Smart Monitoring and Testing of Water Quality in IoT Environment

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Abstract - *Due to the increasing rate of water pollution in the present era, testing and monitoring of water supply on a regular basis has become a very important criterion. Testing water supply allows us to properly address the specific problems of water supply and monitoring of the tested water helps in alerting us to current, the ongoing and emerging problems. Hence our project is an IoT (Internet of things) based Smart Water Quality Monitoring (SWQM) system that aids in testing and continuous monitoring of water quality based on four physical parameters i.e., water level, temperature, pH and turbidity. Four sensors are connected with Arduino-uno discretely to detect the water parameters. Extracted data from the sensors is transmitted to an IoT analytics platform service ThingSpeak with the help of ESP8266.The developed system compares the obtained values of water parameters with the WHO (World Health Organization) standard values. Based on the measured results, the proposed SWQM system can successfully analyse the water parameters and classify whether the tested water sample is drinkable, can be used for irrigation and aquaculture purpose or not. The results are displayed on a web viewer android application created using the platform Thunkable.*

Key Words: **IoT, Arduino UNO, ESP8266, Thunkable, ThingSpeak.**

1. INTRODUCTION

70% of earth's surface is covered with water but only less than 2% of water is available for human consumption and the quality of this 2% of water keeps on fluctuating due to various environmental conditions. Therefore, testing and monitoring of water becomes a necessity.

Testing water quality on a regular basis is an important part of maintaining a safe and reliable source. The test results allow us to accurately rectify the specific issues of water supply. This will help us ensure that the water source is being properly protected from potential contamination, and whether the selected treatment operating suitably. Regular testing is important to identify existing problems, ensure water is suitable for the intended use, especially if used for drinking by humans and animals, track changes over time and determine the effectiveness of a treatment system. The quality of a water source may change over time, unpredictably. If not tested, changes can go unnoticed as the water may look, smell, and taste the same.

Monitoring provides the objective evidence necessary to make sound decisions on managing water quality today and in the future. Water-quality monitoring is used to alert us to current, ongoing, and emerging problems; to determine compliance with drinking water standards, and to protect other beneficial uses of water. Assessments based on monitoring data help law makers and water managers measure effectiveness of water policies, determine if water quality is getting better or worse, and formulate new policies to protect human health and environment more efficiently.

Earlier traditional methods have been followed to test the water quality parameters. Sampling and monitoring of water samples is one of those methods. Sampling could be defined as a process of selecting a portion of volume of sample to be transported and handled in the laboratory. The main difficulty in sampling is the samples are carried to the laboratory. The analysis starts when the samples arrive in the laboratory. The error possibility involved in sample preparation is high due to manual intervention.

To overcome these errors, sensors are used. The key advantage of using sensors includes improved sensitivity during data capture, almost lossless transmission and continuous, real time analysis. Real time feedback and data analytical services ensure that processes are active and are executive optimally. Reconfigurable Smart water quality monitoring system includes water temperature, pH, turbidity and ultrasonic sensor.

The data from these sensors is processed using Arduino UNO which uses Arduino IDE software for programming. The processed data is displayed on ThingSpeak IoT cloud platform and android application.

2. METHODOLOGY

The methodology for smart water quality monitoring system is segregated into three main parts,

