International Research Journal of Advanced Engineering and Science
ISSN (Online): 2455-9024

Performance Analysis Monitoring of Sugar Factory Liquid Waste IoT Based

Sukamto
Lecturer of Engineering Technology, Politeknik Negeri Madiun (PNM), Jl. Serayu no 84, Madiun, Indonesia-63133
Email address: sukamto@pnm.ac.id

***Abstract*—*One of the causes of water pollution is waste water from industrial activities that do not meet the standards and lack of waste water monitoring activities. In an increasingly technological era, manual monitoring activities are one of the problems faced. Sugar Plant Liquid Waste Monitoring Design Building that utilizes the development of this technology is used to conduct waste water monitoring activities that have gone through the wastewater treatment process. This monitoring uses 5 parameters of wastewater namely ammonia / hydrogen sulfide gas, pH, turbidity, temperature and dissolved oxygen levels. Ammonia / hydrogen sulfide gas parameters using TGS2602 gas sensor, pH parameters using pH sensor, turbidity parameter using turbidity sensor, temperature parameters using DS18B20 sensor, and dissolved oxygen parameters using Dissolved Oxygen (DO) sensor. Using Arduino Mega 2560 as a data processor and 433Mhz RF module as a wireless communication medium. The overall test results work well. The gas sensor is able to detect levels of ammonia / hydrogen sulfide from 0 to 30 ppm, turbidity sensors capable of measuring the turbidity level of 0-987 NTU. The pH sensor is able to measure the level of water pH 0-14 which has been calibrated with a pH buffer 9.18. The temperature sensor is able to detect temperature values with a range of -55 ° C - 125 ° C. And at a temperature of 10 ° C - 85 ° C has an accuracy value of approximately 0.5 ° C. DO sensors are able to detect DO values from 0 - 35 mg / L with an accuracy value of approximately 0.1 mg / L which has been calibrated with a 0 mg / L DO solution. RF 433Mhz can send data with a maximum range of 7 m.*

***Keywords*—** *Monitoring; Arduino Mega2560; TGS2602 gas sensor; Dissolved Oxygen (DO) sensor*.

I. INTRODUCTION

Various industrial developments have produced many goods and services and created employment. However, industrial wastewater discharge results in river pollution and harms people who live along the river flow. [1] Water quality is water quality that meets standards for specific purposes. Simply stated, water quality can be expected by seeing clarity and smell it. However, there are materials or parameters that cannot be known only from odor and color, but a series of tests must be carried out in the laboratory. Monitoring the quality of liquid waste is very necessary as an initial form of anticipation of environmental pollution. However, monitoring is carried out by DLH (Environmental Service) within a certain period and is still manual. The lack of experts, the high cost of laboratory tests and the length of handling from the authorities have also been a factor in the slow process of monitoring the quality of liquid waste.

Research on water quality monitoring has previously been made by Ghofar Noor Mahendro in 2016 with the title of Lake Water Quality Monitoring using a Turbidity Sensor, pH, and Web-based temperature. The study monitored Ngebel lake water quality which was utilized as a daily consumption [2].

Based on the problems faced, a fast monitoring system is needed, continuously and can be done remotely. From these problems, the authors made a Web-based Sugar Waste Liquid Monitoring Design Design. The purpose of this study is to create a web-based monitoring tool, knowing the working principle and the reading results of the sensors used.

In this study focused on how to monitor the quality parameters of sugar mill wastewater without controlling the quality of liquid waste. The sensors used are DS18B20 temperature sensor, TGS-2602 gas sensor, pH sensor, dissolved oxygen sensor and turbidity sensor, and use the 433Mhz RF module as a wireless data transmission medium.

II. THEORY

An easy way to comply with the conference paper formatting requirements is to use this document as a template and simply type your text into it.

