



USDA Forest Service – Steam Velocity Measuring Device

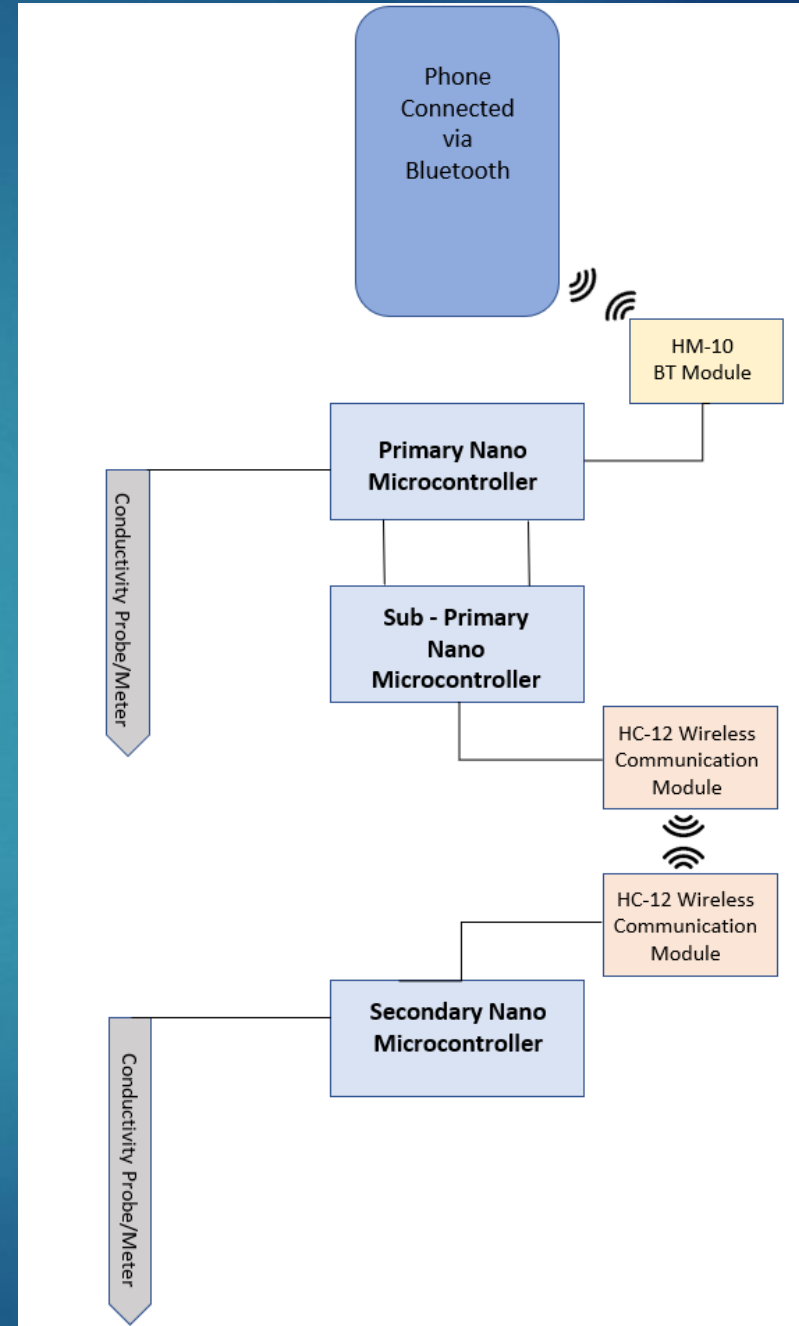
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CLIENTS: PETE ROBICHAUD AND BOB BROWN (FOREST SERVICE)

