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Real Time Water Treatment Plant Monitoring System: Review

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ABSTRACT: Effective treatment of waste water before reuse or disposal is important as well as crucial from safety perspective. The scarcity of the fresh water and the increasing pollution levels have made is necessary for real-time monitoring of water treatment plants for reliability and efficiency. This project deals with the development of Real-time water Treatment plant monitoring and control using IOT. The proposed project consist of multiple sensor nodes placed at inlet and outlet of water treatment plant which will be used monitor and analyse parameters such as temperature, humidity, pH levels and turbidity to determine the efficiency of the water treatment plant. The Data collected from the sensor nodes is pushed to the IOT cloud app developed which can be visualized and monitored by the concerned authorities remotely using IOT communication protocols. The data collected on the cloud can also be monitored as well as saved on the cloud database and can accessed any time. Automation is implemented using IOT to automate and control the parameters of the water treatment plant based on the model.

KEYWORDS: Water Treatment, IOT, Cloud, web Application, Temperature, pH, Turbidity, Automation etc.

I. INTRODUCTION

The most important resource is water. It is frequently used for industrial applications in addition to ordinary and commercial ones. Even so, just 2% of the water present on the earth's surface is suitable for human consumption. Thus, using treated water as an option to meet the world's water needs is increasingly necessary.

Water is an essential requirement for all living things, including humans. Alternative methods of acquiring water supply, like groundwater and surface water, will no longer be able to meet the increasing demand in water supply due to rapid development expansion. As a result of the anticipated water deficit in many emerging nations, this problem is predicted to worsen. Therefore, the current trend is to manage and monitor the available natural water supply to avoid water shortage issues during dry periods. Since it has the potential to replace manual monitoring, water monitoring technologies have made significant progress and are now widely used for the operation of water sources and water treatment facilities. As a preliminary warning method. Treatment of water has become a necessity and effective water treatment monitoring and control can help treating waste water making it reusable there by preventing wastage of water.

IoT is a Creative and powerful technology with the potential to create an intelligent connected systems. The technology can also lessen human dependence, which can boost productivity. Around the world, this programme has been used to create projects to support monitoring spanning from surveillance, healthcare, and ecology. It might not directly apply to other sectors, but the same ideas are involved. Three essential elements of the Internet of Things are sensing hardware, a data transmission network, and data processing capability. With the help of the internet and short-range communication networks, it is more innovative to achieve intelligent identification, information exchange, location, tracking, and network administration using devices like RFID, infrared sensors, GPS, and laser scanners.

In recent days IOT coupled with machine learning is being used to solve the various industrial and domestic problems as it provides with the decision making abilities to the developed smart system in addition to the real-time monitoring and manual control. It helps to build a strong framework which can take decisions based on the previously learnt data which can improve the reliability and the efficiency of the water quality inspection. Contaminants from used water are removed by a wastewater treatment system. Before returning the water to a water body, it filters out hazardous and damaging trash. This lowers the likelihood of water pollution and guarantees that hazardous waste has the least possible negative effects on the environment. Additionally, this water may be recycled for domestic and commercial uses.

This project deals with the IOT based monitoring and control of Water treatment plant with Real-time monitoring, Data logging and Prediction using machine learning approach. The setup is developed as a part of this project which is used to monitor the Water treatment plant using the different sensors nodes which collect the data regarding the TDS, pH,

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Temperature, surrounding humidity, and update it to the cloud hosted IOT panel which will be used to monitor the treatment plant in real-time. Machine learning approach is used to verify the accuracy of the sensor data based on the previously collected dataset of readings and also predict the results as a part of water quality inspection.

II. LITERATURE REVIEW

Raja Vara Prasad Y, Mirza Sami Baig, Rahul K. Mishra et.al. The system proposed integrates different technologies like frequency hopping communication technology and virtual instrument technology to fulfil wireless data transmission for monitoring of water quality. The carrier frequency is adjusted according to the result and full radio spectrum is used with the use of a spectrum hole detection sample. The wireless transmission of data is performed without interference with this specimen and real time information can be received by a system effectively. Moreover, this system is useful for nonprofessional staff also as the data is easy to read and shown clearly. [1]

Devarakonda, S., Sevusu, P., Liu, H., Liu, R., Iftode et.al., Pollution can be effectively monitored with the use of WSN is capable of providing a real time pollution data. The calibration of gas sensors like CO2 gas sensors, NO2 gas sensor is done by using various suitable calibration technologies and then WSN is formed using a multi hop data aggregation algorithm. The pollution data is shown in the form of numbers and charts with the help of web interface and is available on internet as well. Temperature and humidity parameters are measured along with the gases and data is analyzed data fusion. [2]