A. Mechanical Planning

In the design of the liquid waste monitoring tool as a whole has dimensions of 50cm x 40 cm x 50cm. The placement of the gas sensor in the box, while the DO sensor, pH sensor, turbidity sensor and temperature sensor are placed on the small pipes at the bottom of the box in the middle of the float. Figure 1 is a mechanical planning from a Web-based Sugar Waste Liquid Monitoring tool:

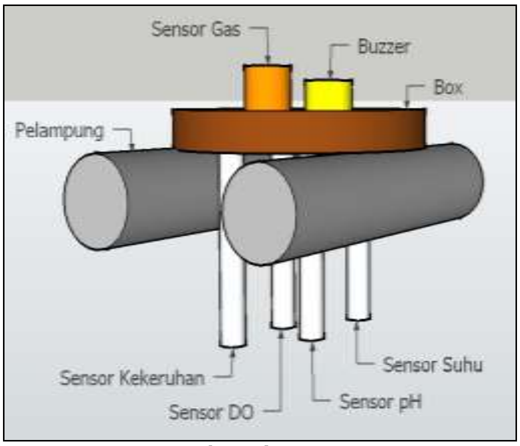

Fig. 1. Mechanical gas monitoring.

B. Polution Index Method

Pollution Index is used to determine the level of pollution relative to permitted parameters. Pollution Index (IP) has a

Sukamto, "Performance analysis monitoring of sugar factory liquid waste IoT based," *International Research Journal of Advanced Engineering and Science*, Volume 3, Issue 3, pp. 140-144, 2018.

International Research Journal of Advanced Engineering and Science
ISSN (Online): 2455-9024

concept that is different from the Water Quality Index. Pollution Index (IP) is determined for a designation, then it can be developed for several uses for all parts of water.

If L_{ij} is the concentration of water quality parameters stated in the water designation standard (j), and C_i expressed as a concentration of water quality parameters (i) obtained from the analysis of a retrieval location from a river channel, then IP_j is the Pollution Index for designation (j) which is a function of $\frac{C_i}{L_{ij}}$ and determined from the resultant maximum value (M) and the mean value (R) ratio of perparamter concentration to the quality standard. Pollution Index Method [reference 17] can be calculated by:

$$IP_j = \sqrt{\frac{(C_i/L_{ij})_M^2 + (C_i/L_{ij})_R^2}{2}} \quad (1)$$

Evaluation of the value of IP_j can determine the class category of Pollution Index:

1. $0 \leq IP \leq 1{,}0$ (Good Condition)
2. $1{,}0 \leq IP \leq 5{,}0$ (lightly polluted)
3. $5{,}0 \leq IP \leq 10$ (Midle Polluted)
4. $IP \geq 10$ (Strength Polluted)

C. Internet of Thing (IoT)

The development of the Internet of Things (IoT), cannot be separated from the basic concept, namely to connect one object to another object (Things) together, making it possible to communicate with each other. By definition, the Internet of Things is described as "a global infrastructure for the information society, enabling advanced services by interconnecting (physical and virtual) things based on existing and evolving interoperable information and communication technologies (ICT)". By applying the IoT technology concept with the interconnection between the physical world and cyberspace, both through the exploitation of identification, data collection, data processing, and the ability to communicate open new opportunities in the IoT dimension to access anything, at any time and from any place. As illustrated in Figure 2 concerning the dimensions of the Internet of Things according to ITU-T Y.2060.

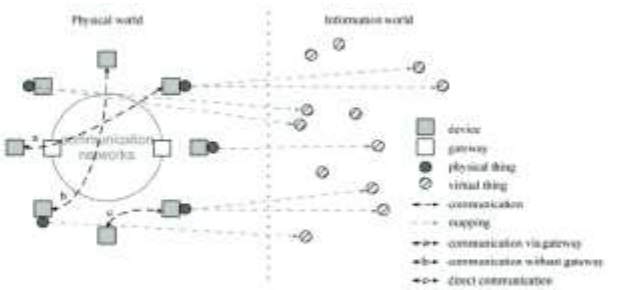

Fig. 2. Technical overview of the IoT.
(researchgate.net)

D. Design Arduino Mega2560 Schematic And RF 433 MHz

The board used in the research design is Arduino Mega2560 as the input data processor from the sensor which is then passed to the output component, namely RF433Mhz. Figure 2 is the following Arduino Mega2560 schematic circuit design:

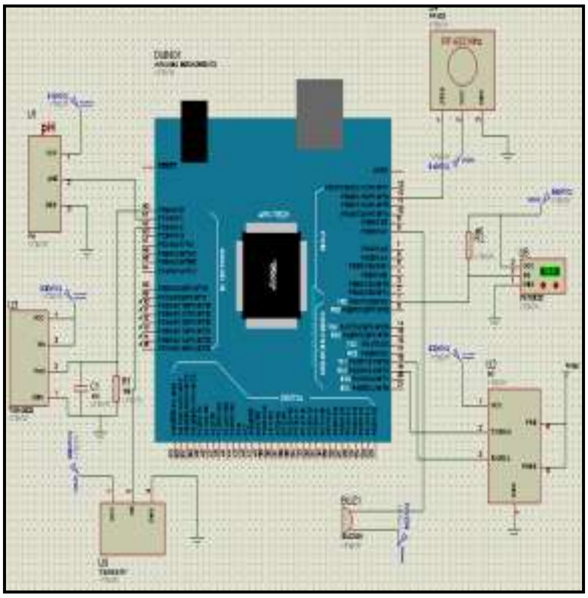

Fig. 3. Design Arduino Mega2560 schematic.

The 433Mhz RF module is used as a wireless data transmission from the monitoring tool to the operator. The 433Mhz RF module consists of a transmitter and receiver. The transceiver has 3 pins, the ATAD pin is connected to pin 12, the VCC pin is connected to the voltage source, and the GND is connected to ground. Figure 4 is designing the transmitter on Arduino as follows:

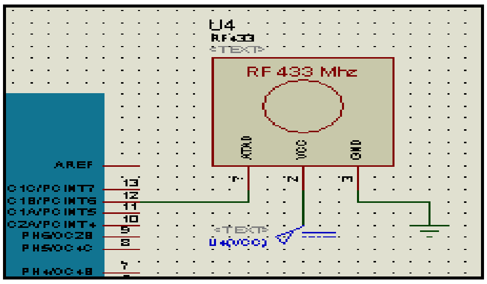

Fig. 4. Transmitter circuit.

In the receiver module there are 3 pins used, namely the VCC pin is connected to the voltage source, the GND pin is connected to ground; and DATA is connected to pin 4. Figure 5 is designing the receiver's schematic circuit on Arduino as follows:

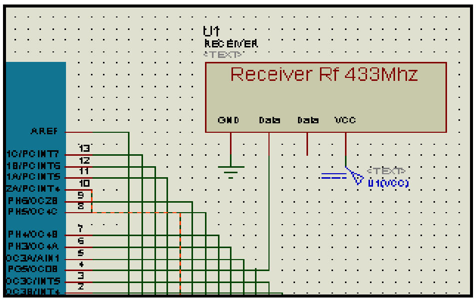

Fig. 5. Receiver circuit.

E. Flowchart System

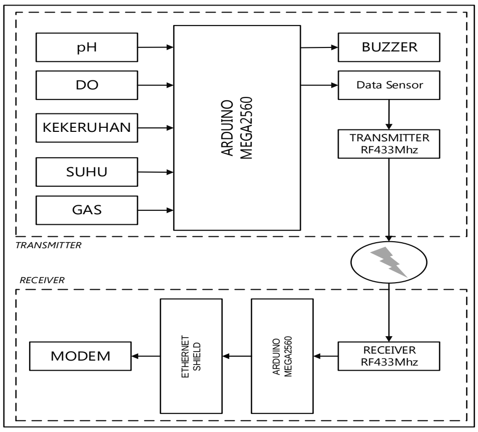

Fig. 6. Flowchart system.

Monitoring of liquid waste is equipped with several sensors, namely temperature sensors, ph sensors, gas sensors, turbidity sensors and oxygen sensors. These sensors are input to Arduino Mega2560. then, on the Arduino Mega2560 the sensor readings will be processed to be compared with the parameter values, if the sensor readings do not match the specified standard then the buzzer will light up. Sensor readings are also sent in the form of serial data using 433Mhz (transmitter) radio frequency. After RF433Mhz (receiver) receives serial data from the sender, the data will be processed by the Arduino to be sent to the server via an Ethernet shield.
The following components are used in the prototype:

1. Gas Sensor TGS - 2602 to measured gas levels in the air.
2. Turbidity Sensor to measured the turbidity of waste.
3. PH Sensor to measured pH levels of waste.
4. Temperature sensor DS18B20 to measure the temperature of the waste.
5. Sensor DO to measured dissolved oxygen levels in the waste.
6. Arduino Mega2560 to process and process sensor input to produce desired output.
7. RF433Mhz for wireless transmission / serial communication.
8. Ethernet Shield to connect Arduino with Internet.
9. Buzzer for alert when sensor value does not match parameters.