Objective

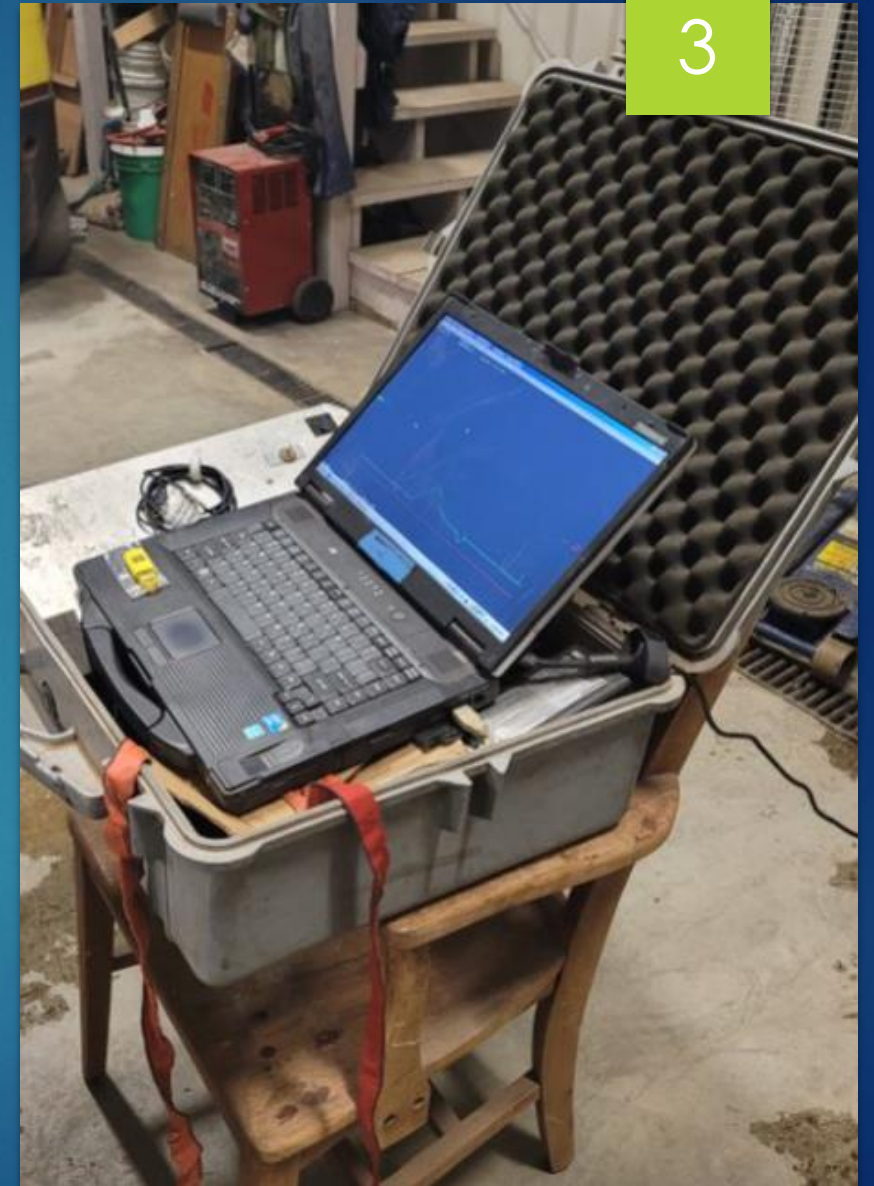
Develop Bluetooth technology that can communicate wirelessly with 2 or more conductivity probes to measure small stream velocity.

The readout of the probes, probe settings, and software should be accessible from a tablet or smart phone.



Value Proposition

- ❓ Updating a system that has been out of date for many years.
- ❓ Creates a safer working environment for the researchers.
- ❓ The new system allows for more efficient data collection by doing the math for the user.



Project Requirements

OPERATING ENVIRONMENT

- Velocity range – 2 L/min to approx. 4 cfs
- Stream Width – sample in USDA lab to Paradise Creek
- Required Probe Separation – 6 stream widths
- Physical Property Used for Measurement – water conductivity

USER FRIENDLINESS

- Remote Operation – wireless system that can read as far as 100 ft
- Versatile Probe Support – may be used by operator for balance in rough terrain
- Display – data available to user on tables or other wireless device
- Set Up – device can be up and running within 20 minutes
- Transportability – can be easily carried ¼ mile by one person (less than 20 lbs)
- Packaging – all components fit within a single waterproof carrying case

Project Requirements (Continued)

