

USDA Forest Service – Stream Velocity Measuring Device (ERR)

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Objective

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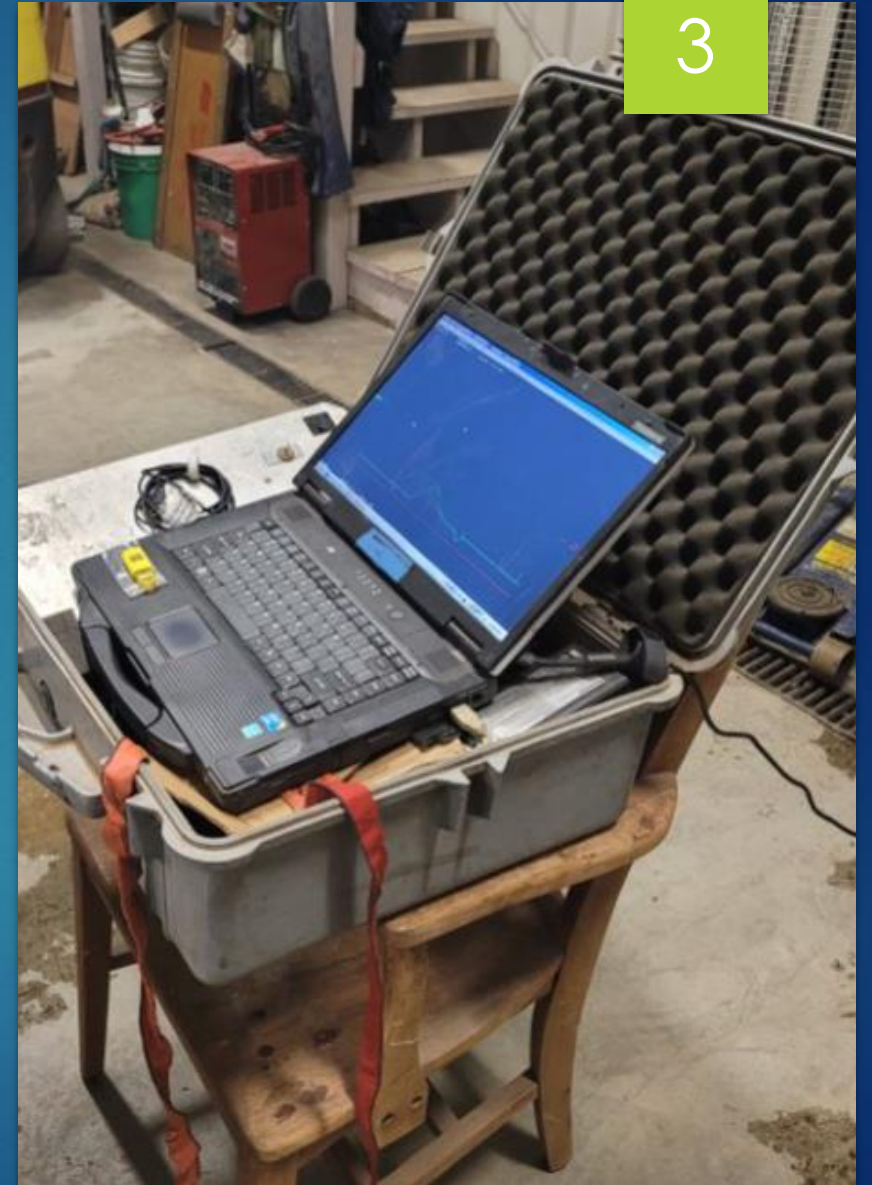
Develop Bluetooth technology that can communicate wirelessly with 2 or more conductivity probes to measure small stream velocity.

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- ❓ Updating a system that has been out of date for many years.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

