Jal Alert

Pipeline Monitoring System

Authors

V. Pradeep Kumar - EDM19B018

P. Lakshmi Viswanadh - EDM19B021

Yash Kumar Sahu - CED19I039

G. Paul Prince - COE19B026

A report presented for the course
Product Design Practice

INDIAN INSTITUTE OF INFORMATION TECHNOLOGY,
DESIGN AND MANUFACTURING, KANCHEEPURAM

April 2022

Abstract

Monitoring water quality plays an important role in determining whether or not we are making progress in cleaning up our waterways. It reveals the health and composition of public pipelines, storage, streams, and rivers at a snapshot in time, as well as over weeks, months, and years. Water quality can be measured by collecting water samples for laboratory analysis manually. The Internet of Things (IoT) is a system of interrelated devices connected to a network and/or to one another, exchanging data without necessarily requiring human-to- machine interaction. To automate and accelerate the water quality testing process, we propose a data logging enabled water quality monitoring IoT device, **Jal Alert**. Our device uses different sensors connected to a micro-controller for monitoring the water quality by determining pH, turbidity, conductivity, temperature and parameters of water. With the use of IoT, the collected sensor data is analyzed and the pollution of water can be investigated by a stringent mechanism.

Acknowledgements

We would like to thank our course faculties,

Dr. Tapas Sil, Associate Professor, Department of Sciences and Humanities, Physics, IIITDM

Dr. Karthik.C, Assistant Professor, Department of Sciences and Humanities, School of Interdisciplinary Design and Innovation (SIDI), IIITDM

Dr. Pandiyarasan Veluswamy, Assistant Professor, Department of Sciences and Humanities, School of Interdisciplinary Design and Innovation (SIDI), IIITDM

Dr. Nachiketa Mishra, Assistant Professor, Department of Sciences and Humanities, Mathematics, IIITDM

for their guidance and support. We would like thank our mentors and course teaching assistants, for helping and guiding us throughout the project. We thank our team and the online community for their invaluable insights and support which made us better understand the project.

Contents

Chapter 1

Introduction

1.1 Background

Monitoring water quality plays an important role in determining whether or not we are making progress in cleaning up our waterways. It reveals the health and composition of public drinking water pipelines, storage, streams, and rivers at a snapshot in time, as well as over weeks, months, and years.

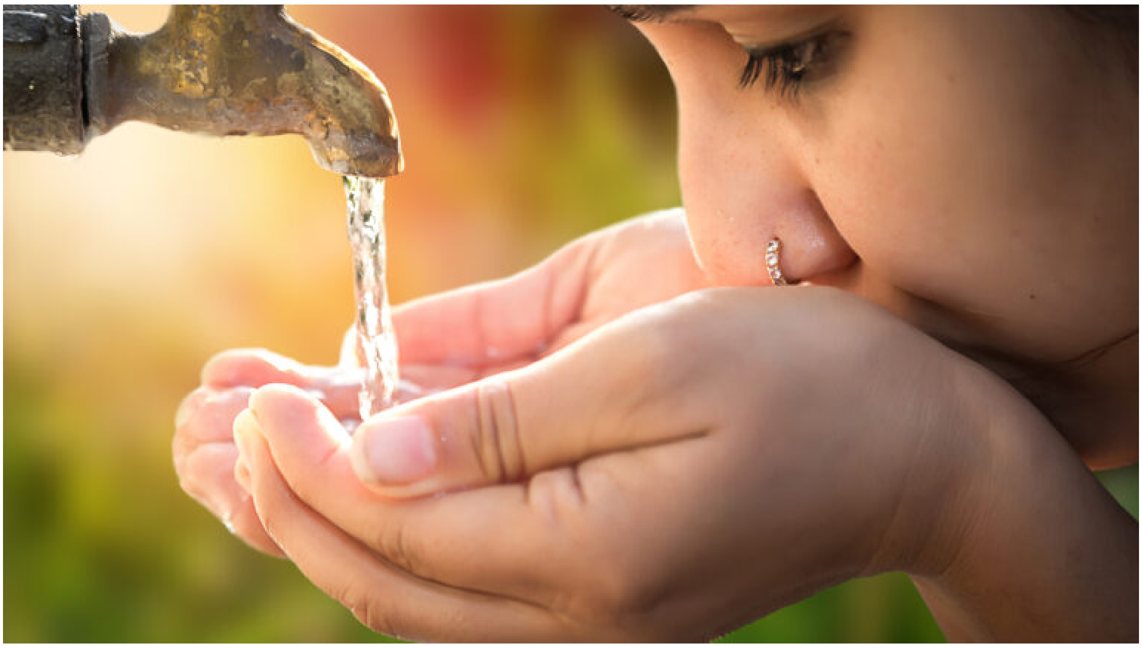

Figure 1.1: A person drinking tap water

1.2 Motivation

Monitoring water quality in the 21st century is a growing challenge because of the large number of chemicals used in our everyday lives and in commerce that can make their way into our waters. A proper and safe method for monitoring water quality.

FIGURE 1.2: Testing water quality manually using chemical analysis

1.3 Objectives of work

To automate and accelerate the water quality testing process by monitoring water parameters and logging the sensor parameters in real time on a database for water contamination analysis.

