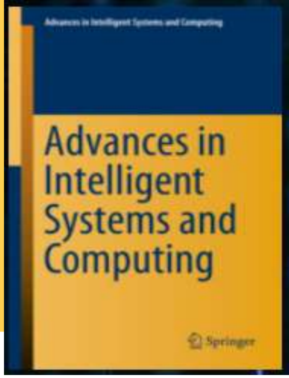


Developing an IoT Based Water Pollution Monitoring System

Md. Mazharul Islam, Mohammad Shamsul Arefin, Sumi Khatun, Miftahul Jannat Mokarrama and Atqiya Munawara Mahi

PID: ICIPCN055

May 06-07, 2020

Springer

Presented by

Md. Mazharul Islam

Contents

Introduction

- Water is a special kind of ecological resource which is a foundation to support the ecosystem on earth.
- It is used in various activities, such as consumption, agriculture and industry, which may affect water quality.
- About 13,700 people die each day from polluted water diseases.
- By making use of the full potential of IoT, It would be possible to prevent individuals from drinking polluted water.

Related Works

- **The Design of Multi-Parameter Online Monitoring System of Water Quality Based on GPRS. (Quio Tie-Zhn, 2010)**
  - Work Done:

    - Used multi-parameter for water's pollution monitoring system.

      i.e. pH, Temperature, COD and TOC.

    - Used GPRS for data transmission.
  - Limitation:

    - Used PC instead of microcontroller only for sensors.
    - Used 2G technology, i.e. GPRS (56 up to 114 Kbps).

Related Works (Contd.)

- **Web Based Water Quality Monitoring with Sensor Network: Employing ZigBee and WiMax Technologies. (Kamal Alameh, 2011)**
  - Work Done:

    - Developed WSN was comprehensively tested in practical area.
  - Limitation:

    - Used ZigBee (maximum speed is just 250kbps) and WiMax both, instead of Wi-Fi.

Related Works (Contd.)

- **Real-time environmental sensor data: An application to water quality using web services (Branko Kerkez , 2016)**
  - <u>Work Done:</u>

    - Used 'NeoMote', a programmable system on chip for field deployment.

    - Used 'Antelope', an integrated collection of programs for data collection.
  - <u>Limitation:</u>

    - Measures only depth and conductivity of water.

Objectives

- To develop an IoT system and a data server for monitoring water pollution in real time.
- To develop an inexpensive as well as economically affordable device for common people.
- To build an android app for real time data visualization.

Methodology

- The overall system is subdivided into three phase. These are:

1. **Physical Phase:** Consist of Sensors, Data Analysis & Communication Module.
2. **Service Phase:** Stores data and Provides tools for analyzing data.
3. **Presentation Phase:** Visualizes the Information to the User and allows user to interact with the system.

Methodology (Contd.)

Physical Phase:

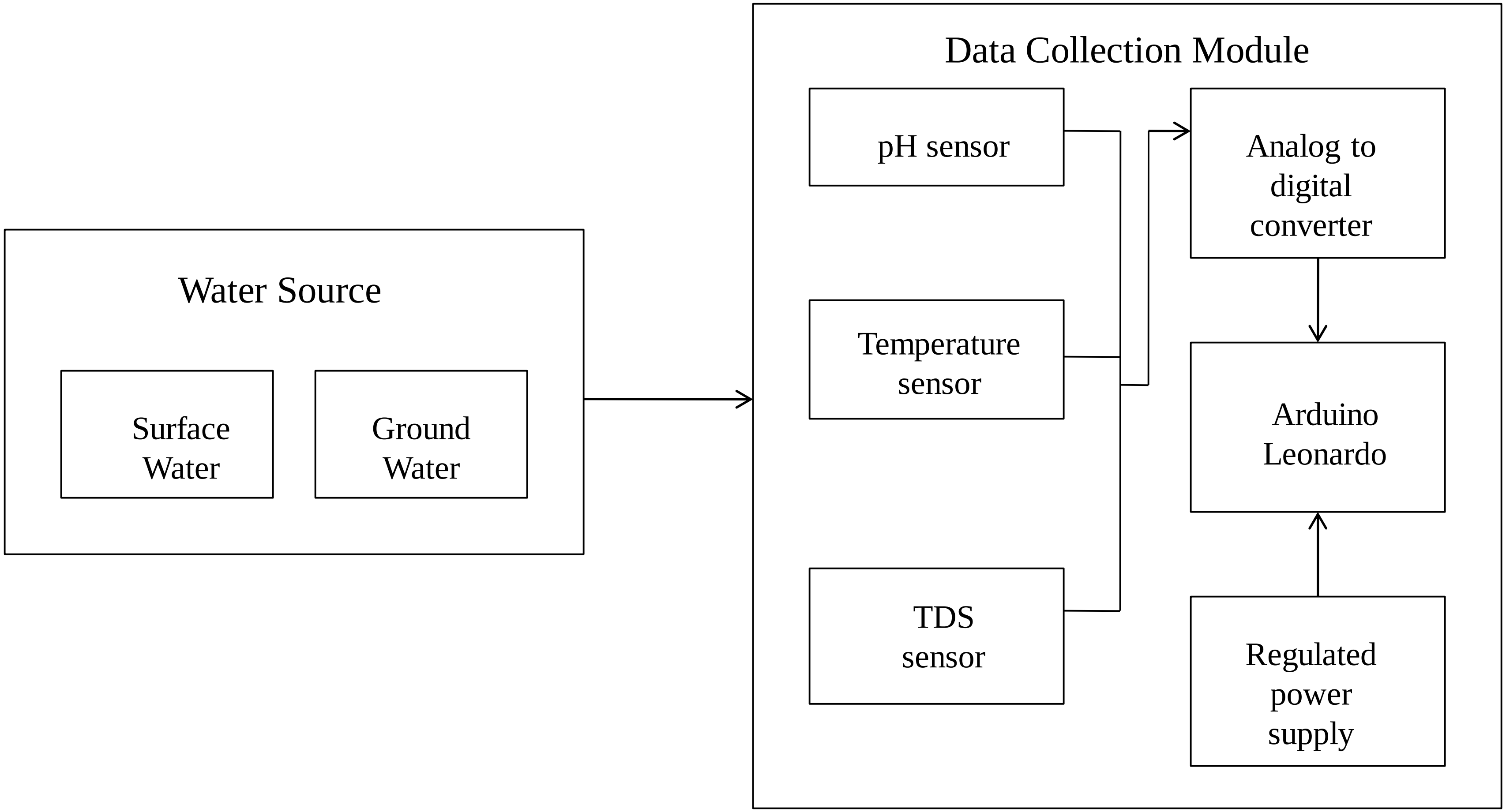


Figure 1: Water Source & Data Collection Module.

Methodology (Contd.)