2.1 Data Collection

2.2 Data Processing

2.3 Wireless Transmission

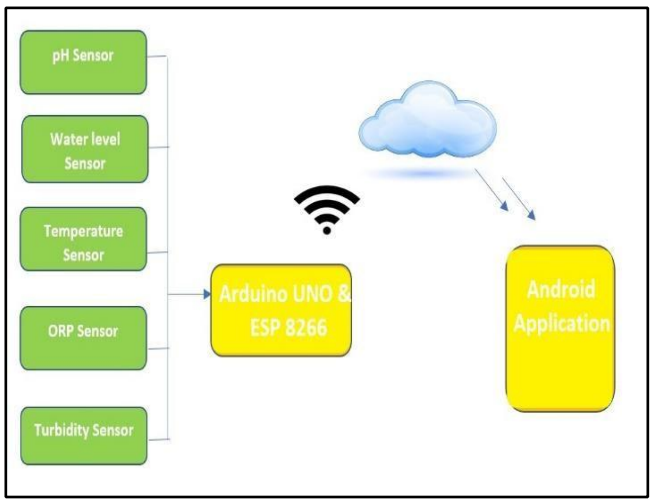

Figure 1: Block diagram of SWQM system

2.1 Data Collection

According to the chosen applications, water parameters like pH, temperature, turbidity and level of water are collected simultaneously from the sensors mentioned below.

2.1.1 pH Sensor

pH sensor helps in measuring acidity or alkalinity of a fluid. It has two electrodes, reference and glass electrode. The glass electrode is sensitive to H+ ions. The potential difference between these two electrodes is nothing but pH itself.

2.1.2 Turbidity Sensor

Turbidity is measure of cloudiness/ haziness caused by suspended particles in the solution. It works by sending a light beam into the fluid to be tested. The light gets scattered due to suspended particles, if present any. The reflected light is detected by the light detector of the sensor. The more is the reflected light the more are the suspended particles and thereby more is the turbidity of the solution.

2.1.3 Temperature Sensor

It is the sensor designed to measure the degree of hotness or coolness of water. The degree is calculated based upon the voltage across the diode of the sensor.

2.1.4 Ultrasonic Sensor

Also known as water level indicator sensor, ultrasonic sensor emits short, high frequency sound pulses at regular intervals. The signals are triggered into the water. When stroked by the water surface, the signals are reflected back as echo signals which helps in computing the distance.

2.2 Data Processing

The data extracted from the mentioned sensors is processed using the controller Arduino UNO. Arduino UNO has ATmega328p microchip and is an 8-Bit AVR microcontroller. It is programmed using Arduino IDE. Arduino Integrated development environment, is an open source Arduino software used to write code and upload it to the Arduino board with the help of functions of C and C++ programming languages.

2.3 Wireless Transmission

The processed data is transmitted to the cloud using ESP8266 Wi-fi module. This module is used to connect the Wi-Fi to wirelessly transmit and receive data. The wirelessly transmitted data from sensors is received and displayed on IoT analytical platform ThingSpeak.

ThingSpeak platform helps in analyzing, visualizing and acting on the received data. It enables us to display the data in terms of graphs, numerical display and gauges. It uses Rest API calls to create and delete channels. These channels contain fields representing data from each of the sensors and can be accessed by the public from anywhere and anytime.

3. APPLICATIONS

3.1 To check potability of water:

Clean water is one of the most important resources required to sustain life and the quality of drinking water plays a very important role in well-being and health of human beings. It is thus paramount to monitor the quality of water which will be used for consumption. The water which is safe for consumption is called Potable water. The sensors used to check the potability of water in designed SWQM system are Ultrasonic, Ph and turbidity. The WHO standards specified for potable water are mentioned below.

Water Parameters	Min.	Max.
Ph	6.5	8.5
Turbidity	1(NTU)	4(NTU)

Table 1

3.2 Aquaculture:

Aquaculture or Aquafarming, is the cultivation of aquatic plants and fish. It requires high-quality water to increase production and profitability. Many facilities now use water quality monitoring equipment to measure water temperature and conductivity, two of the many factors that can affect the physical condition of aquatic animals. The designed SWQM system uses temperature and Ph sensors. The WHO standards specified for aquaculture for

variety of fishes is mentioned below.

Water Parameters	Min.	Max.
Temperature (Fish dependent) Eg: Salmon and Trout Catfish	 48F 75F	 65F 90F
Ph	6.5	9

Table 2

3.3 Irrigation purpose

Irrigation is application of controlled amounts of water to plants at needed intervals. Irrigation helps to grow agricultural crops, maintain landscapes and re-vegetate distributed soils in dry areas. The designed SWQM system checks for the alkaline and acidic nature of water. Also, the system uses ultrasonic sensor for water level indication of the water body which supplies water for irrigation.

