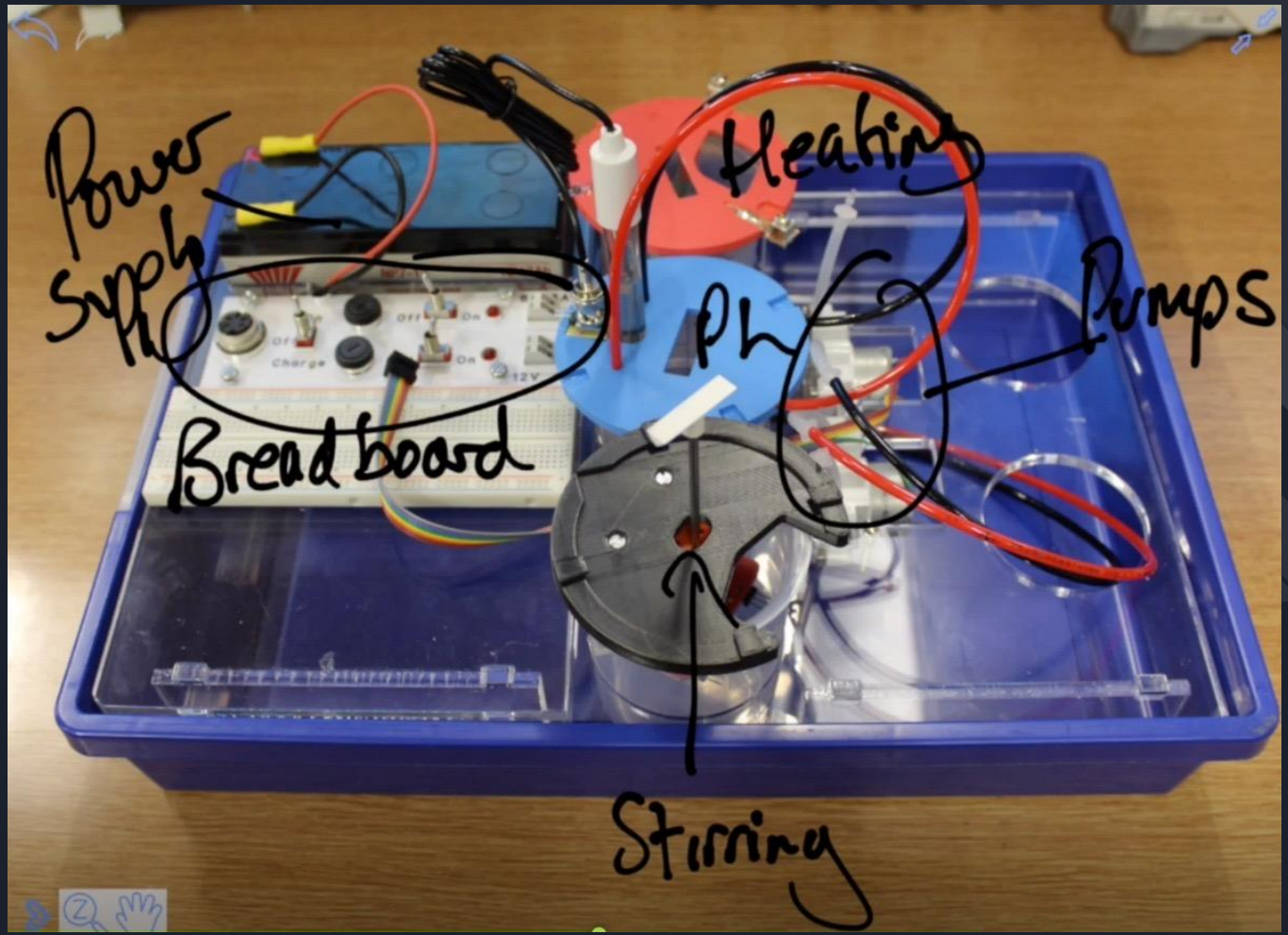


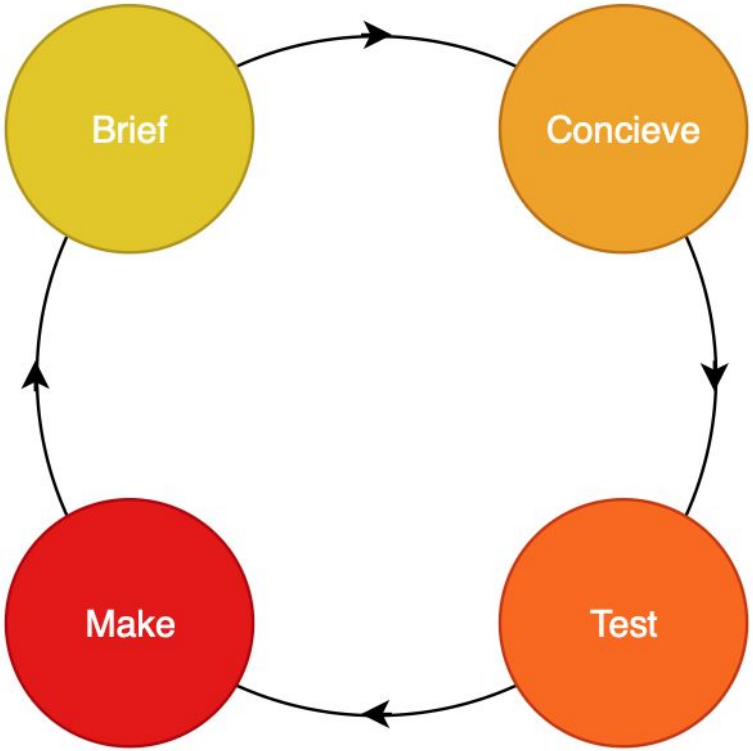
Bioreactor Control System

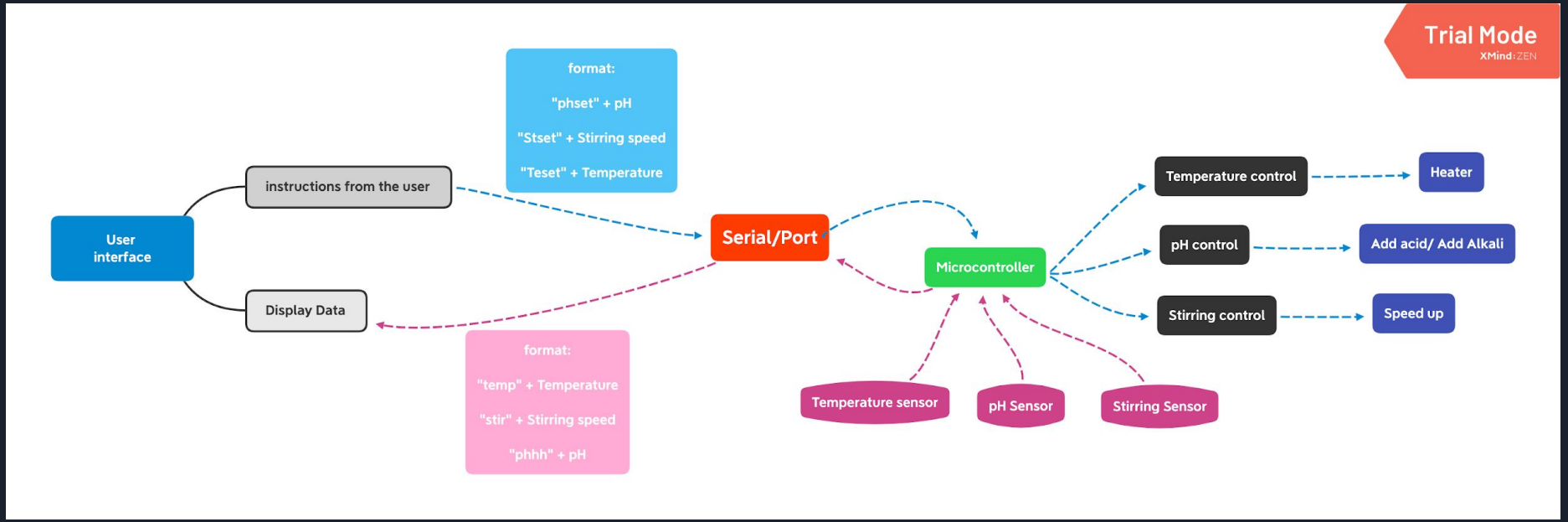
CS & EEE Team 7

Hardware platform



Design process





User Interface

sketch_191128b

10.131
Bio Reactor CS-EEE-7

PHSUBMIT

PH

STIRSUBMIT

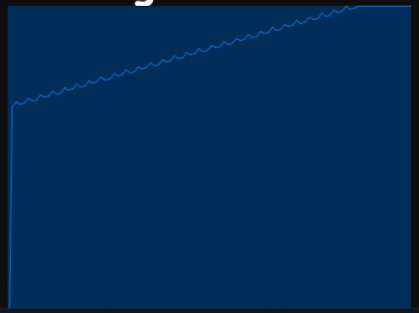
STIRRING

TEMPSUBMIT

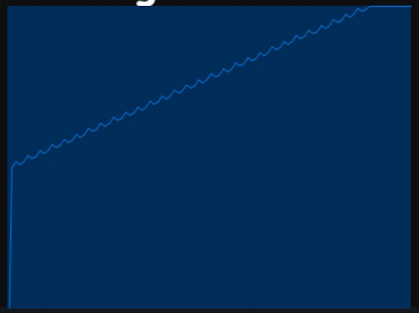
HEATING

```
Current temperature is 40.84996
Current pH is 10.150002
Current stirring speed is 2037
Current temperature is 41.34996
Current pH is 10.270001
Current stirring speed is 2067
Current temperature is 41.09996
Current pH is 10.240002
Current stirring speed is 2052
Current temperature is 41.19996
Current pH is 10.300002
Current stirring speed is 2064
Current temperature is 41.69996
Current pH is 10.420002
Current stirring speed is 2094
Current temperature is 41.44996
Current pH is 10.390002
Current stirring speed is 2079
```

