POLLUTANT DETECTION IN AQUATIC ENIVORNMENTS USING SMART TECHONOLOGY

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***Abstract*—The main objective of this project is to determine the quality of water, by continuously monitoring using IoT devices like Node MCU. This system makes use of a Water quality monitoring sensor, cloud and Web UI, IOT Node MCU ESP8266, Temperature sensor, PH sensor, Turbidity and TDS sensors, Arduino, Fast alerts and Buzzer. In India, water contamination is a serious environmental issue. Untreated sewage is the main cause of water contamination in India. Most Indian rivers, lakes, and surface waters are polluted by uncontrolled small-scale industries. In conventional systems, the monitoring procedure includes manually gathering sample water from various places, followed by testing and analysis in a lab. This method is inefficient because it is laborious, takes a longtime, and doesn't yield results right away. Instead, create a low-cost system for real-time water monitoring using wireless sensors network (WSN). Node MCU has a connected built-in Wi-Fi module that enables internet access and sends sensor data measurements to the systems. To evaluate the quality of water from aquatic bodies, a number of sensors are employed to monitor a variety of factors like Ph value, TDS, Turbidity, temperature and water level to determine if the water is appropriate or not, the results are saved in the cloud. A warning message is sent to the master kit from WSN for monitoring and also to PWD department if dirty water is found.**

***Index Terms*— Node MCU, MCUES8266, TDS sensors, Wi-Fi module, Turbidity.**

I. INTRODUCTION

In recent years, there have been a tremendous number of flood instances due to the altered rainfall pattern. Flood catastrophes cause harm to the economy and to people's lives. Floods afflict millions of people each year. To reduce flood casualties, the government was compelled by this to develop a flood forecasting method. The installation of alert systems near any significant body of water or water region gives vital wealth of knowledge that can both save lives and protect property. Some places are more prone to flooding than other places. Of course, the most effective flood warning systems cost a lot of money, require a lot of upkeep and require highly skilled personnel to operate them.

Every human being in the world needs access to water as one of their basic needs. A human life can be severely impacted by the poor management of a water storage system. The proposed model was created as a result of technological advancement to control water storage facilities like dams and lakes using sensor signals that are located remotely. Sensors placed in storage regions estimate the lakes' and dam's durability and capacity for storage. This increases the accuracy of flood predictions in river routes and enables the oncoming dam to release some water outside to make room for arriving waters. For the purpose of analyzing water flow management, the data produced from dams that are connected to one another are stored in the cloud. To prevent cable connections, using an IoT platform, sensors in a lake or dam are connected. As a result, this model prevents unexpected floods occur when it rains, which assures the lake's and dam's physical strength through ongoing monitoring. In the case of a flood, rivers that are close to populous or strategically significant places can harm property and put people at danger of injury. Radar and ultrasonic sensors used in conventional river flood monitoring systems might not be entirely reliable as well as usually need on site human calibration. One of the natural disasters that cannot be prevented is flooding. It happened too quickly and had a huge impact on both people and property. Flooding is a natural occurrence that sparks interest around the world. Both lives are lost and the ecosystem is severely damaged as a result. Flooding is caused by heavy rains, faulty structures and a variety of human factors. Precipitation levels and rates, topography, geology, land use and pre-existing moisture conditions all play a role in floods. Prior to this, the majority of the systems that have been developed only concentrated on a few areas. In addition, because they lack information and data on the weather, the bulk of the population is unable to track and is unaware of when a flood will occur. All the issues with the current system will be resolved by using IoT monitoring system. This is appropriate for urban and rural locations. Additionally, if a member of public has internet access, they can keep track of events and fore see the possibility of a web server flood. Its design is affordable and upkeep is simple. By doing so, the web server's water level will be updated and the system will inform the public to evacuate so that quick, required action may be done. New Low Power Wide Area Network (LPWAN) methods are being used as part of the plans of Internet of Things (IoT) systems, which has been a set of circumstances that is constantly evolving, for monitoring systems and to prevent future risks with smaller and less unaffordable structures. To provide the possibility to interface various types of sensors without significantly altering the proposed node architecture's hardware, the entire system is created from a modular perspective. The data is stored in a sensor and microcontroller equipped device that is linked to LoRa wireless module for data transmission, after then it is analyzed as well as saved via a web application framework where the flood alert feature is implemented. However, the system cannot solve flooding issues on its own. Public institutions must operate in tandem with civil society, volunteers, organized volunteer work organizations and community organizations. In order to decrease the danger of fatalities, property damage and environmental degradation, this proposed work can provide information to the relevant emergency services along with authorities.