- **Physical Phase:**

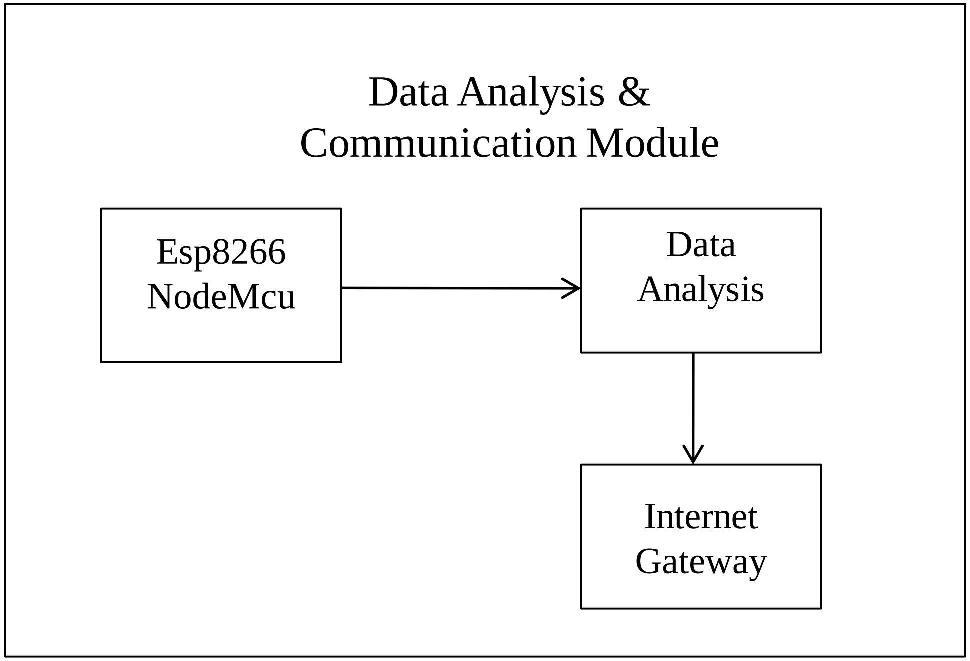


Figure 2: Data Analysis & Communication module.

Methodology (Contd.)

Service Phase:

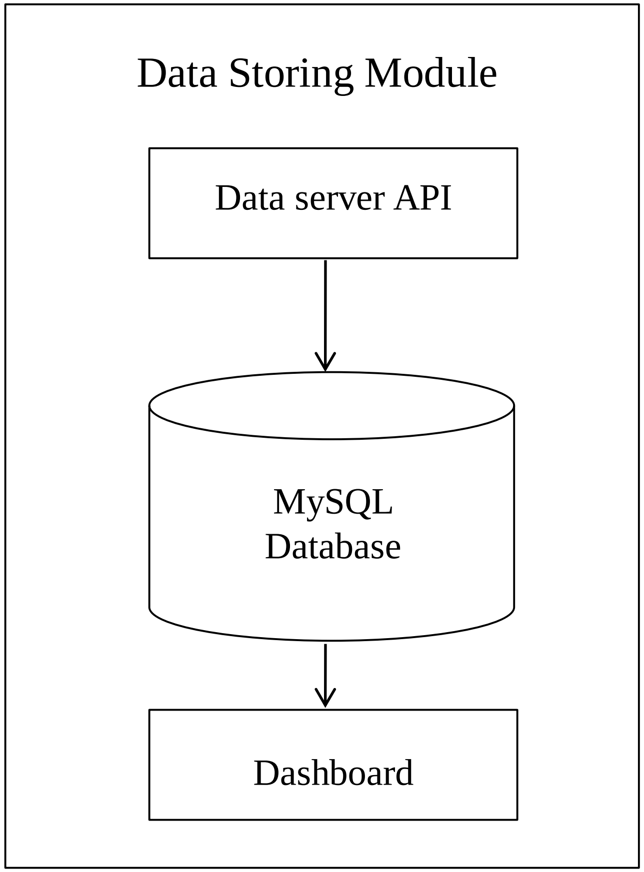


Figure 3: Data Storing Module.

Methodology (Contd.)

<u>Presentation Phase:</u>

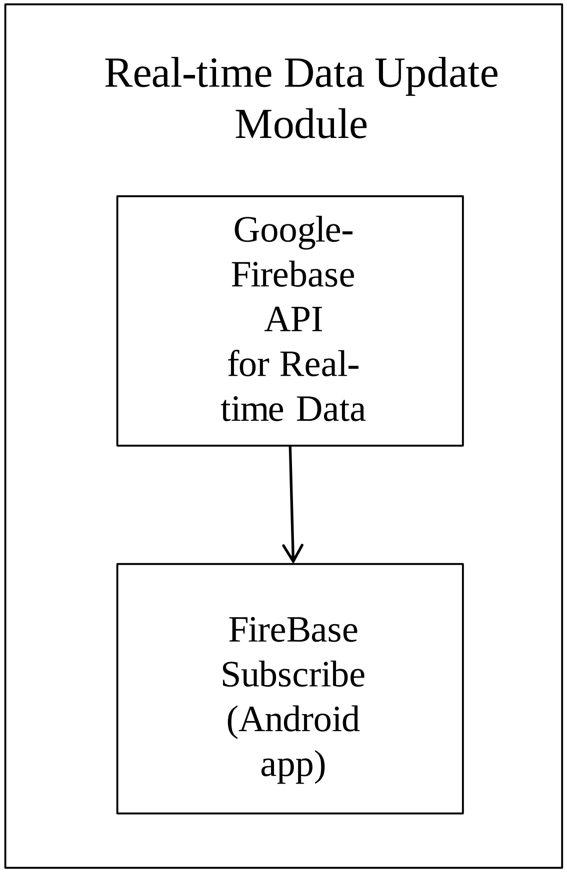


Figure 4: Data visualization module.

Methodology (Contd.)

