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River Monitoring System Using Raspberry PI

KeerthiVasan S
B.E, Electronics and Communication Engineering
National Engineering College,
Kovilpatti
1911078@nec.edu.in

Mugesh S
B.E, Electronics and Communication Engineering
National Engineering College,
Kovilpatti
1911033@nec.edu.in

Dinesh R
B.E, Electronics and Communication Engineering
National Engineering College,
Kovilpatti
1911411@nec.edu.in

Mr.T.Devakumar
Assistant Professor
B.E, Electronics and Communication Engineering National Engineering College,
Kovilpatti
tdkece@nec.edu.in

***Abstract*—To maintain the quality of the River's water, environmental regulations demand that the River's environmental state be monitored. Conductivity, dissolved o2, and microorganisms are measured manually using manual sensors. Additionally, a Secchi disc is used to measure turbidity roughly. Workers would survey the rivers located once a week from May to October to conduct testing. It takes many hours to complete the journey and data collection. Upon finishing, the collected data is sent to a web server. To sample bacteria, water is collected, and it is delivered to a laboratory nearby. Between each of these weekly cycles, there appears to be a lag in time and a danger that data will be misrecorded or lost. Due to these possibilities, the River-Keeper cannot fully assess the current state of the river and has little time to look into and address sources of poor water quality. Therefore, it's crucial to monitor water quality. To solve this challenge, we suggest an embedded technology that continuously checks the water quality and publishes the output data to a web UI, so that the customer can know about the status of the water, whether it is consumable or not.**

Keywords—River Monitoring System, IoT, Water monitoring, internet of things, Message Queuing Telemetry Transport, cloudiot.

I. Introduction

Globally, the problem of water pollution is becoming more and more important, and it is having a serious effect on both the environment and human health. Due to the time and resource requirements of traditional techniques of water quality monitoring, it is difficult to quickly and effectively identify and address water pollution. By providing real-time monitoring of water quality parameters, sensors, and remote sensing technologies offer a possible answer to this issue. Thistechnology can deliver data on water quality that is more precise and effective, enabling the early identification and reduction of pollution.A more thorough understanding of the factors affecting water quality can be achieved by combining remote sensing with ecological water quality modeling, which are both useful techniques. The main causes of water pollution can be found and addressed, as opposed to only addressing the symptoms, by looking at the transfer function between sources of pollution and water quality. The construction of an automated water monitoring system with various pH, conductivity, turbidity, and dissolved oxygen sensors can significantly increase the precision and timeliness of data on water quality. IoT technology can be used in this system to create a widespread early warning system for portable water quality, enabling quick detection and action in the event of water pollution. The protection of both human health and the environment depends on solving the problem of water pollution. It is possible to create more effective and efficient water quality monitoring systems by utilizing advancements in sensor and remote sensing technology and ecological water quality modeling. With the use of these technologies, water pollution's negative effects can be lessened and water resources can be safeguarded for future generations. Water pollution is a serious environmental issue that requires monitoring of various parameters. Manual collection and analysis of water samples are resource-intensive and time-consuming, making sensors a more efficient solution. A multi- sensor real-time water monitoring system can be used to monitor water quality, which varies depending on intended human use and environmental factors. The IoT concept can be used to connect and communicate with other items in the environment to enhance water quality monitoring. Maintaining current quality requirements and protecting fisheries and recreational use are typical water quality regulations.

II. Literature Survey

A water level sensor is used in the proposed system, an Internet of Things-based river quality monitoring system, used for real- time water level detection. The information is kept on a cloud server, and a remote dashboard shows the water levels. This approach might be helpful in disaster-prone places where water levels are a crucial factor in flood forecasting[1]. The mechanism for detecting water quality described in this paper is an Arduino development board with sensors that measure conductivity and water for temperature, turbidity, and pH. Through Bluetooth, the system transmits data to a smartphone and sends alerts for unusual values. Results indicate that the system is reliable and precise, making it a good choice for many water quality monitoring scenarios[2]. In this study, a low-cost approach to determining water quality is presented. It makes use of the signal conditioning IC, three sensors, and the ARM CORTEX M4F Microcontroller-Unit for scaling and collection of data. A microcontroller and Wi-Fi module is utilized and the information is transmitted to a cloud server. The association between temperature and pH is investigated once the sensors are calibrated using a standard solution.For the upcoming water quality research, the measured data is kept in a cloud database[3]. By building a monitoring