Shruti Sridharan, et al., addressed about developing an efficient wireless sensor network (WSN) based water quality monitoring system that examines water quality, an important factor as far as; irrigation, domestic purposes, industries, etc. are concerned. The parameters involved in the water quality monitoring such as the pH level, turbidity and temperature are measured in real time by the sensors that send the data to the base station or control/monitoring room. As the monitoring is intended to be carried out in a remote area with limited access, signal or data from the sensor unit will then be transmitted wirelessly to the base monitoring station. The application of wireless sensor network (WSN) for a water quality monitoring is composed of a number of sensor nodes with networking capability. Such monitoring system can be setup emphasizing on the aspects of low cost, easy ad hoc installation, easy handling and maintenance. The use of wireless system for monitoring purpose will not only reduce the overall monitoring system cost in terms of facilities setup and labour cost but will also provide flexibility in terms of distance or location. In this paper, the fundamental design and implementation of WSN featuring a high-power transmission Zigbee based technology together with the compatible transceiver is proposed. It is chosen due to its features that fulfil the requirement for a low cost, easy to use, minimal power consumption and reliable data communication between sensor nodes. The development of graphical user interface (GUI) for the monitoring purposes at the base monitoring station is another main component. The GUI should be able to display the parameters being monitored continuously in real time. The developed GUI platform using MATLAB is cost effective and allows easy customization [3].

R Karthik Kumar et al. investigated underwater wireless sensor network to monitor the quality of water using wireless sensor network (WSN) technology powered by solar panel. Underwater wireless sensor network is the simple and basic way to monitor the quality of water using wireless sensor network (WSN) technology powered by solar panel. To monitor the quality of water over different sites as a real time application, a base station and distributed sensor nodes are suggested. A WSN technology like ZigBee is used to connect the nodes and base station. To design and implement this model powered by solar cell and WSN technology is a challenging work. Through WSN various data collected by various sensors at the node side such as pH, Turbidity and oxygen level are sent to base station. At the base station collected data is displayed as visual and is analyzed using different simulation tools. The advantage in this system is low power consumption, no carbon emission, more flexible to deploy at remote site and so on. [4]

Marco Zennaro, Athanasios FloroSs, Gokhan Doga et al., proposed the design of a water quality monitoring system and, building upon the Sunspot technology, a prototype implementation of a water quality wireless sensor network(WQWSN) as a solution to the water quality monitoring problem. More than one billion people lack access to safe drinking water in the world. Providing a way to measure auto- metrically water quality will help tackle this problem. The design of a water quality measuring system and proposes a prototype implementation of a water quality wireless sensor network (WQWSN) as a solution to this challenging problem. When applied to developing countries, the design and implementation of such a system must take into consideration the difficult environment in which it will operate. An application to water quality measurement in Malawi reveals the relevance of using our novel solution to mitigate two challenging issues: energy consumption of the system and the inter-networking problem. [5]

Kiran kumar G.Sutar, Prof.Ramesh T.Patil presented the fish farm monitoring system based on wireless sensor network. The system is constituted by a base station and sensor nodes. The sensed parameters with their exact precision values are transmitted to the observing station through wireless communication and details are monitored by the administrator. When any of the parameter is found to be above a threshold value an indicator will indicate it. The

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system has advantages such as low power consumption, more flexible to deploy. In recent years, the interest in Wireless Sensor Network (WSN) has been growing dramatically. To meet this trend, we have designed Wireless Sensor Network system to monitor the fish farm. The application requires two different kinds of modules; the sensor itself and the wireless module. The sensor collects and transmits the information to a wireless module using wired connection. Once the information reaches the wireless node, it is forwarded to the central unit through a wireless protocol. The sensor module includes a temperature sensor and pH sensor. The wireless node collects the sensed data by means of a synchronic wired serial polling communication. The use of this kind of protocol allows connecting single master with multiple slaves. [6]

III. OVERVIEW

It is imperative to strengthen water treatment and management systems at this point since freshwater is on the verge of extinction. Water treatment facilities cost money to establish and operate, though. Water treatment facilities cost money to establish and operate, though. The system's adoption of the Internet of Things lowers these facilities' operational expenses, promoting their construction even in remote places. These treatment facilities are the new safety net for various industrial and general-use applications. They are lessening environmental contamination and will unquestionably aid in our future efforts to combat water constraint. There needs be a solution for complete real-time monitoring of water treatment plants for effective treatment along with prediction of accuracy and making decisions using the machine learning techniques.

