IoT based River Water Quality Monitoring System

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Abstract---Water pollution is a major global problem that requires ongoing assessment and adaptation of water management principles at the international level. River pollution can affect all living things. Current water quality monitoring systems are manual systems with monotonous processes and are time consuming. To overcome this time- consuming process this project is developed. More effective monitoring and control measures can help both marine lives and health of people.

Keywords: Smart system, IoT, Marine Life, Water Quality

I. INTRODUCTION

In the world, especially in India, river water is the main source of all human activities such as drinking water, irrigation and agriculture. Farmers use fertilizers and pesticides to improve crop growth. However, these fertilizers and pesticides can be washed out of the soil by rain and eventually washed into rivers. The water quality of the river is deteriorating day by day. When large amounts of fertilizer and agricultural waste enter the river, the concentration of nitrates and phosphates in the water increases significantly. Algae use these substances to grow and reproduce rapidly, turning the water green. This overgrowth of algae, called eutrophication, causes pollution. When algae die, they are decomposed by rapidly growing bacteria that use up the oxygen in the water, leading to the destruction of marine life. The project consists of a web application and a mobile application that allow authorities to track real-time data on the river. Both apps give authorities the ability to monitor river water parameters and then control engines remotely. Here you can get results from technologies like Python 3.7 with ibmiotf module, IBM Watson Platform, Node-red. Primary parameters such as pH, DO, temperature, turbidity, ammonia and nitrate are tracked and some secondary parameters such as TSS, zinc, chloride and conductivity are displayed in additional tabs. Authority has a separate engine control tab that automatically switches when parameters deviate from the norm. It has remote engine access to filters using IoT technology.

II. LITERATURE SURVEY

River water consists of many elements, where the parameters must be maintained at certain levels. When the parameters exceed in levels, the lives dependent on the water bodies are affected then leads to imbalance in the ecosystem. An efficient river water monitoring system is needed to monitor 24/7. Real-time water quality checks the Water quality measurement system Measures water quality with various sensors (one for pH, conductivity, and temperature). As water bodies are affected due to many pollutions the living things finds it difficult to make a life out of the source. These problems fall under the authorities of the Water Monitoring Authorities of India. Water quality monitoring systems must detect any changes in the water that will quickly notify government officials for immediate action to manage water quality. They have the responsibility to inform and take precautions action to save the lives dependent of water. So, they need a perfect monitoring service to access the real-time data from the river and get notified when the parameters go abnormal.

Table. 1. Existing Problem

Author and Year	Technique/ Methodology	Limitations/ Drawback	Advantages	Applications
Mohammad Salah Uddin Chowdurya, etal, 2019	Wireless sensor networks (WSNs)	Costly, Network Stability	Alerts if the parameters of water are in danger	Rivers
Nidal Nasser, etal, 2013	Raspberry Pi, Sensor Network	Costly, Network Stability	Automatically detects any abnormal characteristics of water	Domestic water bodies
Delight Sekhwela, etal, 2020	Sensor Network, Reservoir Based Testing	Costly, Network Stability	Higher Accuracy in testing	River Water

III. PROPOSEDSYSTEM

The concentration of nitrates and phosphates in water rises which is sedated from agricultural fields significantly when large amounts of fertilizer and agricultural wastes enter rivers. Algae use these substances to grow and multiply rapidly, turning the water green. This algae overgrowth, called eutrophication, leads to pollution. When algae die, they are decomposed by the action of bacteria. Bacteria multiply rapidly and use up all the oxygen in the water, causing many animals to die. The Project can be placed in line to the water flow, so that the water can be easily monitored and washed-off with the flow, ease to maintain. Create a design which handles the river environment and works in moist situation. Collect the data from the water and store in the cloud for processing. Smart system to monitor the components and transmit the data without any errors. Set a threshold level for each component to identify harm or safe and notify at the instance of harm. 24/7 monitoring with rechargeable battery system. All characteristics of water regarding should be noted and the set of data created can be used to predict the cause of the problem and provide a better solution. Use sensors like DO sensor (Dissolved Oxygen sensor), TDS (Total Dissolved Solid) Sensor and PH sensor. Better understandability in the application for user to understand. The authorities should be able to monitor and evaluate the level of minerals and chemical substances. End-user should have the data on time, the telecasting should be in sync. In end-user application the data set should be represented graphically.