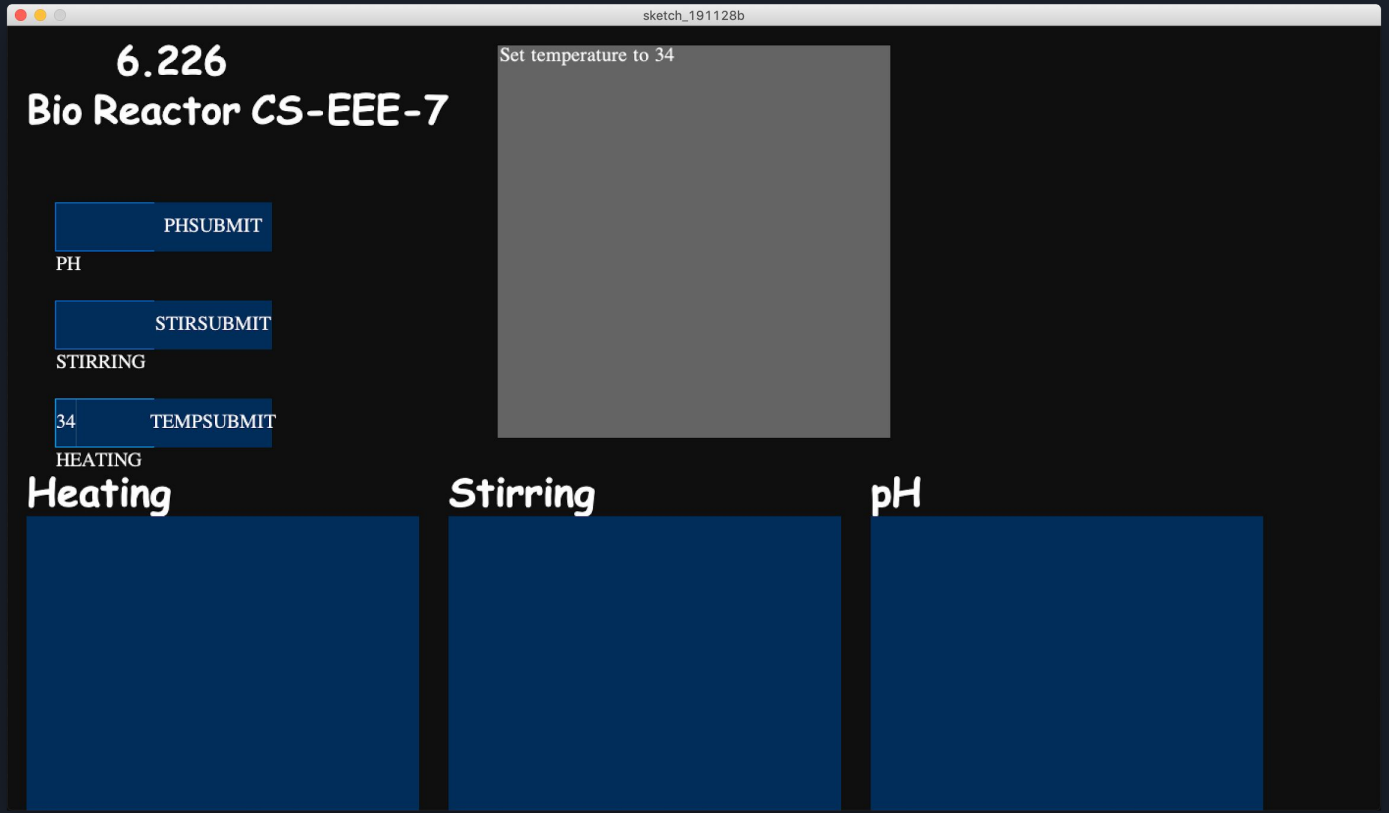
Heating



Stirring



pH


sketch_191128b
6.226
Bio Reactor CS-EEE-7
Set temperature to 34
PHSUBMIT
PH
STIRSUBMIT
STIRRING
34
TEMPSUBMIT
HEATING
Heating
Stirring
pH

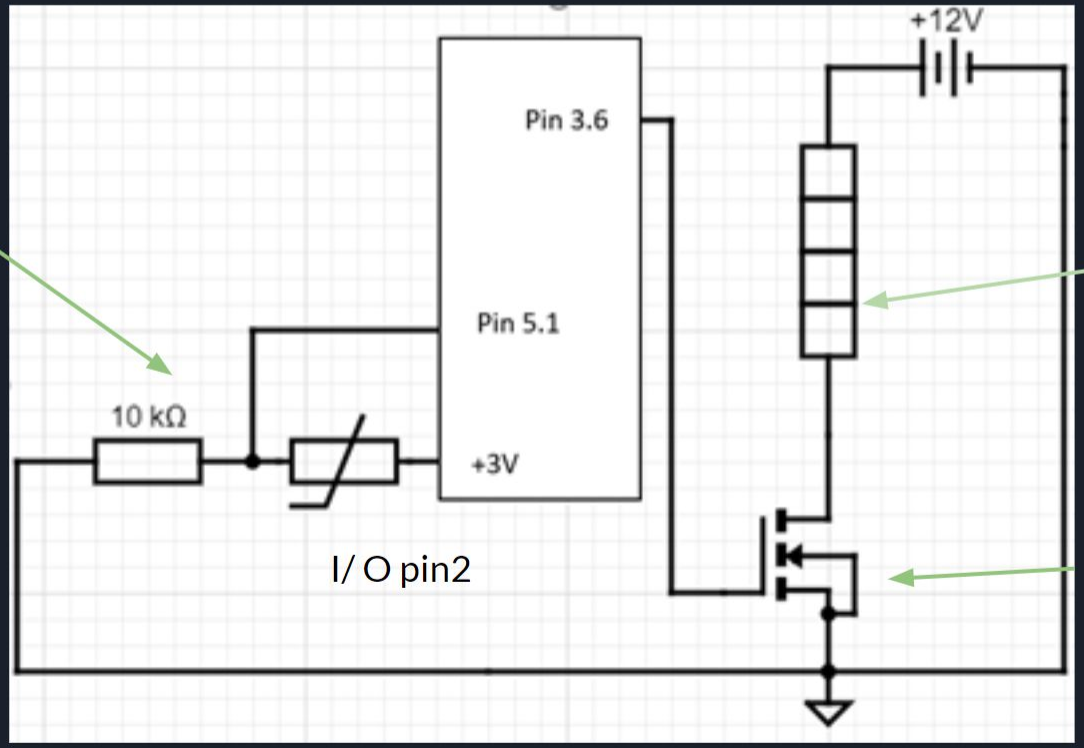
Heating Requirements:

- Water comes in at 10-20 degrees Celsius
- User can set a temperature from 25- 35 degrees Celsius
- The system should maintain a temperature within 0.5 degrees Celsius of the desired temperature.