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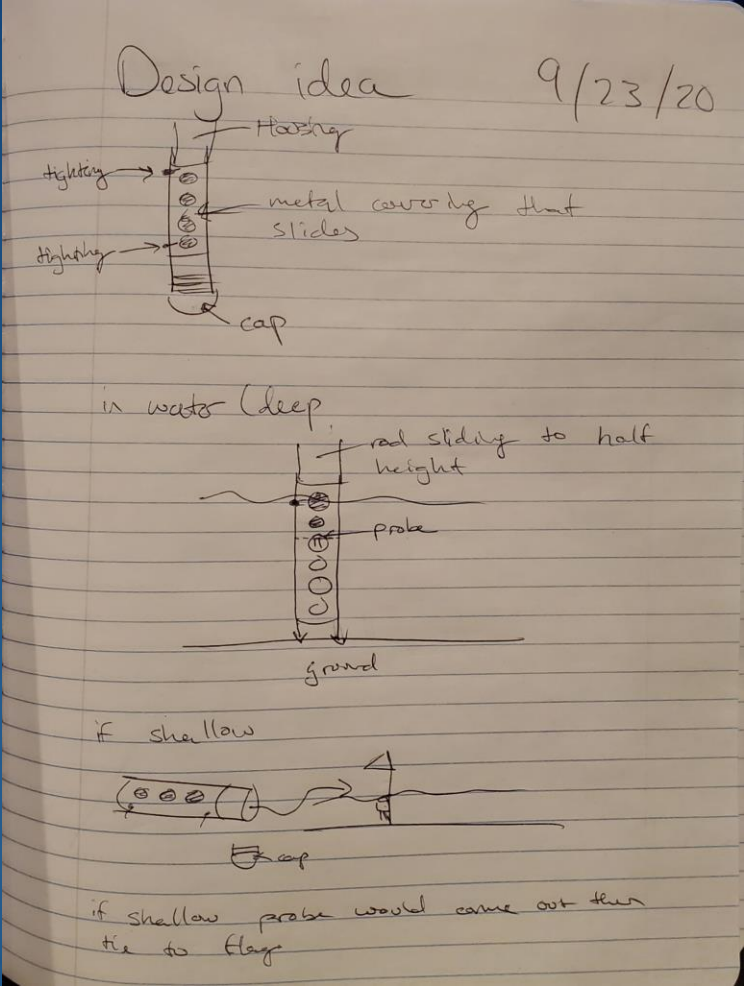
DURABILITY

- Must be suitable for use in all weather conditions, including rain/sleet/snow
- Streams can be full of sediment that can interrupt testing
- Cannot break in such a way that the device pollutes the environment
- Batteries can support field operation for at least 10 hours with no recharging

SOFTWARE

- Velocity Calculation – probe separation divided by time between peak-to-peak concentrations
- Reliability – integration of peak with 5% error
- Data Logging – DAQ that runs on batteries equipped with Excel-like tool
- Sampling Rate – 8 readings/sec with simultaneous sampling from two channels

Concept Development – Probe Stick (Old)