IV. DESIGN APPROACH

The Project contains both Hardware and Software logic to complete the given task. Here the hardware parts like sensors and controllers are simulated, and the Software part handles the data flow and calculations to know about the environment. Once there is abnormal activity in the water bodies, the system alerts the user using both the Application and the SMS Service.

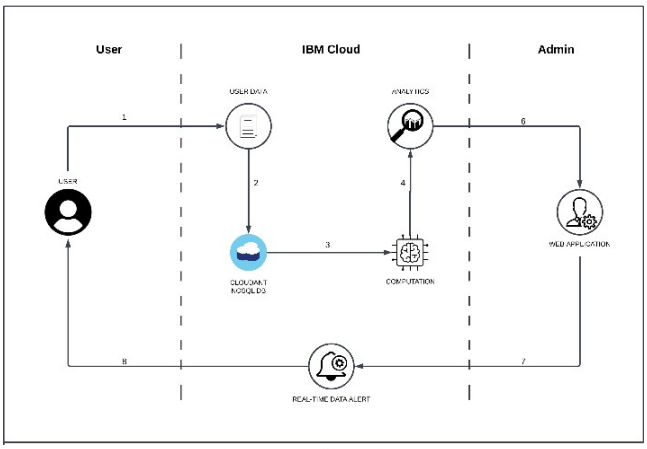

Fig. 1. Data flow Diagram

V. IMPLEMENTATIONS OF THE PROPOSED SYSTEM

SPRINT 1

The first task is to generate the data which is monitored from the river. The product uses python 3.7 to simulate the data using the special function called Random from Module Random. Parameters like pH, Temperature, DO, etc., are simulated according to the data mentioned in the data sheet mentioned in table 2.

S.no	Parameter	Measurement Range	Normality Range	Units
Primary Parameters				
1	Temperature	0 – 100	25 – 35	°C
2	pH	0 – 14	6 – 8	pH
3	DO	0 – 150	80 – 120	%
4	Ammonia & Nitrate	0 – 100	0 – 35	mg/L
5	Turbidity	0 - 20	5 - 10	NTU
Secondary Parameters				
1	TSS	0 – 3700	50 – 1000	ppm
2	Manganese	0 – 1000	1 – 200	mg/L
3	Copper	0 – 2000	9 – 823	mg/L
4	Hardness	0 – 1000	15 – 375	ppm
5	Zinc	0 – 100	10 – 40	mg/L
6	Conductivity	0 – 2000	50 – 1500	mS/cm
7	Chloride	0 – 200	45 – 155	mg/L
8	Sulphate	0 - 1000	0 - 630	mg/L

Table 2. Data-set and Range for Observation

SPRINT 2

In this sprint, the task is to set up the cloud platform to receive the data from the python code and publish it to the IoT device. Also needed to add modification to the python code, so that it is configured to get connected to the IBM IoT Watson Platform. Then the cloud is connected to node-red for further process like processing, interpreting, finding abnormal values and displaying the final readings

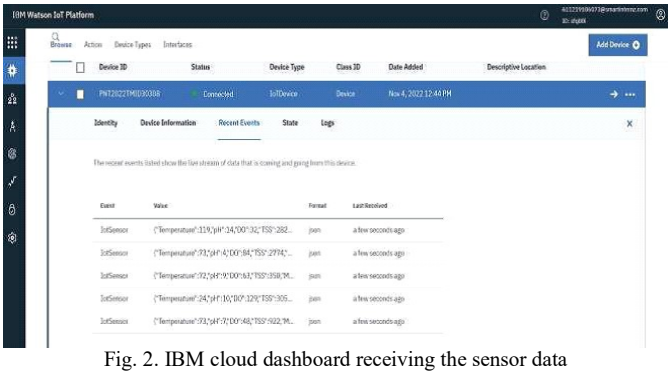

Fig. 2. IBM cloud dashboard receiving the sensor data

SPRINT 3

The main task of the sprint is to create a web UI for user to interact with the reading and monitoring dashboard. Web UI first begins with the get started page then they will be receiving at the at the login page. As this is an industry project and there is only one user there is no create user page. Once the user is logged in, then they will reach the dashboard page of the Node-red. The webpage is then developed into then Mobile App to do the same. This part consists of the main Web of the project, the page's flow goes as, Homepage -> Login Page -> Dashboard.

