H41S-2023: LilyPad

Internet Connected Freshwater Reservoir Monitoring Device

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ABSTRACT AND PURPOSE

Fresh water is one of the most important resources of our time. An area's ability to measure their available water storage and accurately measure losses is important for water stability in a region. Modern technologies are available to manage water storage and levels. For water management organizations to make informed decisions on where to invest in their infrastructure they need data. The LilyPad sensor platform intends to meet those needs by monitoring evaporation levels and provide live data to inform decision making. To do this the LilyPad measures the temperature of the water along with the temperature and humidity of the air. It is also equipped with a 4G board and an SD card to log data both locally and on the cloud.

LilyPad Prototype

COMPONENT BREAKDOWN

[SHT31] - Waterproof temperature and humidity probe

[VEML7700] - Light intensity sensor with separate ambient and white light sensors

[DS18B20] - Waterproof temperature sensor submerged in the water

[Sparkfun LTE Shield] - Allows the LilyPad to connect to the internet, used a Hologram SIM

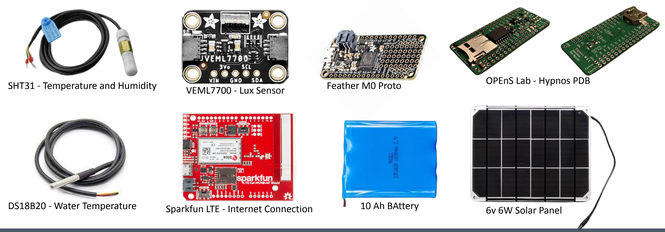
[Feather M0] - Interfaces with the sensors and LTE shield

[Hypnos] - Power distribution, RTC, and SD logging

[Solar Panel] - 6V 6W panel for system charging

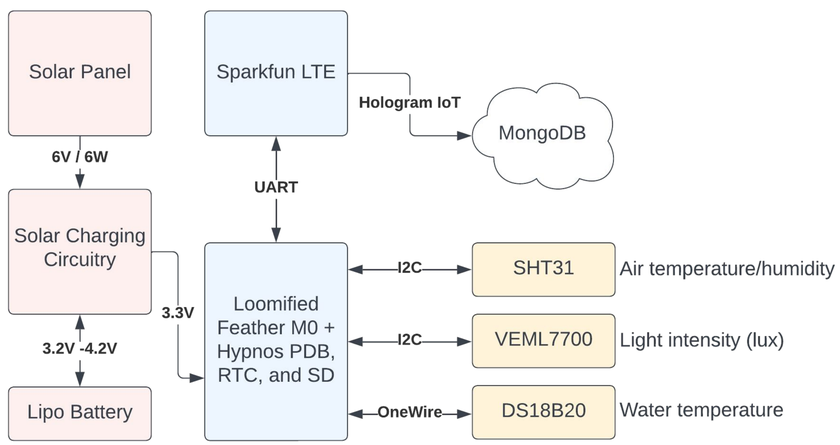
[LiPo Battery] - 10,050mAh battery for long deployment times

[10k Thermistor] - Attached to the LiPo battery for safer charging



Electronics

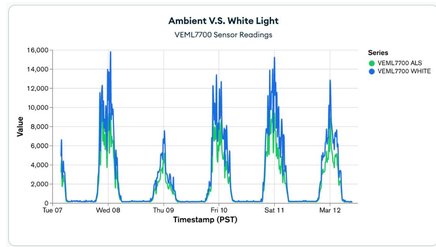
The LilyPad's circuitry is designed to gather and transmit environmental data, including air temperature, humidity, light intensity, and water temperature, to a MongoDB database and SD card. This is accomplished by utilizing I2C and OneWire protocols to capture sensor readings and transmit them via an LTE connection to the internet. The LilyPad benefits from the Hypnos's RTC and power management capabilities, enabling it to operate for extended periods of time without requiring a battery charge. A 6V 6W solar panel and 10,050mAh Lipo battery, controlled by a bq27074 Lipo charging IC, supply power to the Feather M0 microcontroller.

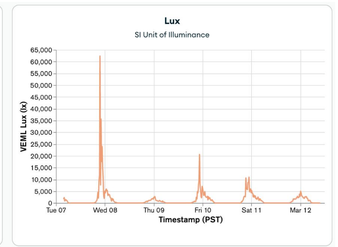


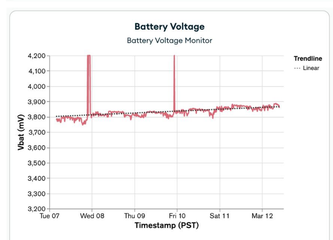
TESTING

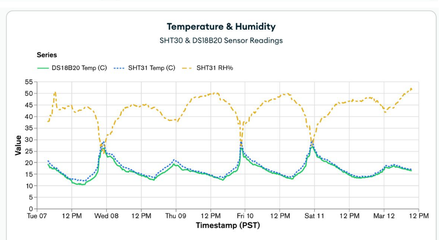
The LilyPad is currently in deployment at University of Western Ontario in Canada for complex research. Currently, long-term testing is underway to ensure the longevity the LilyPad must withstand.

The graphical representations below depict the discernible metrics that the LilyPad is able to capture. The VEML7700 sensor enables the measurement of ambient and white light intensities, and a comparative analysis can be gleaned from the top-left graph, whereas the Lux graph on the adjacent right hand side denotes the resulting calculated SI unit of illuminance. Alongside the light metrics, the LilyPad proffers a record of water temperature, measured by the DS18B20 sensor, and air temperature, gauged by the SHT30 sensor, which are conspicuously portrayed in the lower right hand side graph. Further, the SHT30 sensor is also capable of capturing relative humidity of the air, which is represented in the same chart. Lastly, the LilyPad is equipped to document battery voltage, and this metric can be observed in the lower-left chart.









CONCLUSIONS: FUTURE DIRECTION

With the goal being that each unit is able to run for one year in the field uninterrupted we have spent much of our time ensuring that it will stand up to environmental and hardware degradation. After we are done testing and ensuring that the hardware is prepared for the field they will be deployed in Oregon. There are currently 3 LilyPads in deployment at University of Western Ontario and we hope to gain valuable data and insight into how well they fare. In the future, we hope to be able to offer the LilyPad frame as a tool for other researchers and projects at the OPEnS Lab to use as well.

ACKNOWLEDGMENTS

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LilyPad wiki

OPEnS Lab Website

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