International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 05 Issue: 11 | Nov - 2021 ISSN: 2582-3930

Smart Water Quality Management System

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***Abstract*— With growing world population and industry advancement, environmental pollution became big concern. Systems for water quality monitoring are required for activity analysis and their impact on nature of the power plants, mining sector, oil industry, etc. Basically, determination of water quality relies on estimation of values of some important and indicative parameters. Sensor-enabled devices can help monitor the water quality. This paper presents a Smart Water Quality Management System using Arduino, Sensors and PC.**

***Keywords*—Smart, Arduino, Parameters, Sensors.**

I. INTRODUCTION

Nowadays drinking water is the most precious and valuable for all the human beings, drinking water utilities faces new challenges in real-time operation. This challenge oc curred because of limited water resources growing population, ageing infrastructure etc. Hence therefore there is a need of better methodologies for monitoring the water quality.

II. EXISTING TECHNIQUE

Traditional methods of water quality involve the manual collection of water sample at different locations, followed by laboratory analytical techniques in order the character the water quality. Such approaches take longer time and no longer to be considered efficient. Although the current methodologies analysis the physical, chemical and biological agents, it has several drawbacks: a) poor spatiotemporal coverage b) it is labor intensive and high cost (labour, operation; and equipment) c)the lack of real time water quality information to enable critical decisions for public health protection. Therefore, there is a need for continuous online water quality monitoring.

III. PROPOSED SYSTEM

By focusing on the above issues we have developed a low cost system for real time monitoring of the water quality in IOT environment. In our design Arduino is used as a core controller. The design system applies a specialized IOT module for accessing sensor data from core controller to the cloud as shown in Fig 1.

A. Temperature

Temperature is a critical water quality and environmental parameter. It governs the kinds and types of aquatic life. Regulates the maximum dissolved oxygen concentration of the water. In quinces the rate of chemical and biological reaction..

B. Salinity

Salinity is a measure of the content of salts in soil or water. Salts are highly soluble in surface and groundwater and can be transported with water movement. Large salt deposits are a stored deep in soils or as surface salt deposits and salt lakes. This natural distribution of salt in the landscape is referred to as 'primary salinity'. In normal circumstances, the deep roots of native plants absorb most water entering the soil before it reaches the salt contained in groundwater below the plant root zone. However, widespread vegetation clearance, poor land use, irrigation and industrial practices have made it easier for salt to be transported to the soil surface or to waterways. The additional salt from these altered land use and management practices is referred to as 'secondary salinity' Excessive amounts of dissolved salt in water can select agriculture, drinking water supplies and ecosystem health.

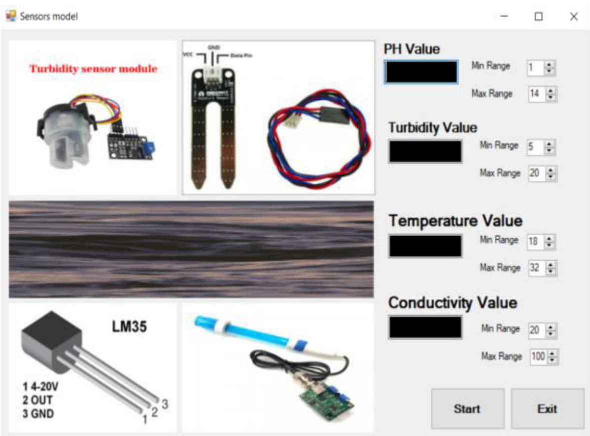

Fig. 1 Sensor Module Graphical Interface.

C. Turbidity

Turbidity is the amount of cloudiness in the water. This can vary from a river full of mud and split where it would be possible to see through the water(high turbidity) to spring water which appear to be completely clear(low turbidity). Turbidity can be caused by: Slit, Sand and other. Bacteria and other germs. Chemical precipitates.

D. pH

pH indicates the sample's acidity but is actually a measurement of the potential activity of hydrogen ions (H+) in the sample. Solutions with a pH below 7.0 are considered acids, Solutions with a pH above 7.0, up to 14.0 are considered bases. The pH of water determines the solubility and biological availability of chemical constituents such as nutrients (phosphorus, nitrogen, and carbon) and heavy metals. There are many factors that affect the Ph of water like, The bedrock and soil composition through which the water moves. Amount pH plant growth and organic material in water body. Dumping of chemicals by individuals, industries and communities. Amount of acid precipitation. Lastly stems from coal mine drain.

E. *Arduino*

Arduino is a series of credit card-sized single board computers. We have used Arduino for computation as it is efficient in cloud computing. It supports full edged operating system. It has several pins which facilities us to connect sensors and other devices to make computation easy. Arduino Allows to embedded with hardware device. Arduino is low cost. Arduino quad core with 1GB RAM

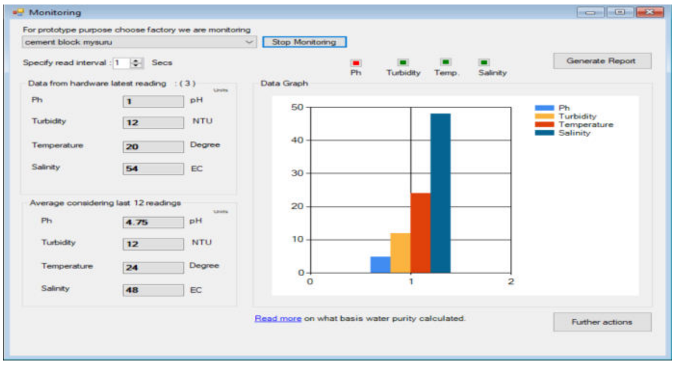

Fig. 1 Graph of water parameters

An Arduino is a microcontroller motherboard. A microcontroller is a simple computer that can run one program at a time, over and over again. It is very easy to use. A Raspberry Pi is a general-purpose computer, usually with a Linux operating system, and the ability to run multiple programs. It is more complicated to use than an Arduino An Arduino board is best used for simple repetitive tasks: opening and closing a garage door, reading the outside temperature and reporting it to Twitter, driving a simple robot. Raspberry Pi is best used when you need a full-fledged computer: driving a more complicated robot, performing multiple tasks, doing intense calculations (as for Bitcoin or encryption). Anywhere in the document , if referred as Arduino/Raspberry Pi refers to IOT environment , which can be replaced by other based on the users requirements and performance