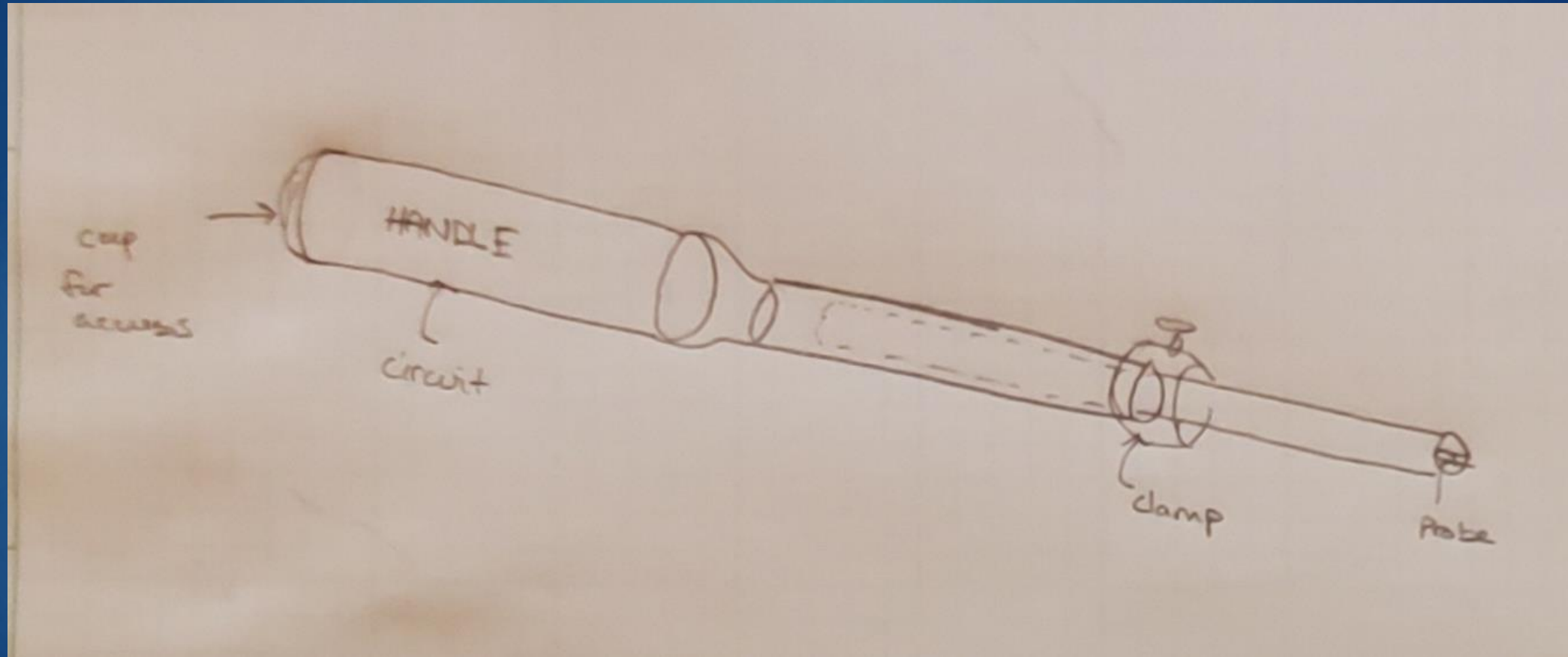
SOFTWARE

- 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

☐ [Design Validation Plan](#)