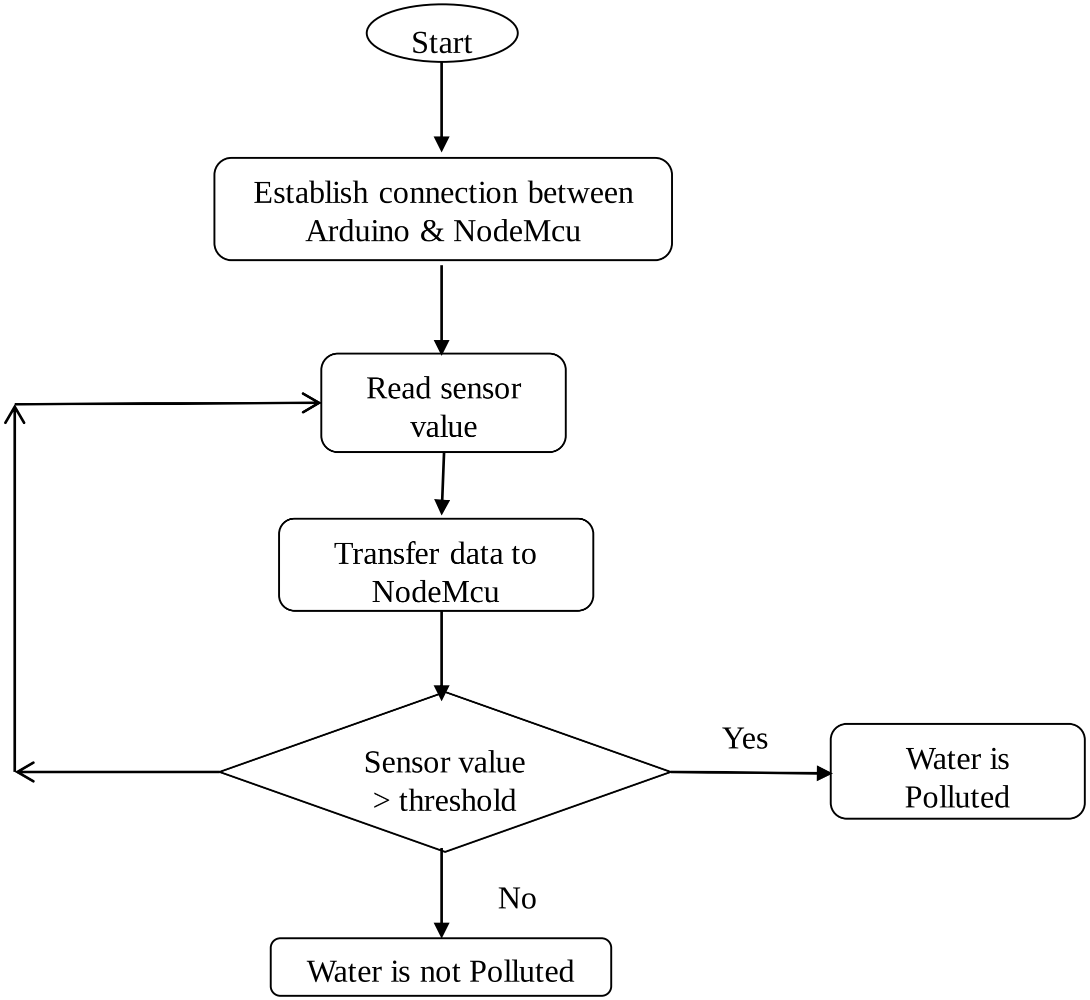
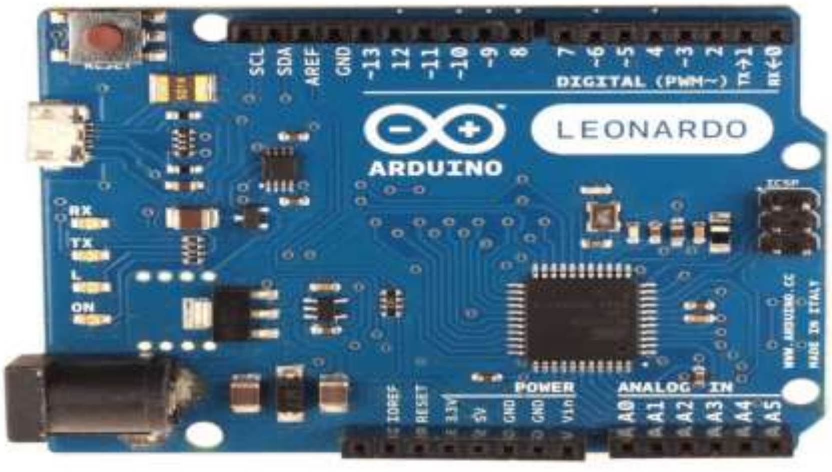
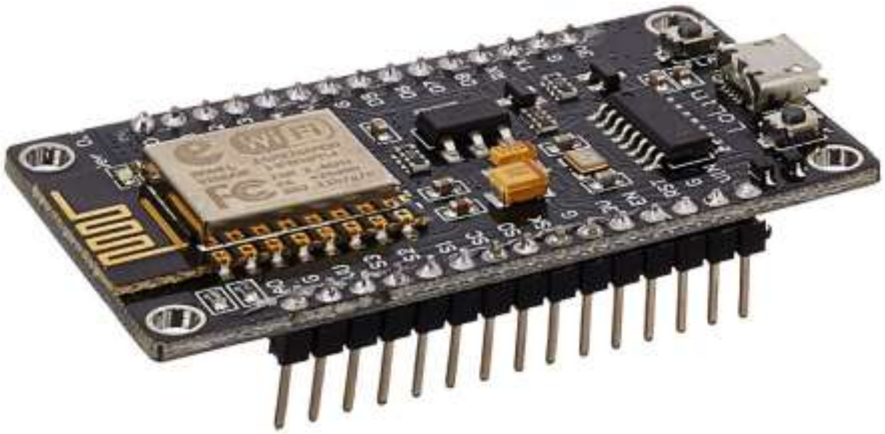


Figure 5: Flowchart representation of data analysis & communication module.

Implementation

Hardware:



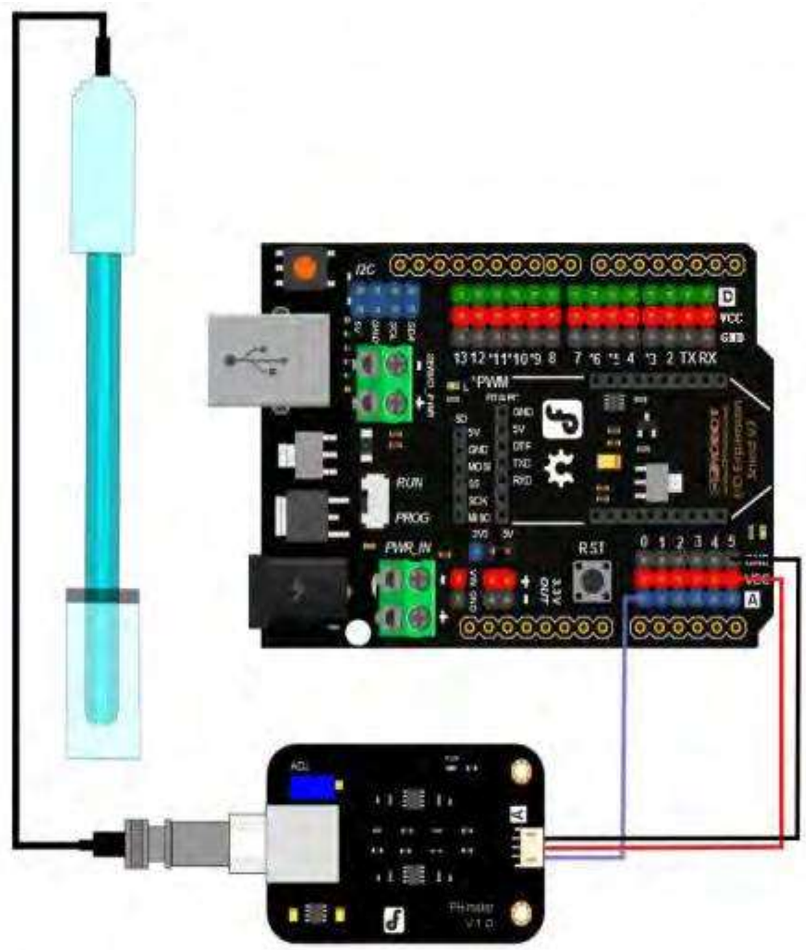


a) Arduino Leonardo

b) Esp8266 NodeMcu

Figure 6: Arduino Leonardo & NodeMcu.

Implementation (Contd.)



SL	Max	Min	Comment
1.	9.0	6.5	Natural Water
2.	6.5	4.5	Slightly Acid
3.	4.5	<4.5	Very Acid
4.	11.5	9.0	Slightly Alkaline
5.	>11.5	11.5	Very Alkaline

Figure 7: pH Sensor

Implementation (Contd.)