Heating Subsystem

Circuit

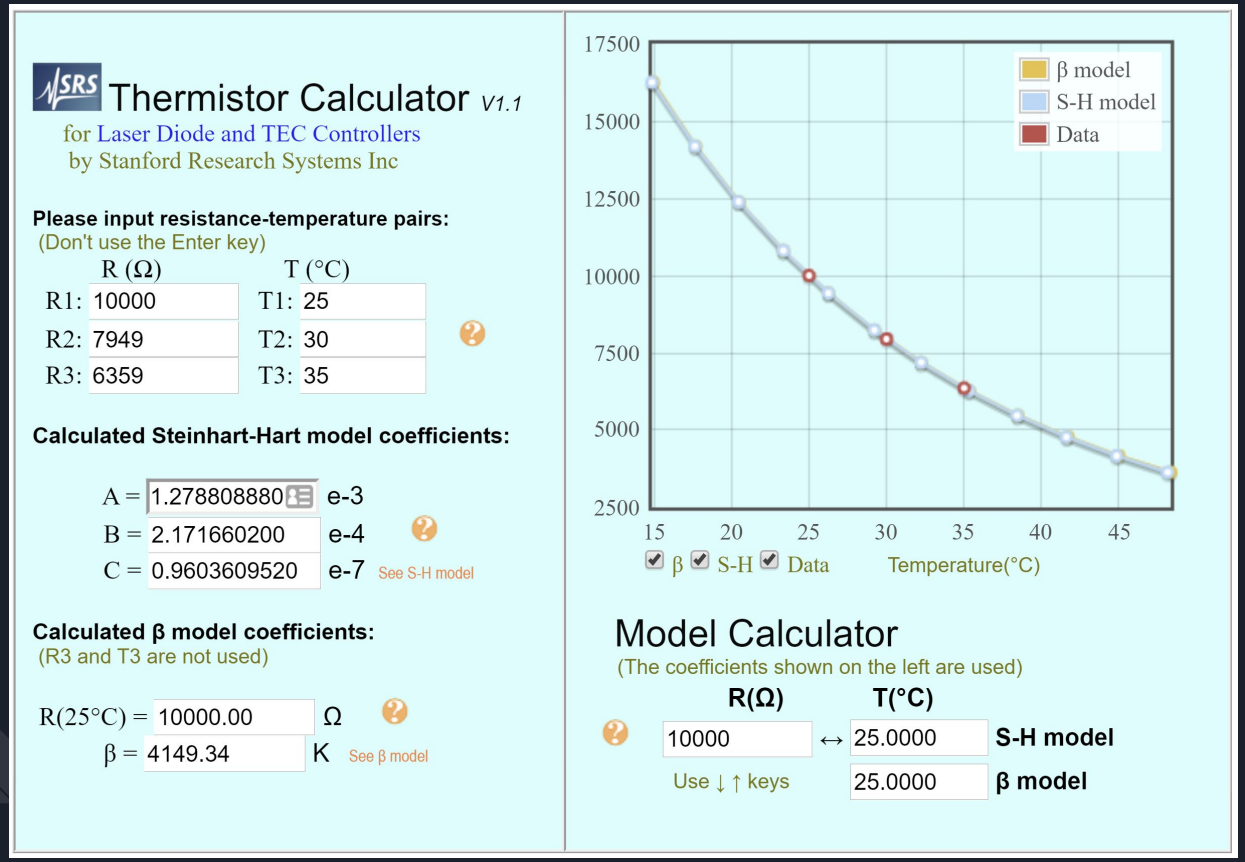
Potential Divider circuit to measure voltage across resistor instead of thermistor as the thermistor would otherwise use all the voltage and always read 3V. Voltage used to work out temperature using Steinhart-hart equation.



Heater

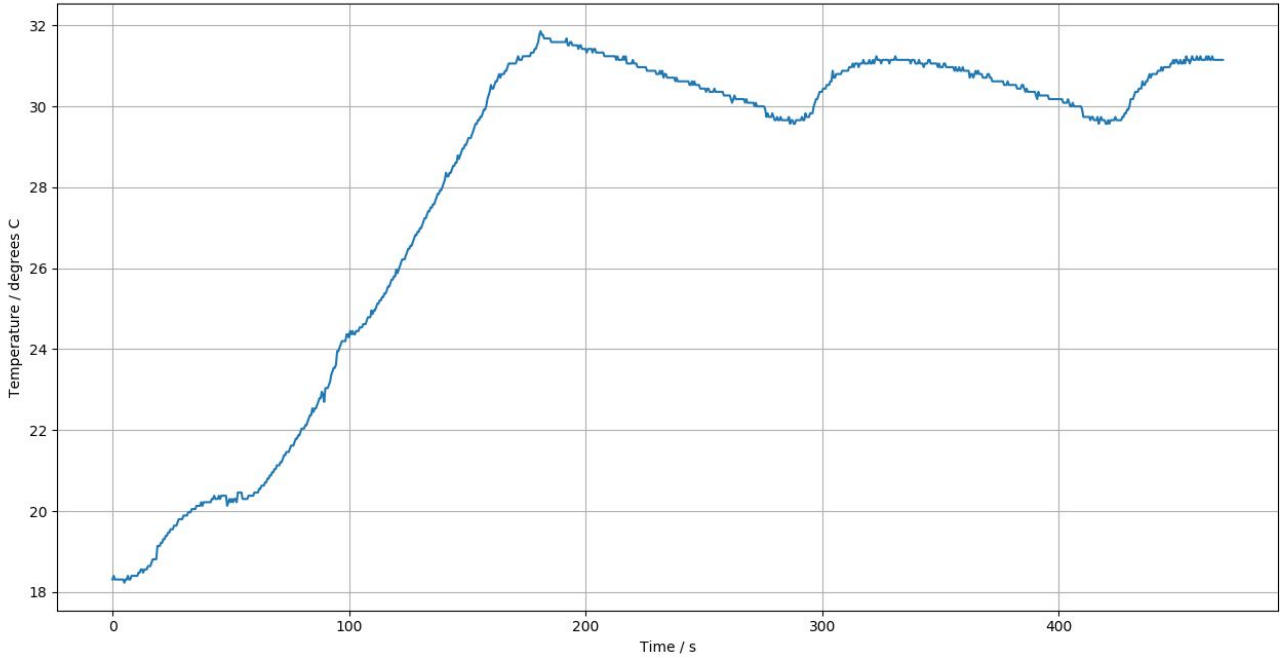
Transistor - Circuit Switch, if HIGH (switch closes) heater is on if LOW (switch opens) heater is off.

