CUNY Office of Research

Interdisciplinary Climate Crisis Research Grant 2020

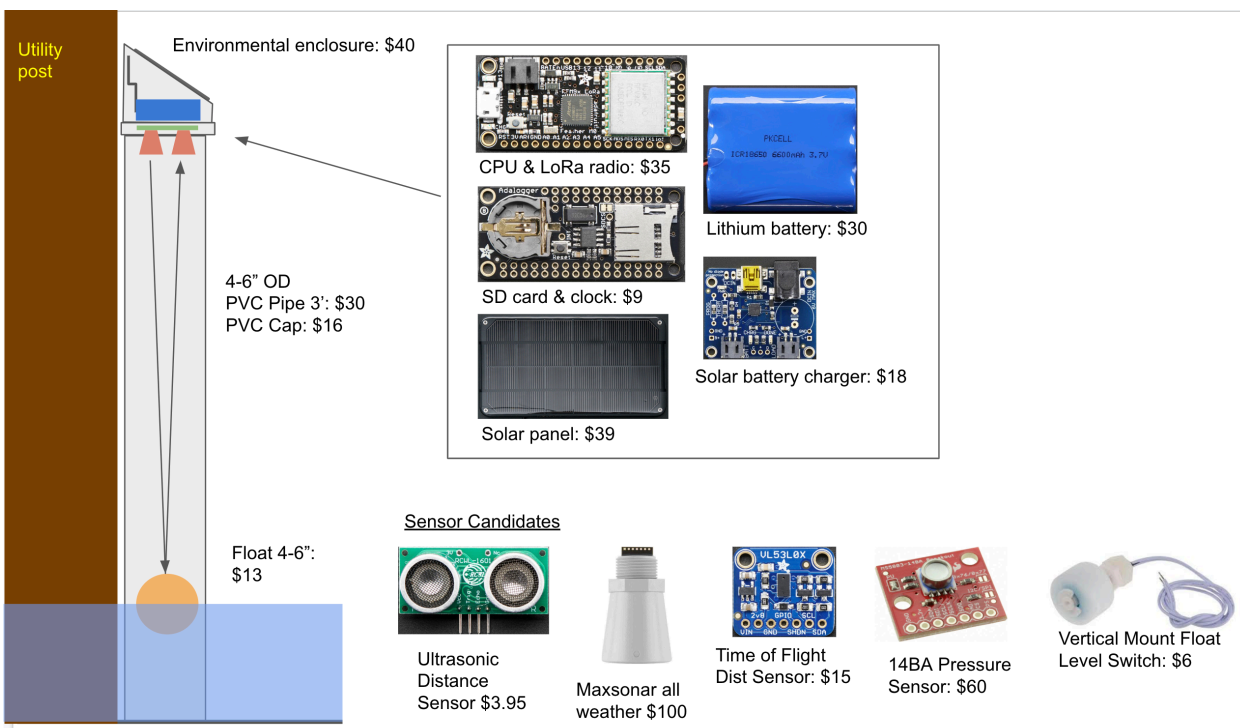
Sea Level Sensors Pilot

Technical Proposal

The goal is to assemble and deploy two prototype flood monitor/sensors in the city connected to the internet through radio transceivers. The sensors are to be installed on a road or sidewalk and report distance to the ground. When a flooding event occurs they report the depth of the flooding (the sensors could also be placed over water). The design is based on existing networks such as the Smart Sea Level Sensors Partnership (https://www.sealevelsensors.org/) and the Flood Network in UK (https://flood.network/).

The work will ideally be done by two Master's level students working half time for 6 months at the NGENS lab under direction of Ricardo Toledo-Crow.