One of the most frequent and dangerous natural disasters is flooding. A better response to flood threats is required, given the growing number of flood related deaths as well as financial losses seen every year around the world. It's interesting that in the past ten years, there have been numerous academic endeavors looking at how camera footage and wireless sensor data from IoT networks could improve flood management. The presented work sheds light on the potential for creating an alarm system to reduce the risk of flooding. It is able to estimate how quickly the flood will occur by sending the user an alarm message along with the timing and pace of the water rise. Additionally, it has undergone testing in a controlled setting to gauge performance.

II. LITERATURE SURVEY

As in [1], a novel architecture for the transceiver is proposed in order to increase the service range of IEEE 802.11ah, which is necessary for the long-range IoT communication of emergency messages in emergency situations. Experimental results show that the presented architecture is suitable for the long-range IoT communication of emergency alert messages. As in [2], a wireless sensor network system could remotely monitor the real time data of water condition in the identified areas. To monitor the water conditions such as water level, flow and precipitation level, wireless sensor network system is developed. As in [3], GRAB, designed for robust data delivery in face of unreliable nodes and available wireless link. GRAB forwards data along band of interleaved mesh. As in [4], in Wireless Sensor Networks (WSN) the user requirements are often desired to be evolvable, whether driven by changes of the monitored parameters or WSN properties of configuration, structure, communication capacities, node density and energy among many others. As in [5], the functionality is supported by the reflective and component-based Grid Kit middle ware, which provides support for both WSN and Grid application domains.

As in [6], a distributed system is proposed using water level monitoring sensors named Shonabondhu. The sensing nodes are distributed all across the country and the servers that collect data from sensors are spread around various regions. The servers use a function of rainfall and current water level that indicate a particular gradient to that sensors. As in [7], a proposed cooperative monitoring algorithm based on the node location information. Basically, IoT is a part from WSN but sometimes there have a problem on connectivity end to end device because there are varieties of devices used in the network architecture. A consistent design system is needed to implement, where the main application requirements for low cost, fast deployment of large numbers of sensors, and reliable and long unattended service are considered at all level.

As in [8], the system must be able to handle the variety of data types, providing interoperability among all the components. This is because of the various environments of the IoT device give a different perspective in terms of information processing, communication capabilities, and data transferring that are coming from the devices. The communication device is important in the system, example is using of ZigBee network protocol. The protocol had free communication frequency and used for low power consumption for communication that saves the hardware cost of, instead of using GPRS and reduce the cost of the whole system. The advantages of the ZigBee network is it can achieve mutual communication sensor nodes. It helps the system discovers sensor nodes within the range of monitoring stations in short time, reduce the scanning time to collect data, improve the reliability of the information collection and transmission. As in [9], the various remote sensing technologies used for the detection, monitoring, and assessment of oil spills, emphasizing the crucial role these technologies play ineffectively managing oil spill incidents.

As in [10], provide a thorough exploration of embedded system design, detailing the modeling techniques, synthesis tools, and verification methods essential for developing reliable and efficient embedded systems.

As in [11], underscores the importance of utilizing a multi sensor approach to improve the classification of oil spill thicknesses. By integrating data from optical, SAR, and thermal infrared sensors.

