TEXAS STATE UNIVERSITY

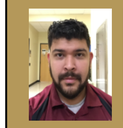
The rising STAR of Texas

E1.1 - Remote pH Sensor

Matthew Presley, Jason Castillo, Mason Hagen, Matthew Hughes
Sponsored by Ingram Readymix Inc.

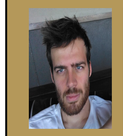
Ingram Readymix Inc.

Team Bio

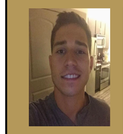


Jason Castillo
Major: Electrical Engineering
Concentration : Micro and Nano Devices

Matthew Presley (Project Manager)
Major: Electrical Engineering
Concentration : Networks and Communications



Mason Hagen
Major: Electrical Engineering
Concentration : Micro and Nano Devices



Matthew Hughes
Major: Electrical Engineering
Concentration : Computer Engineering

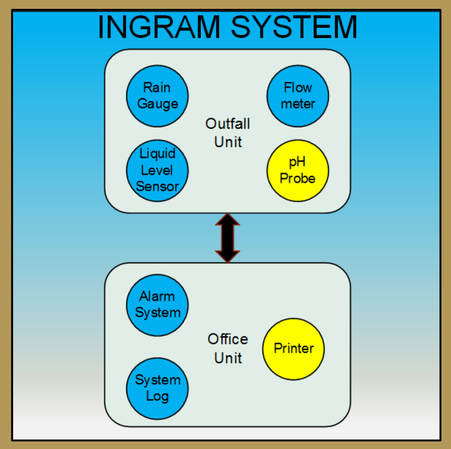
Existing System

Ingram Readymix Inc. is a concrete plant required to take monthly samples of the water that leaves the property. Usually a result of heavy rainfall, the water discharge goes through an outfall into the county drainage ditch. Currently an employee must verify water is leaving the property, take a grab sample, and measure pH with a handheld probe. Rainfall duration and water discharge are both difficult to accurately quantify. A system to detect rainfall and water discharge has been designed by two Senior Design teams.

TXG110000

- Regulates the discharge of facility wastewater and storm water associated with industrial activities from ready-mixed concrete plants.
- TCEQ monitors the plant's compliance.
- Benchmark pH is 6.0-9.0
- Describes Storm Water Pollution Prevention Plan

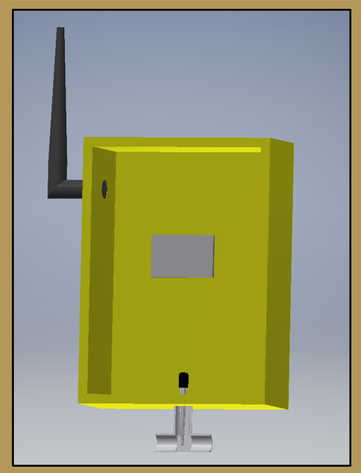
System Overview



- To maintain regulatory compliance, a ready-mix concrete plant is required to test the pH of water when it leaves the property.
- The remote pH sensor will work in conjunction with a rainfall and water discharge monitoring system previously developed by Ingram Engineering students.
- When water discharge occurs, a sample needs to be taken within 15 minutes.
- The project aims to remotely measure the pH and return the results to a printer.
- The finished product will consist of a pH probe, hardware interface, Raspberry Pi, communications and printing systems.
- The remote pH sensor will satisfy the requirements for permit TXG110000, by measuring the pH and logging the data for inspection by the TCEQ.
- A long term vision of the Ingram System will include the pH sensor in an array of smart technology deployed at Ingram Readymix plants around Texas.

Design Approach

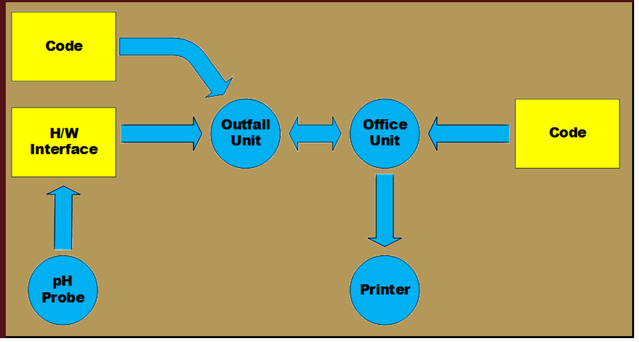
- A Raspberry Pi 3 will be used to interface with the pH probe and Xbee communications module.
- Python will be used to write the software to interpret the data from the probe and send the measurement to the printer.
- An ISFET probe will be used to collect the pH measurement.
- A touchscreen at the Outfall Unit will allow access to pH probe calibration.
- The probe enclosure will be designed with Autodesk Inventor.
- A printer will be used to print a physical log of the data.



Constraints

- **Budgetary** – The budget is set at $500 for all devices and supplies. The choices of pH probe are greatly reduced due to this total.
- **Design Feasibility** – Due to limited experience with ADC and Analog Front End Design, the type of probe we can use is limited.
- **Maintainability** – All pH probes are intended to be handheld and require regular calibration
- **Environmental** – The system must work in poor weather conditions with heavy rainfall typically the precursor to water discharge. Additionally, the system must operate in temperatures up to 120°F.

Design Level Diagram



Definitions

- **Grab Sample** - Water sample that needs to be tested within 15 minutes
- **Outfall** – the place where a culvert empties to the drainage ditch
- **TCEQ** - Texas Commission on Environmental Quality
- **Water Discharge** – characterized by the overflow of water from the retention pond into a holding tank which contains an outfall

2nd Semester Plans

- Test ISFET probe to determine whether it is feasible for the project
- Develop hardware interface
- Develop code for communications and printing systems
- Integrate the remote pH sensor with rainfall and discharge detection system

Performance

Hardware Performance Parameters:
- pH probe must be reliable
- pH probe must be accurate to 0.1 pH units
- Printer must produce a receipt with an accurate pH reading, date, time, location, and other relevant stats
- Enclosure must be able to stand the harshest weather conditions

Software Performance Parameters:
- Calibration Interface must load in 30 seconds
- Calibration Menu must be intuitive
- System Log will store correct pH measurements
- Access to the source code will not be available

Acknowledgments

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