WASTEWATER MONITORING AND CONTROLLING USING CLOUD-BASED IOT SYSTEM

Murugasamy R[1], Abinesh J[2], Arun SK[3], Dinesh S[4], Kavin H[5]

[1]Assotiate professor, [2,3,4,5]Students
Department of Electronics and Communication Engineering,
Nandha Engineering College, Erode, Tamil Nadu, India.

Abstract- **A new industrial IoT cloud-based model for real-time wastewatermonitoring and Controlling is proposed for monitoring water from treatment plants. This system consist of several sensors used to measure the physical and chemical parameters of the water. The parameters such as Temperature, pH, Phosphorus of the water can be measured and O_2 sensor is used to measure the oxygen level in atmosphere in treatment plant, thereby indicating the wastewater that the plant cannot handle. The Nodmcu collects and uploads real-time sensor readings to the cloud using an IoT Wi-Fi Module. Additionally, it reports or identified unexpected industrial wastewater outlets usingSMS notifications and alarms. Control Valves are used to close the outlet of the waste water from treatment plants to prevent it from damaging the water bodies and it sends the wastewater to retreatment to the plant. The tools that areused in proposed solution are thingspeak, PIC Microcontroller, Nodemcu, LCD display and sensors like temperature sensor, pH sensor, phosphorus sensor and O_2 sensor.**

I.INTRODUCTION

The importance of IIOT(INDUSTRIAL INTERNET OF THINGS) has been demonstrated by its use in mission and safety-critical systems. Because it handles critical and sensitive data, a detailed search is required to determine its susceptibility to security issues. Existing security solutions are becoming less effective and applicable as the Existing security solutions are becoming less effective. Monitoring the wastewater outlet into the plant is important to provide early detection and alerts in cases of not properly treatment wastewater outlet to the water bodies. As a result of the growth of IoT in industrial and environmental monitoring, a viable solution for dynamic, continuous, and real-time wastewater monitoring has emerged. In this paper, an integrated cloud based IoT model is developed to monitor the outlet treatment wastewater to the river or ocean. In this paper the concept is to develop a cloud-based IoT system for monitoring and controlling wastewater in industry in order to reduce the environmental impact of wastewater. This system will allow for real-time monitoring of wastewater levels in various locations, as well as the ability to set alarms and alerts for when certain levels are reached. Additionally, this system will be able to control wastewater levels by automatically controlling pumps, valves, and other wastewater management systems. Using IIOT it allows authorities to track water composition and establish an enterprise asset management (EAM) system as well as a computerized maintenance management system (CMMS). It improves data gathering capabilities and provides real infrastructure monitoring. Performance characteristics of machines can be monitored utilizing real-time data collected 4 from various embedded sensors, resulting in increased equipment productivity and a reduction in maintenance tasks. IIOT in recycled wastewater management can also be utilized to determine residual chemicals after treatment. This data can also be used to determine the efficiency of the treatment process and ensure that water quality requirements are fulfilled before it is discharged into a water bodies.

II.LITERATURE SURVEY

"Reconfigurable smart water quality monitoring system in IoT environment" was proposed in the year 2017. The proposed WQM system collects the five parameters of water data such as water pH, water level, turbidity, carbon dioxide (CO2) on the surface of water and water temperature in parallel and in real time basis with high speed from multiple different sensor nodes.

"Real-Time Water Quality Monitoring and Estimation in A IoT for Freshwater Biodiversity Conservation" was proposed in the year 2021. A IoT techniques can be applied to pollutant discharge monitoring and other water quality regulatory applications for freshwater biodiversity conservation. IOT unmeasurable parameters are estimated using a general regression neural network (GRNN) model and a multivariate polynomial regression (MPR) model.

"An Internet-of-Things Enabled Smart System for Wastewater Monitoring" was proposed in the year 2022. The special conditions of the sewer environment bring special challenges for the design of an IoT system and of its real-time algorithm for anomaly detection and localization in wastewater networks.