Water Parameters	Min.	Max.
Ph	5.5	7.5
Water level	2cm	4m

Table 3

4. RESULTS AND DISCUSSION

The prototype model of smart water quality monitoring system is shown in the figure 2.

4.1 ThingSpeak Webpage:

The potabilty of water is checked in two cases and the same is displayed on the webpage of ThingSpeak in the figure 3 and figure 4.

Figure 2: Prototype of SWQM system

Case 1: Drinkable

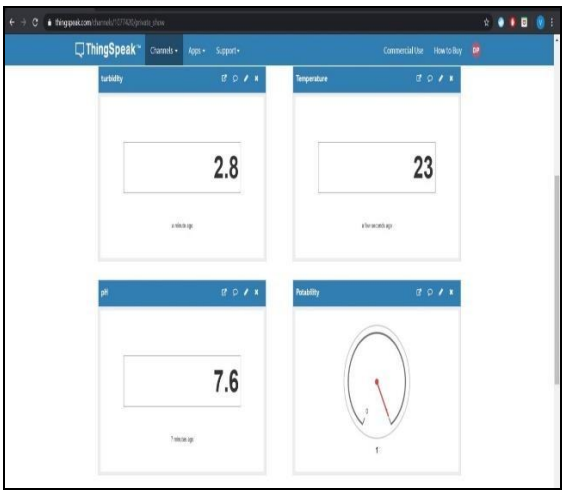

Figure 3

According to WHO standards the values for potable water are mentioned in Table1. The values for first case we detected are as follows:

- Turbidity – 2.8
- Ph – 7.6
- Temperature – 23 degree Celsius

As the values lie in the desired range of WHO standards, the potability meter displays 1 which indicates the water is fit for drinking.

Case 2: Not drinkable

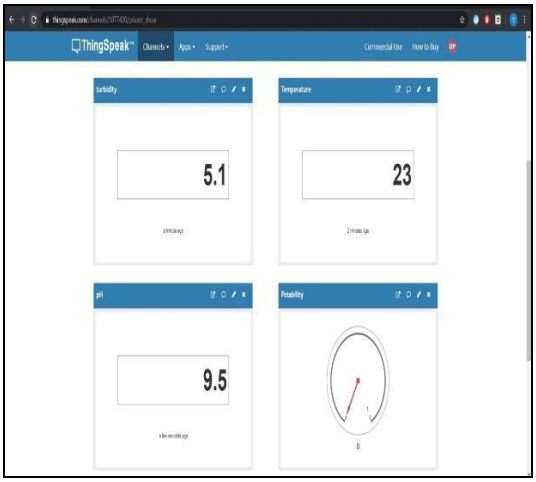

Figure 4

The values for second case detected are as follows:

- Turbidity – 5.1
- Ph – 9.5
- Temperature – 23 degree Celsius

As the values do not lie in the desired range of WHO standards, the potability meter displays 0 which indicates the water is not fit for drinking.

Similarly, the designed SWQM system can be reconfigured for other applications like irrigation and aquaculture purpose too.

4.2 Android Application

Figure 5: App logo

The data collected from the sensors is displayed on the web viewer app which is designed using Thunkable platform.

Thunkable is a cross-platform app builder that enables anyone to build their own native mobile apps. All apps built on Thunkable work for both Android and iOS devices. As the designed application is a web viewer application, the Web Viewer component, can open up any website within the app to display. So, the designed application opens ThingSpeak website within it.