Chapter 2

Methodology

2.1 System Overview

A IOT-based microcontroller is responsible for interacting with different sensors to collect data and upload data to a specific web server. Using our product one can estimate the water contamination, purity, pipeline leaks, and amount of volume flown. Determining the leakages in the pipeline network using a pressure sensor. Real-time monitoring of the pipeline network can be achieved using our product. Data will be updated in the web server, where users can monitor the pipeline network

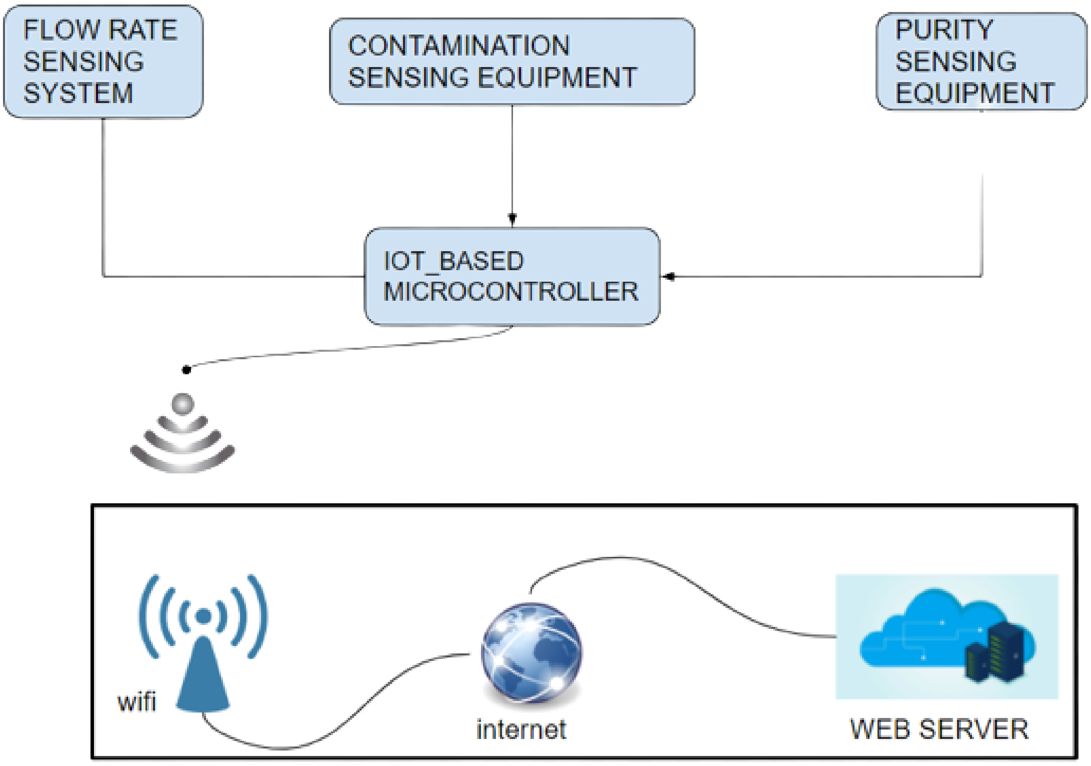

FIGURE 2.1: Product System Architecture

2.2 Parameter Calculation

- There are a lot of parameters for judging water quality. Using multiple parameters, we can get a more accurate estimate of water quality.
- So, in our product we are using 6 parameters but only using 3 sensors, and extraction of remaining parameters were from a combination of these sensors.

SN.NO	PARAMETER	MODE OF SENSING
1)	PH	PH SENSOR
2)	TDS	TDS SENSOR & TEMP SENSOR
3)	CONDUCTIVITY	**TDS(mg/L)≅EC(dS/mor umho/cm)×(0.55–0.7)**
4)	HARDNESS	From tds sensor we can extract hardness
5)	SALANITY	SAR = {(PH – a)*(1 + c*EC)/b}^2
6)	CHLORINITY	SALANITY = 1.80655*Chlorinity(ppt)

FIGURE 2.2: Parameters Equations, refer Appendix - A for hardware components

2.3 Data Logging

Data logging is the process of collecting and storing data over a period of time in different systems or environments. It involves tracking a variety of events.