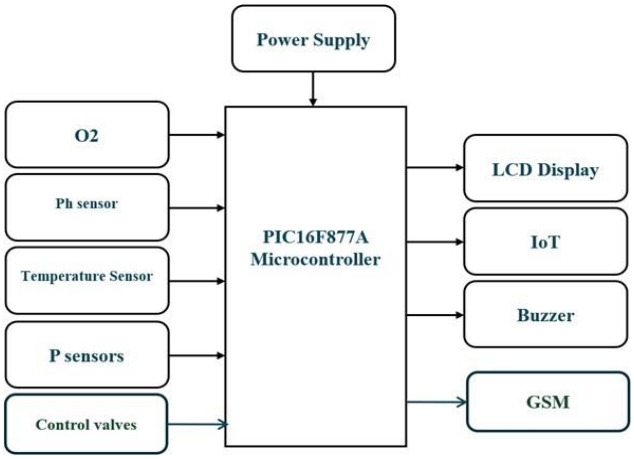
''An IoT-based innovative real-time pH monitoring and control of municipal wastewater for agriculture and gardening''. They proposed realtime pH monitoring and control system of local wastewater using IoT for gardening and agriculture applications. The system was programmed to use a solenoid valve that operates automatically. For online monitoring of water pH and temperature, the Arduino Mega 2560 and a Wi-Fi transceiver (Wi-Fi shield) were utilized, as well as an android app. The microcontroller and Wi-Fi module can transmit and receive and instructions within a 100-foot interior limit and 300-foot LOS communication range if needed.

"Control Console of Sewage Treatment Plant with Sensors as Application of IOT" was proposed in the year 2020. The project involves using the sensors to make the traditional STP more robust and efficient. By monitoring the quantities of gases, it is possible to instantaneously account for the extent of treatment that is taking place at any given point of time.

''A real-time smart wastewater monitoring system using IoT: Perspective of Bangladesh,'' using IoT, a smart wastewater online monitoring system was built to remotely monitor wastewater information and identify harmful effects. The authors used five smart sensors to measure the primary five water parameters of heating value, acidity or alkalinity percentage, total 8 suspended particle (TSP), turbidity, and total dissolved solids (TSS). Besides, microcontroller technology involving a GSM-GPRS module was used to send the collected data to the webserver through a modem together with a specific website for monitoring wastewater data.

III.THE PROPOSED SYSTEM

The proposed solution has the high Scalability – By adding several additional sensors at lower cost and Providing temporal and spatial coverage by monitoring data in real-time, monitoring more parameters at the same station and managing and monitoring several stations at the same time. Adding security options to protect system from attacks and to analyze the data and preparing reports. By adding a warning system with notifications through SMS.



BLOCK DIAGRAM

The figure shows power supply is fed into the PIC16F877A MicroController. The sensor like O2 sensor ,pH sensor ,temperature, phosphorus sensors get the power supply from PIC Microcontroller here the sensor sense the parameters in water(pH, temperature, Phosphorus sensors) and air(O2 sensor) around water give the analog output .The LCD display is connected to the controller to view real time reading directly(manually).2Here pickit2 is used to code the PIC Microcontroller .Then the analog values are converted into digital values which sends further data to the Nodemcu .Where Nodemcu is connected to the internet to perform IOT operation .In the IOT system thingspeak is a open source application which is used to see the output or the reading of the sensors value that is connected to the internet by Nodemcu. The output is taken in particular interval of time.

Here we are using a buzzer for give an alarm to workers if the readings goes higher in the sensor and we are using a GSM module for sending a alert message to the administrator and it sends a reading to the administrator if the value reaches the limit fixed by them. The GSM is also is used to locate the location of the water treatment plant. The system consists of five main components: Power Source, Sensing Devices, IoT Device to the cloud, Data management, and cloud-to-user interface. The data storage component collects the received sensor data that has arrived in the cloud system. The data processing component can analyse any stored data. A web interface allows users to access the collected data. Here we use Thingspeak wed application which is used to get the data from the sensor and process the data in the sensor and the values of the sensor is stored in the application. The stored value is shown in the graphical format.

IV.RESULT AND DISCUSSION

THINGSPEAK OUTPUT GRAPH

Temperature Sensor Graph

The above figure shows the temperature increase and decrease in a day.This value was taken by the temperature senser and the values or data send to IOT system by using thinkspeak we can view the values or data in a particular time in the graph. Here data has in x axis show the time period and y axis showsthe temperature value.by viewing x and y axis we can get the value of temperature at a particular time.