F. Dissolved Oxygen (DO) Sensor

The dissolved oxygen sensor is part of the electrochemical sensor where the oxygen gas reaction with the electrolyte solution produces a signal electrically equivalent to the amount of oxygen concentration.

The DO sensor has a DO measuring range from 0.01 - 35.99 mg / L and a maximum pressure of 690 kPa at a depth of 60m at 50 ° C. It has 2 protocol data types, UART and I2C. The main parts of this dissolved oxygen sensor include sensing electrode / working electrode, reference electrode, and counter electrode. These three electrodes are separated by a thin electrolyte solution as well as the exterior of the sensor covered by a permeable gas membrane. This membrane has the function of passing oxygen gas through the diffusion process so that it reacts with the electrolyte solution and prevents leakage of the electrolyte solution.

Sensing electrode serves as an electrode where the electrochemical process takes place. Reference electrode is used as a reference point on the measurement of potential difference to other electrode, in this case is sensing electrode. While the counter electrode serves as an electrical connection to the electrolyte solution so that the current can flow to the sensing electrode.

Fig. 7. Dissolved oxygen kit.

III. Testing and Analysis

Testing of the tool is carried out after all components and circuit in the design of the monitoring system is completed. At this stage, the testing process includes several parts, including Arduino Mega2560 microcontroller testing, pH sensor testing, temperature sensor, DO sensor, gas sensor, turbidity sensor, Arduino Ethernet Shield board and RF 433Mhz. The purpose of testing tools is as follows:

a) The results of the design and manufacture of tools.
b) Analyze the errors and weaknesses of tools that are then compared.
c) The shortcomings and weaknesses of the circuit or device that has been made so that in case of errors or damage can be fixed.

A. PH Sensor Testing

In testing the pH sensor, which needs to be prepared are pH and module sensors, Arduino, PC, pH meters and test samples. The test sample consisted of 2 samples, namely mineral water and pH solution 9,18.

After all of the requirements are available, upload the pH sensor program to the Arduino Mega2560. First, the pH sensor test on a buffer solution of 9.18 mixed with water. Insert the pH and pH meter sensors into the container containing the buffer solution.

Fig. 8. PH sensor test in buffer solution 9,18.

Rinse the probe tip of the pH sensor using clean water before testing on the second sample. This is done so that the remainder of the first sample solution does not affect the pH value of the second sample. Do the same with the first sample in the second sample test.

TABLE 1. PH sensor result.

Sample	Sensor pH	pH meter	Information
pH *buffer* 9,18	9,03	9,1	Basa
Mineral Water	6,12	6,0	Netral

B. *DS18B20 Temperature Sensor Testing*

Temperature sensor testing DS18B20 conducted by using 3 water samples, namely warm water, ice water, and usual water. Equipment required in testing the temperature sensor is the DS18B20 temperature sensor, digital thermometer, Arduino, PC and test sample. The first step is to upload the temperature sensor program on the Arduino, then enter the temperature sensor and thermometer in the first sample containing the usual water.

After obtaining values from temperature sensor readings and thermometers, move the sensor and thermometer to the second sample container containing ice water.

Fig. 9. DS18B20 test in cold water.

After obtaining the result from the second sample reading, remove the sensor and thermometer from the container for a while so that the temperature of the sensor and the thermometer returns to room temperature for the time required for the temperature sensor to not take too long in the reading of the third sample. Insert the temperature sensor and thermometer into a container that contains warm water.

Fig. 10. DS18B20 test in warm water.

TABLE 2. DS18B20 result.

No.	Sampel	Sensor Suhu (°C)	*Thermometer* (°C)
1.	Normal water	28	27,9
2.	Cold water	10	10,5
3.	Hot water	70	70,3

C. *Overall Testing*

In performing the overall testing tool, Arduino, DO sensor, TGS 2602 gas sensor, DS18B20 temperature sensor, turbidity sensor, pH sensor, Ethernet Shield, RJ45 connector, 433Mhz RF module and test sample are required. Upload the whole program on Arduino, then insert the tool into the sample test spot.

Fig. 11. Overall testing.