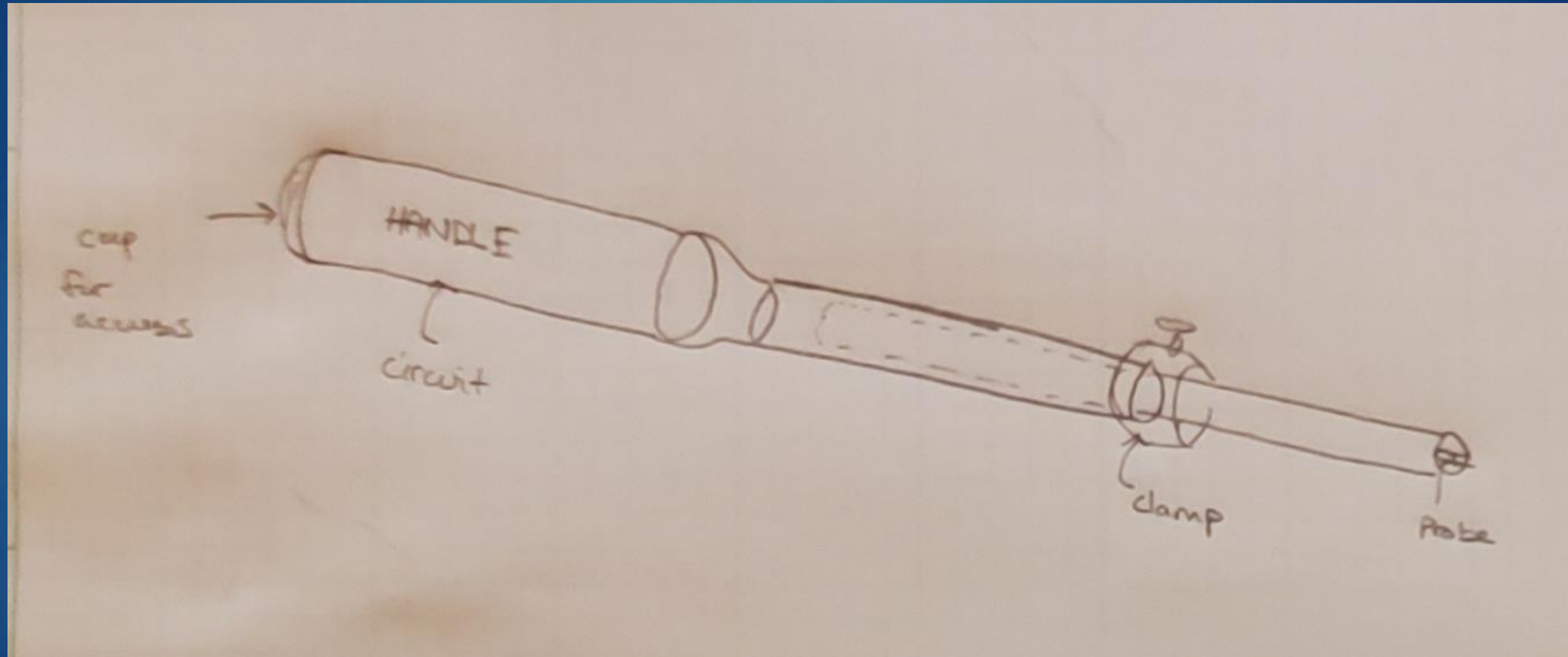
Initial Holder Design



SolidWorks 3D Model

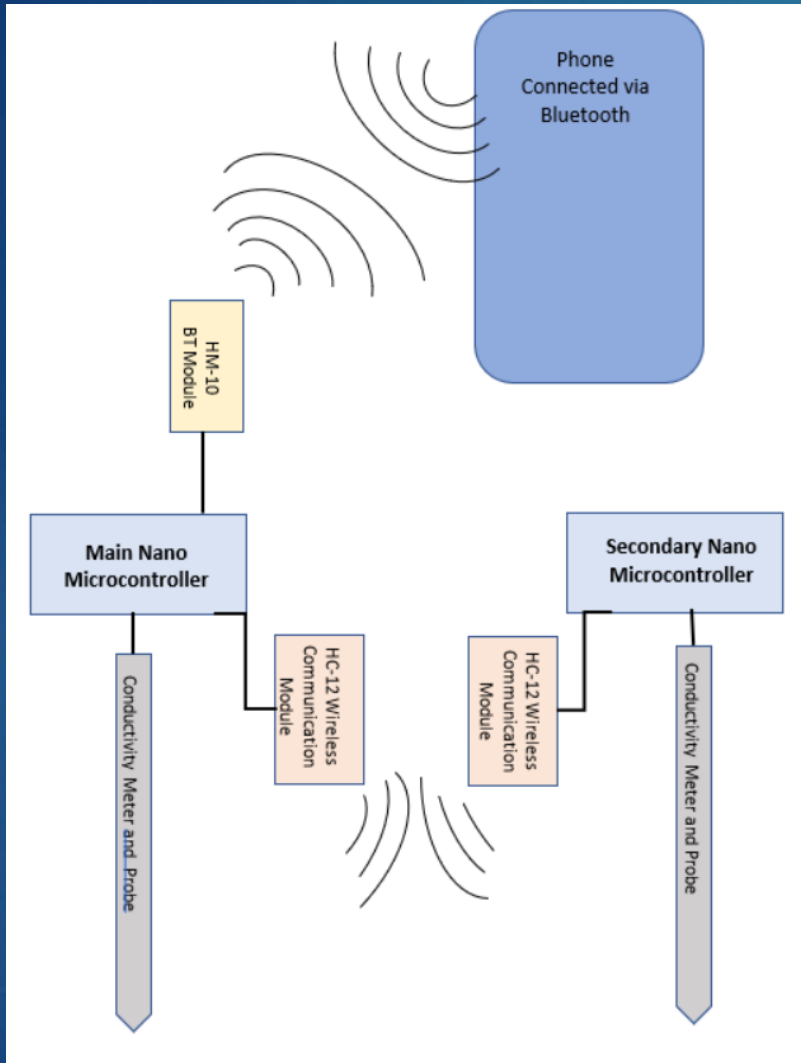