III. PROPOSED METHODOGY

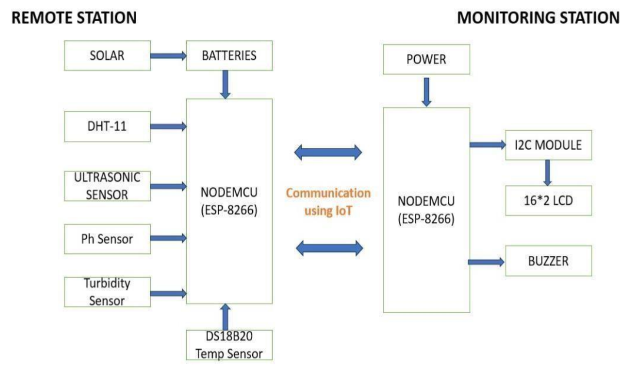

Figure.1 Block diagram of proposed method

The main objective of this work is to determine the quality of water by continuous monitoring using IoT devices like NodeMCU. This system makes use of a Water quality monitoring sensor, Node MCU ESP8266, Temperature sensor, pH sensor, turbidity and TDS sensors, Arduino, Fast alerts and Buzzer.

REMOTE STATION:

Solar Panels and Batteries: These provide power to the remote station, ensuring it can operate independently and sustainably.

DHT-11: The DHT11 is a Digital Temperature and Humidity sensor, measures ambient temperature and humidity. The sensor outputs a digital signal, making it easy to interface with microcontroller like the Node MCUESP8266.

Ultrasonic Sensor: Used for measuring the water level or detecting the presence of objects.

pH Sensor: Determines the acidity or alkalinity of the water. pH sensor is useful in both aquatic and terrestrial ecosystem.

Turbidity Sensor: Measures the clarity of the water by detecting suspended particles. High turbidity level indicate pollutant, sediment runoff, or other environmental disturbances.

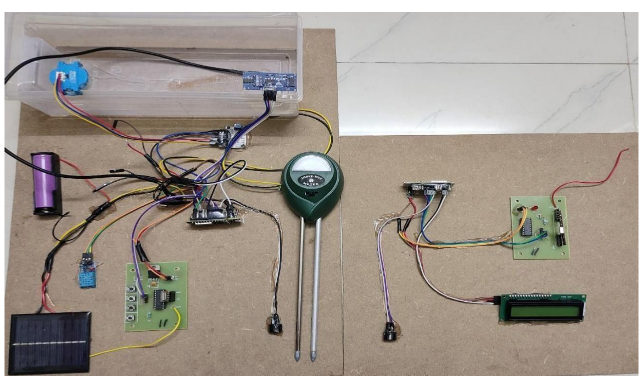

Figure 2 Overview of the project

DS18B20 Temperature Sensor: Specifically measures water temperature. It can measure temperatures in the range of -55°C to 125°C.

NODEMCU (ESP-8266): This microcontroller unit processes the data collected from the sensors and sends the data to another Node MCU present in the monitoring station.

COMMUNICATION USING IOT:

The data processed by the NODEMCU at the remote station is to sent to the monitoring station via IoT communication protocols. Node MCU devices are used to enable real-time data transfer for water quality monitoring via IoT. Node MCU, equipped with sensors, collects data and publishes it to an MQTT broker over a Wi-Fi network. Another Node MCU subscribes to the broker, receiving and processing the sensor data. This setup ensures continuous, wireless monitoring of water pollutants, enhancing the efficiency and accuracy of environmental management.

MONITORING STATION:

NODE MCU (ESP-8266): Similar to the remote station, it receives and processes the data. The Node MCU in monitoring station processes the received data and transfer the data to 16*2 LCD to display.

I2C Module: Interfaces with other components for data display and alerts. I2C is a serial communication protocol that allows multiple devices to communicate over a common bus.

16*2 LCD: A 16*2 LCD module consists of 16 characters per line and 2 lines. Displays the real-timed data received from the remote station.