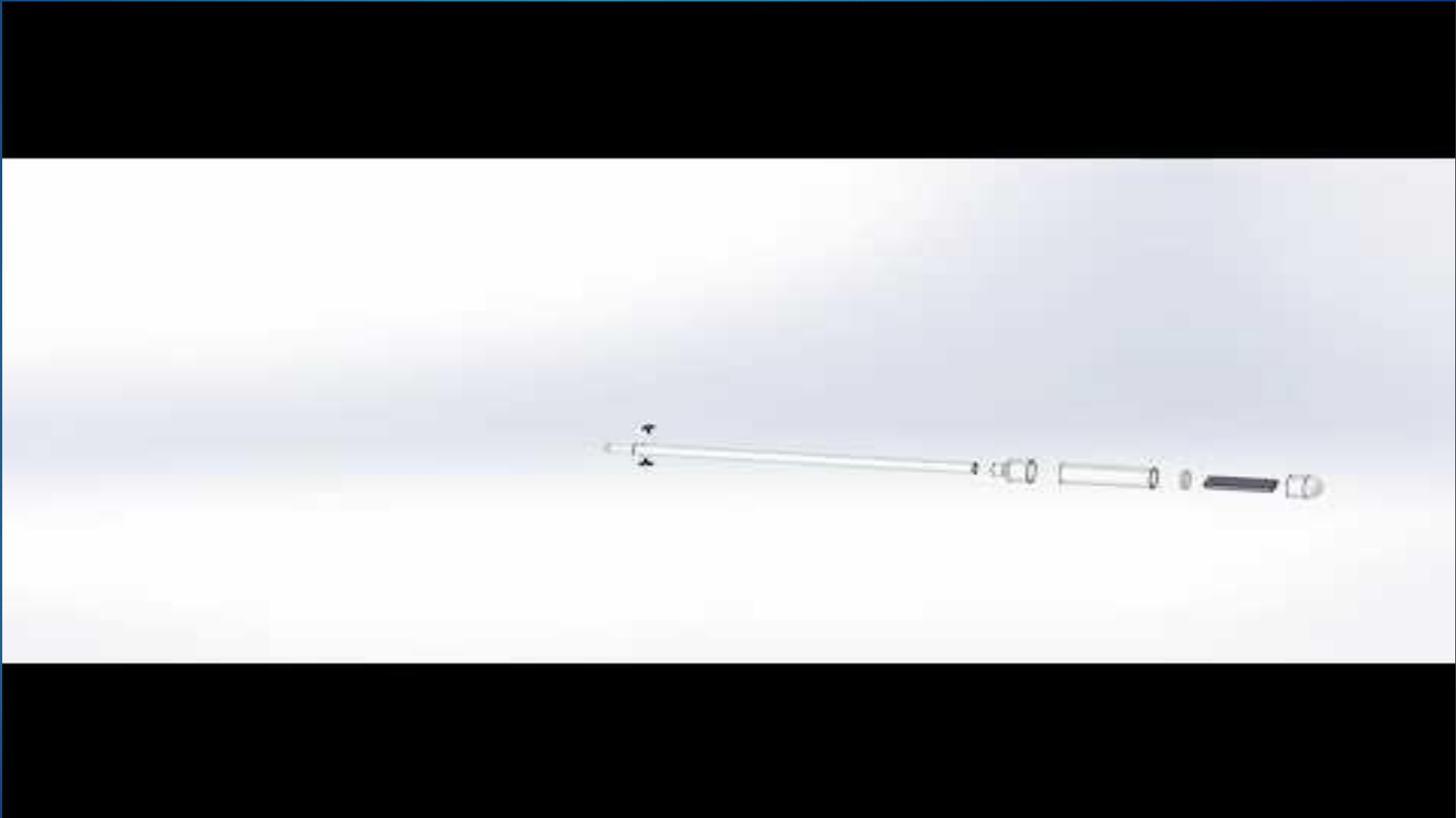
Updated Progress on probe stick

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Drawings

▣ Drawings



Key Attributes

PVC Probe Holders:

- PVC design allows for durability in all-weather types.
- Lightweight (less than 20lbs).
- Waterproof casing for electrical components.
- Usable for various stream sizes.

Nano Microcontroller:

- Able to take readings from the conductivity probe at 10 per second.
- Able to run for 10+ hours.
- Calculates velocity within 5% error of the original setup.

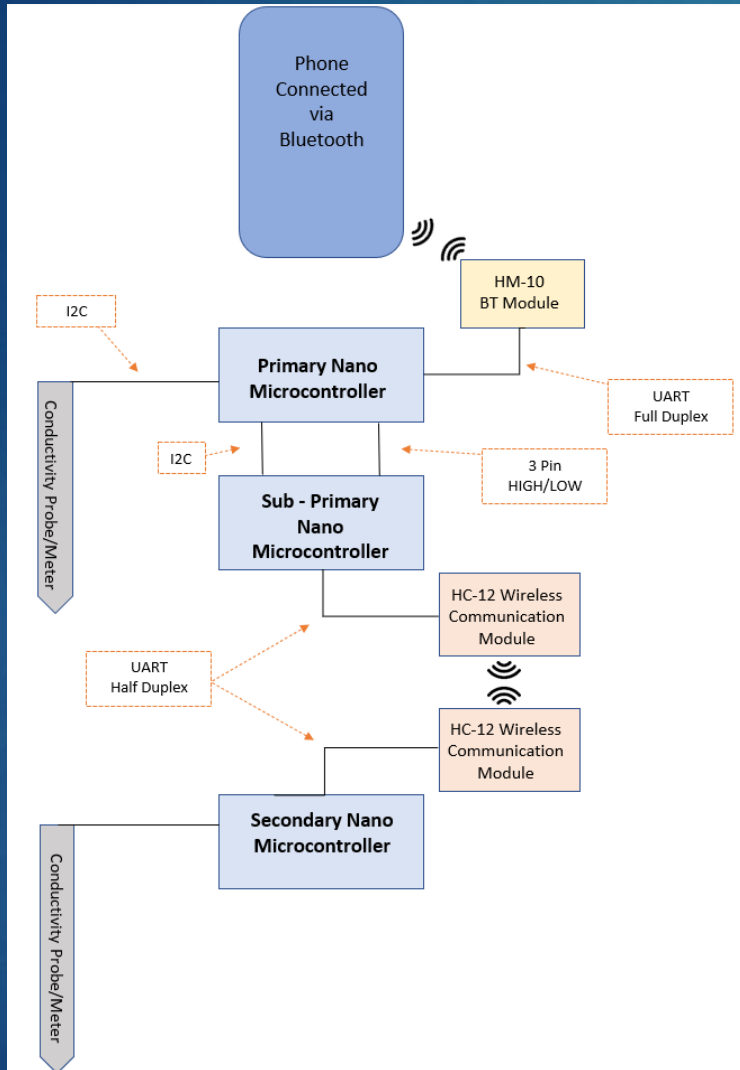
Wireless Communications:

- HC-12 allows for a 1000m communication between probes.
- HM-10 allows for a 100ft communication between probe and control device.

