DALHOUSIE UNIVERSITY
FACULTY OF ENGINEERING

WATER MANAGEMENT

ARDUINO

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Remote Water Quality Analyzer for HVAC Systems

Introduction

Conventionally, water quality in HVAC system require onsite testing by technicians. This method demands:

- onsite data acquisition periodically -> **Inefficient**
- sending technicians to scattered locations -> **Expensive**

With the COVID-19 pandemic, it is also essential to reduce commuting to reduce human contact.

Our goal is to design a device for **remote real-time monitoring** water quality in HVAC system in various residential buildings from the WMC offices so that the technicians will be onsite only when necessary.

Design Process

Acquire domain knowledge

- **Learned technical background**
- **Reviewed existing product**
- **Reviewed stakeholders and constraints**

Draft conceptual design

- **Brainstormed on architectural design**
- **Selected necessary hardware**
- **Compared and selected communication method**

Design and Analysis

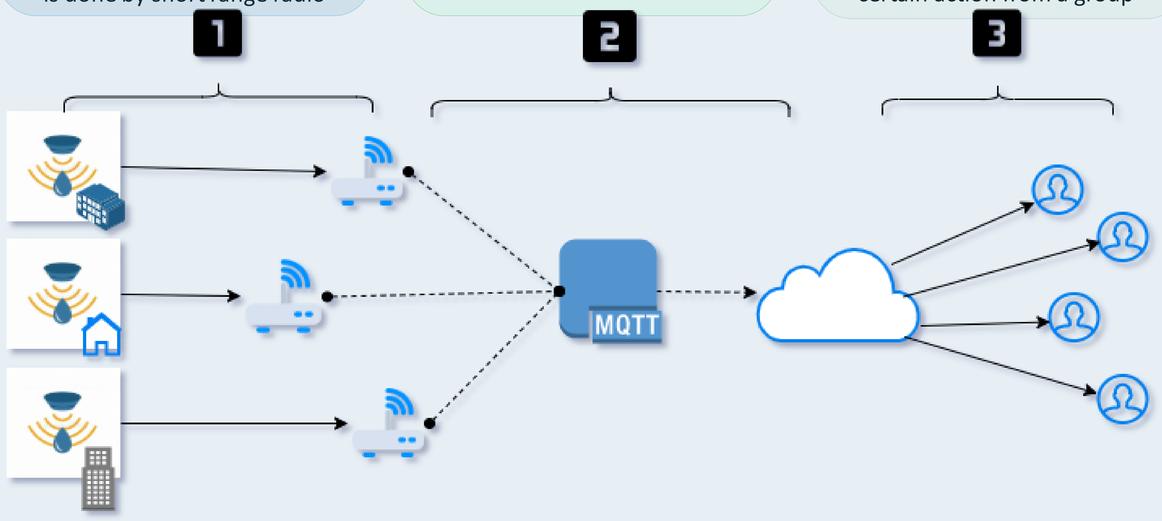
- **Programmed the sensors**
- **Designed PCB & outer casing**
- **Designed and pivoted on communication method**

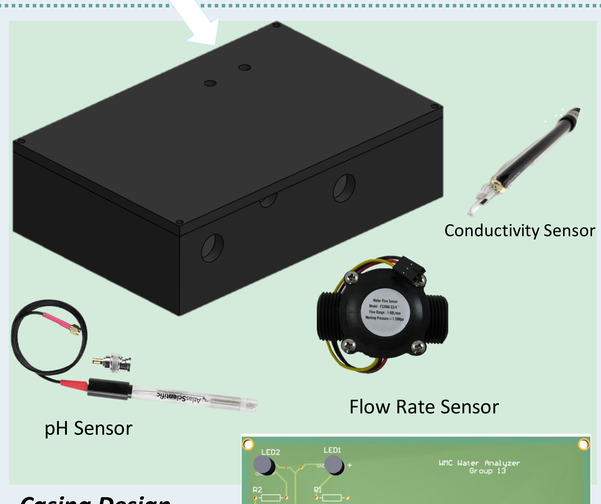
Build and Validation

- **3D Printed the PCB and outer casing**
- **Tested sensors in different environment**
- **Developed link between device and MQTT broker**
- **Visualize the data**

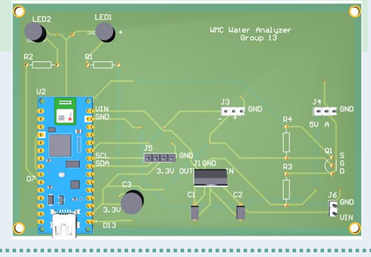
Details of Design

1. Sensor node embedded with Wi-Fi/BLE chip that can communicate with Wireless Access Point
2. Data transfer at each location is done by short range radio
3. Data transfer by MQTT protocol is lightweight and operational flexible
4. Data secured by network Transport Layer Security
5. Users can view data from dashboard embedded in any Cloud platform of choice when connected
6. User privilege is set up allow certain action from a group

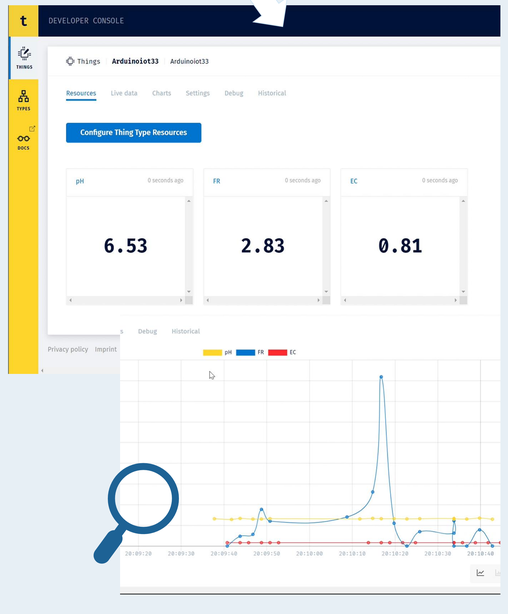




Casing Design



PCB Design



Live Data Visualization on Dashboard

Key Accomplishments

Hardware

- Outer case design is **water resistant.**
- **T-Pipe fitting** for easy **installation** in piping systems.
- **pH, Flow rate, and Conductivity** sensors, all **tested** and **calibrated to** ensure **high accuracy.**
- Sophisticated **power delivery system** to reduce **transient behaviors.**
- **Hardware Encryption** from **ATECC608A** chip.
- **PCB designed** with header pins **for easy component replacement.**
- Hardware **cost within budget.**

Software

- **Programmed code smoothly connects to Wi-Fi**
- Product **functions in low bandwidth/high latency network.**
- **Data** from the sensor are **published to the IoT data platform consistently.**
- **Real-time data stream** to an open-source developer console **for viewing and analysis.**

Future Recommendations

- **Build a simple, cost effective Wireless Access Point** for remote locations.
- **Migrate sensor readings** from open-source platform **to commercial cloud** (e.g., AWS IoT, Azure, Google Cloud, etc.) for extra layer of security.
- **Assign user groups with certain viewing privilege** for the client and external users.

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