Buzzer: Acts as an alarm system, which can be triggered if the pollutant levels exceed predefined safe thresholds.

IV. SIMULATION RESULTS AND DISCUSSION

In the process of pollutant detection in aquatic environment using IOT, the quality of water continuously monitored using IoT devices like Node MCU. In this system, several sensors are used to detect current physical conditions, and send the data to microcontroller (Node MCU ESP8266). This system makes use of a Water quality monitoring sensor, Node MCU ESP8266, Temperature sensor, pH sensor, Turbidity sensors, 16*2 LCD Display, Fast alerts and Buzzer. This system has two stations, they are Remote station and Monitoring station. In Remote station, the Node MCU ESP8266, pH sensor, Turbidity sensor, Ultrasonic sensor, RF Transmitter, Solar panel and Battery are integrated. These sensors are used and send the status of those sensors to Node MCU. Then, the data will be processed by Node MCU and transfers the data to the Monitoring station through Internet of things (IOT). The Monitoring station consist of Node MCU ESP8266, RF Receiver, 16*2 LCD Display and Buzzer. The Node MCU in Monitoring station is similar to the remote station, it receives and processes the data. The 16*2 LCD Displays the real-time data received from the remote station. The buzzer acts as an alarm, which can be triggered if the pollutant levels exceed predefined safe thresholds.

ISSN: 2366-1313

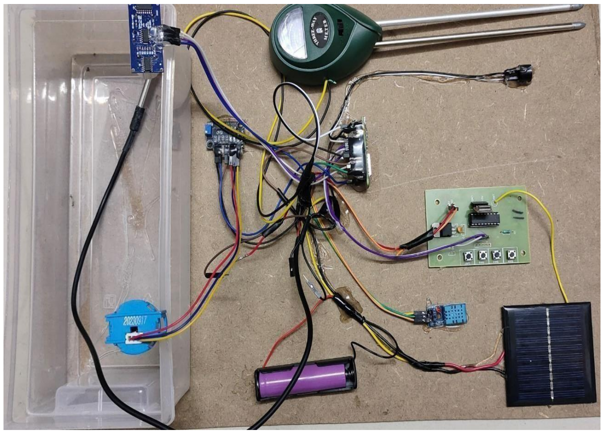

Figure 3 Remote station or Transmitting Section

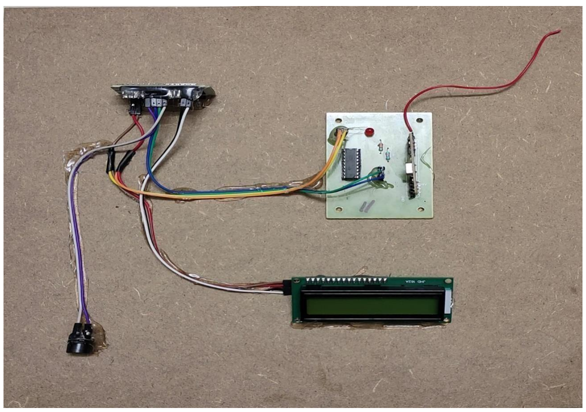

Figure 4.Monitoring Station or Receiving Section

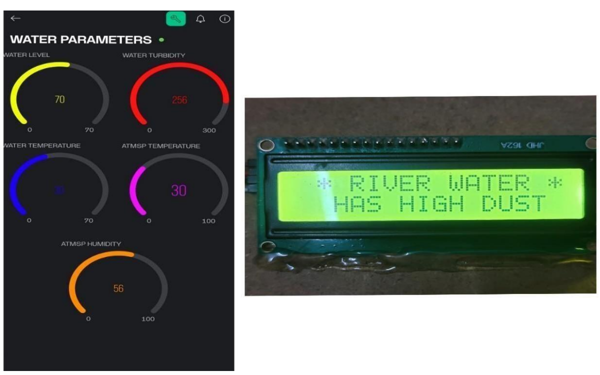

Figure 5. Specifying the Water Level Increase

Here, the Blynk is used to display sensors data such as Water Level, Water Turbidity, Water Temperature, Atmosphere Temperature and Atmosphere Humidity.