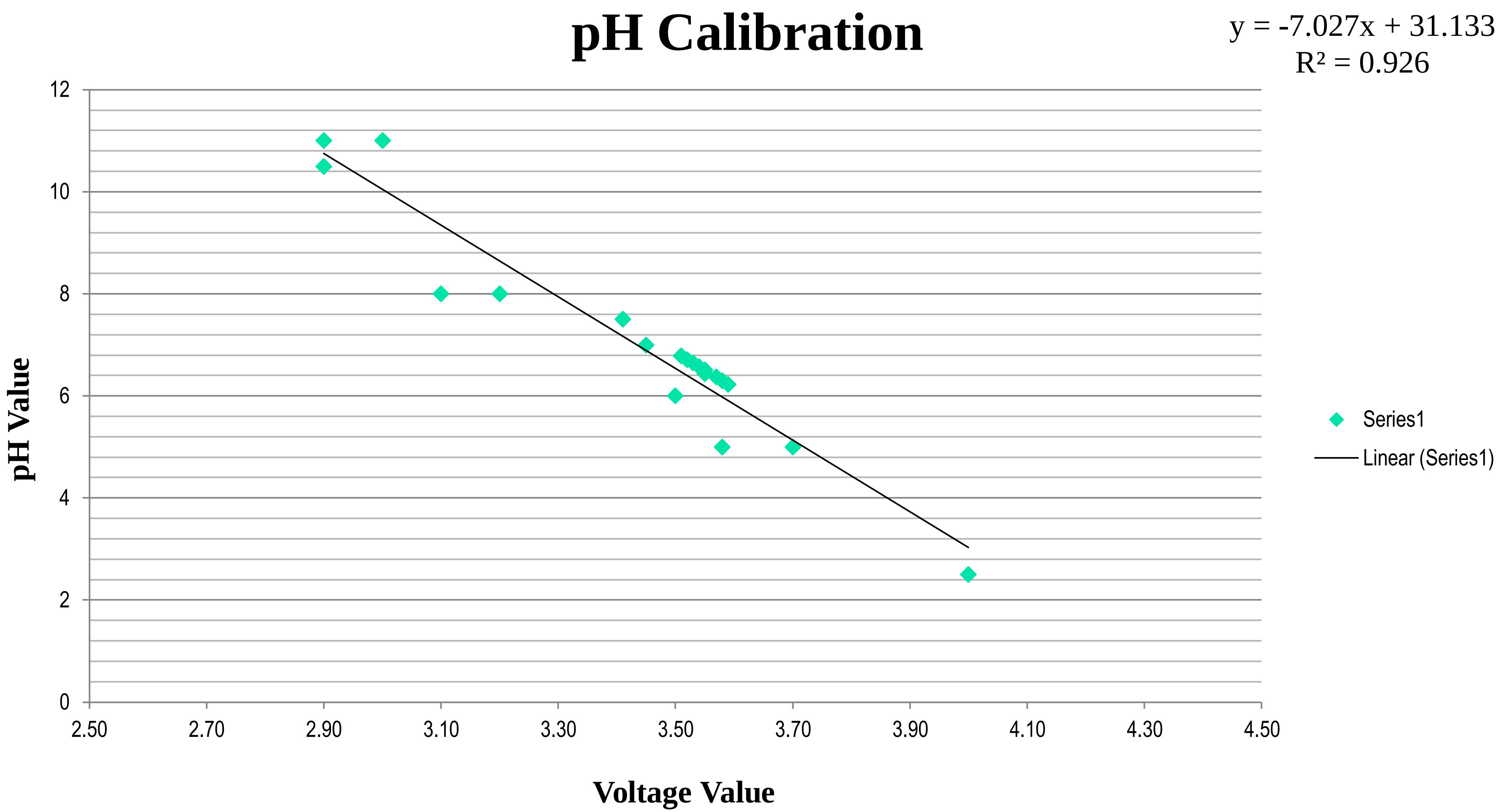
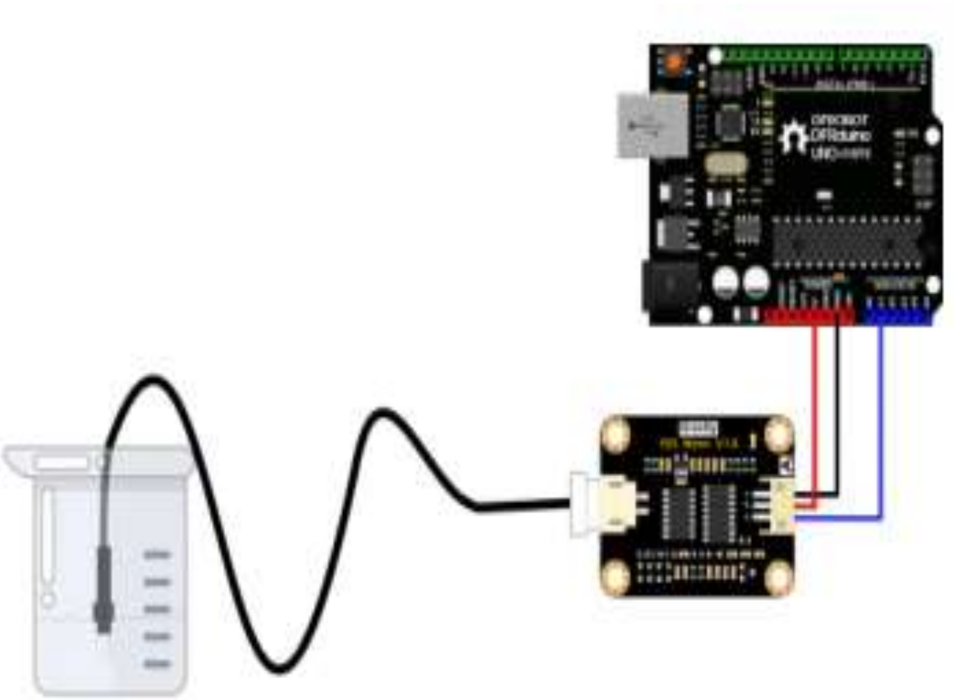


Figure 8: pH Sensor calibration.

Implementation (Contd.)



SL	Max	Min	Comment
1.	400	<400	Excellent
2.	600	400	Good
3.	900	600	Fair
4.	1200	900	Poor
5.	>1200	1200	Unacceptable

Figure 9: TDS Sensor

Implementation (Contd.)