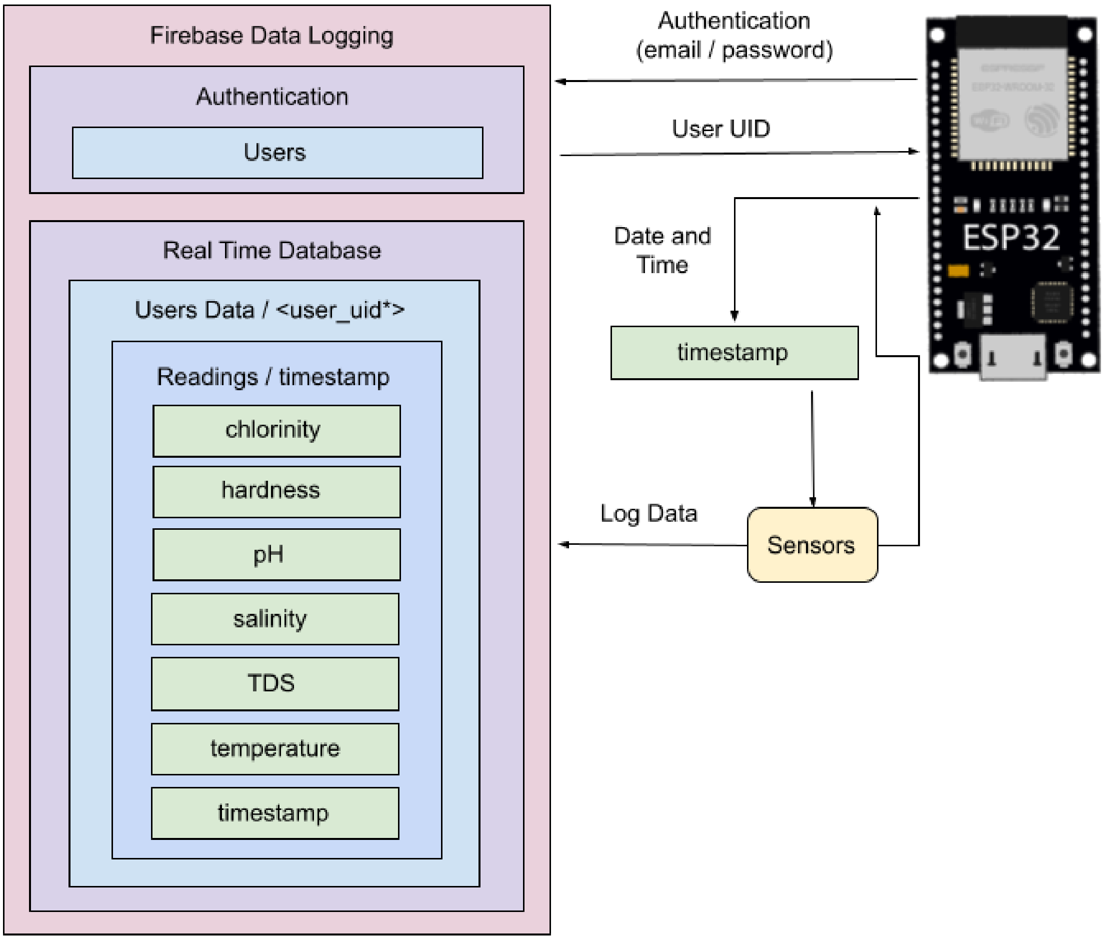

Figure 2.3: Technical Architecture of Data Logging

- The ESP32 authenticates as a user with email and password. After authentication, the ESP32 gets the user with a unique UID
- The ESP32 gets chlorinity, hardness, pH, temperatrure, salinity and Total Dissolved Salts (TDS) from the sensor modules
- It gets epoch time right after gettings the readings (timestamp).
- The ESP32 sends chlorinity, hardness, pH, temperatrure, salinity, Total Dissolved Salts (TDS) and timestamp to the database.
- New readings are added to the database periodically. Record of all readings on the Firebase realtime database.

Chapter 3

Work Done

3.1 Work done - Hardware

- This is our complete product, which uses PH, tds and temperature sensor. We covered our entire electronics in a closed box.

FIGURE 3.1: Overall product

- we used a perf board to integrate every electronics components and soldered every component in the board as shown in the figure:3.2

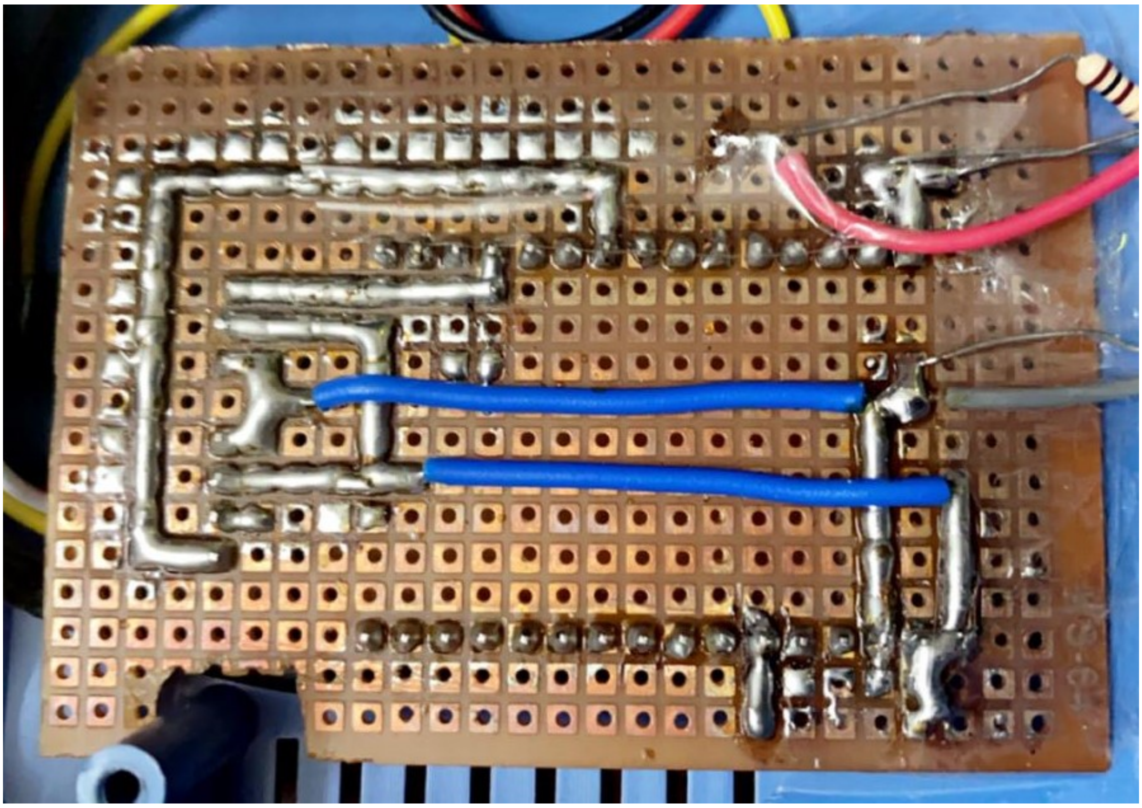

FIGURE 3.2: PCB

- This is the complete product circuit which is packed inside a box, where every components and sensor modules are pleased.