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system for water management, an IoT system may be constructed to measure the quality of the water. Remote communication technology can aid in sending the data, and the Raspberry Pi can be utilized as an embedded system to help with the development of the detecting sensor device. The resulting real- time online water quality monitoring system powered by the Internet of Things (IoT) can function as an autonomous surface water monitoring system.[4]. The study suggests a cloud- and deep learning-based river monitoring system that predominantly checks the quality of water in water bodies to guarantee safe water delivery. To measure different water parameters, the system makes use of IoT devices like Node Micro-Controller-Unit and numerous sensors. Predictions about how usable water will be are made using deep learning algorithms. Fighting environmental problems and raising living standards are the goals of the system[5]. Based on the information provided, it appears that the existing system for monitoring water quality is primarily manual and relies on human intervention to take readings and collect samples for laboratory analysis. This approach can be time-consuming, inefficient, and may not provide real-time information on water quality. To address these limitations, an automated system could be implemented that uses sensors and other advanced technologies to continuously monitor water quality parameters and provide real-time data on water quality. This system could be integrated with a central control center, which could receive and analyze data from multiple sensors and devices, providing a comprehensive view of the water quality at various locations within the system. The system could also be designed to automatically detect and alert operators in case of any deviations from acceptable levels of water quality. Additionally, data from the automated system could be used tooptimize treatment processes and ensure that the water meets the required quality standards. Overall, an automated system for monitoring water quality could provide several advantages over the existing manual system, including increased efficiency, accuracy, and real-time monitoring capabilities.

III. Methodology

Our suggested system uses the appropriate sensors to analyze water parameters such as turbidity, pH, temperature, and ambient temperature & humidity. To produce the appropriate output, the above-mentioned sensors are connected to the digital and analog pins of the Arduino UNO. A serial interface, the Raspberry Pi 4 Model B, and Arduino UNO are now integrated. The Pi's serial port is used to access the output data. To read the data sent through the serial port, a straightforward Python script is utilized. The findings are then shown online when these data are sent to the cloud platform. Then we distribute the data to nodes or subscribers who have subscribed to the central node, using the Message Queuing Telemetry Transport server. The broker on the raspberry pi serves as a centralized node by disseminating data to all subscribing devices.

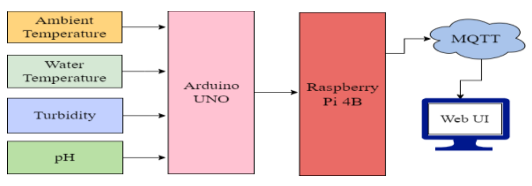

Fig. 1. Proposed system block diagram

Our system includes a Digital Temperature and Humidity11 sensor to gauge the temperature and humidity of the environment, as well as a DS18B20 sensor that analyzes water parameters and provides us with the temperature in degrees Celsius. We determine whether water is drinkable based on the pH sensor's ability to determine whether the water is acidic, neutral, or alkaline. The turbidity sensor measures the water's cleanliness. It reveals if anything is clear, cloudy, or unclean. The digital pins of the Arduino UNO are wired to the data pins of the Digital Temperature and Humidity11, turbidity, and water temperature sensors. Since the data pin of the pH sensor is attached to the analog pin of the Arduino, it is an analog sensor.

The proposed solution of using embedded technology to continuously monitor water quality and publish the output data to a web UI could be an effective way to improve the River- Keeper's ability to monitor the river's environmental state. This solution has several potential benefits, such as:

A. Real-time monitoring: The embedded technology can monitor water quality continuously, providing real-time data on the river's environmental state. This will enable the River-Keeper to detect any changes in the water quality immediately and take necessary action.

B. Improved accuracy: The manual sensors used currently have limitations that may lead to inaccuracies and inconsistencies in the data collected. The embedded technology can eliminate these limitations and provide accurate data.

C. Reduced workload: The proposed solution can reduce the workload of the River-Keeper as they will not have to manually collect data once a week. This will free up their time, enabling them to focus on identifying and addressing sources of poor water quality.

D.Improved accessibility: The web UI will enable easy access to water quality data, allowing interested parties to check the status of the river's environmental state at any time. This can increase transparency and accountability.

E.Cost-effective: The embedded technology can be cost- effective in the long run as it eliminates the need for manual sensors and reduces the frequency of lab testing.

The raspberry pi's Message Queuing Telemetry Transport (mosquitto) protocol is used to publish the output data from the Arduino to the Web UI. The data is uploaded to the Web using a straightforward Python program. Here, the publisher and subscriber concepts from MOSQUITTO were applied. Data is published by Mosquito utilizing topics. To get the data and transmit the data to the web UI, we must subscribe to the same topic on the subscriber end.