Calculating Steinhart-Hart Equation Constants

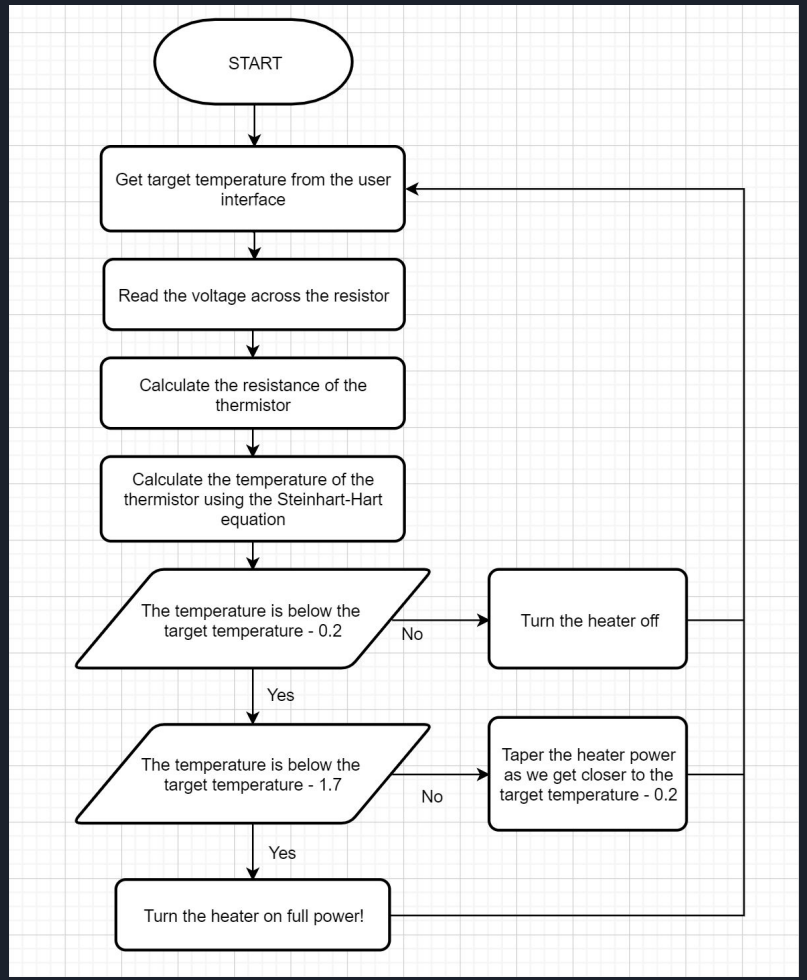


https://www.thinksrs.com/downloads/programs/therm%20calc/ntccalibrator/ntccalculator.html