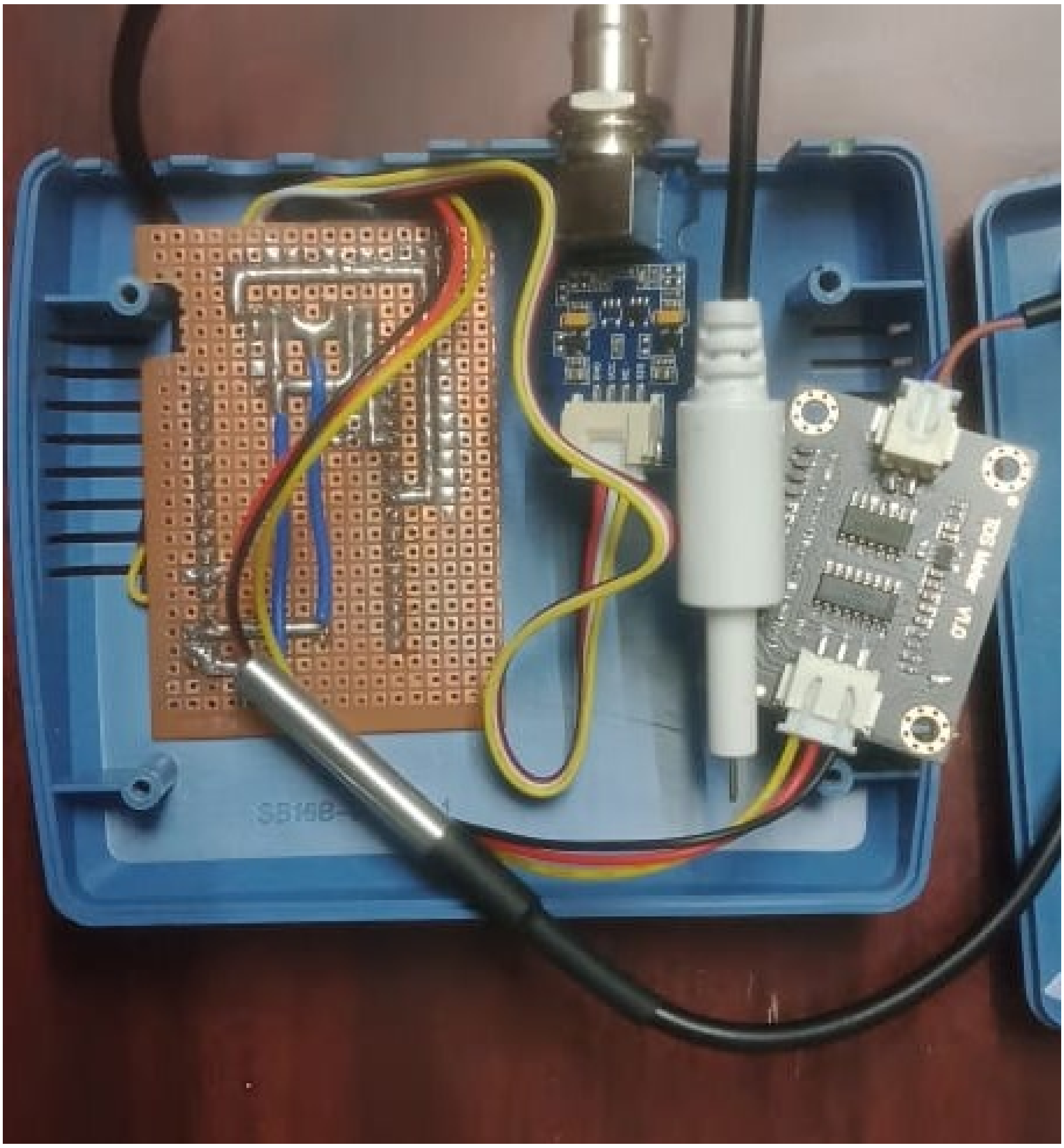

FIGURE 3.3: Product Circuit

3.2 Work done - Software

FIGURE 3.4: Web app authentication

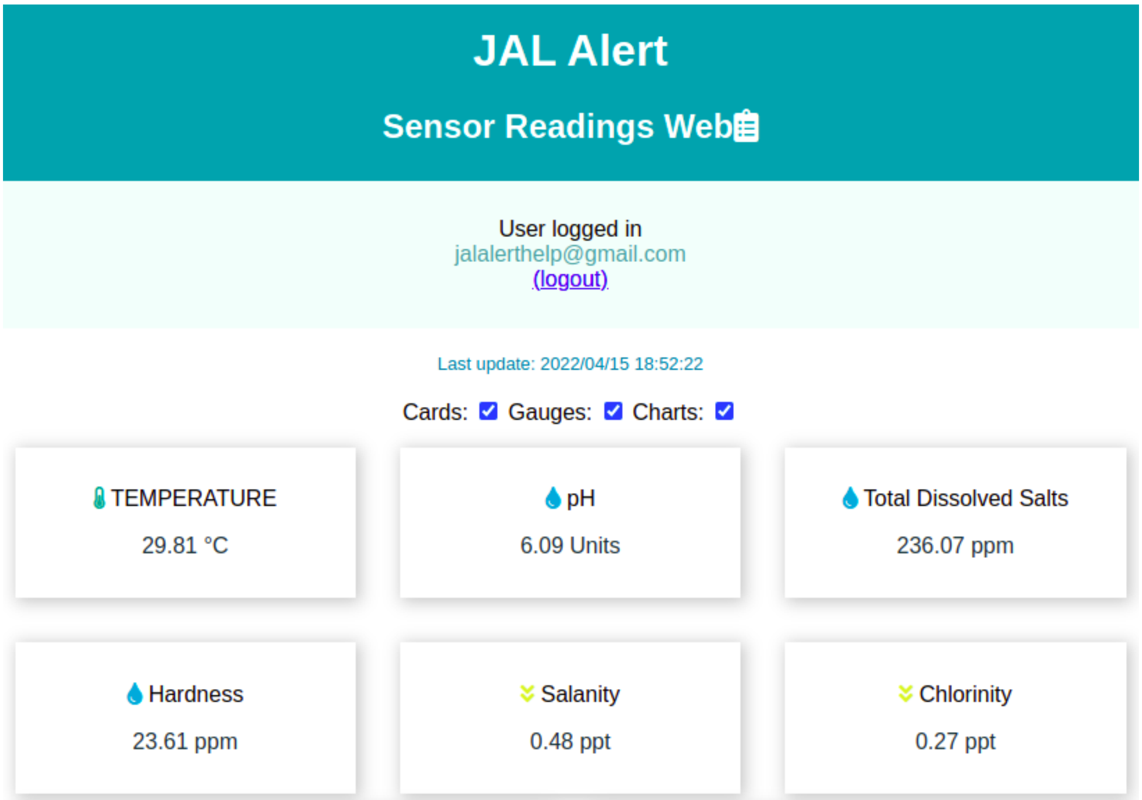

FIGURE 3.5: Realtime readings

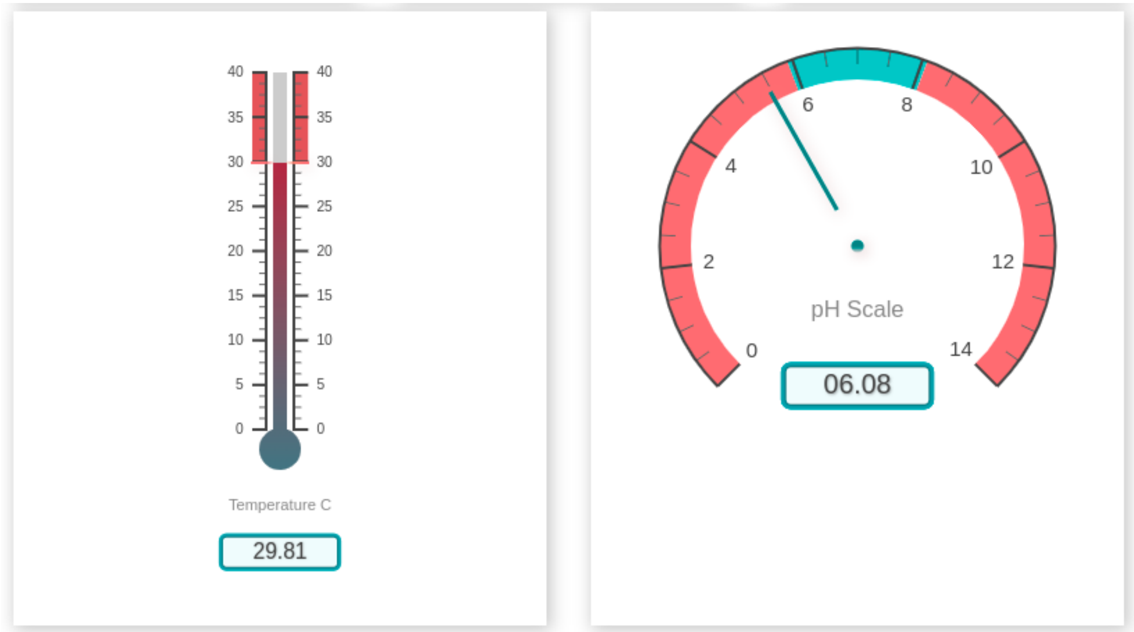

FIGURE 3.6: Realtime reading gauges

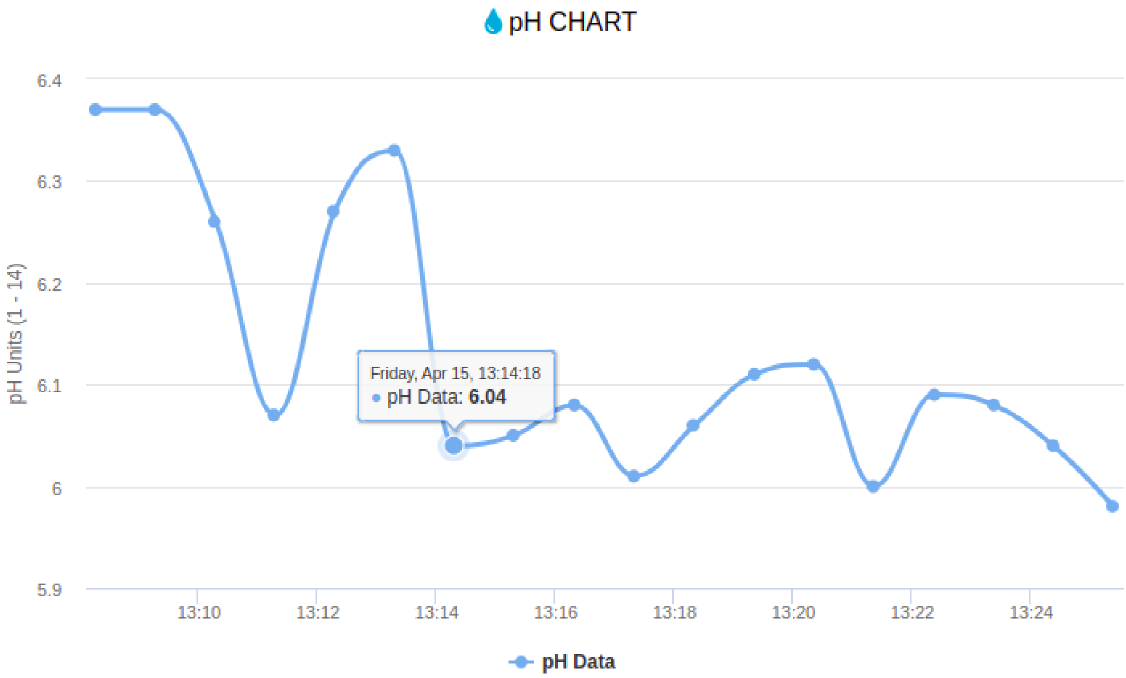

FIGURE 3.7: pH readings plot

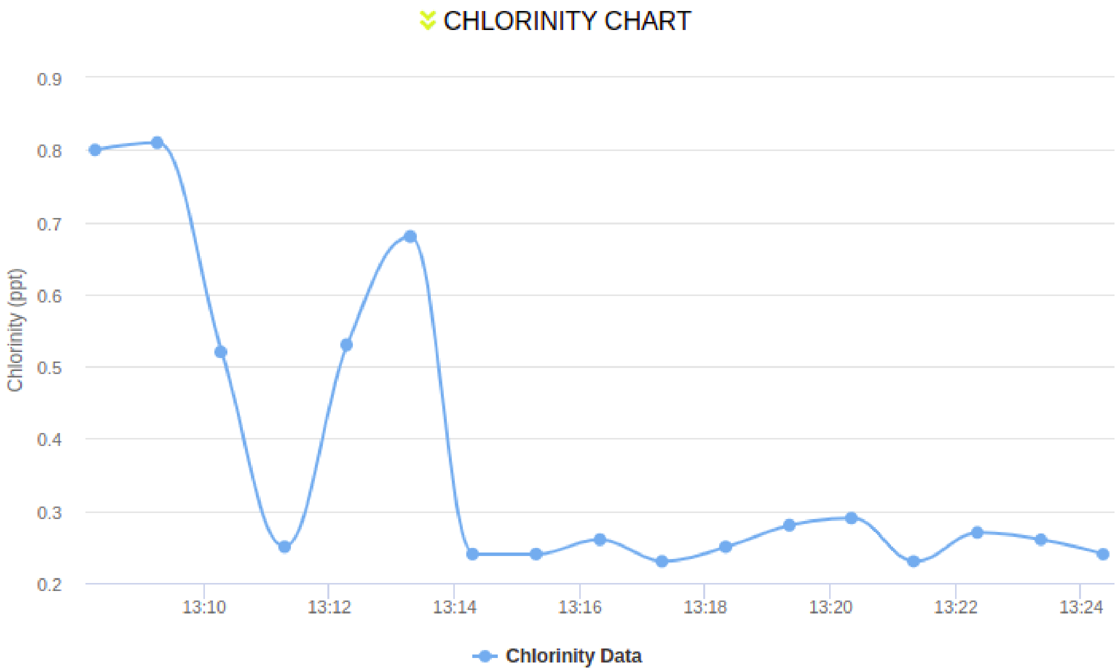

FIGURE 3.8: Chlorinity readings plot

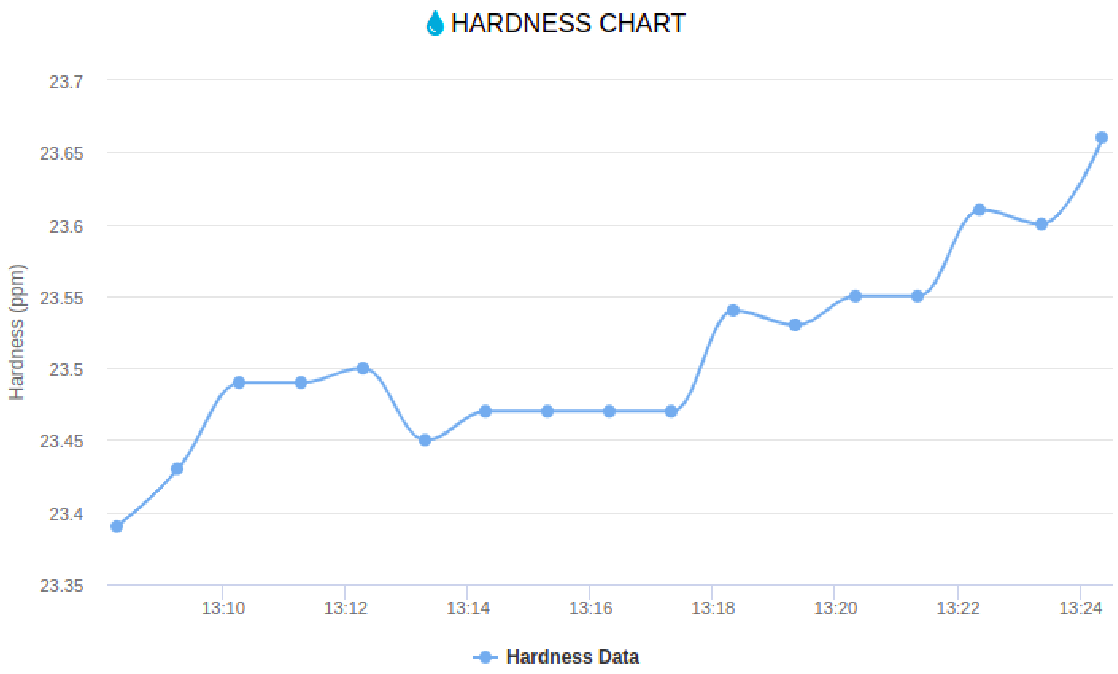

FIGURE 3.9: Hardness readings plot

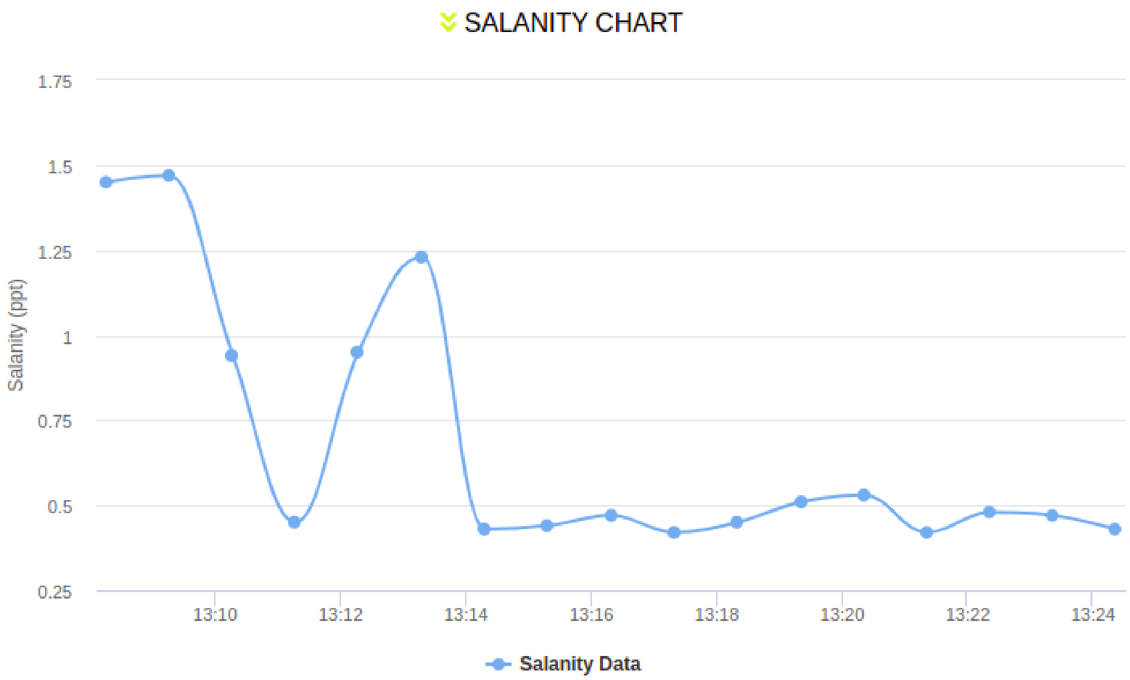

FIGURE 3.10: Salinity readings plot

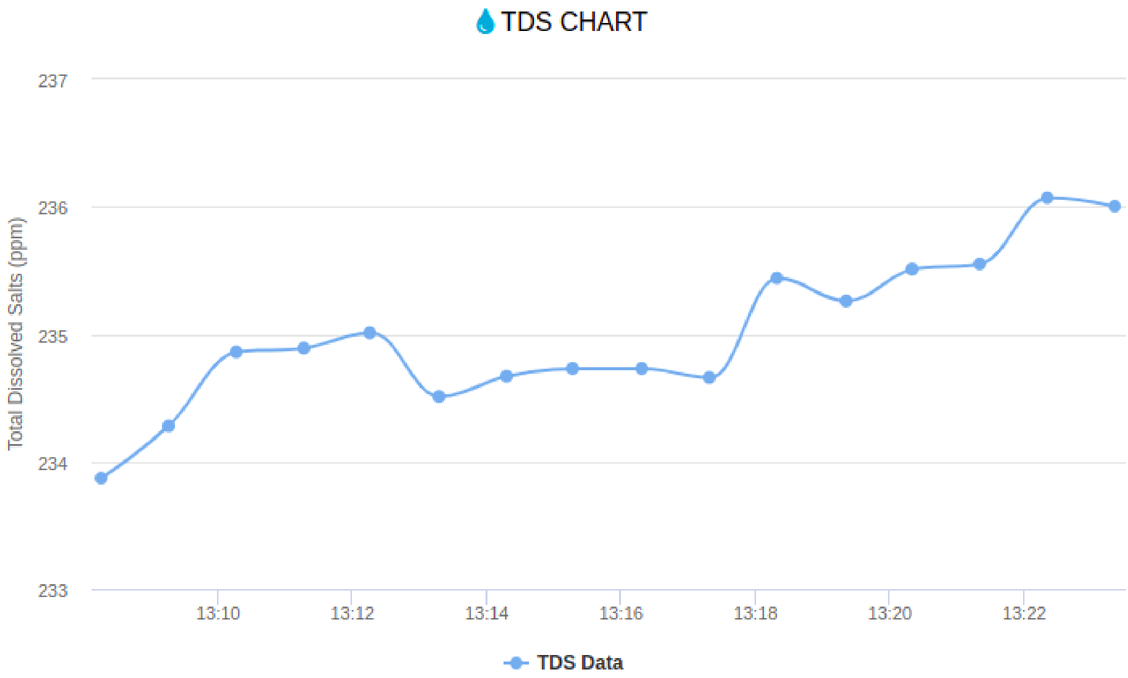

FIGURE 3.11: Total Dissolved Salts (TDS) readings plot

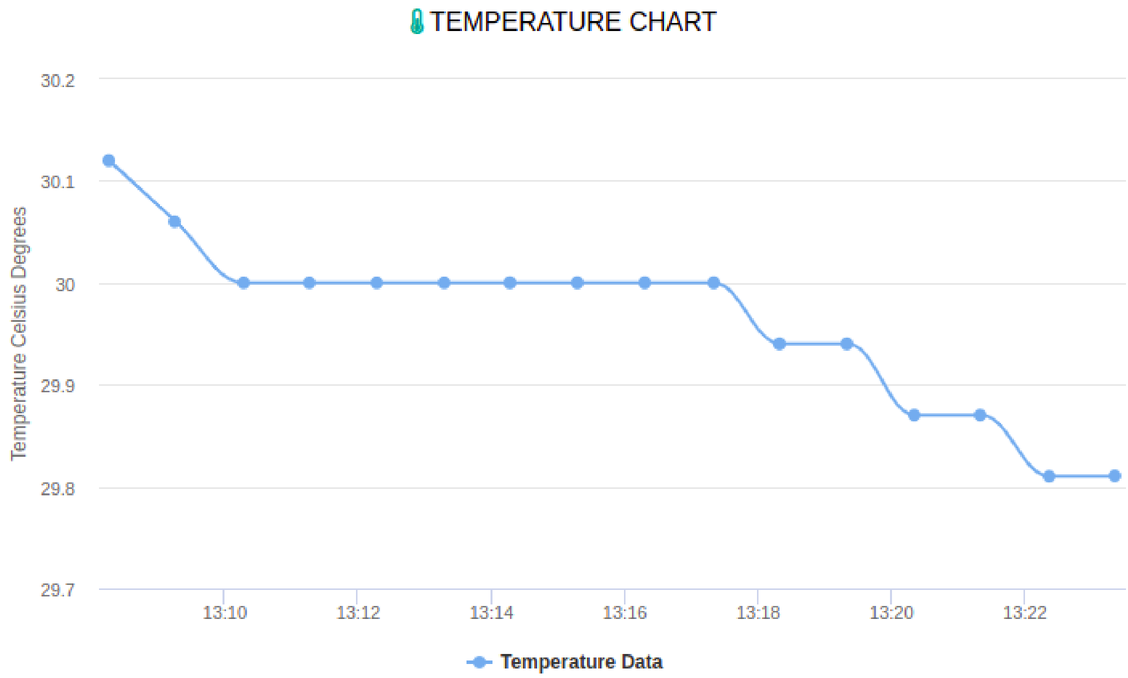