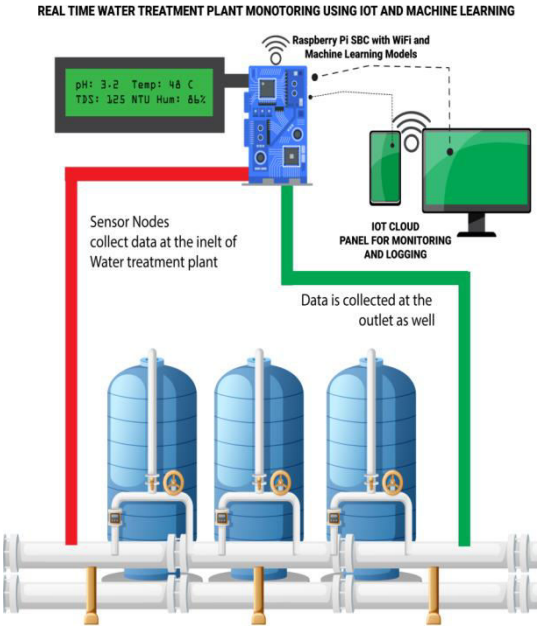

Fig 1:- Conceptual Model

1. IoT in Water Treatment Plant Monitoring:

IoT (Internet of Things) in Water Treatment Plant (WTP) Monitoring refers to the use of interconnected devices to remotely monitor and manage various processes and components in a water treatment plant. The IoT technology can be used to collect data from various sensors, machines, and other devices used in the treatment process. The data collected can be analysed and used to optimize the operation of the WTP, improve efficiency, and reduce costs.

Some of the common IoT devices used in WTP monitoring include water quality sensors, flow meters, TDS sensors, temperature sensors, and level sensors, Turbidity sensors, PH sensors. These sensors can be connected to a central network, allowing real-time monitoring of various water treatment processes. This technology can also be used to remotely control various devices in the WTP, such as pumps and valves.One of the primary benefits of using IoT in WTP monitoring is that it allows for proactive maintenance and repair of equipment. By continuously monitoring equipment performance and detecting abnormalities, plant operators can identify potential issues before they become significant problems, reducing downtime and maintenance costs.

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Moreover, IoT technology enables water treatment plant operators to monitor and control their systems from anywhere, allowing them to respond quickly to changes in water demand, equipment performance, or weather conditions. This results in more efficient use of resources and better decision-making capabilities. Here's a simplified block diagram of an IoT system for water treatment plant monitoring:

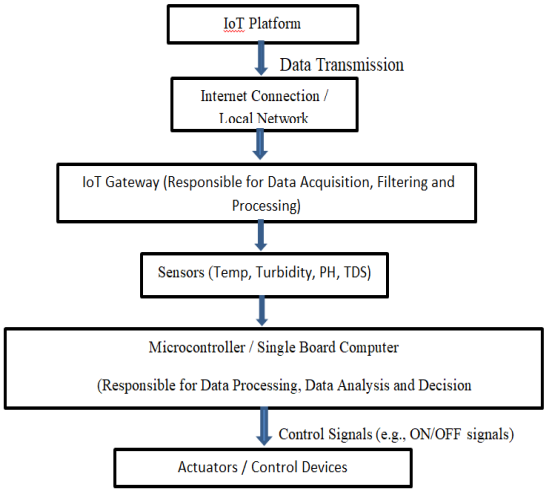

Fig 2: Flow of IOT in water treatment plant monitoring

In this system, the IoT platform serves as the central management hub for the data collected by sensors in the water treatment plant. The IoT gateway acts as the interface between the sensors and the platform, collecting and processing the data before sending it to the platform for storage and analysis.
Overall, this block diagram shows how an IoT system can be used to monitor and control various processes in a water treatment plant, providing real-time data analysis and decision-making capabilities to optimize efficiency and reduce costs.

IV. EXPECTED OUTCOMES

The project deals with the implementation of the IOT and machine learning based water treatment plant monitoring monitoring system. Form the project we can expect that the implemented project can be used to monitor the parameters of the water both at the inlet of the treatment plant as well as exit using web application connected to internet. The proposed project concept is expected to provide a single window portal hosted on cloud which can be used to monitor the water treatment plant using multiple sensor nodes giving collective data of different parameters. The proposed project is also expected to implement machine learning solution for autonomous monitoring, control and efficiency prediction of the water treatment plant by passing real-time sensor data to the trained machine learning model based on previously collect data. Thus the proposed system is expected to provide the feasible and reliable solution for water treatment plant monitoring and automation as well as efficiency estimation using IOT and machine learning.

V. FUNCTIONS OF SYSTEM

The function of a water treatment plant monitoring system using IoT and machine learning approach is to improve the efficiency and effectiveness of water treatment operations by leveraging data analytics and automation. Some specific functions of such a system may include:

1. Real-time monitoring of water quality parameters such as pH, turbidity, temperature, and dissolved oxygen using sensors and IoT devices. This allows plant operators to quickly identify and address any issues with water quality before they become critical.
2. Prediction of water quality changes based on historical data and machine learning algorithms. This can help plant operators anticipate changes in water quality and take proactive measures to prevent them.
3. Optimization of water treatment processes using machine learning algorithms to identify the most efficient and effective treatment methods for different types of water sources.

