DALHOUSIE UNIVERSITY
FACULTY OF ENGINEERING

Electrical Engineering Team 2
Erin Aucoin
Jenna Libbus

Sponsored by John Batt,
Dalhousie Aquatron Laboratory

Department of Electrical and Computer Engineering

Sensor Network with Remote Interface for Aquatic Research Facility

Introduction

- The Dalhousie Aquatron Laboratory consists of a variety of aquatic tanks and laboratories for performing both industrial and academic work.
- The main goal of this project is to create an internet connected sensor network so that information about the lab can be accessed remotely.
- It will be useful for people away from the lab to be able to monitor various quantities to prevent critical issues and reduce manual labour.

Deliverables

- Sensor network for one lab
- Remotely accessible user interface
- Detailed plan for expanding the network
  - to other labs
  - to include more sensors

Design Requirements

Sensors

- The following parameters must be measured:

Parameter	Range
Water level	Correct/Too low
Water temperature	0 to 60 °C
Room temperature	0 to 40 °C
Humidity	0 to 100 %
Water on floors	Yes/No
Light intensity	Relative range

- The sensor packages should be easy to reproduce.
- It should be possible to add more sensors to measure different parameters.

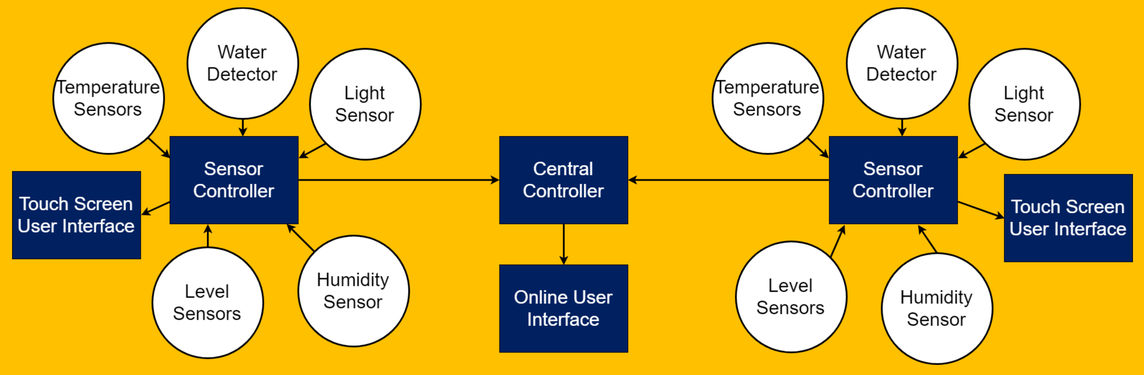
Interface

- An alarm system that notifies users when a parameter is outside the desired range must be included.
- The data collected by the system must be accessible remotely.
- All data must be stored on a Dalhousie server.
- Data from the last 6 months should be accessible.
- There should be an option to export the data.

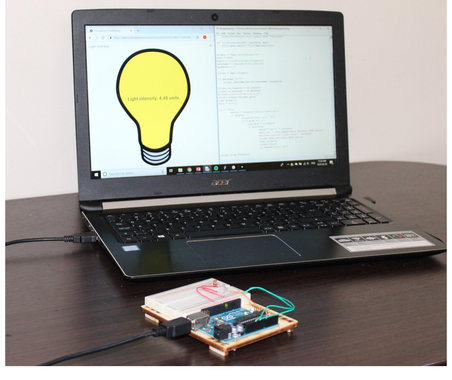
Design Details

- Each lab will have its own controller and sensor package to measure the required parameters and a local touch screen interface to display this data.
- All connections between controllers will be wired and use serial communication.
- The central controller will make its data viewable using an online user interface so that the data for each lab can be accessed remotely.
- The sensor controller will be an Arduino Due and the central controller will be a Raspberry Pi.

System Design



Proof of Concept



- A photoresistor was connected to an Arduino Uno that was programmed to continuously read the pin voltage and transmit it to a computer via serial connection.
- The computer was configured as an MQTT client and sent the light data to a ThingsBoard MQTT broker.
- A ThingsBoard dashboard was set up to display the incoming light data.
- This proof of concept demonstrates that the network and interface for this design work for one sensor.

Test Plan

- Ongoing testing will be performed during development as the sensor packages, controllers, network connection, and user interface are developed.
- Edge cases will be tested by conducting a splash test and simulating a power outage.
- The prototype will be installed in one of the labs and monitored over a couple of weeks to verify that it continues to function as expected.
- The effort required to add another sensor to the package, add another controller to the network, and replace a sensor will be analyzed.

Future Work

- Select other sensors and connect them to the Arduino.
- Add touchscreen interface to the Arduino.
- Modify the user interface to include all parameters.
- Set up central controller on Raspberry Pi.
- Make user interface accessible remotely.
- Test the prototype.
- Document work and create report of recommendations and procedure for expanding the system.

References

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