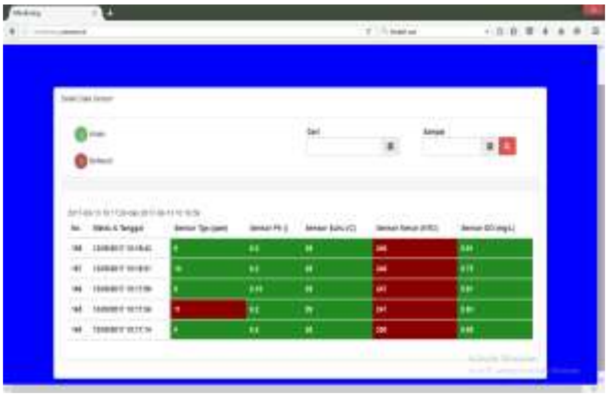

Fig. 12. Test view on the web.

IV. Conclusion

Based on the results of design, testing, and analysis that has been done on the Design of Liquid Waste Monitoring of Sugar Factory Based on Web, it can be concluded:

a) Can make monitoring tool of sugar factory liquid waste practically ie without using a cable in process of sending data. The sensor output data can be sent using RF 433Mhz without using cable. Monitoring the liquid waste of the sugar factory uses the TGS2602 gas sensor as a detector of ammonia/hydrogen sulfide, pH sensor as water pH detector, a DS18B20 temperature sensor as the temperature detector, turbidity sensor as turbidity detector, and DO sensor as the detector of dissolved oxygen.

b) Can know how each sensor works when it detects each of the parameters. That is TGS 2602 gas sensor able to detect parameters of ammonia/hydrogen sulfide on liquid waste, pH sensor able to detect parameters of liquid waste pH, temperature sensor DS18B20 able to detect liquid waste temperature parameter, turbidity sensor can detect parameter of turbidity turbidity level and DO sensor able to detect parameters dissolved oxygen content. Test results are working well.

c) A gas sensor capable of detecting ammonia/hydrogen sulfide 0 - 30 PPM, turbidity sensor able to measure turbidity 0-987 NTU. The pH sensor is capable of measuring the levels of pH water 0-14 that have been calibrated with a buffer pH of 9.18. Temperature sensors are able to detect temperature values with a range of -55 ° C - 125 ° C. And at a temperature of 10 ° C - 85 ° C has an accuracy value of approximately 0.5 ° C. The DO sensor is able to detect DO values from 0-35 mg / L with an accuracy value of approximately 0.1 mg / L which has been calibrated with DO 0 mg / L solution. In sending data from the Arduino to the laptop as a server to send data to the web has been successfully done. Using 2 Arduino boards and RF 433Mhz data capable of being sent indicates that the use of RF 433Mhz for unsigned sender media has been successful and capable of sending and receiving data with a maximum range of 7m.

ACKNOWLEDGEMENT

We would like to thank Politeknik Negeri Madiun And KEMENRISTEK DIKTI For support during research work.

REFERENCES

[1] R. G. P. Yudha and Dirvi Eko J., "Analysis of unsynchronization carrier frequency offset for OFDM system using moose estimation method" *International Research Journal of Advanced Engineering and Science*, vol. 2, issue 4, pp. 42-45, 2017.

[2] R. G. P. Yudha, I. G. Puja Astawa, and A. Sudarsono, "Performance analysis of CP-Based and CAZAC training sequence-based synchronization in OFDM system," *EMITTER International Journal of Engineering Technology*, vol. 4, no. 2, pp. 221-236, 2016.

[3] Ghofar Noor Mahendro, Monitoring Kualitas Air Danau menggunakan Sensor Turbidity, pH, Suhu Berbasis Web. Tugas Akhir, Politeknik Negeri Madiun, 2016.

[4] Muhammad Rizqi Zulkarnain, "Sistem Monitoring Kualitas Air Sungai Yang Dilengkapi Dengan Data Logger Dan Komunikasi Wireless Sebagai Media Pengawasan Pencemaran Limbah Cair," Tugas Akhir, Institut Teknologi Sepuluh Nopember, 2015.

[5] Sulaiman, *Jenis-jenis Limbah*, Termuat dalam https://sulaimantap.wordpress.com/2011/03/04/jenis-jenis-limbah/, 2011.

[6] Rosani, Dwi. *Pengelolaan Limbah Cair untuk Pengendaian Pencemaran Air*. Termuat dalam http://dewienvironmental.blogspot.co.id/, 2010.

[7] Putra, Mandala. 2010. *Turbiditas (Kekeruhan)*. Termuat dalam http://mandala-manik.blogspot.co.id/2010/01/turbiditas-kekeruhan.html.