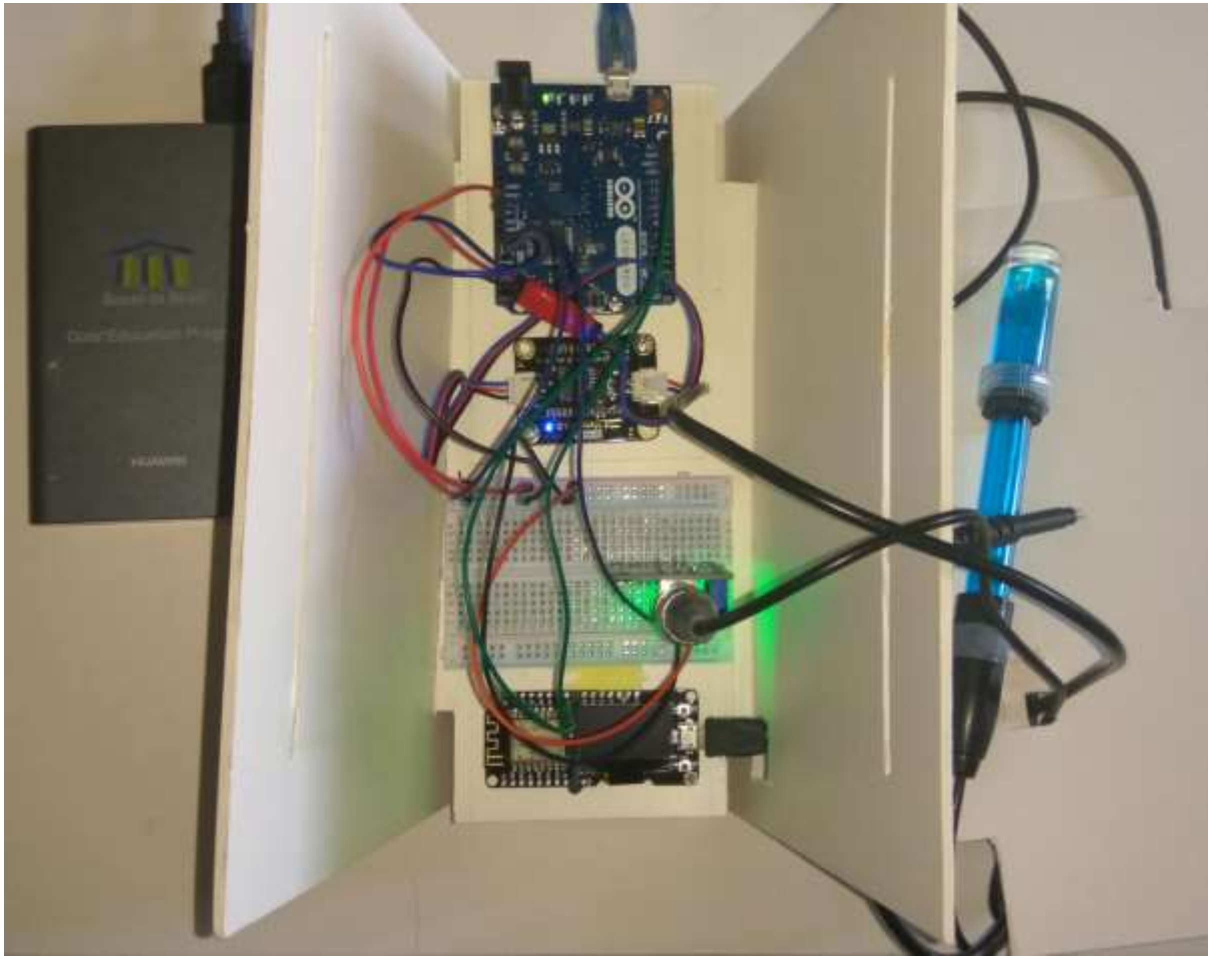


Figure 10: Top View of this Device

Implementation

Software:

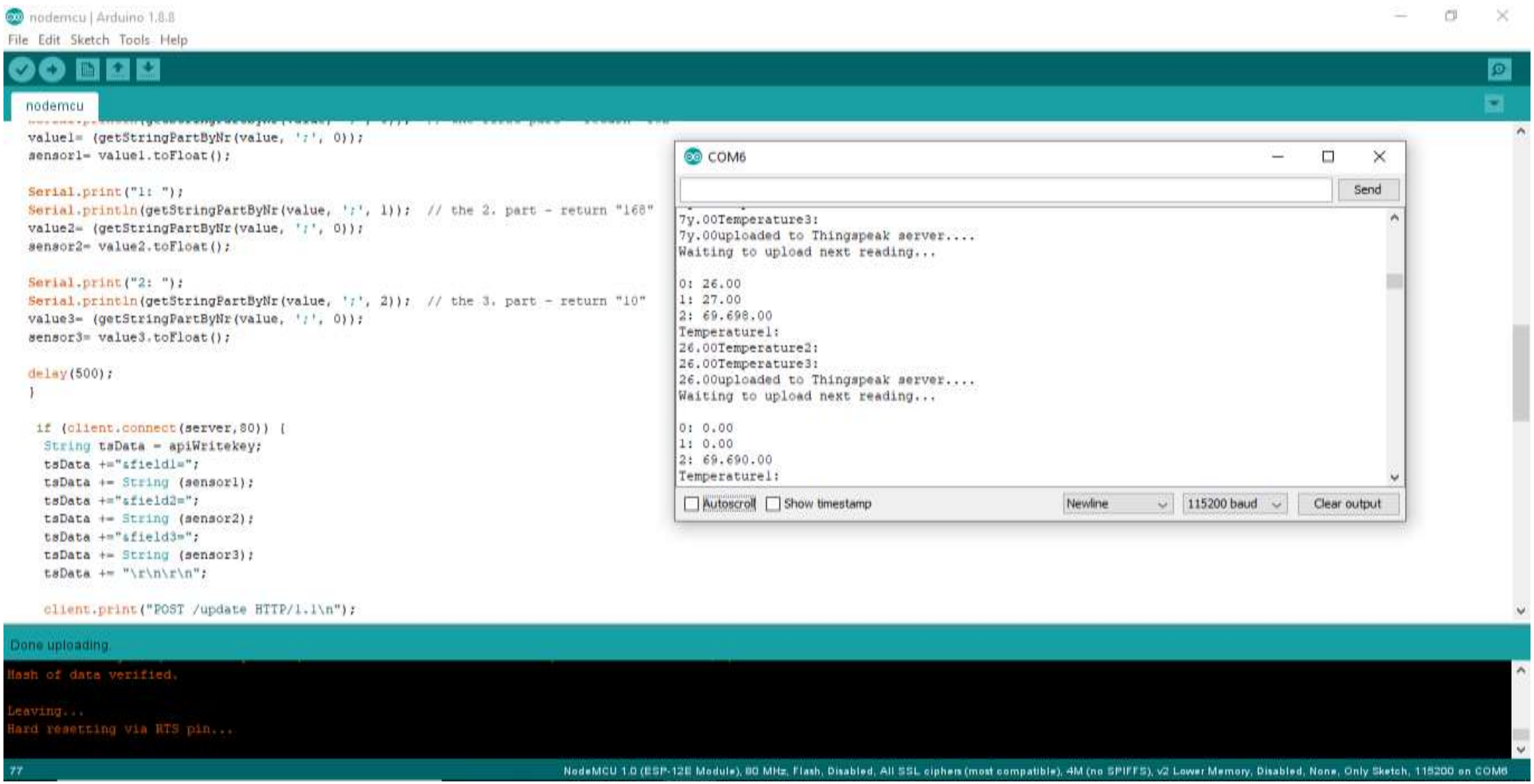
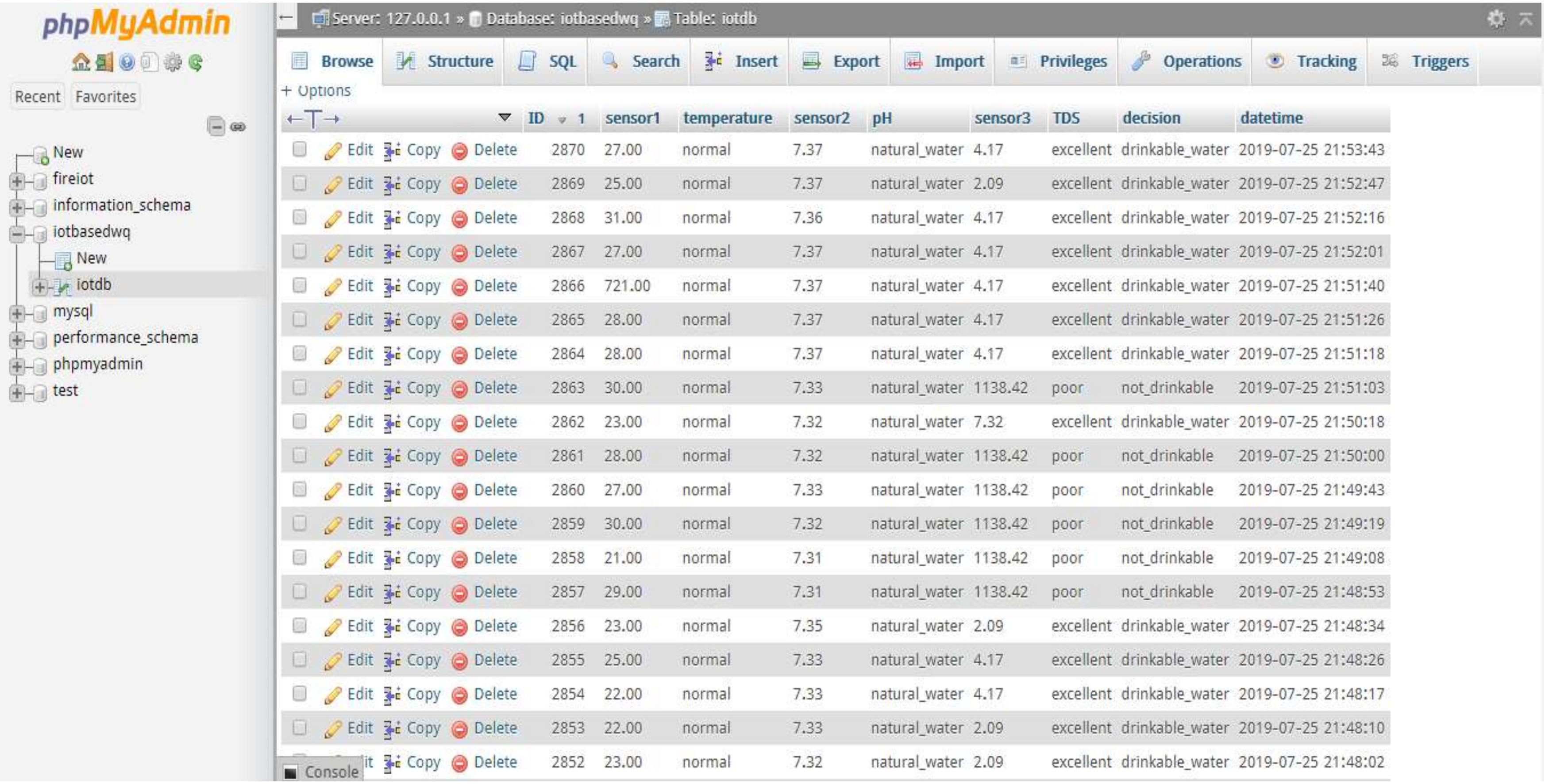