FIGURE 3.12: Temperature readings plot

Timestamp	Temp (°C)	pH	TDS	Hardness	Salanity	Chlorinity
2022/04/15 18:54:22	29.75	6.04	236.59	23.66	0.43	0.24
2022/04/15 18:53:22	29.81	6.08	236.00	23.60	0.47	0.26
2022/04/15 18:52:22	29.81	6.09	236.07	23.61	0.48	0.27
2022/04/15 18:51:21	29.87	6.00	235.55	23.55	0.42	0.23
2022/04/15 18:50:21	29.87	6.12	235.51	23.55	0.53	0.29
2022/04/15 18:49:21	29.94	6.11	235.26	23.53	0.51	0.28
2022/04/15 18:48:20	29.94	6.06	235.44	23.54	0.45	0.25
2022/04/15 18:47:20	30.00	6.01	234.66	23.47	0.42	0.23
2022/04/15 18:46:19	30.00	6.08	234.73	23.47	0.47	0.26
2022/04/15 18:45:18	30.00	6.05	234.73	23.47	0.44	0.24
2022/04/15 18:44:18	30.00	6.04	234.67	23.47	0.43	0.24
2022/04/15 18:43:18	30.00	6.33	234.51	23.45	1.23	0.68
2022/04/15 18:42:17	30.00	6.27	235.01	23.50	0.95	0.53
2022/04/15 18:41:17	30.00	6.07	234.89	23.49	0.45	0.25
2022/04/15 18:40:17	30.00	6.26	234.86	23.49	0.94	0.52
2022/04/15 18:39:16	30.06	6.37	234.28	23.43	1.47	0.81
2022/04/15 18:38:16	30.12	6.37	233.87	23.39	1.45	0.80
2022/04/15 18:37:16	30.12	6.41	233.88	23.39	1.69	0.94

FIGURE 3.13: Readings Database

Project GitHub link: `https://github.com/YashKSahu/JAL-Alert`

Chapter 4

Conclusion and Extensions

4.1 Conclusion

This report we proposed a data logging enabled water quality monitoring IoT device, **Jal Alert**. The devices was tested with different kinds water samples. The sensor generated readings were successfully logged on to an online database. A web application is created to display sensor readings and