Updated Progress on probe stick

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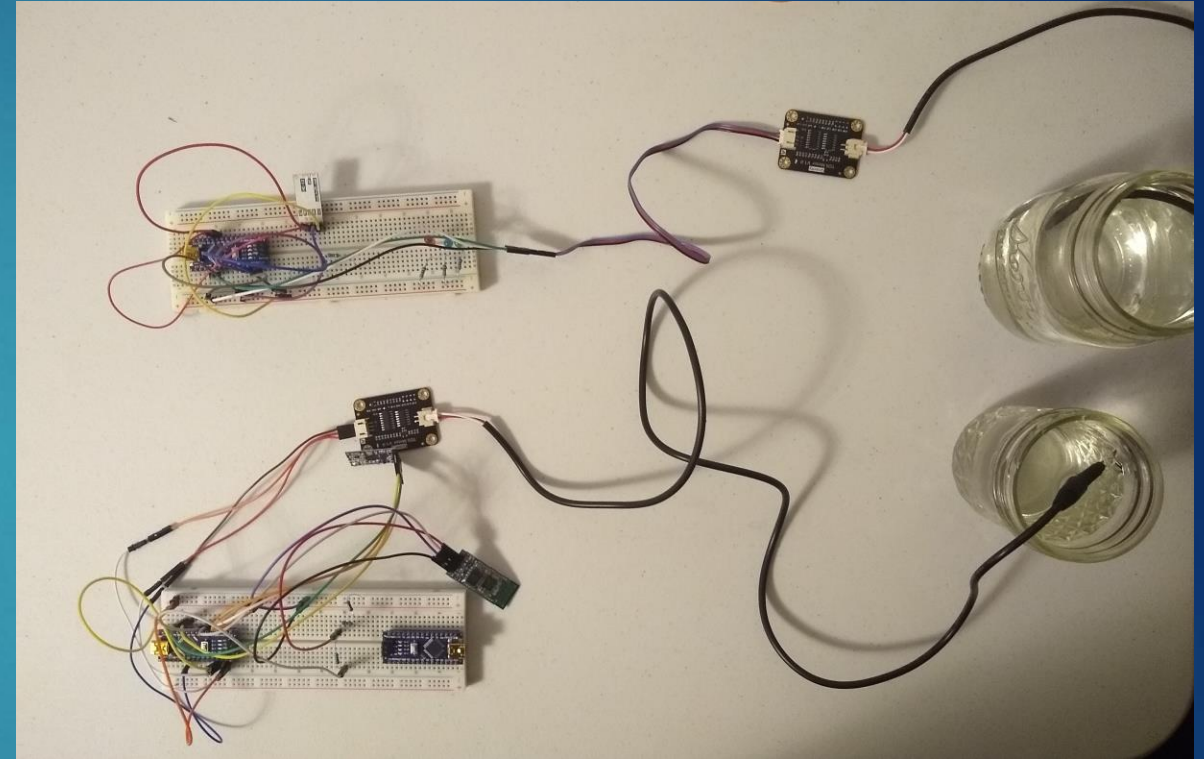