When power supply is provided for both the Transmitting section and Receiving section as shown in Figures 2 to 4 and when the floods occur then the flow of water increases. So that, the level of water increases then the distance between the water and ultrasonic sensors decreases. Then the Node MCU in the Remote stations send the data to the Node MCU in the Monitoring station and 16*2LCD displays that "RIVER WATER LEVEL INCREASING" as shown in

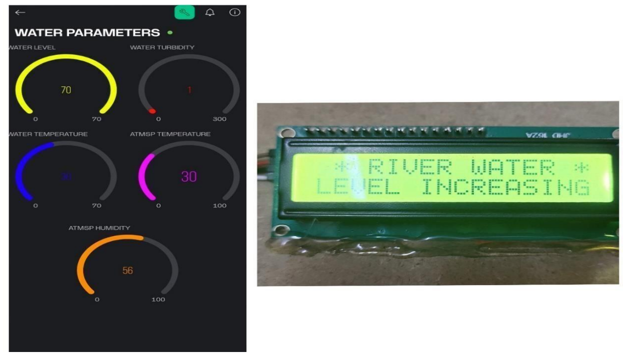

Figure.5.

Figure 6. Specifying the River Water has High Dust

When the floods occur or any industry release pollutants mix into the river water, then the water get polluted due to increase in inorganic components and harmful substances in the water. Turbidity sensor measure the clarity of water by detecting suspended particles. Any change occur in water clarity, then that data will be collected by the Node MCU in the Remote station sends that data to the Node MCU in the Monitoring station. The 16*2LCD displays that "RIVER WATER HAS HIGH DUST" as given in Figure.6.

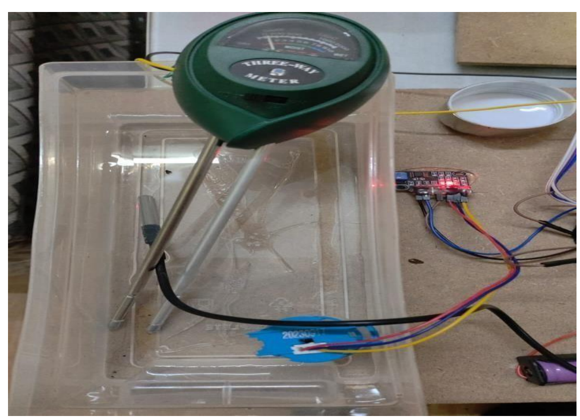

Figure 7. Specifying the pH value of Water

ISSN: 2366-1313

When the pH meter is placed in the water, it measures the pH value of the water and displays the pH value as shown in Figure. 7.

V. Conclusion

The potential to create an alarm system that will mitigate the risk of flooding is highlighted in this work. In the case of a flood or other dangerous natural disaster, it might also support a variety of governmental bodies or authority, which might aid society and humanity. The suggested model has been tried out and is functioning as described in this manuscript. It will keep an eye on all potential sources of flooding. It will quickly transmit a warning if the water level increases along with the speed. Additionally, it makes dealing with and recovering from this disastrous situation more accessible. Also, it will aid the neighborhood in making quick judgment and preparing for this strategy.

References

[1] K. S. Adu-Manu, N. Adam, C. Tapparello, H. Ayatollahi, and W. Heinzelman, ‘‘Energy-harvesting wireless sensor networks (EHWSNs): A review,’’ ACM Trans.SensorNetw.,vol.14,no.2,pp. 1–50,Apr.2018.

[2] Z. Asif, Z. Chen, C. An, and J. Dong, ‘‘Environmental impacts and challenges associated with oil spills on shorelines,’’ J. Mar. Sci. Eng., vol.10, no.6, p.762, May 2022.

