A Smart Approach for Industrial Effluent Monitoring System for Conservation of Lakes

[1]Prof.Malini K V.HOD.EEE. [2] Prof.R.Gunashekari[3] Harshith H [4] Bharath H P [5] Sowmiya C
[12345]EEE Department, Sri Sairam College Of Engineering , Bengaluru,INDIA

Abstract— **The Rapidity of industrialization that has recently become the need of the hour, for developing country like India especially in Bangalore. Industrialization has turned into a major source of ground water contamination. Huge inputs of pollutants from industries have been taking the pollutant levels beyond the prescribed tolerable limits. The industries that's induce the pollutants into the surface and ground water sources from their activities do not strictly regulate their pollutant to safe limits.**

Many industries discharge their effluents without any proper treatment into nearby open pits or pass them through unlined channels which move towards the low level depressions on land, resulting in the contamination of ground water and surface water sources. This makes causes of water pollution. Such requires periodic and continuous surveillance so that it can be followed up for specific treatment.

Pollution control boards given many measures for industries like sewage treatment but pollution board fails to monitor the industrial waste water supplied to lakes which are destroying lakes is considered as one of the most important and indispensable resources, by considering this point of view we designed the Waste water monitoring device which uses PLC technology for monitoring waste water based on GIS (Geographic Information System).to determine the parameters like turbidity, pH, and temperature sensors are used . The result of this project reveals that displaying and mapping the conditions of waste water under surveillance and alerts are generated when the quality of waste water reaches a threshold value set to the owner of the factory.

Keywords— Industrialization, PLC (Programmable Logic Controller), GIS (Geographic Information System) Turbidity, pH, and Temperature.

I. Introduction

Industries liquid waste contains synthetic materials that are difficult to dissolve in water and are very dangerous if the waste is delivered directly to the environment with the absence of sufficient processing [1]. Supervision of factory's liquid waste ruled by the government enforces factories conduct laboratory tests for their waste water to measure its concentration of waste whether it has been in accordance with the applied regulations or not.

The advancement of computer and communication technology must be able to provide alternative ways in monitoring factory's liquid waste. One of them is by making a monitoring tool that can assess the quality of liquid waste.

In this paper, we develop a waste water monitoring application that uses Sensors for waste water sensing devices include temperature sensors, pH sensors, and turbidity sensors. PLC technology is used to improve the quality of data transmission from monitoring tools to the server [3]. SCADA is one of the communication technologies that utilizes which have advantages as follow: energy efficient, wide range as well as fast and safe data transmission [4]. Data taken from the sensor is represented in a way that the user can understand and use it easily. The Geographic Information System (GIS) is used in the system to show data according to its geographical location.

II. Literature Review

Internet of Things (IoT) is a topic that very popular today among practitioners and researchers. Although various definitions have been proposed in recent years, there is no uniform understanding of the IoT concept so far [5]. Internet of Things is based on an integrated system of various types of identification, sensing, networking, and computation processes [6]. The enabling technology becomes large-scale and additional services that personalize user interactions with various things. IOT can be used for various fields such as traffic, logistics, health, agriculture, smart city, long distance monitoring, and process automation. In this case, IoT holds great benefits for the private sector and the public sector [7].

Internet of Think (IoT) is the concept of an object that has the ability to transfer data through a network in the form of interaction between machines [8]. In the application of IoT many communication technologies between systems that can be used, one of which is PLC [9]. The use of PLC technology to be one of the best choices in IoT development is because PLC is easy to build between machines that can be connected to the internet so the user can easily access such machines [11]. PLC also provides features that support the development of smart city associated with the concept of IoT [12].

Data gathered from sensors can be collected by the sensors and outputted to the Geographic Information System (GIS)-based tool. This GIS is a system developed to manage, analyse and display geographic information [13]. Geographic Information Systems offers a system that integrates spatial data with textual data in which it is a thorough description of the object and this eases users to disseminate relation to other objects in the space of the earth [14].