Home page

The home page Explains about the project and has a button "Get Started", which brings us to the login page.

Login Page

Login Page consists User ID and Password Input box, where only one user is allowed to use the page, which is predefined in the code. These is no Create account option, because this is an Industry project where the Water Quality Monitoring authorities of Government can only access the Data and Control the motor.

Dashboard

Dashboard consists of three pages in Navigation bar, where they have three options. They have a look into the primary Parameters like pH, Turbidity and Stuffs. Second, they can access the secondary parameters, and at last, they have motor controls, where they can turn on and of the motors.

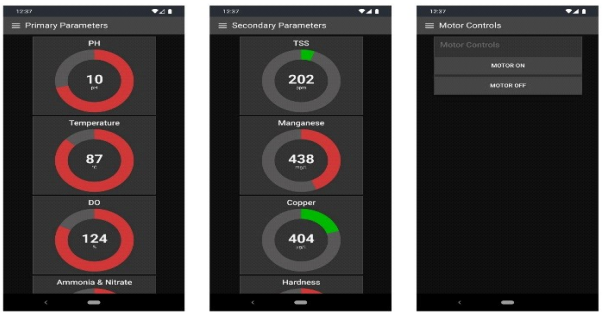

Fig. 3. Dashboard page of both Mobile app and Web UI

SPRINT 4

Here the Dashboard is then upgraded to check some conditions. The Data set referred in table 2 is used to create the condition and set the nodes to raise an alert when even the values of parameters reach abnormal state. There are two types of parameters, primary and secondary, so there are two types of notifications in the web UI itself. For primary abnormal activities, POP UP notification with a button Go to motor controls is created. For secondary, just a push notification is given. When the user clicks the button in pop-up notification, then UI shifts to the motor control page automatically.

SMS and Alert!

This part contains both SMS alert using Twilit Trail account service and in UI alert in dashboard page, UI alert is made with the notification node in node-red configured as to alert with pop up notification with a button as "Go to Motor Controls" whenever there are issues in primary parameters and push notification when there is an issue in the secondary parameters.

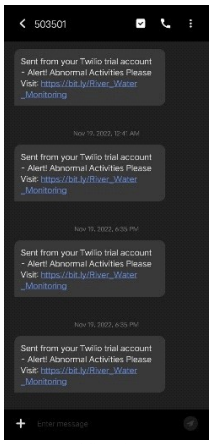

Fig. 4. Receiving SMS Notification to targeted mobile phone

UI Alert

The UI alerts are based on the parameters as discussed above. The feature is that, when there is a pop-up message due to issues, there is option shown to go to Motor Controls as a button, when the button is pressed, the UI is shifted to Motor Controls page.

SMS

Using Twilit Trail Account, the SMS node is added to the node red at the condition function.

Condition Node

This node is the set the condition according to the dataset.

VI. CONCLUSION

In future, this project still might be helpful to solve many issues related to river water monitoring. In spite of the reason, the product can be even upgraded and can be added more and more features to help people monitor water to have a healthy lifestyle. There can be some upgrades can be made. Those are like, the monitoring station can be made portable and automatic so that each and every part of the river is being monitored and analyzed, and also there is another possibility where the station can be dynamic using the wireless sensor network technique so that we don’t need any static structure to monitor the water. Once the sensors are deployed, they will communicate to each other and the controller and hence user can have the service at low cost. Also, they monitoring system can be made dynamic by using ML algorithms to monitor and analyze on its own and send period reports for further analysis. The product can also be improved in efficiency with increased speed in the internet. With less latency, the speed of transmission of the data, so that the process gets completed at faster rate. For this the 5G helps a lot to achieve this result for increased efficiency.

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