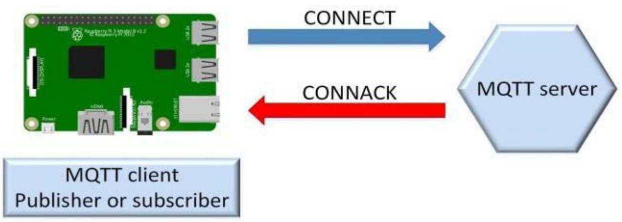

Fig. 2.Message Queuing Telemetry Transport

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An Message Queuing Telemetry Transport client must subscribe to an Message Queuing Telemetry Transport topic to receive messages. Publishing is the process of sending messages in Message Queuing Telemetry Transport. A client is free to publish on whichever subject they like. There aren't any reserved topics at the moment. Brokers may, however, limit access to some topics. If multiple clients subscribe to the similar topic, the published message will be sent to each client. Multiple topics can be allowed only if they are parsed as json payload or single string. The broker will send a message to all connected clients who have subscribed to a topic when a client publishes a message on that subject. The message is taken down from the broker once it has been delivered to thoseclients. The message is deleted from the broker if no customers have subscribed to the topic or if they are not currently connected. Typically, the broker doesn't keep messages on file.

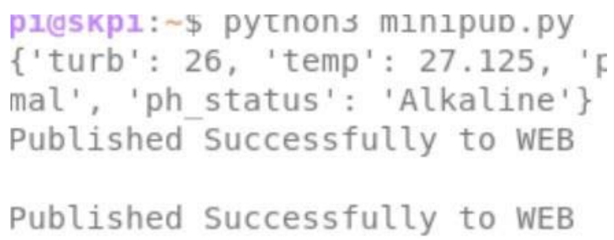

Fig. 3. Message Queuing Telemetry Transport publisher output

IV. System Software

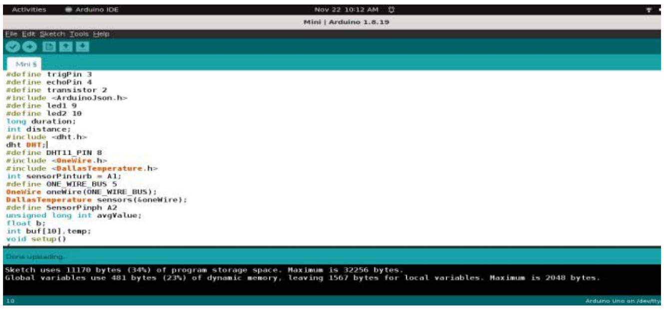

Fig. 4. Arduino IDE simulation window

To display readings from the sensors, we have created a web user interface. We used turbidity, pH, water temperature, and environmental temperature sensors in this instance. The user dashboard presents the data in a card view. PHP is used to retrieve the cards from the database. Here, the data from the sensor was published via Message Queuing Telemetry Transport. Javascript was used to create the publisher and subscriber objects, which send and receive data respectively over Message Queuing Telemetry Transport. Once theconnection has been made, the payload string will be returned when we subscribe to the topic that we published in Message

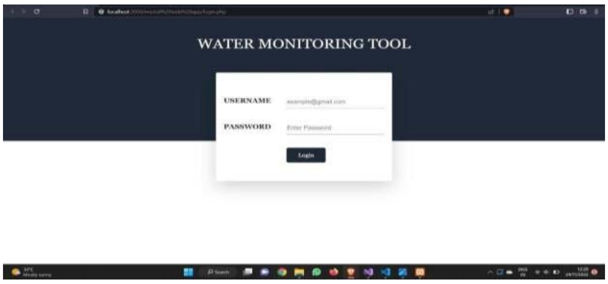

Fig. 5. Web UI login page

Queuing Telemetry Transport. Using card ID, the Message

Queuing Telemetry Transport returned value is shown on the web. The database was queried for the sensor list. The sensor id and its name will be generated at the same time as the dashboard exists. Replace the id with the appropriate sensor value using javascript.

V. Results And Discussion

Our proposed system has been successfully developed to continuously monitor water quality parameters, including conductivity, dissolved oxygen, microorganisms, turbidity, ambient temperature, and humidity. It's also great to hear that the system is capable of analyzing chemicals and impurities present in the water.The use of Message Queuing Telemetry Transport (MQTT) server to deliver data to the targeted system is an effective way to ensure that data is transferred securely and efficiently. The use of Message Queuing Telemetry Transport protocol also allows the system to handle a large number of sensors and data streams simultaneously, making it suitable for continuous monitoring.The web-based UI is a user-friendly interface that allows easy access to the output data generated by the system. This will make it easier for interested parties to check the status of the river's environmental state at any time.It's also great to hear that the suggested system operates continuously, allowing for daily water quality analyses. This will provide the River-Keeper with real-time data to detect any changes in water quality and take necessary action promptly.However, it's important to ensure that the system is regularly maintained and calibrated to ensure accurate and reliable data. Additionally, proper data management is crucial to ensure that the data is properly stored, analyzed, and accessed in a timely manner. Overall, the suggested system seems like an effective solution to improve water quality monitoring and provide accurate, real-time datato the River-Keeper. The system's continuous operation and web-based UI will allow for prompt action to address sources of poor water quality, leading to improved water quality and a healthier environment.