results. A pattern of errors in the generated sensor plots was found and requires algorithmic optimization and fusion of data from additional sensors to improve accuracy for determining water contamination.

4.2 Future Work

In the next phase of our product, we will be focusing on testing water pipelines leakage and fault detection.

Appendix A

Reference figures

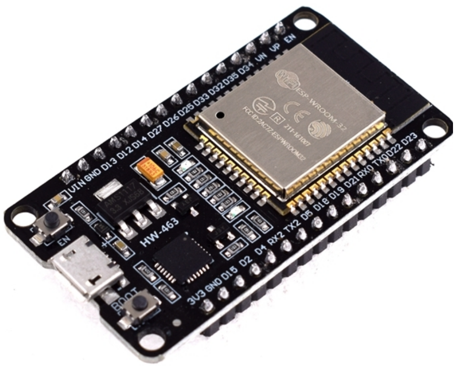

Figure A.1: ESP32 Micro-controller Board

Figure A.2: Analog pH Sensor

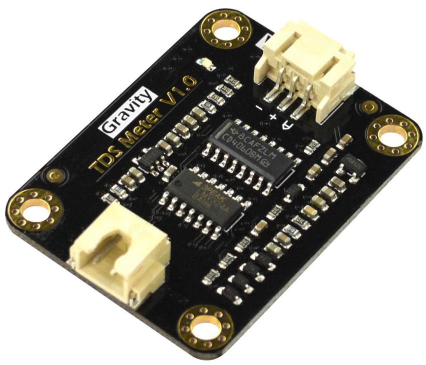

Figure A.3: TDS Sensor

Figure A.4: Waterproof Temperature Sensor

Bibliography

[1] M. Abdelhafidh, L. Chaari Fourati, M. Fourati, and A. Abidi, "Hybrid mechanism for remote water pipeline monitoring system," in *2017 13th International Wireless Communications and Mobile Computing Conference (IWCMC)*, 2017, pp. 2140–2145.

[2] M. Abdelhafidh, M. Fourati, L. C. Fourati, and A. Abidi, "Remote water pipeline monitoring system iot-based architecture for new industrial era 4.0," in *2017 IEEE/ACS 14th International Conference on Computer Systems and Applications (AICCSA)*, 2017, pp. 1184–1191.

[3] A. Almazyad, Y. Seddiq, A. Alotaibi, A. Al-Nasheri, M. Bensaleh, A. Obeid, and S. M. Qasim, "A proposed scalable design and simulation of wireless sensor network-based long-distance water pipeline leakage monitoring system," *Sensors (Basel, Switzerland)*, vol. 14, pp. 3557–77, 02 2014.

[4] (2020) Random nerd tutorials. [Online]. Available: https://randomnerdtutorials.com/