O_2 Sensor Graph

The above figure shows the O_2 level increase and decrease in a day. This value was taken by the O_2 senser and the values or data send to IOT systemby using thinkspeak we can view the values or data in a particular time in the graph. Here data has in x axis show the time period and y axis shows the O_2 value.by viewing x and y axis we can get the value of O_2 level at a particular time.

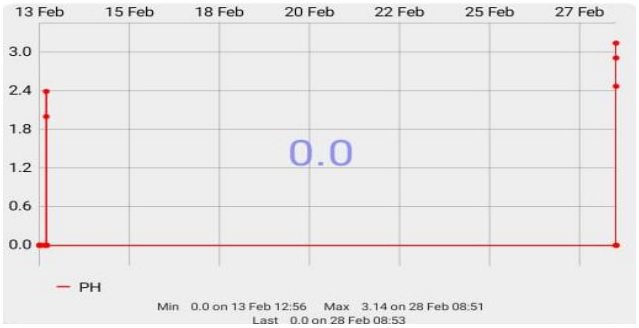


Figure 6.3 pH Sensor Graph

The above figure shows the pH level increase and decrease in a day. This value was taken by the pH senser and the values or data send to IOT systemby using thinkspeak we can view the values or data in a particular time in the graph. Here data has in x axis show the time period and y axis shows the pH value.by viewing x and y axis we can get the value of pH at a particular time. Here the pH value should be below 3 then this is normal water which is used in the environment.

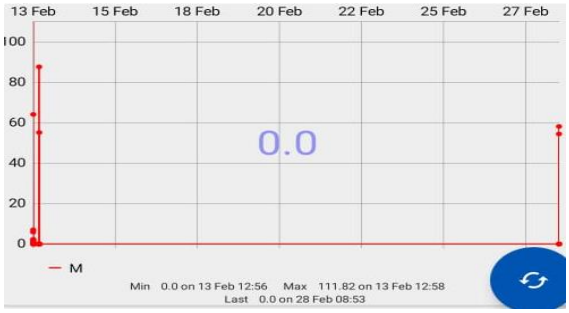
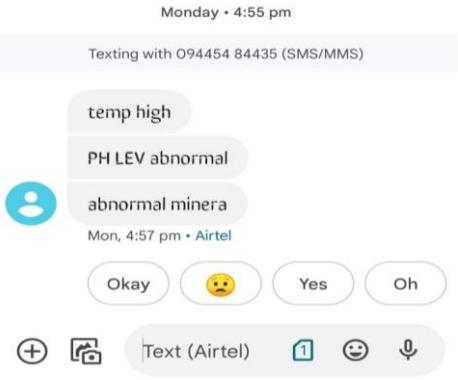


Figure 6.4 Phosphorus Sensor Graph

The above figure shows the Phosphorus level increase and decrease ina day. This value was taken by the Phosphorus senser and the values or data send to IOT system by using thinkspeak we can view the values or data in a particular time in the graph. Here data has in x axis show the time period and yaxis shows the Phosphorus value.by viewing x and y axis we can get the value of Phosphorus level at a particular time. Healthy water should generally have 1-10 micrograms/L.



Massage From GSM Module

The above figure shows that when the temperature , pH , Phosphorus and oxygen value when it reach the critical value the GSM module send the SMS notification to the authorized person so , the issue can be solved immediately.

LCD Display Shows Sensor Values

The above figure shows the different types of sensor used to measure the water parameter and atmospheric oxygen level. In the LCD display the temperature is mentioned as temp, phosphorus is mentioned as M, oxygen and $_{pH}$ is mentioned as O_2 and pH. The values of the sensor is also shown in the figure.

LCD Display in Abnormal level of sensor

The above figure explains that if the pH, temperature,O_2, phosphorus value reaches the high level the LCD display shows the value abnormal and the buzzer is ON and SMS is send to notify. when the value of any sensor is high then the control valves will be closed automatically.

Sensors are used to collect measurements from recycled water at the delay of 1000 ms. The sensors collect data on the monitoring parameters and sendit to the IoT module. The data from the sensors is processed by the IoT module,as indicated in the graphical format. The thingspeak application is used to visualize theuploaded sensor data. Because the system is configured in continuous mode, it is refreshed every 1000ms delay, the data is monitored often and displayed on every action. The obtained values will be graphed and stored for future use. Thingspeak live graphs plot live value of pH , temperature ,O_2 ,phosphorus sensor data as they are being uploaded to the database via IoT device.