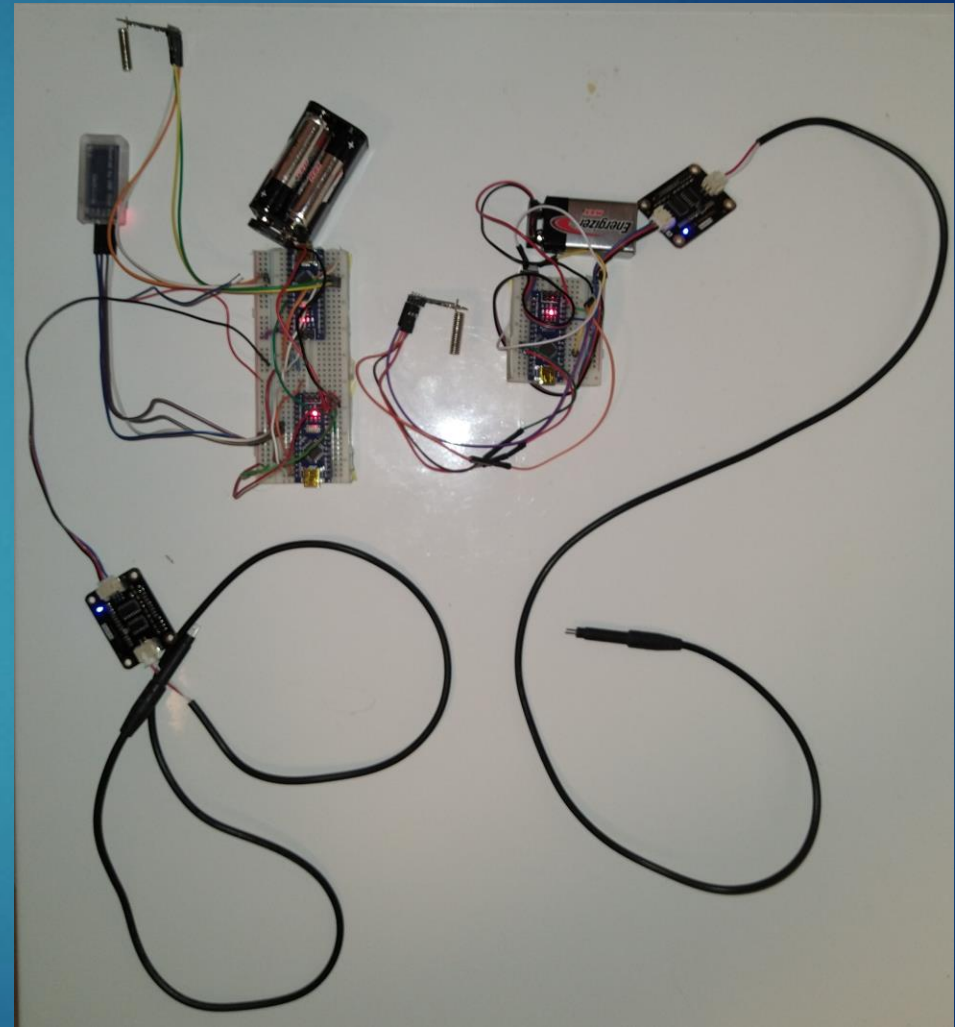
Stream Velocity App:

- Allows for wireless control over probes.
- Able to store incoming data readings into an Excel file.
- Displays calculated stream velocity.
- Real-time graph of probe readings.
- Compatible with phone or tablet.