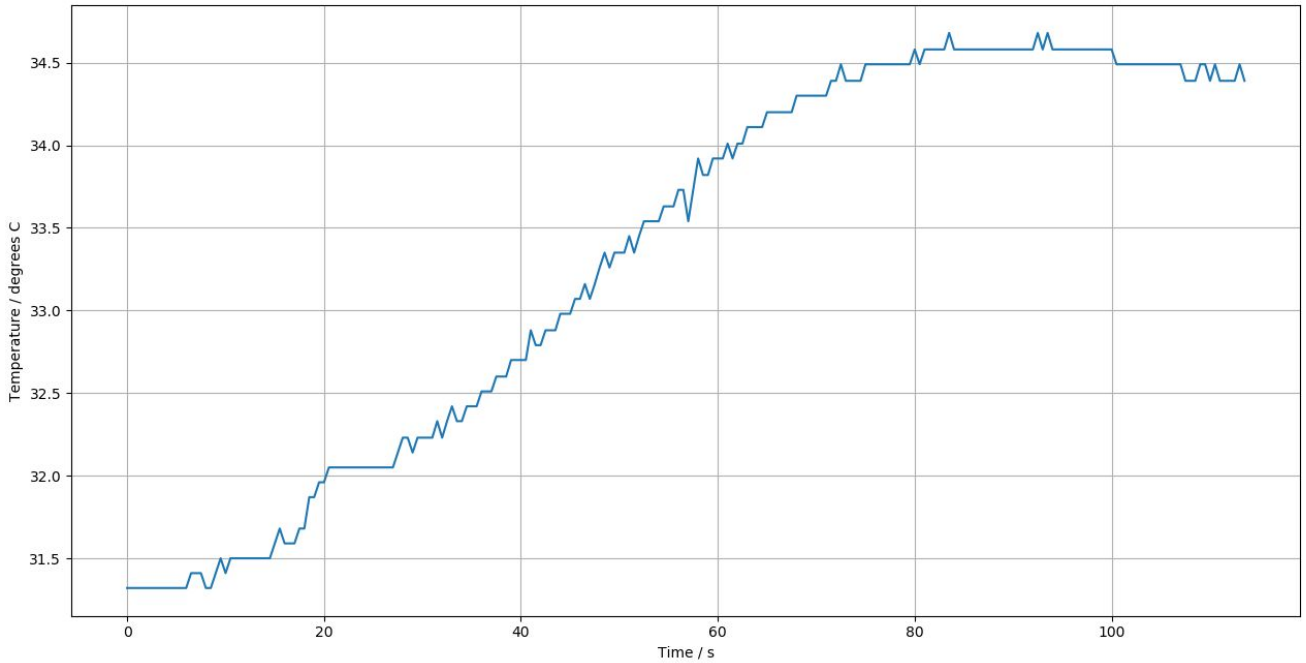
Heating to 30C without tapering

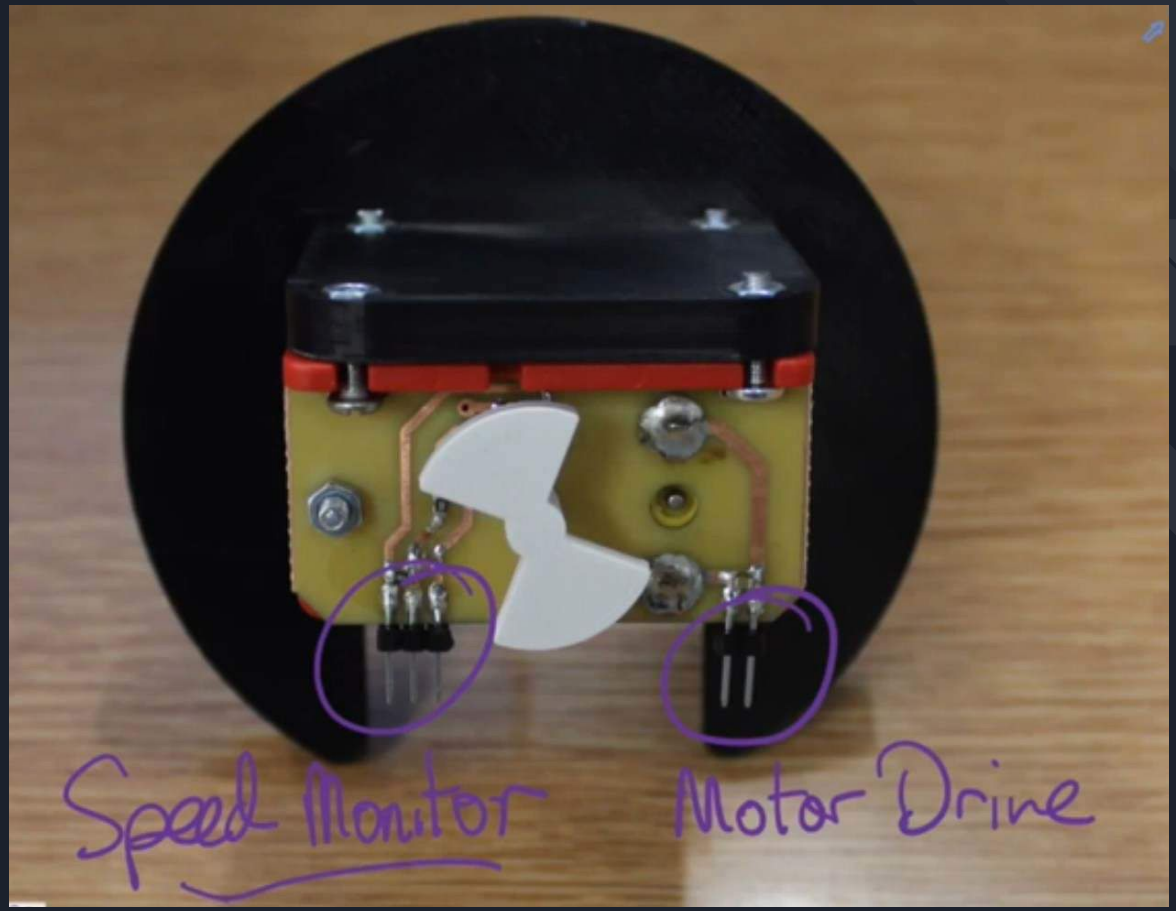


Heating Flow Chart



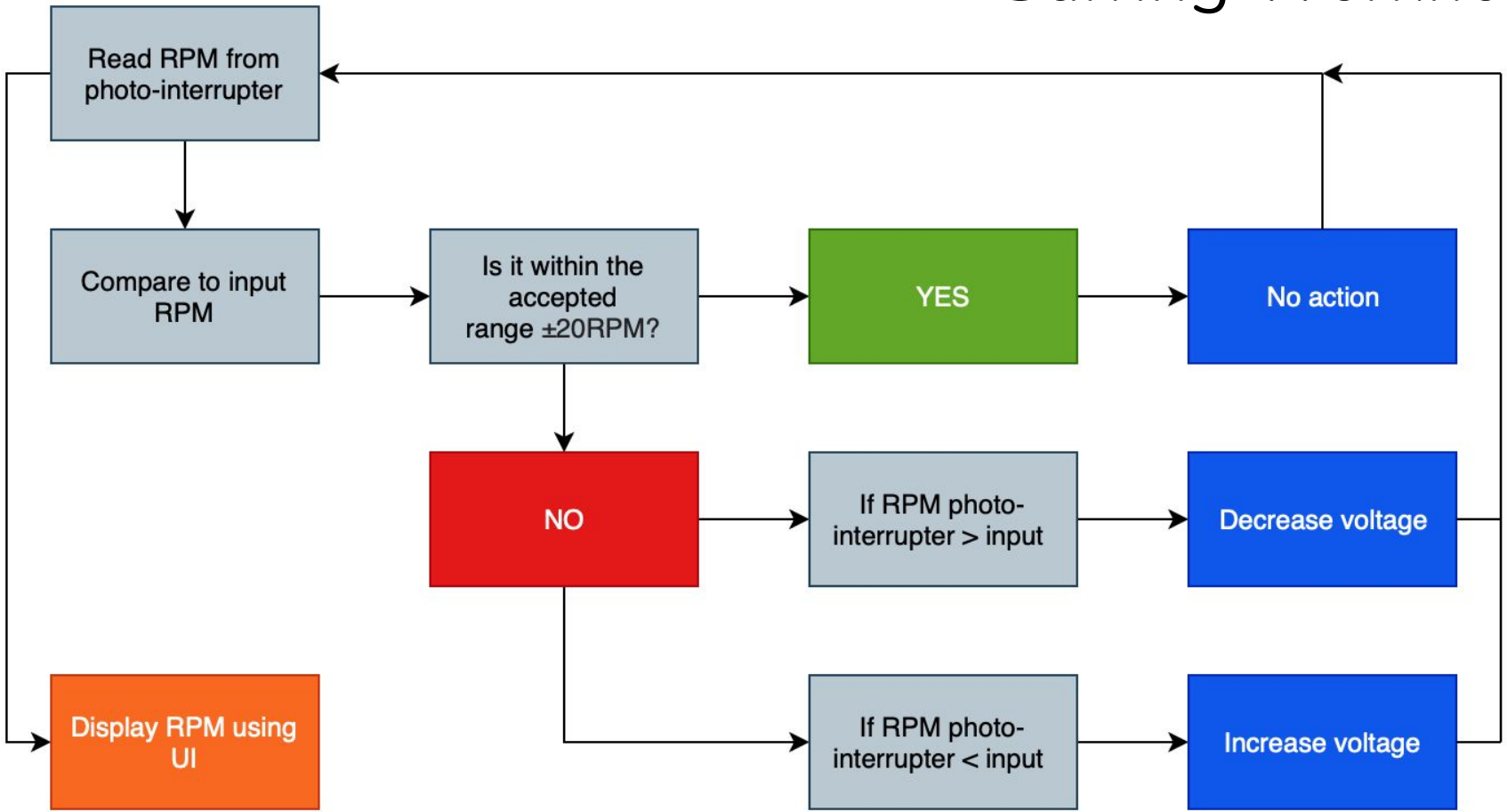