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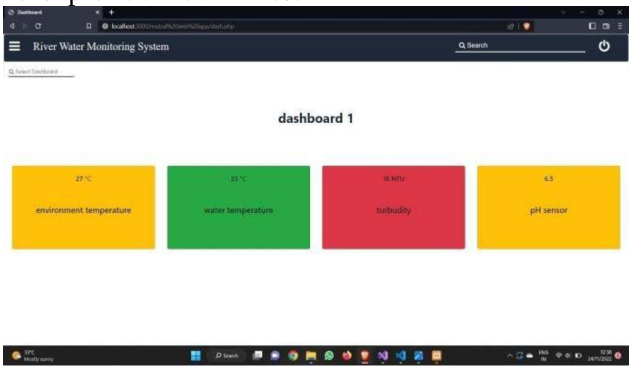

Fig. 6. Web UI output

TABLE 1. HISTORY OF SENSOR VALUES

Time	11:00	11:10	11:20	11:30
Environment Temperature (℃)	26	27	26	28
Water Temperature (℃)	25	27	25	26
Turbidity (NTU)	10	11	10	10
pH	6.5	7	7	8

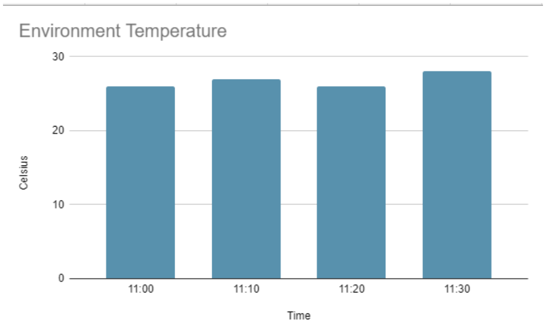

Fig. 7. Environment Temperature graph

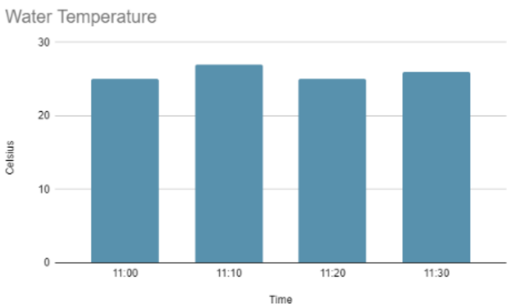

Fig. 8. Water temperature graph

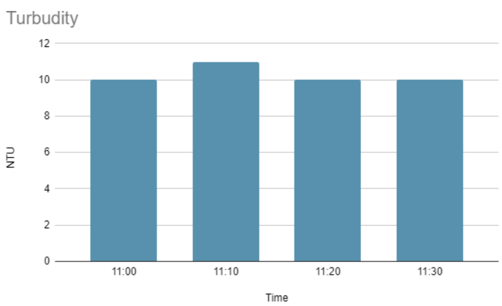

Fig. 9.Turbiditygraph

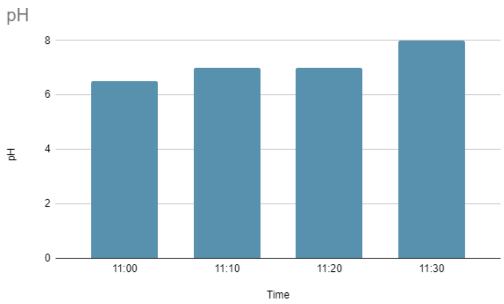

Fig. 10. pH graph

V.CONCLUSION

The major objective of our work is to constantly evaluate the water quality 24/7 and the data will be sent to the web-based UI. The data also gets stored in the database to review the history. Our suggested system tells whether the water is consumable or not. Our system is more feasible and efficient as it shows more accurate values. In the future, our system can be enhanced with more sensors and we are planning to add a mobile application also.

VI ACKNOWLEDGEMENT

We acknowledge that this work is original and has not been published elsewhere nor is it currently under consideration for publication elsewhere

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