Test Case ID	Description	Expected Output	Status
TC01	Run the Application	Application should run without any interrupts	Pass
TC02	Administrator Login	Direct to main screen on correct username and password	Pass
TC03	Database Connection	Readings collected from software module should be displayed	Pass
TC04	Exit	Exit all the applications	Pass

Fig. 3 Unit Test cases

Test Case ID	Description	Expected Output	Status
TC01	Connectivity of database to cloud and proper working of mail server	mail sent to factory manager	Pass
TC02	Connectivity of database to cloud lost and improper working of mail server	Notification to Monitoring manager	Pass

Fig. 4 Integration Test cases

IV. Results

The graph that has been plotted in Fig 2 shows the result of our project. Based on this graph the water analysis is conducted. If certain parameter in the water is not suitable for the environment then respective button becomes red indicating that the water needs to be purified for that parameter.

Water Quality test report generated for the factory cement block mysuru
on Date : 28-05-2021 13:55:32

To
cement block mysuru
9611966977
Dewans Road, Subbarayanakere, Chamrajpura, Mysuru, Karnataka 570004, India

Readings from the sensors to measure water quality			
pH	Temperature	Salinity	Turbidity
Poor (4.75)	Good (24)	Excellent (30 = rainfall) (48)	Fair (12)

Temperature
Why would you test it ?

Water temperature has a direct link with toxic absorption, salinity and dissolved oxygen. Some organisms cannot reproduce if water is not at the correct temperature, for example, coral polyps reproduce well in a narrow temperature range above 26 ° C. Altitude and proximity to coasts will influence natural water temperature eg: water in the Snowy Mountains may be 3 ° C, but this is its natural state, not necessarily poor quality. Keep this in mind when measuring. The values provided above are readings from sensors

pH
Why would you test it ?

pH measures hydrogen ions in the water and indicates if the water is alkaline (>7), neutral (7) or acidic (<7). This level of solubility tells what nutrients are available to aquatic life. Metals tend to become more toxic at a lower pH because they are more soluble.

Salinity
Why would you test it ?

High levels of salt affect plant growth, water quality and soil quality. Many areas of Australia have natural levels of salinity however an increased reading can mean human activities have negatively impacted the environment.

Turbidity
Why would you test it ?

Turbidity is the level of suspended solids in the water (murkiness). Turbidity may be a result of erosion, algal growth or sewage. This can affect the reproduction of aquatic life.

Note: You should immediately take actions to purify water otherwise data will be posted to internet for public and department will take legal actions.

Fig. 5 Generated Report

There are 4 parameters that we are checking on to decide the quality of the water the pH temperature turbidity and salinity. If any 1 out of 4 parameters blinks red then the water department sends a notification for that particular factory of which the water has been tested. A pdf report is generated with the details of the factory the time and the date as shown in Fig 5. The report contains values of each parameter and what that kind of water is suitable for. The parameter button blink red based on these values:

1. For Temperature in Celsius: if the sensor reads 0-9 degree Celsius poor, 10-14 degree Celsius fair, 15-25 degree Celsius good, 26-36 degree Celsius fair, greater than 37 degree Celsius poor

2. For pH: if sensor reads less than 5.5 poor, 5.5-6.5 average, 6.5 to 8.0 good,8.1 to 8.5 average, greater than 8 .6 poor.

3. For turbidity in nephrons electric turbidity units: if sensor reads less than 10 good, 11 - 29 fair, greater than 30 poor

4. For salinity in micro Siemens : if the sensor reads: 0 to 100 Excellent (30 = rainfall),500 Fair, greater than 750 Poor (840 = sewage eluent),1600 Upper limit for drink-ing,5000 Upper limit for crops,8000 Upper limit for livestock,50 000 Seawater. The project is tested with the unit test cases and integration test cases as shown in Fig 3 and Fig 4 respectively.

V. Conclusions

The above presented project was successful in what it had to achieve. Our main objective was to reduce the time required for testing of water in laboratories, and we have been able to achieve it but with lesser accuracy. It reduces the laboratory equipment that would be required for the traditional way of testing the water for its quality. The major point is we have been able to record all the details obtained in our testing in cloud. The results can be viewed and fetched whenever required. The monitoring of water can be done online easily using this system. Hence, we have tried to achieve all our objectives.

Acknowledgment

The contentment and joy of a successful project will be incomplete without mentioning the people who constantly supported and motivated us throughout. I take this opportunity to express my deepest gratitude towards all those who have directly or indirectly helped me to complete this project.

I would like to express my deep sense of respect and gratitude towards our advisor and guide Pavithra D. R., Assistant Professor, Department of Electronics and Communication Engineering, who has been the guiding force behind this work. I am greatly indebted to her for her constant encouragement, valuable advice and for constantly pushing us to do better in every aspect of the project.

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