Sensor Requirements: 1) Low cost, 2) Discrete /unobtrusive/ weatherproof / rugged, 3) Telemetry & logging, 4) Battery / solar operation, 5) Measurement range: 0 – 1m.



https://www.adafruit.com/product/4007

https://www.digikey.com/product-detail/en/maxbotix-inc/MB7389-100/1863-1009-ND/7896781?utm_adgroup=Sensors%20%26%20Transducers&utm_source=google&utm_medium=cpc&utm_campaign=Dynamic%20Search&utm_term=&utm_content=Sensors%20%26%20

Transducers&gclid=Cj0KCQjwyPbzBRDsARIsAFh15JZjzG1FhtOCHAClt_9GbpjnlaPSqBot9YUF36lzFVPj8yp0sxsnp8saApShEALw_wcB

https://www.digikey.com/catalog/en/partgroup/gravity-vl53l0x-tof-laser-range-finder/78265
https://www.amazon.com/MS5803-14BA-Pressure-Waterproof-Precision-Interface/dp/B07CSS6QH8

https://www.amazon.com/Anndason-Pieces-Plastic-Switch-Liquid/dp/B072QCHQ2P/ref=sr_1_7?dchild=1&keywords=float+switch&qid=1585344955&sr=8-7

https://www.sparkfun.com/distance_sensor_comparison_guide

Sensors: We will be testing a number of sensors of different technologies and prices. The acoustic and laser sensors can provide accurate position of the water level, and we propose to include a float as the target reference. We also have a pressure sensor that could operate underwater to provide an indirect measurement of water depth. Lastly a series of 3 or 4 on/off float switches will be tested. The goal is to find a balance between reliability and cost.

Enclosure: The system will go in a schedule 80 (thick) 4” or 6” OD PVC pipe. The bottom opening goes against the ground, possibly covered with a mesh to keep stuff out. The top cap will hold the sensors, controller, transceiver, battery, antenna and solar panel. Only the solar panel will be visible.

We propose LoRa transceivers and gateways because NGENS has experience with this technology and it is becoming the de-facto standard in academia [Performance Evaluation of LoRa Considering Scenario Conditions, Sanchez-Iborra, R; Sanchez-Gomez, J; Ballesta-Vinas, J; et al. SENSORS V18 I3 DOI:10.3390/s18030772 MAR 2018]. A micro SD memory card is included in the controller. Access to the SD card may be remotely (TBD).

The design is to be enclosed in a schedule 80 PVC pipe and caps. The sensor, controller and transceiver will be in a watertight PVC box. The only outwardly visible part will be the Solar panel. Battery and Solar panel are integrated to the controller.

Costs & budgeting:

1. Two Master’s level students working 20hrs/week (1/2 time) for 6 months.
2. Prototype sensor units: $550 each. This cost includes the purchase of several different sensor candidates to be tried out for reliability and ruggedness. We estimate that the final design will be in the ~$350 range max.
3. LoRa WAN Gateway: $200 indoors, $1130 outdoors. Gateway needs to be installed within radio range (~1-2km) of the sensors. Each gateway can handle multiple sensors. Both sensors can connect through a single gateway if they are both within range.
4. Installation costs: There will be some cost to each installation depending on the exact location of the sensor.

Hardware for pilot (OTPS)			
	quantity		
	2	1095.82	Pilot sensor units
	1	1,130.26	Network gateway

	1	1,000.00	Installation costs
Total hardware costs		3226.08	
Totals			
Hardware		$3,226	
Students		$37,494	Personnel costs: ½ time for 6 months
TOTAL		$40,720	

Budget breakdown in attached spreadsheet.