Concept Development – Electronics

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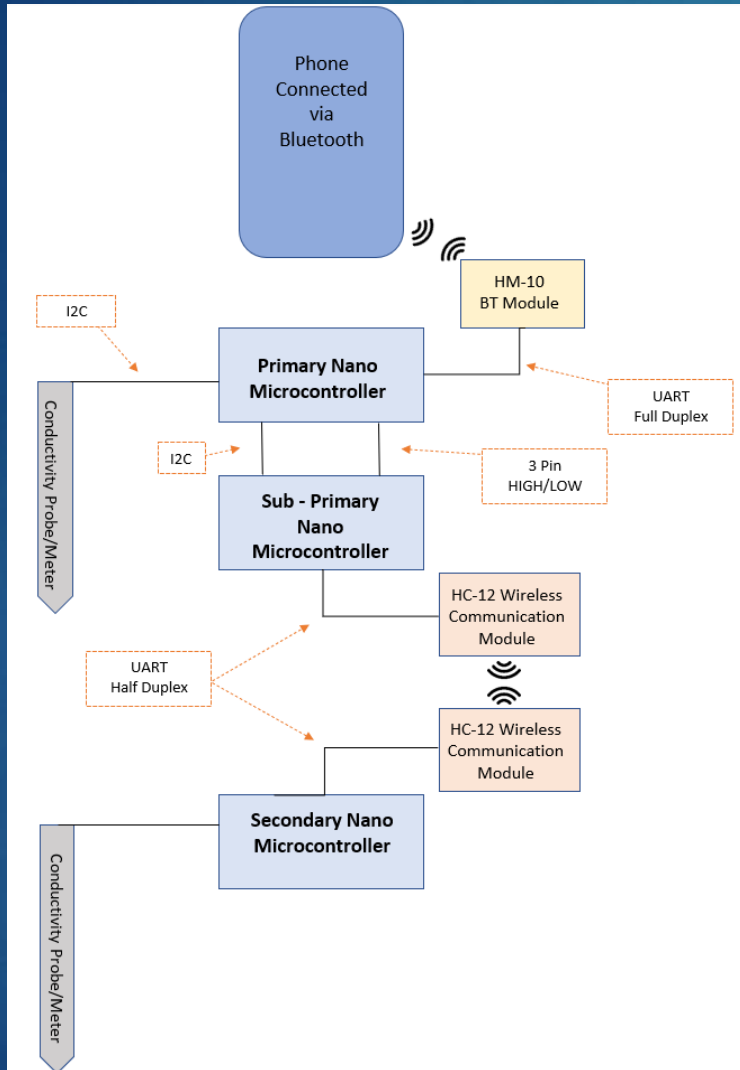