V.CONCLUSION

Wastewater monitoring and controlling using cloud-based IoT systemis to create a small, economical, flexible, easily configurable, and portable system that could monitor and control industrial wastewater discharged into water body. The sensor is used for Monitor and control the valves are important for assessing the health of the waterbody. The proposed system uses sensor to measure the O_2 level in atmosphere and temperature, pH and phosphorus of the wastewater at the treatment water outlet water from treatment plant, the NodeMcu module is programmed to receive the measured data.

The concept of waste water monitoring and controlling using PIC Controller, O_2 sensor, pH sensor, temperature sensor, phosphorus sensor, control valves, LCD, buzzer, GSM, and cloud based IoT system is a complex but very effective system for efficiently managing the quality of waste water. The PIC Controller is the central processing unit of the system, receiving data collected from various sensors, such as the O_2 sensor, pH sensor, temperature sensor, and mineral sensor, and then processing and analyzing the data to determine the quality of the water. The control valves then adjust the water flow rate in order to maintain the desired quality of the water. The LCD, buzzer, and GSM are used to monitor and display the quality of the water, while the cloud based IoT system is used to store and access data remotely. All of these components come together to create a complete system for efficiently monitoring and controlling the quality of waste water.

VI.FUTURE SCOPE

A wastewater treatment plant is a facility that uses a variety of methods(physical, chemical, and biological) to treat industrial effluent and remove the impurities in water. Wastewater treatment facilities are critical to environmental protection. The application of suitable technology in conjunctionwith well-established operating procedures may enable the removal of numerous contaminants from wastewaters, such as organic matter, nitrogen, andphosphorus, while minimizing their negative environmental implications. The efficacy and efficiency of treatment systems would result in significantly less waste and improved resource use. The GSM module can be used efficiently in the future to send location of the treatment plant and also send warning if the component is failed or the component show the false reading. We wish to see new developing innovativetechnology used in the sector, resulting in lower energy prices.

REFERENCE:

1. UN-Water, The United Nations World Water Development Report 2017, Wastewater the Untapped Resource, United Nations World Water Assessment Programme, Perugia, Italy, 2017, pp. 1–12.

2. Y. C. Ho, K. Y. Show, X. X. Guo, I. Norli, F. M. Alkarkhi, and N. Mor, ‘‘Industrial discharge and their effect to the environment,’’ in Industrial Waste.Rijeka, Croatia: InTech, 2012.
3. N. P. Cheremisinoff, ‘‘Biological treatment of industrial wastes: Mutant bacteria,’’ in Biotechnology for Waste and Wastewater Treatment, N. P. Cheremisinoff, Ed. Norwich, NY, USA: William Andrew, 1997, pp. 111–149.
4. N.Vijayakumar & R.Ramya, “The Real Time Monitoring of Water Quality in IoT Environment”, International Journal of Science and Research (IJSR)Vol.4(3), 2015.
5. M.N Barabde & S.R Danve, “Continuous Water Quality Monitoring System for Water Resources at Remote Places”, International Journal of Engineering Research and General Science Volume.3,Part 2, 2015.
6. B. Siregar, ABA Nasution, F. Fahmi , “Integrated pollution monitoring system for smart city", ICT For Smart Society (ICISS), 2016 International Conference on",49-52,2016,IEEE, 2016.
7. F Yuan, Y Huang, X Chen, E Cheng, “A Biological Sensor System Using Computer Vision for Water Quality Monitoring,” IEEE Access, vol. 6, pp. 61535-61546, 2018.
8. Pavana NR and Dr. M. C. Padma, “Design of Low Cost System for Real Time Monitoring of Water Quality Parameters in IOT Environment,” International Journal of Advanced Research in Computer Science and Application,vol.4,Issue5,May2016.
9. Nikesh Gondchwar, R. S. Kawitkar , “IoT Based Smart Agriculture,” International Journal of Advanced Research in Computer and Communication Engineering (IJARCCE), vol. 5, no. 6, Jun 2016.
10. S. M. G. Nikkam, V. R. Pawar, “ Analyzing Water Quality for Industrial Application Under IOT Environment,” International Research Journal of EngineeringandTechnology,vol.3,2016.