III. Methodology

A. Hardware Design

The hardware design employs Sensors, PLC, Filters. The hardware design is shown in Fig. 1.

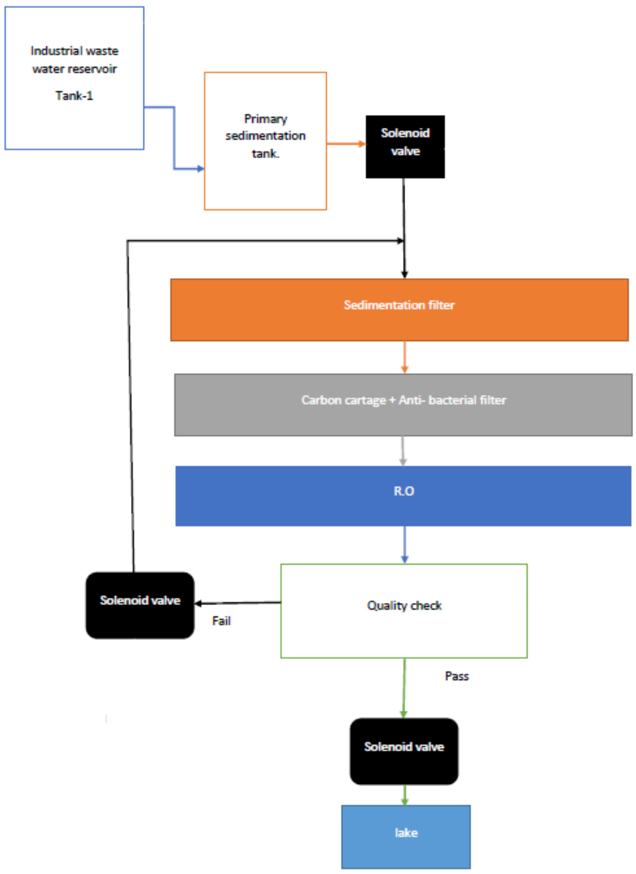

Fig. 1. Hardware Design

The function of each component is as follows:

1. Industrial Effluents are collected in Reservoir Tank.
2. Then water is supplied to sedimentation tank.
3. Solenoid valve is connected because monitor the pump.
4. Sedimentation filter is used remove unwanted dirt particles.
5. Carbon filter is used to remove contaminants and impurities using chemical absorption.
6. RO Filter is used to remove ions, unwanted molecules and larger particles from drinking water.
7. Quality of water is checked after filtration. If water is not purified, passed on through the solenoid valve to sedimentation filter. If quality check is passed, water is passed through solenoid valve to lake.

B. Software Design

The software design is used to provide a clear step for creating the program that displays data from hardware. A system credential must be used. Username and password are required to enter the GIS-based system. Fig. 3 shows the flowchart of the system.

IV. Result

The system has been created and tested, from the view of a Geographic Information System and the reading of monitoring instrument sensors.

A. Geographic Information System

Geographic Information System (GIS) can be accessed by users with the use of web browsers. The start page view of the system displays map and data showing factory position points as shown in Fig. 4.