Double Nano Circuit Diagram

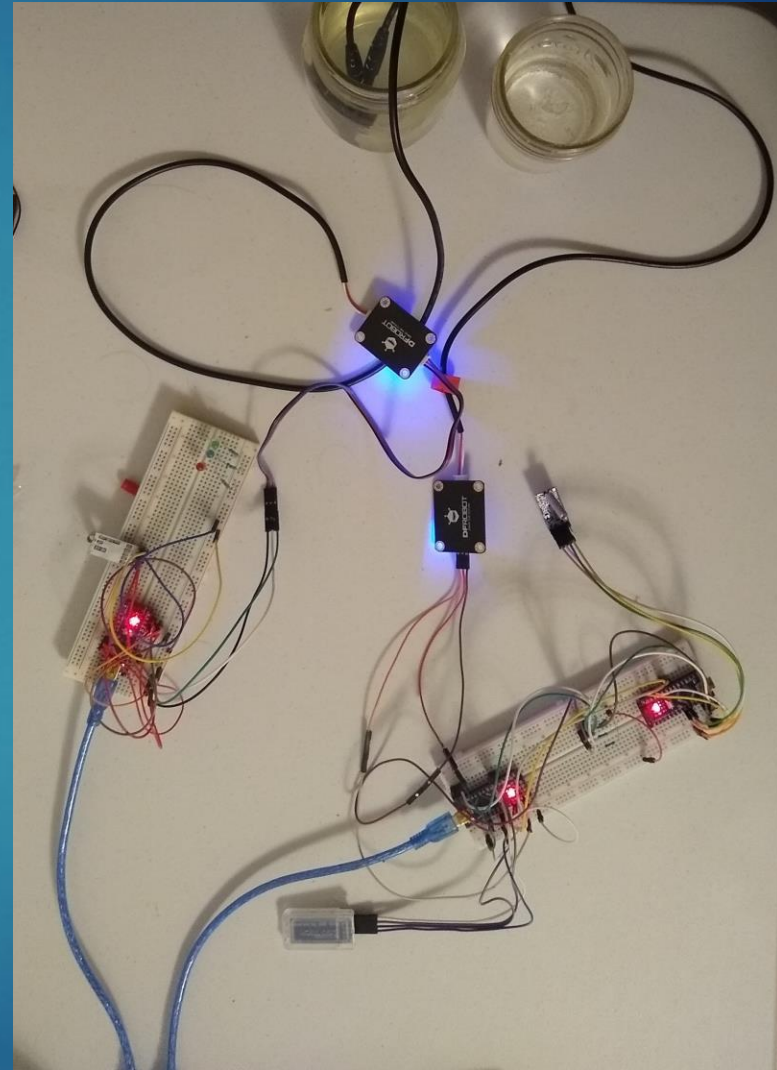


Double Nano System

Updated System Design



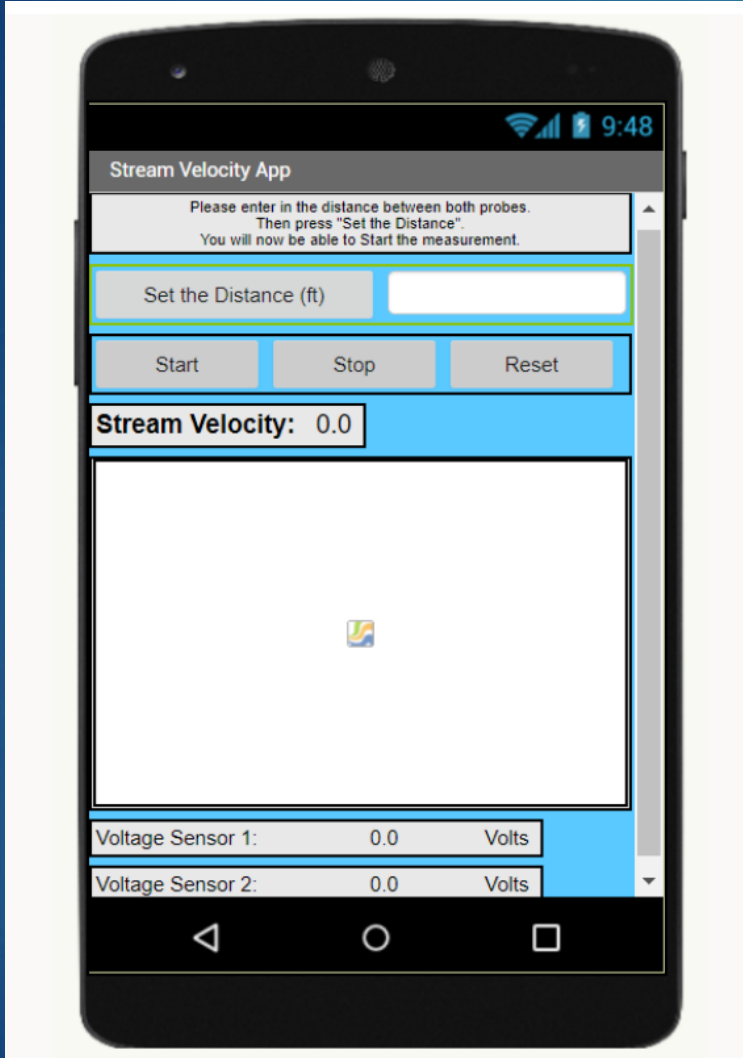
Triple Nano Circuit Diagram



Triple Nano System

Concept Development – Electronics

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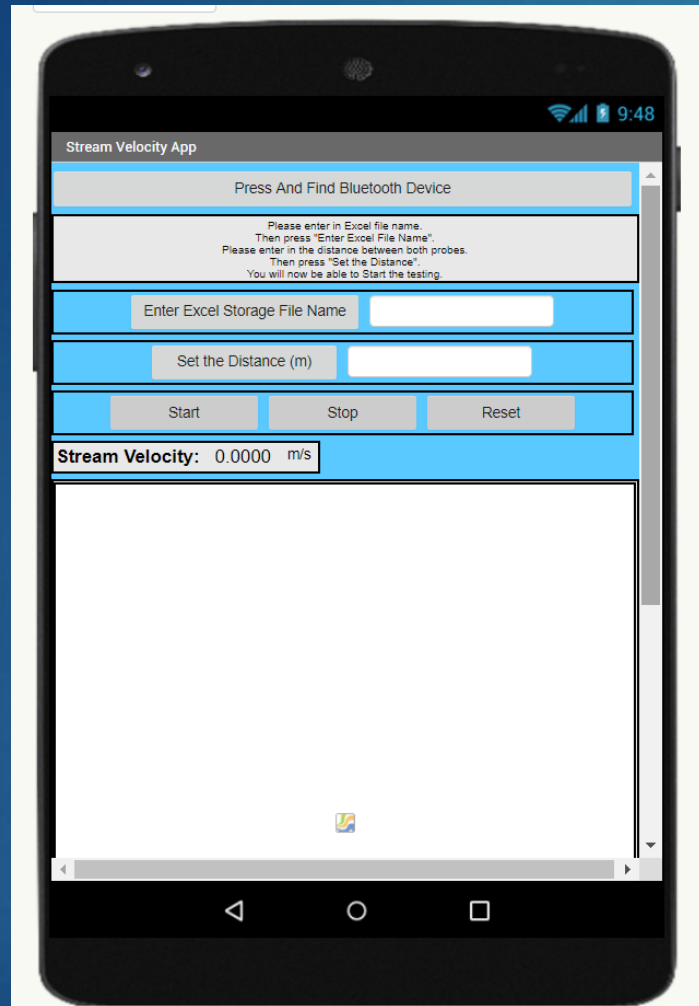
App Design

```
COM4
13:54:42.677 -> Enter Distance:
13:54:47.468 -> 15.00
13:54:54.695 -> Start
13:54:54.695 -> TDS 1
13:54:54.695 -> 1032.00
13:54:54.695 -> TDS 2
13:54:54.695 -> 0
13:54:54.741 -> HIGH-----
13:54:54.940 -> TDS 1
13:54:54.940 -> 1040.16
13:54:54.940 -> TDS 2
13:54:54.940 -> 0
13:54:54.940 -> HIGH-----
13:54:54.940 -> HIGH2-----
13:54:55.143 -> TDS 1
13:54:55.143 -> 1048.38
13:54:55.143 -> TDS 2
13:54:55.143 -> 722
13:54:55.143 -> HIGH-----
13:54:55.342 -> TDS 1
13:54:55.342 -> 1052.51
13:54:55.342 -> TDS 2
13:54:55.342 -> 722
13:54:55.342 -> HIGH-----
13:54:55.387 -> HIGH2-----
13:54:55.594 -> TDS 1
```

Data Reception

Updated App with Data Storage

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Updated App Design

	A	B	C	D	E
1	Stream Velocity Testing				
2	Start Test				
3	Distance =20				
4					
5	1169.98				
6	0				
7	1160.88				
8	660				
9	1183.75				
10	662				
11	1183.75				
12	668				
13	1165.42				
14	662				
15	1179.14				
16	673				
17	1151.84				
18	665				
19	1160.88				
20	670				
21	1160.88				
22	662				

App's Saved Excel File Data

Testing

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Risk Management

- ❑ Water Damage – ACTION: Test everything for a proper seal prior to allowing the electrical components near them
- ❑ Durability – Ensuring that the material can take a fall as well as mitigate damage to the internal system
- ❑ Lack of Power – LED battery indication lights
- ❑ Losing grip – a wrist strap
- ❑ Connection issues – Range is far more than what is required
- ❑ Damage of Probes – waterproof clip that allows for replacement

Validation

- ▣ Design Validation Plan

Project Management

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▣ Schedule

▣ Budget

Feedback / Questions?