The screenshots of the application displaying results are shown below:

Figure 6

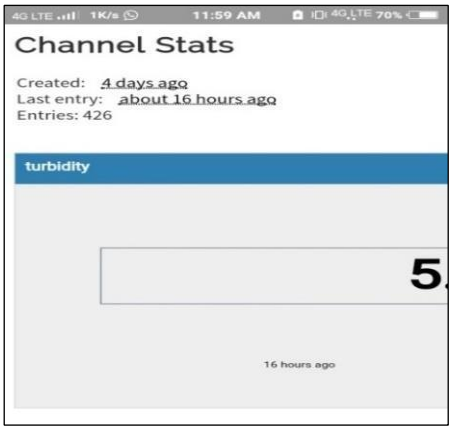

Figure 7

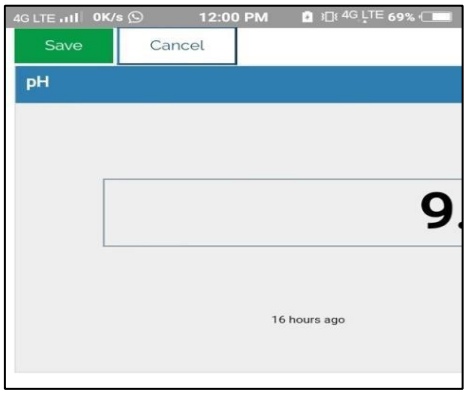

Figure 8

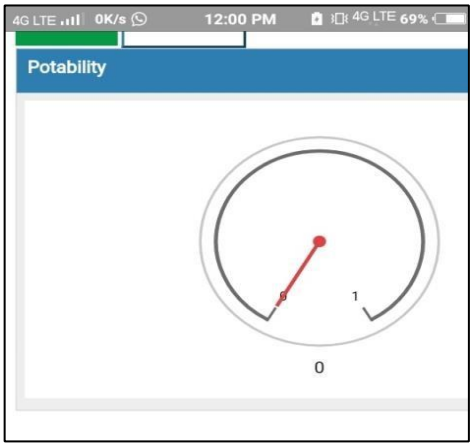

Figure 9

5. CONCLUSION

In the SWQM system, the configured Arduino board collects and processes various water parameters from the sensors. Then the collected water parameters are transmitted wirelessly and monitored on android application Thunkable via cloud ThingSpeak using Wi-Fi. Hence, based on the obtained real-time data it can be concluded whether the water source is fit or unfit for drinking, irrigation purpose and aqua-culture.

6. FUTURE SCOPE

The capability of water quality monitoring system can be enhanced to obtain more efficient and reliable results. The number of parameters to be sensed can be increased by the addition of multiple sensors to measure different water parameters. The system can be further upgraded using wireless sensor networks. Work can also be carried out for controlling the supply of water.

REFERENCES

[1] Reconfigurable Smart Water Quality Monitoring System in IoT Environment: Cho Zin Myint, Lenin Gopal, and Yan Lin Aung, Department of Electrical and Computer Engineering Curtin University Malaysia M. Young, The Technical Writer's Handbook. Mill Valley, CA: University Science, 1989.

[2] Vijayakumar. N., and Ramya. R., "The Real Time Monitoring of Water Quality in IoT Environment", IEEE Sponsored 2nd International Conference on Innovations in Information, Embedded and Communication systems (ICIIECS), 2015.

[3] J. A. Stankovic,"Research directions for the Internet of Things," IEEE Internet Things J, vol. 1, no. 1, pp. 3–9, Feb. 2014.

[4[Monira Mukta, Samia Islam, Surajit Das Barman, Ahmed Wasif Reza, M Saddam Hossain Khan ,"IoT based Smart Water Quality Monitoring System ", 23-25 Feb. 2019.

[5] Dr.Nageswara Rao Moparthi, Ch. Mukesh, Dr. P. Vidya Sagar ,"Water Quality Monitoring System Using IOT" 2018 Fourth International Conference on Advances in Electrical, Electronics, Information, Communication and Bio-Informatics(AEEICB),Feb. 2018.

[6] Srishaila Mallikarjuna Swamy P M, Mahalakshmi G, "Real Time Monitoring Of Water Quality Using Smart Sensor", JETIR (ISSN-2349-5162, September 2017, Volume 4.