Heating to 34.5C





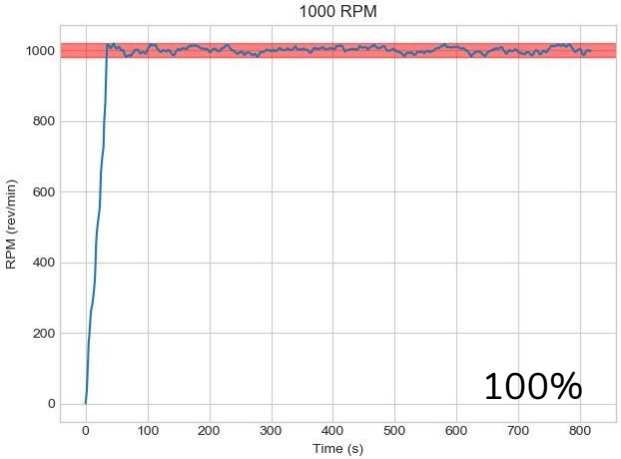
Stirring Subsystem

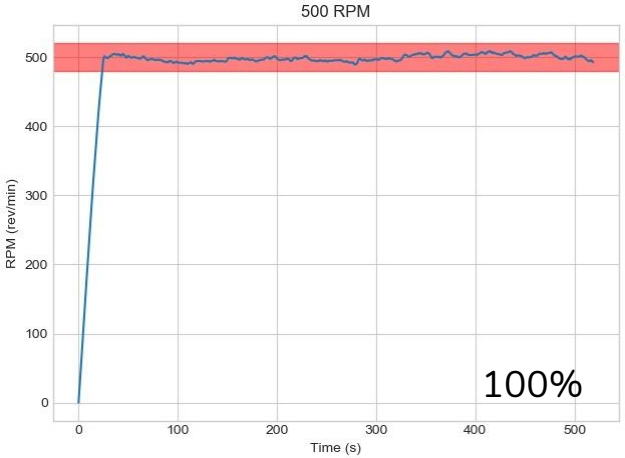
Stirring Workflow