Updated System Design



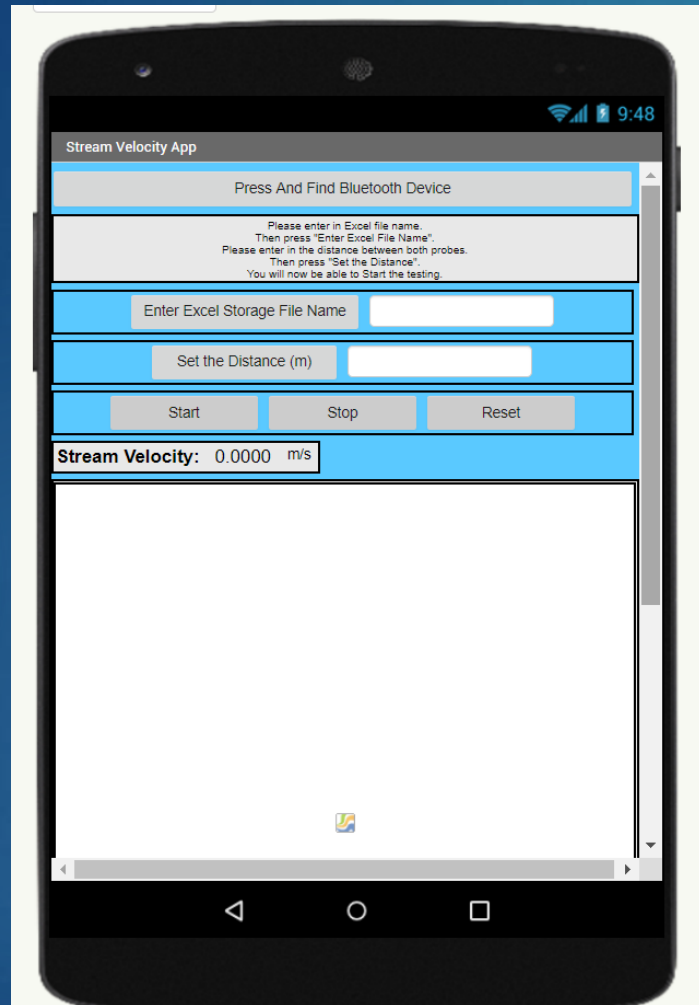
Triple Nano System Diagram



Triple Nano System

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

Make vs. Buy

- ❑ The only piece we are manufacturing is the Acrylic Disk
 - ❑ Buy
 - ❑ Quote for 1 \$6.96
 - ❑ Quote for 5 is approx. \$2.50
 - ❑ Manufacture
 - ❑ 2 sheets of 12" x 12" acrylic sheets at \$17.49
 - ❑ Can cut approximately 72 plugs from the two sheets
 - ❑ Price per disk is \$0.24

Sourcing of Components

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- ❑ Moscow Building Supply
 - ❑ Conduit PVC
 - ❑ Glue
 - ❑ Sealant
 - ❑ Fasteners
- ❑ The acrylic sheet was leftover scrap from the shop on campus
 - ❑ More acrylic sheets can be bought off Amazon
- ❑ All other components were bought off Amazon

Responsibilities

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☐ Cole and Josh (EE)

- ☐ Assemble the probe electronics
- ☐ With all components, can be assembled in approximately 1-2 hours

☐ Anthony and Max (ME)

- ☐ Assemble the probe housing
- ☐ Can be assembled in approximately 1-2 hours, with appropriate time after to let sealant cure.

Cost

- ❓ The overall price of the components is \$150.90
- ❓ Approx. 2-4 hours in total assembly/manufacturing time (estimated at \$15/hour)
- ❓ The overall price with manufacturing time is approximately \$180.90-\$210.90

COMPONENTS	UNIT COST	AMOUNT USED	TOTAL COST
TDS Sensor	\$16.80	1	\$16.80
HM-10 Bluetooth Module	\$9.99	1	\$9.99
Battery Case (3 Pcs)	\$7.58	1	\$7.58
Waterproof Connectors (10 Pcs)	\$10.99	1	\$10.99
Conduit (1" X 10' with 2 cuts)	\$8.99	1	\$8.99
Conduit (1/2" X 10' with 2 cuts)	\$5.29	1	\$5.29
Loctite Plastic Bonder	\$6.64	1	\$6.64
Simple Seal Kitchen and Bath	\$4.93	1	\$4.93
Wing Bolt Style Fasteners	\$3.13	4	\$12.52
PVC Reducer	\$7.70	1	\$7.70
PARTS WE ALREADY HAVE			
Arduino Nano (3 Pcs)	\$14.59	1	\$14.59
HC-12 Wireless Communication Module (2 Pcs)	\$10.79	1	\$10.79
TDS Sensor	\$16.80	1	\$16.80
Acrylic Sheet 12" X 12"(2 Pcs)	\$17.29	1	\$17.29

Project Management

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▣ Schedule

▣ Budget

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

Feedback / Questions?