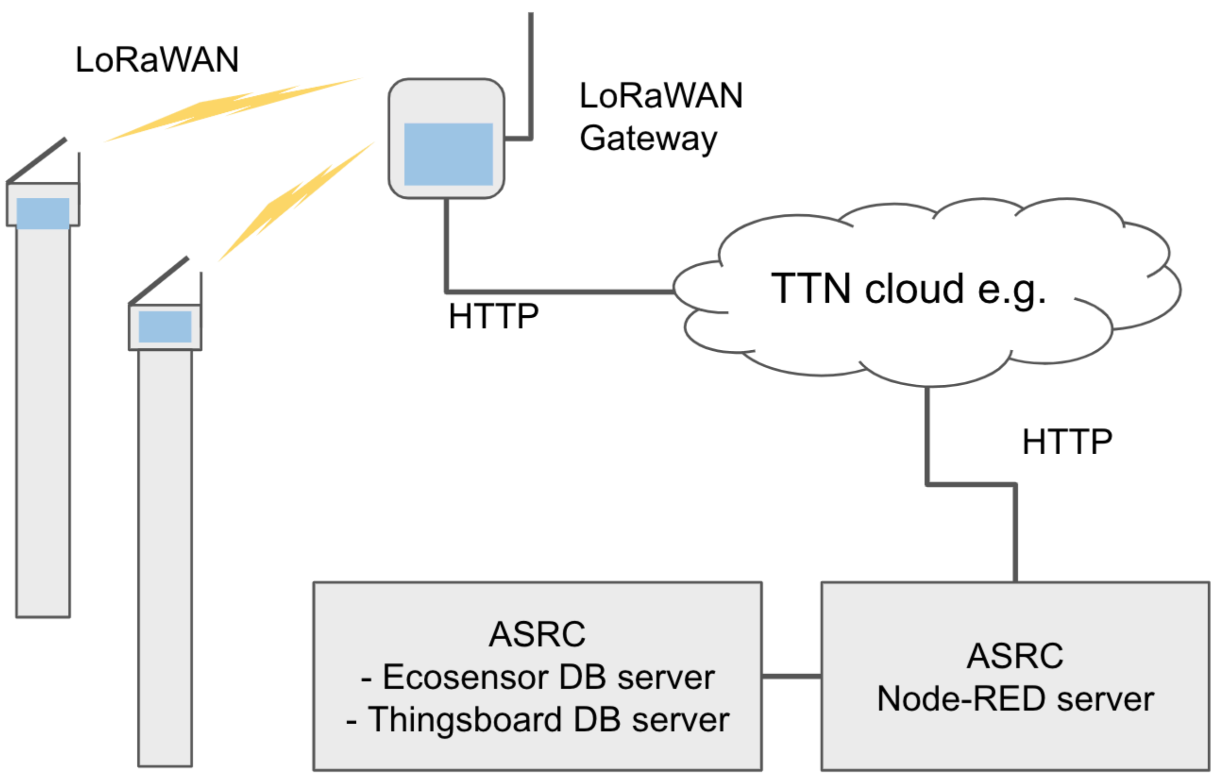
Timeline:

Months 1. Test different sensor designs using existing microcontrollers and transceivers in the Sensor Lab.

Month 2-3. Assembly of sensors and integration to network in NGENS lab. Identification of target sites for sensors and a site to install Gateway.

Months 4-5. Deployment of Sensors to selected sites. Installation of gateway. Activation.

Month 6: Troubleshooting, debugging.



Undergraduate student profile

The ideal candidate for this project is majoring in something other than Electrical, Computer, Mechanical, [etc.] Engineering, Science or Physics, but that has interest in technology and instrumentation to further her/his research. A background in ‘tinkering’ is ideal.

Skills minimum:

- Comfortable and interested in computers (Word, Excel, Macs, PCs, OSx, Windows 10)
- Basic electronics (Soldering, multimeter use, AC/DC sources).
- Physics 101 or equivalent
- At least one programming language (C, Java, Scratch, R, etc.).

Skills desired:

- Has played with a microcontroller (Arduino, Raspbery PI or similar).
- Experience with Linux
- Experience with data manipulation
- Knows some workshop tools (drill press, band/rotary saws, sanders, power tools)

Ideal skills:

- CAD design
- 3D printing
- ECAD design
- CNC experience
- Micro controller programming and debugging (ATSAMD21G in particular)
- Experience with networks and radios