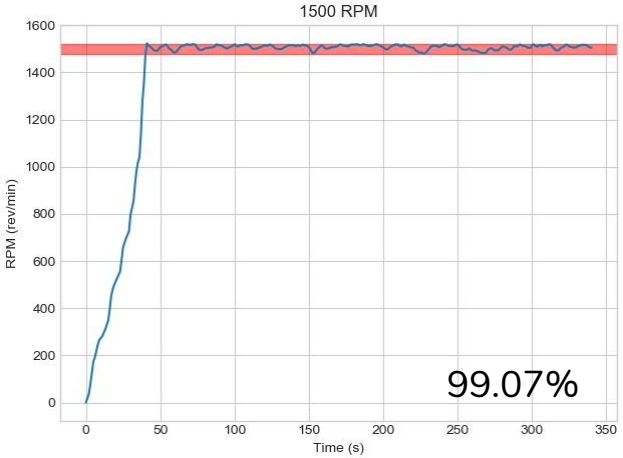


Testing

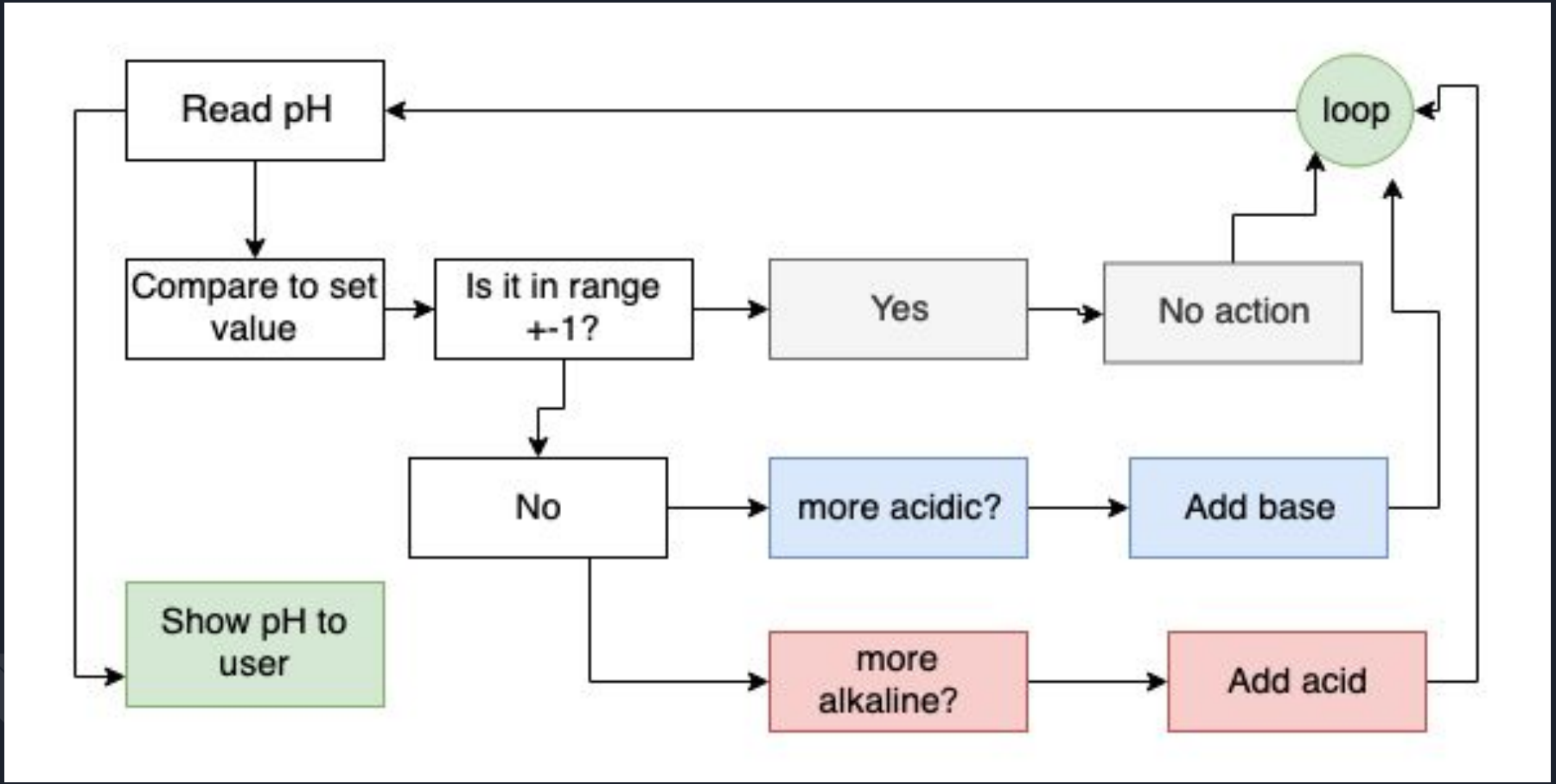
System requirements	
Stirring speed range	500 to 1500 RPM
Stability of speed	±20 RPM