[3] A. L.Balogun, S.T.Yekeen, B.Pradhan, and K.B.W.Yusof, ‘‘Oil spill trajectory modeling and environmental vulnerability mapping using GNOME model and GIS,’’ Environment. Pollution, vol.268, Jan.2021, Art.no.115812.

[4] A.M. Bernabeu, M. Plaza-Morlote, D. Rey, M. Almeida, A. Dias, and A.P. Mucha, ‘‘Improving the preparedness against an oil spill: Evaluation of the influence of environmental parameters on the operability of unmanned vehicles,’’ Mar. Pollut. Bull., vol.172, Nov.2021, Art.no.112791.

[5] M.Bhuyan, Intelligent Instrumentation: Principles and Applications. Boca Raton, FL,USA:CRC Press,2013.

[6] C.M.Bishop, Pattern Recognition and Machine Learning (Information science and Statistics), 1sted. Springer, 2006.

[7] H.Denkilkian, A.Koulakezian, R.Ohannessian, M.S.Chalfoun, M.K.W.Jouiou, Chehab, and I. H. Elhaii, “Wireless sensor for continuous real-time oil spill thickness and location measurement,” IEEE Trans. Instrum. Meas.,vol.58, no.12,pp.4001-4011,Dec.2009.

[8] R.C. Eberhart and Y.Shi, Computational Intelligence: Concepts to Implementations,1sted.SanMateo, CA,USA: Morgan Kaufmann,2007.

[9] M.Fingas and C.Brown, ‘‘A review of oil spill remote sensing,’’ Sensors, vol.18, no.2, p.91, Dec. 2017.

[10] D.D.Gajski, G.S.S.Abdi, and A.Gerstlauer, Embedded System Design: Modeling, Synthesis and Verification,1sted.Springer,2009.

[11] O. Garcia-Pineda, G. Staples, C. E. Jones, C. Hu, B. Holt, V. Kourafalou, G.Graettinger, L. DiPinto, E. Ramirez, D. Streett, J. Cho, G. A. Swayze, S. Sun, D.Garcia, and F. Haces-Garcia, ‘‘Classification of oil spill by thicknesses using multiple remote sensors,’’ Remote Sens. Environ., vol. 236, Jan.2020, Art.no.111421.

[12] I.Good fellow, Y.Bengio, and A.Courville, Deep Learning (Adaptive Computation and Machine Learning Series). Cambridge, MA, USA: MIT Press, 2016.

[13] A.Géron, Hands on Machine Learning With Scikit Learn Keras and Tensor Flow,2nded. O'Reilly Media, 2019.

[14] L. Haulin, ‘‘A state-based method to model and analyze the power consumption of embedded systems,’’ Tech.Rep.,2018.

[15] R. Hidalgo-Leon, J. Urquizo, C. E. Silva, J. Silva-Leon, J. Wu, P. Singh, and G.Soriano, ‘‘Powering nodes of wireless sensor networks with energy harvesters for intelligent buildings: A review,’’ Energy Rep., vol.8, pp.3809–3826, Nov.2022.

[16] P. Keramea, K. Spanoudaki, G. Zodiatis, G. Gikas, and G. Sylaios, ‘‘Oil spill modeling: A critical review on current trends, perspectives, and challenges,’’ J. Mar. Sci. Eng., vol. 9, no.2, p.181, Feb.2021.

[17] C. Koulamas and M. Lazarescu, ‘‘Real-time embedded systems: Present and future,’’ Electronics, vol.7, no.9, p.205, Sep.2018.

[18] .E.A.Lee and S.A.Seshia, Introduction to Embedded Systems: A Cyber Physical Systems Approach, 2nd ed. Cambridge, MA, USA: MIT Press, 2017.

[19] I. M. M. El Emary and S. Ramakrishnan, Wireless Sensor Networks: From Theory to Applications, 2013.

[20] P. Marwedel, Embedded System Design: Embedded Systems Foundations of Cyber-Physical Systems, and the Internet of Things, 4th ed. Springer, 2021.