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4. Fault detection and predictive maintenance of equipment using machine learning algorithms to analyse sensor data and identify potential equipment failures before they occur. This can help reduce downtime and maintenance costs.
5. Automated control of water treatment processes using machine learning algorithms to adjust process parameters based on real-time data. This can help ensure consistent water quality and reduce the need for manual intervention.

VI. CONCLUSION

In conclusion, the use of IoT and machine learning in water treatment plant monitoring has shown promising results in improving the efficiency and effectiveness of water treatment processes. The integration of IoT and machine learning technologies has enabled real-time monitoring of water quality parameters, predictive maintenance, and optimization of treatment processes. The benefits of using these technologies include improved accuracy of water quality prediction, reduced costs, improved equipment uptime, and improved quality of treated water.

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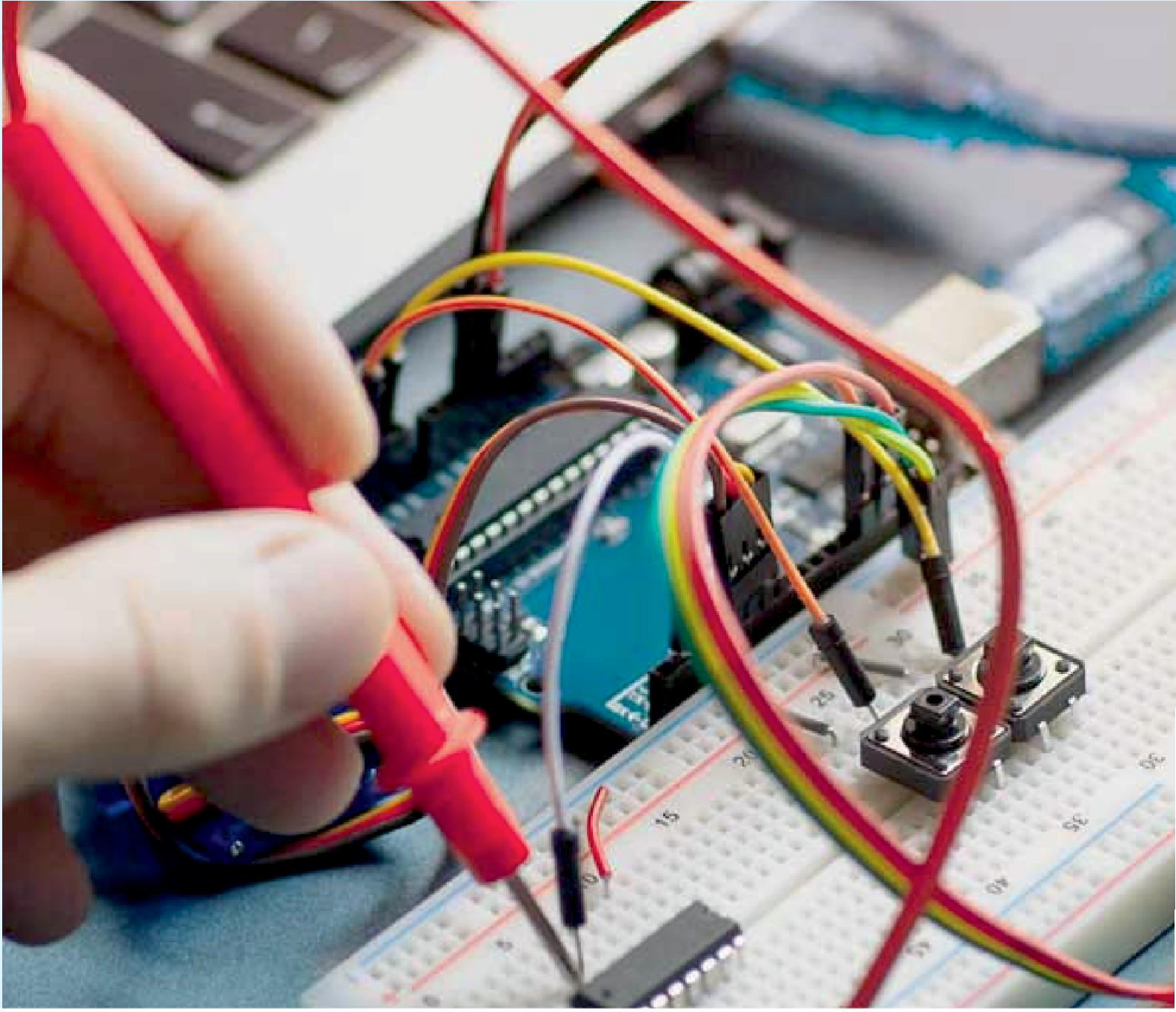

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