Figure 11: NodeMcu Coding in Arduino.cc IDE.

Implementation (Contd.)



ID	sensor1	temperature	sensor2	pH	sensor3	TDS	decision	datetime
2870	27.00	normal	7.37	natural_water	4.17	excellent	drinkable_water	2019-07-25 21:53:43
2869	25.00	normal	7.37	natural_water	2.09	excellent	drinkable_water	2019-07-25 21:52:47
2868	31.00	normal	7.36	natural_water	4.17	excellent	drinkable_water	2019-07-25 21:52:16
2867	27.00	normal	7.37	natural_water	4.17	excellent	drinkable_water	2019-07-25 21:52:01
2866	721.00	normal	7.37	natural_water	4.17	excellent	drinkable_water	2019-07-25 21:51:40
2865	28.00	normal	7.37	natural_water	4.17	excellent	drinkable_water	2019-07-25 21:51:26
2864	28.00	normal	7.37	natural_water	4.17	excellent	drinkable_water	2019-07-25 21:51:18
2863	30.00	normal	7.33	natural_water	1138.42	poor	not_drinkable	2019-07-25 21:51:03
2862	23.00	normal	7.32	natural_water	7.32	excellent	drinkable_water	2019-07-25 21:50:18
2861	28.00	normal	7.32	natural_water	1138.42	poor	not_drinkable	2019-07-25 21:50:00
2860	27.00	normal	7.33	natural_water	1138.42	poor	not_drinkable	2019-07-25 21:49:43
2859	30.00	normal	7.32	natural_water	1138.42	poor	not_drinkable	2019-07-25 21:49:19
2858	21.00	normal	7.31	natural_water	1138.42	poor	not_drinkable	2019-07-25 21:49:08
2857	29.00	normal	7.31	natural_water	1138.42	poor	not_drinkable	2019-07-25 21:48:53
2856	23.00	normal	7.35	natural_water	2.09	excellent	drinkable_water	2019-07-25 21:48:34
2855	25.00	normal	7.33	natural_water	4.17	excellent	drinkable_water	2019-07-25 21:48:26
2854	22.00	normal	7.33	natural_water	4.17	excellent	drinkable_water	2019-07-25 21:48:17
2853	22.00	normal	7.33	natural_water	2.09	excellent	drinkable_water	2019-07-25 21:48:10
2852	23.00	normal	7.32	natural_water	2.09	excellent	drinkable_water	2019-07-25 21:48:02

Figure 12: MySql database for the proposed system.

Implementation (Contd.)