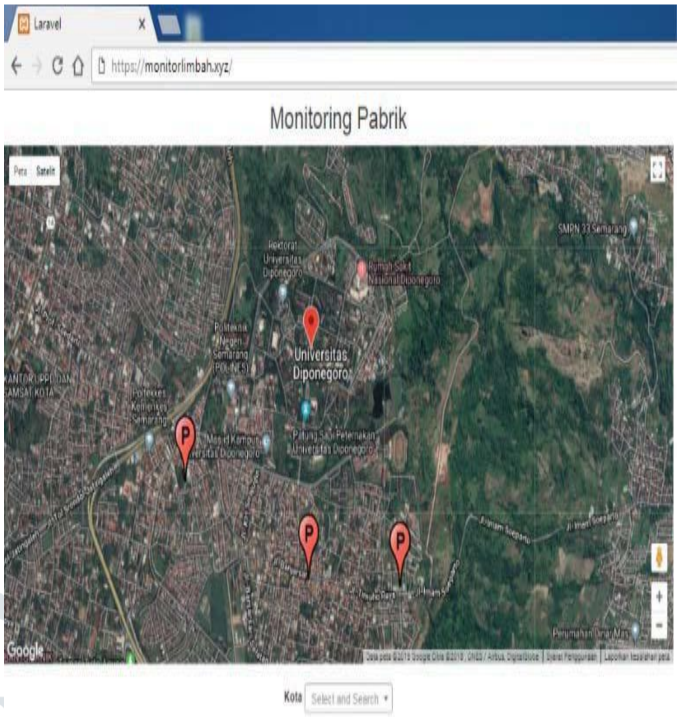

Fig. 4. GIS-based application showing factory positions.

The reading of the sensor data will be forwarded and stored temporarily on the PLC gateway before being forwarded to the server via the Internet. The data available on the server can be accessed by the clients through web browsers in which it is displayed at the GIS-based application at respective geographic areas.

This information system displays information about factories, as shown in Fig. 5. Information regarding to factories, their production water, and waste water can be managed remotely (dummy data can be seen in Fig. 5 - Fig. 7)

B. Temperature Sensor (DS18B20)

Sensor DS18B20 is a sensor used to measure water temperature. Sensor testing is done by comparing the value of sensor output with a digital thermometer available in market. Testing is done five 5 times for every temperature set in Table

The accuracy of sensor measurements averaged 96.77%. Table 1 Temperature Sensor Test Results (DS18B20)

Testing	Comparative Tool (^{o}C)	Temperature Sensor (^{o}C)	Error	Fault Tolerance	Accuracy (%)
1	34	33	2.94	1	97.06
2	33	31	6.06	2	93.94
3	36	37	2.78	1	97.22
4	49	50	2.04	1	97.96
5	43	44	2.32	1	97.67
Average			3.23	1.2	96.77

C. pH Sensor

Sensor testing was performed by using a pH calibration powder diluted with water of 250 mL. The solution used was a solution of pH 4.00, pH 6.86, and pH 9.18. The pH value is taken 3 times for every experiment and the results are averaged. Table 2 shows the results of pH sensor testing.

Table 2 PH Sensor Testing

Testing	Calibration on Fluid	pH Sensor	Error (%)	Fault Tolerance	Accuracy (%)
Acid	4	3.9	2.5	0.1	97.5
Neutral	6.86	6.7	2.33	0.16	97.67
Base	9.18	9.1	0.87	0.08	99.13
Average			1.9	0.11	98.1

Based on Table 2, the average accuracy of pH sensor measurement reached 98.1% of the calibration solution.

D. Turbidity Sensor (SEN0189)
E.

The SEN0189 sensor is a sensor that can be used to measure the turbidity level of water in NTU units. The test is performed using turbidity calibration solution. The solution used is the solutions of 1 NTU, 100 NTU, and 500 NTU. The value is taken 30 times and the results are averaged. Table 3 shows the results of turbidity sensor testing.

Table 3 Turbidity Sensor Testing (SEN0189)

Testing	Calibration Fluid (NTU)	Sensor SEN0189 (NTU)	Error (%)	Fault Tolerance	Accuracy (%)
1	1	1	0	0	100
2	100	93.42	6.58	6.58	93.42
3	500	458.41	8.32	41.59	91.68
Average			4.96	16.06	95.03

Based on the experiment listed in Table 3, the average accuracy measurement of the turbidity sensor reaches 95.03% of calibration solution.

E. E-mail Alert

The system provides warning to the factory owner via email registered in the system. When the system receives data and it is considered to be "bad", an e-mail is sent to the owner informing such a critical data/situation. The status of "bad" is considered when the temperature sensor readings are above 38^{o}C, or the pH sensor is beyond the value of 3-9, or the turbidity value is above 50. The alert information can be seen in Fig. 8.