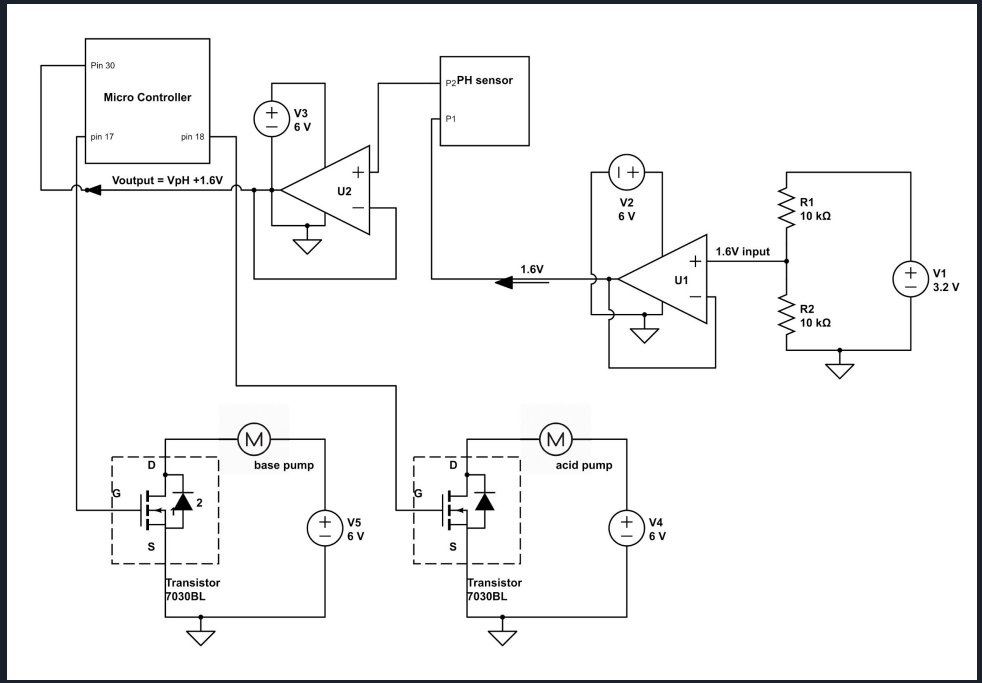




pH workflow

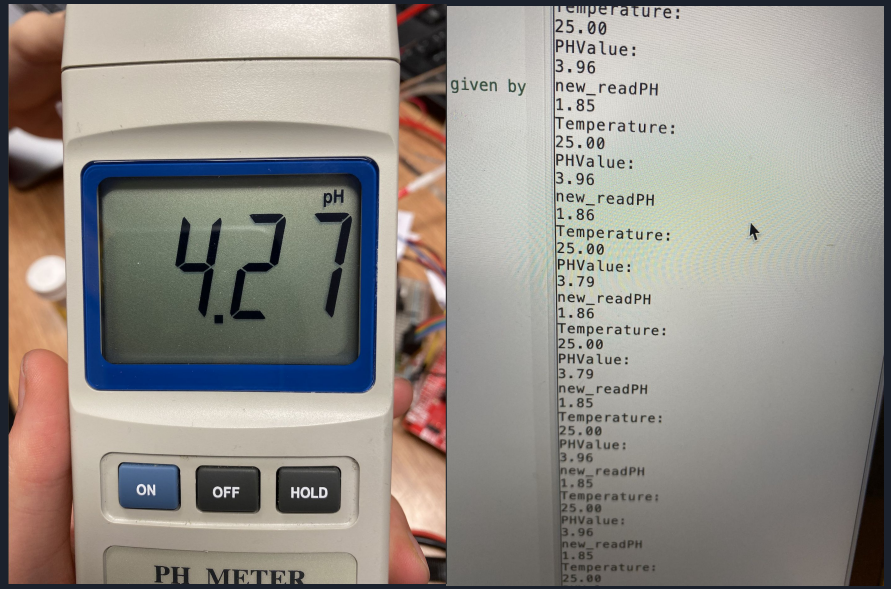

Read pH
loop
Compare to set value
Is it in range +-1?
Yes
No action
No
more acidic?
Add base
Show pH to user
more alkaline?
Add acid

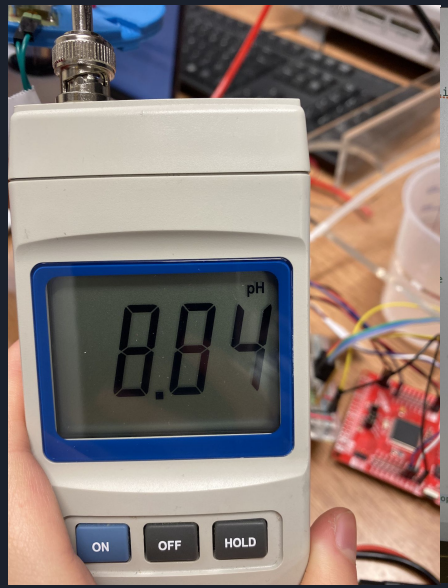
Circuit

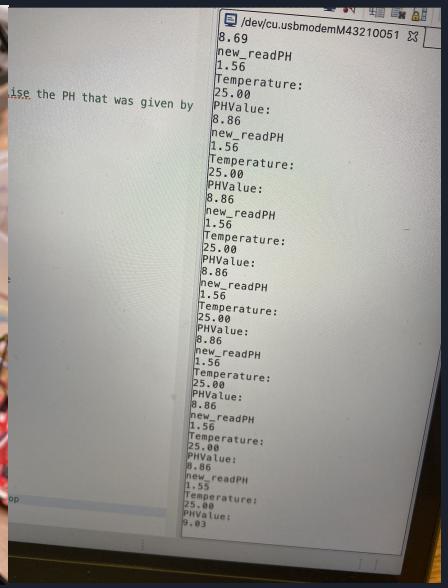


PH system

Testing







PH system

Questions