Team Sedi-Sensor

Pollution Monitoring in Plaster Creek

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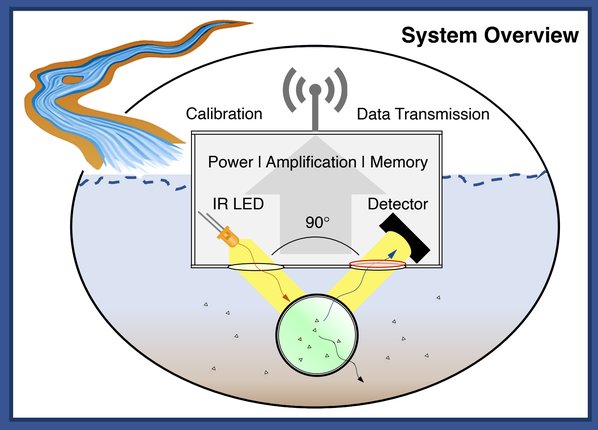
PROBLEM

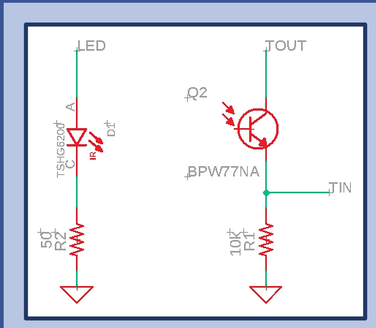
- Pollution reduction due to Plaster Creek Stewards' intervention efforts is poorly understood.
- Quantitative measures of efficacy are limited by manpower and lack of tools necessary to complete measurements.



SOLUTION

- Field deployable turbidity probe capable of retrieving data sufficient to study intermittent flooding.
- Ultra-low power draw enables 3 months of automated data collection and integrated wireless data transfer.

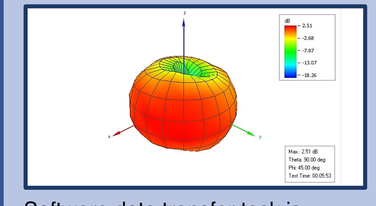
ELECTRICAL & SOFTWARE



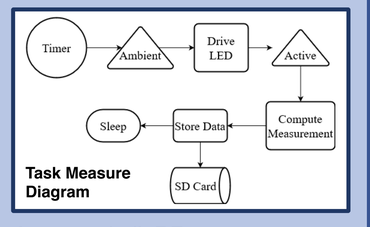
An IR LED acts as the source. Light output is sufficient with a 50-ohm resistor and overdrive is not needed.

A phototransistor acts as the detector. The detector is also an integrated amplifier in the common collector configuration. Various amplification methods were prototyped but was found to be unnecessary.

Software measure task limits the time the device spends in active mode by turning on for a 2 second measurement every 15 minutes. The remainder of the time the device spends in deep sleep, conserving power to meet our lifetime goals.

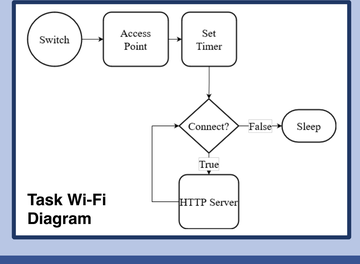


Software data transfer task is activated by a magnetic switch at the top of the device. This ensures that the probe only broadcasts when an operator is there to collect the data, improving battery life. An SD card acts as a hardware back-up in the event that wireless transfer fails. BLE data transfer was successfully prototyped, but advertising BLE drew too much power.



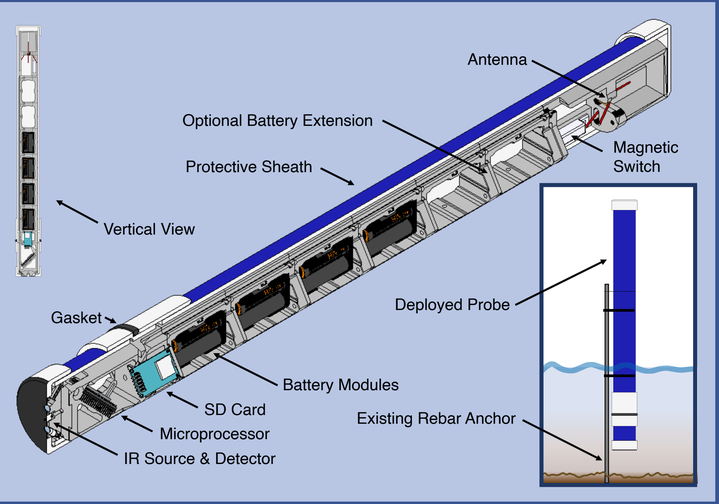
Task Measure Diagram

A custom-built RF antenna improves transmission signal strength by 3 dB of gain and is impedance matched to a 2' long shielded transmission cable. This allows for variable depth measurement capability. The antenna's radiation pattern can be seen in the 3D model to the left.



Task Wi-Fi Diagram

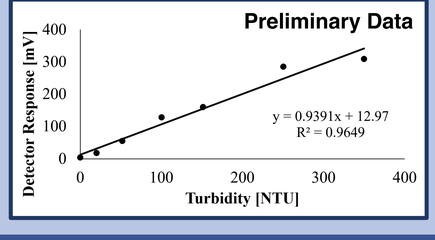
INTEGRATED SYSTEM



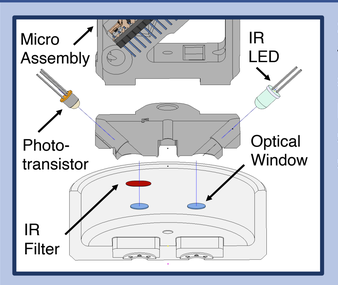
CALIBRATION

Initial data supports device function over a range of turbidities typical of small streams. Preliminary results indicate a linear detector response with $R^2 = 0.96$. More data is necessary to statistically validate results.

Calibration samples were constructed using colloidal lipid suspensions validated against a small panel of formazine (industry standard) solutions and a commercial instrument. Our calibration samples are cheaper and less toxic than formazine.



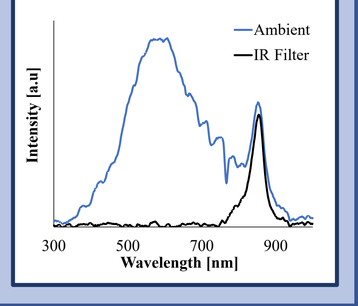
MECHANICAL & OPTICS



Sapphire optical windows were selected for their high transparency at 850 nm and resistance to scratches.

Light is detected at 90 degrees from the source to limit non-linearities due to stray light and variations in particle size.

The IR wavelength selected allows for optical filtering of ambient light. The graph to the right shows the ambient conditions with our source before and after filtering. A combination of red and green stage light filters effectively blocks visible light while allowing our IR signal to pass through.



TEAM MEMBERS

From left to right:
Moses Yang (ME), Christian Ro (EE), Kris Miedema (EE), Isaac Spackman (ME), Joseph Lewis (EE)

Photo taken during a site visit to a potential deployment location in Plaster Creek.

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