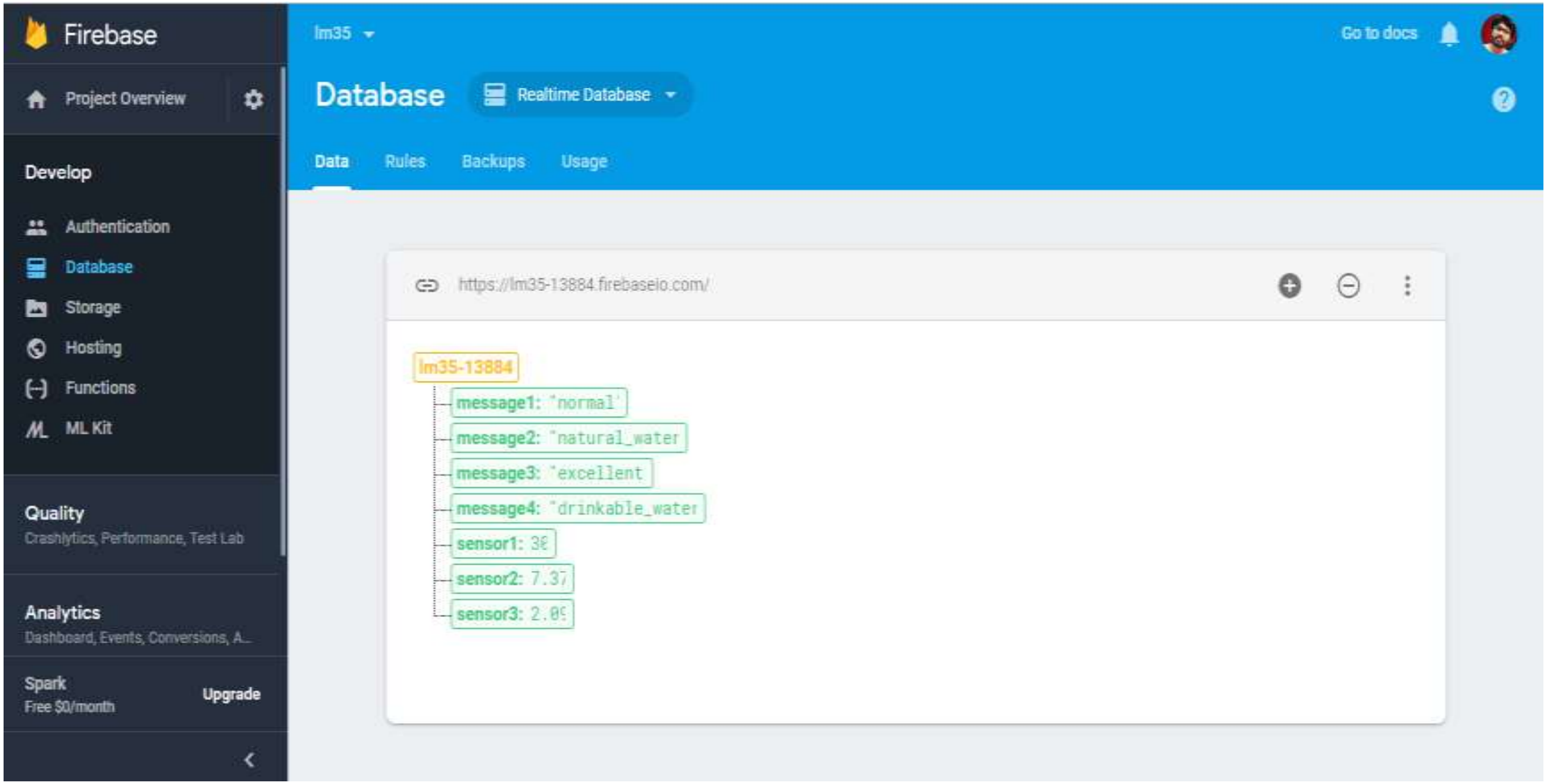
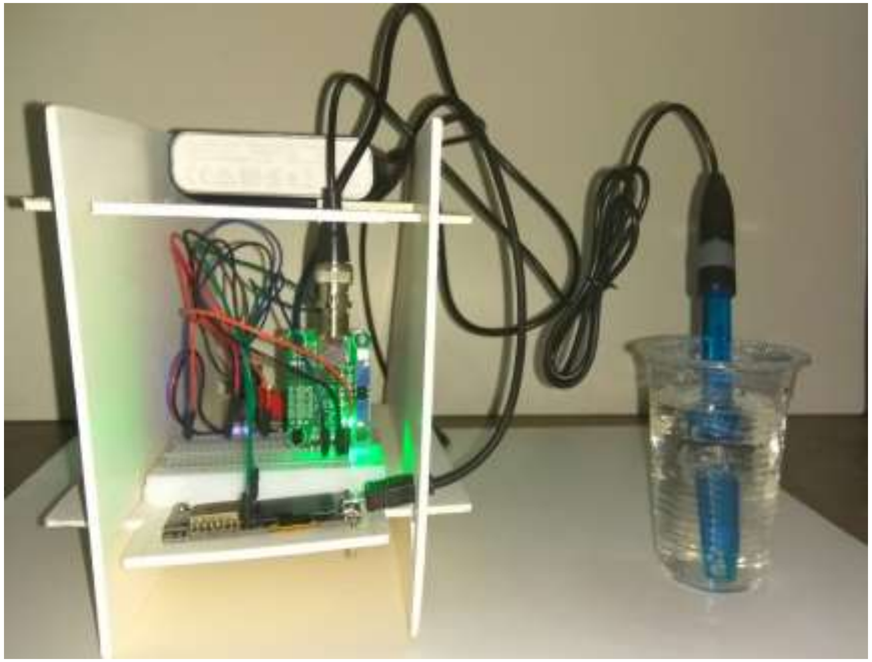


Figure 13: Google-Firebase for real-time data update.

Results



a) testing tap water pH, TDS and temperature value

b) data logger for the system.

Figure 14: Testing the tap water quality.

Results (Contd.)

Search by

ID | Temperature | pH | TDS | Type of Water | Date & Time

IoT Based Water Quality Monitoring System								
ID	**Temperature**	**Type of Temperature**	**pH**	**Type of pH**	**TDS**	**Type of TDS**	**Type of Water**	**Date & Time**
2421	27.00	normal	8.45	natural_water	12.45	excellent	drinkable_water	2019-07-09 16:02:13
2420	29.00	normal	8.45	natural_water	12.45	excellent	drinkable_water	2019-07-09 16:02:08
2419	21.00	normal	8.47	natural_water	12.45	excellent	drinkable_water	2019-07-09 16:02:03
2418	29.00	normal	8.47	natural_water	12.45	excellent	drinkable_water	2019-07-09 16:01:57
2417	24.00	normal	8.46	natural_water	12.45	excellent	drinkable_water	2019-07-09 16:01:52
2067	23.00	normal	12.45	very_alkaline	22.00	excellent	not_drinkable	2019-07-09 15:19:48
1956	30.00	normal	8.32	natural_water	1160.88	poor	not_drinkable	2019-07-08 14:27:27
1955	23.00	normal	8.31	natural_water	1165.42	poor	not_drinkable	2019-07-08 14:27:21
1954	21.00	normal	8.29	natural_water	1165.42	poor	not_drinkable	2019-07-08 14:27:15
1953	24.00	normal	8.30	natural_water	1165.42	poor	not_drinkable	2019-07-08 14:27:10

Figure 15: Real-time datasheet for Sensor Value and Decision Parameter.

Results (Contd.)