Table 4 Email alert testing

Testing	Temperature Sensor (^{o}C)	pH Sensor	Sensor SEN0189 (NTU)	Status (good/bad)	Email Send (Y/N)
1	40	6	47	Bad	Y
2	32	11	46	Bad	Y
3	31	6	54	Bad	Y
4	40	10	58	Bad	Y
5	45	2	55	Bad	Y
6	31	8	46	Good	N
7	31	7	47	Good	N
8	33	7	47	Good	N
9	32	7	46	Good	N
10	32	8	46	Good	N

Table 4 shows the testing of email alerts. The system sends an e-mail alert to all "bad" status of data.

V. Conclusion

The system can accurately display waste water data from factories. Geographic Information System shows the location of the waste water plant as well as the existing condition of waste water. The Digital Display System will gives Water chemical and Biological properties to the Public. The system works well sending alerts to the factory owner and Pollution Control Board when the waste water conditions exceed thresholds set.

References

[1] Yudi E. Windarto, Agung B. Prasetijo, "GIS based Waste Water Monitoring System".

[2] S. Ghosha, A. J. Goswamia, G. K. Ghoshb, and P. Pramanika, "Quantifying the relative role of phytase and phosphatase enzymes in phosphorus mineralization during vermicomposting of fibrous tea factory waste," *Ecological Engineering.*, vol 116, pp. 97–103. 2018.

[3] Y. Chen, and D. Han, "Water Quality Monitoring in Smart City: A Pilot Project," *Automation in Construction* 89, pp. 307-3016. 2018.

[4] Y. Song, J.Lin, M.Tang and S. Dong, "An Internet of Energy Things Based on Wireless LPWAN," *Engineering*, vol 3, pp. 460-466. 2017.

[5] Y. Song, J. Lin, M. Tang, and S. Dong, "An Internet of Energy Things Based on Wireless LPWAN," *Engineering.*,vol 3, pp. 460–466. 2017.

[6] S, Madakam, R. Ramaswamy, and S. Tripathi, "Internet of things (IoT): A literature review," *Journal of Computer and Communications.*, vol 3, pp. 164–173. 2015.

[6] A. Colacovic, and M. Hazialic, "Internet of Things (IoT): A Review of Enabling Technologies, Challenges, and Open Research Issues," *Computer Networks.*, 2018.

[7] X. Qiu, H. Luo, G. Xu, R. Zhong, & G. Q. Huang. "Physical assets and service sharing for IoT-enabled supply hub in industrial park (SHIP)". *International Journal of Production Economics*, 159, pp. 4–15. 2015.

[8] R. S. Sinha, Y. A. Wei, and S. H. Hwang, "A survey on LPWA technology: PLC and NB-IoT". *ICT Express.*, vol 3 pp. 14–21. 2017.

[9] R. Jedermanna, M. Borysova, N. Hartgenbuscha, S. Jaegerb, M. Sellwigc, and W. Lang, "Testing PLC for food applications - Example application for airflow

measurements inside cooled warehouses with apples," *Procedia Manufacturing.*, vol. 24, pp. 284–289. 2018.

[10] A. J. Wixted, P. Kinnaird, H. Larijani, A. Tait, A. Ahmadinia, and N. Strachan, "Evaluation of PLC and PLCWAN for wireless sensor networks," *IEEE SENSORS*, pp. 1–3. 2016.

[11] T. Petric, M. Goessens, L. Nuaymi, A. Pelov, and L. Toutain, "Measurements, Performance and Analysis of PLC FABIAN, a real-world implementation of LPWAN," Jun. 2016,

[12] D. Magrin, M. Centenaro, and L. Vangelista, "Performance Evaluation of PLC Networks in a Smart City Scenario," *IEEE ICC SAC Symposium Internet of Things Track*. 2017.

[13] Crosier, Scott., "*ArcGIS 9: Geocoding in ArcGIS*," *ESRI Publisher*., Redland, New York, 2004.

[14] R. Nourjou, and M. Hashemipour, "Smart Energy Utilities based on Real-Time GIS Web Services and Internet of Things," *Procedia Computer Science*, vol. 110, pp. 8–15. 2017.