<u>Accuracy:</u>

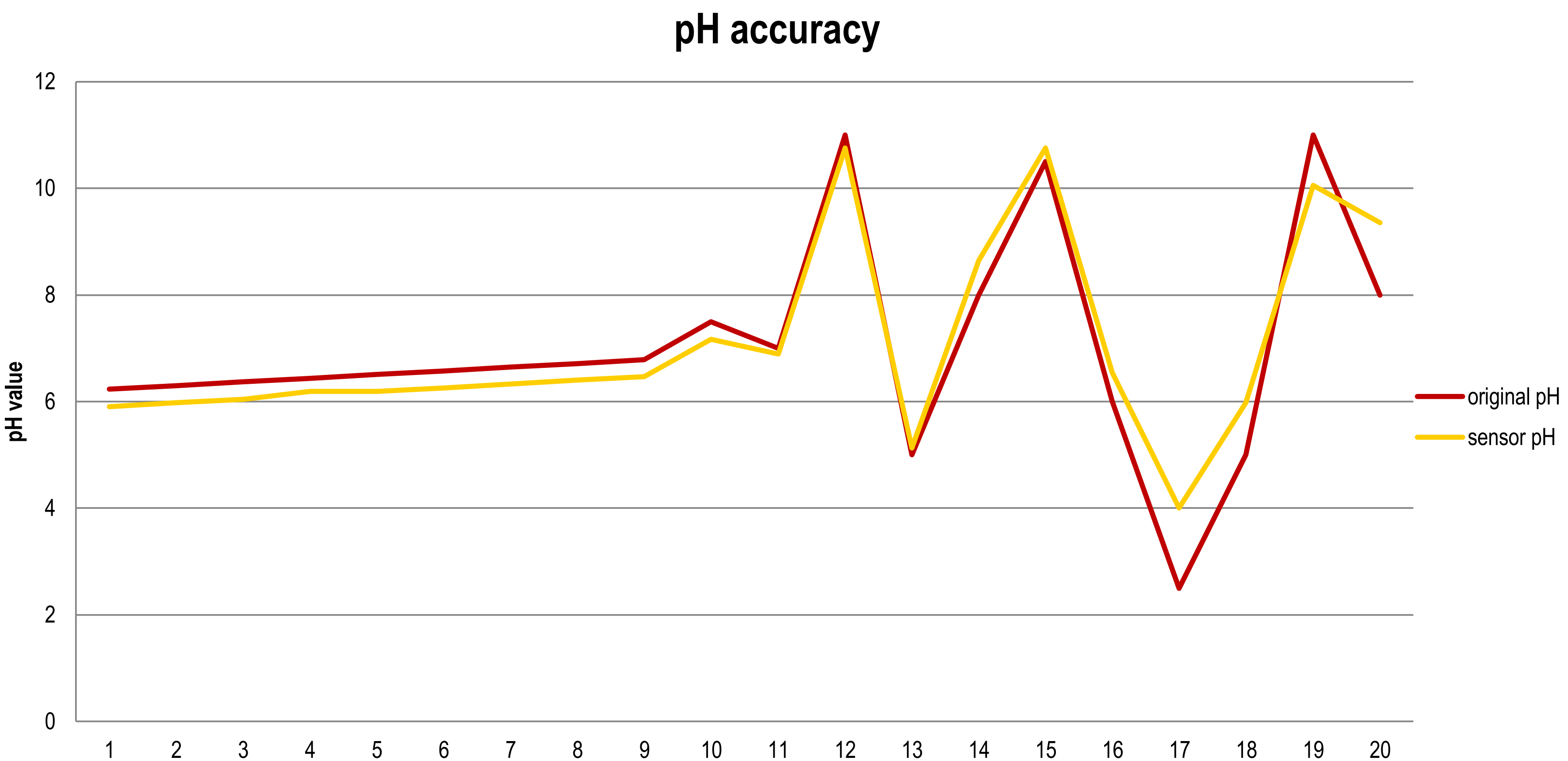


Figure 16: pH accuracy curve.

Advantages

- **Advantages**
  - ✓ Due to automation it will reduce the time to measure the parameters.
  - ✓ This is economically affordable for common people.
  - ✓ Low maintenance.
  - ✓ Prevention of water diseases.

Limitation

- **Limitations**
  - Based on only three parameters: Temperature, pH, TDS.
  - Type of water pollution could not be determined,

    i.e. Chemical water pollution, suspended matter, microbiological water pollution etc.
  - Works over high-speed WiFi only.

Future Work

- Turbidity, electronic conductivity and Oxidation-Reduction Potential (ORP) can be quantified for more accuracy.
- Arsenic contamination can be identified using Machine learn -ing.

Conclusion

- IoT based water pollution monitoring system has significant application scenarios in the context of smart cities.
- It ensures the reduced amount of time and energy required to provide analytical services.
- As developing countries have deficiency for socio-economic environment, So, In this project I have concentrated my thou -ght on developing a low cost IoT device, that will ensure proper analysis of polluted water with the minimum amount of resources being available.

References

- [1] What is IoT? Definitions from Industry Experts [Online].

  Available: https: //blog.getkisi.com/what-is-iot
- [2] Internet of Things (April 2016) [Online].

  Available: https://en.wikipedia.org/wiki/Internet_of_Things
- [3] Internet of Things (IoT)(April 2016) [Online].

  Available: http://internetofthingsagenda.techtarget.com/definition/Internet-of-Things-IoT
- [4] Amy Nordrum, "Popular Internet of Things Forecast of 50 Billion Devices by 2020 Is Outdated". [Online]

  Available: https://spectrum.ieee.org/tech-talk/telecom/internet/popular-internet-of-things-forecast-of-50-billion-devices-by-2020-is-outdated
- [5] Understanding Internet of Things. [Online].

  Available: http://internetofthingswiki.com/internet-of-things-definition

References (Contd.)

- [6] Smart Water Sensors to monitor water quality in rivers, lakes and the sea. [Online]

  Available: http://www.libelium.com/smart-water-sensors-to-monitor-water-quality-in-rivers-lakes-and-the-sea
- [7] S. Kartakis, E. Abraham, and J. A. McCann, "Waterbox: A testbed for monitoring and controlling smart water networks," *Proceedings of the 1st ACM International Workshop on Cyber-Physical Systems for Smart Water Networks*. ACM, 2015, p. 8.
- [8] B. P. Wong and B. Kerkez, "Real-time environmental sensor data: An application to water quality using web services," *Environmental Modelling & Software*, vol. 84, pp. 505–517, 2016.
- [9] Tun L Dinh, Wen Hu, PavanSikka, Peter Corke, L. Overs, Stephen Brosman, "Design and Deployment of a Remote Robust Sensor Network: Experiences from Outdoor Water", *32nd IEEE Conf. on Local Computers*, pp 799-806, Feb., 2007.

References (Contd.)

- [10] Quio Tie-Zhn, Song Le, "The Design of Multiparameter On line Monitoring System of Water Quality based on GPRS", *Report: Advanced Transducers and intelligent Control System Lab, Taiyuan Technical University, Taiyuan, China,* 2010.
- [11] Steven Silva, Hoang N Ghia Nguyen, Valentina, Tiporlini, Kamal Alameh, "Web based water Quality Monitoring with Sensor Network: Employing ZigBee and WiMAX Technology",*36th IEEE Conf. on Local Computer Networks*, 2011.
- [12] Donge He, Li-Xin Zhang, "The Water Quality Monitoring System based on Wireless Sensor Network" *Report: Mechanical and Electronic Information Institute, China University of GeoScience, Wu Hen, China*, 2012.
- [13] Pavlos Papageorgiou, "Literature Survey on Wireless Sensor Networks", *Report: University of Maryland*, 16 July 2003.

The End

Thank You