ANALYSIS OF THE MEASUREMENT OF PH LEVELS AND LEVELS OF WATER CLARITY ON THE SHIP'S ROBOT

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Abstract

The ship robot uses a pH meter sensor to measure the water acidity and LDR sensors for measuring water clarity. The measurement results will be sent directly using bluetooth communication. This ship robot is made with the aim to facilitate in doing research on pH levels and water clarity level To get accurate results required sensitivity and proper sensor placement. Testing sensitivity on ship's pH robot sensors by comparing two gauges to see the difference in measurement values obtained. Sensory clarity test by looking at the change in Lux value (Lighting Refraction) based on sensor placement distance. Lux value is the readable value of the smartphone to display the clarity level in the water. Sensory clarity test using 3 samples with clear category, somewhat clear, cloudy. Distance of sensor placement ranging from 1-5 cm. For acidity measurements, the SKU pH sensor: SEN0169 has an average accuracy of 0.06-2.33%. While on the measurement of clarity, the higher the value of lux then the higher the level of clarity and the lower the value of lux then the lower the level of clarity.

Keywords: bluetooth, pH meter, robot ship, LDR sensor, lux

INTRODUCTION

One of the essential daily needs of living beings in this inseparable world is water. However, water can be disastrous if it is not available under the right conditions, both quality and quantity. Large cities such as Java and Sumatra are the most polluted rivers. Pollution occurs due to industrial, household, and agricultural wastes (Warlina, 2004).

According to Permenkes RI No. 416 of 1990, on the requirements of water quality and

Permenkes RI No. 907 in 2002, water that is good for consumption is water having pH value 6,5-8,5 and turbidity maximal level is 5 NTU (Nephelometric Turbidity Unit).

Ships robots can help researchers to observe the state of river water from the edge to the middle of the river. To get accurate data, sensitivity and proper sensor placement are required. so in this journal the author tries to compare the sensitivity level between the author circuit pH sensor with factory-made pH sensor. Meanwhile, to measure the level of turbidity the author tries to test the influence of the distance between the LDR and LED lenses, so can get accurate results.

Robot comes from Czech, robota, meaning worker. Basically robots are made to support and assist human work, as seen in the field of industry where the robot can improve production. The word robot was introduced in English in 1921 by Wright Karel Capek in a satirical drama, R.U.R (Rossum's Universal Robot). Robots are the result of human assemblies that can work tirelessly (Singgeta, Sompie, Lumenta, & Wuwung, 2013).

The robot is one of the robots that can move on the water surface. In this research, ship robots are used to facilitate the measurement of acidity and water clarity. the distance of the robot control ship ranges ± 20 meters.

Figure 1. Robot pH detector and water clarity level

pH meter itself is an electronic device that serves to measure the pH (acidity or alkalinity) of a liquid (there is a special electrode that serves to measure the pH of semi-solid material). A pH meter consists of an electrode (measuring probe) connected to a device that measures and displays pH values. This tool is very useful for the drinking water industry, laboratories, aquariums, apparel industry especially batik and colored clothing. The pH meter used on the ship's robot is pH meter with Pro SKU type: SEN0169.

Pro SKU pH meter sensor: SEN0169 Is a sensor used to measure pH levels. This sensor is specially designed to be easily used on Arduino. The sensor also uses industrial electrodes and has a practical, easy-to-use and durable connection, making it perfect for online monitoring. This sensor has an LED that serves as a Power Indicator, Connector and BNC and pH 2.0 sensor interface. To use it, simply connect the pH sensor with the BND connector, then attach the pH 2.0 interface to the analog input port of the Arduino control anywhere in this case A0 and then programmed as needed. Once programmed then the sensor is ready for use. Here is a series of SKU pH meter sensors: SEN0169
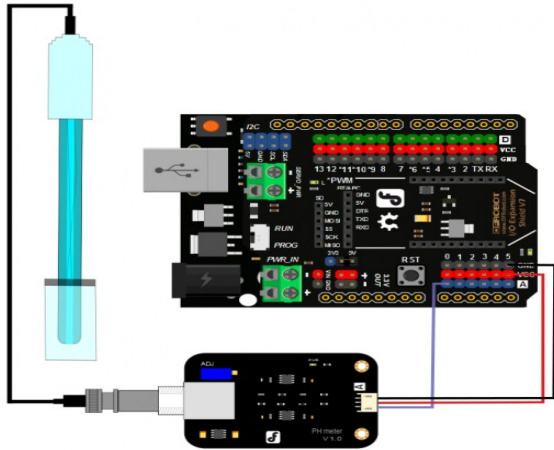
Figure 2. The basic pH meter circuit scheme

LDR Sensor (Light Dependent Resistor)

According to Philemon in his journal, one type of resistor that can experience changes in resistance when experiencing a change in light reception is LDR (Light Dependent Resistor). The amount of resistance value on the LDR sensor depends on the amount of light received by the LDR itself. LDR is also often called resistors that are sensitive to light (Ginting, Allo, Mamahit, & Tulung,2013)
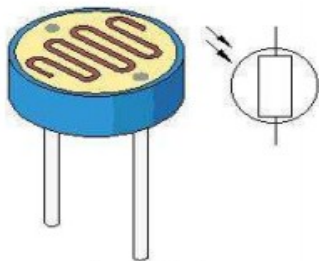

Figure 3. Physical shape and LDR symbol

Bluetooth is a wireless communication technology that provides real-time communication services between bluetooth devices with a further distance of service from infra red media. Bluetooth technology is widely used as a medium of data exchange on various smartphone devices including android (Pauline 2014).

In this research, bluetooth module used is arduino bluetooth module with type HC-05 which function to transmit data result of pH sensor and LDR sensor in detecting pH level and water clarity level. Through this bluetooth network data will be sent directly to the user and will be displayed through android smartphone that has been installed blue term applications. Blue term applications can be installed for free on the existing play store menu on android smartphone.

Figure 4. bluetooth HC-05

METHOD

In this study discusses the comparison of measuring values on pH sensors and LDR Sensors in measuring acidity and water clarity. For pH meter sensors used on SKU type vessels SKU: SEN169 which will be compared with pH meter factory pH-009-A sensor. As for the LDR sensor will do the comparison by determining the ADC value from the placement distance of the LDR and LED sensor installation, so it can know the exact distance where the sensor to determine the water clarity level.

Block Diagram is a part of the principle and performance of a system in making a tool design. The overall workings of the tool to be created lie in the system block diagram. Here is a block diagram of the ship's robot working sys-

tem in detecting acidity and clarity / water clarity.
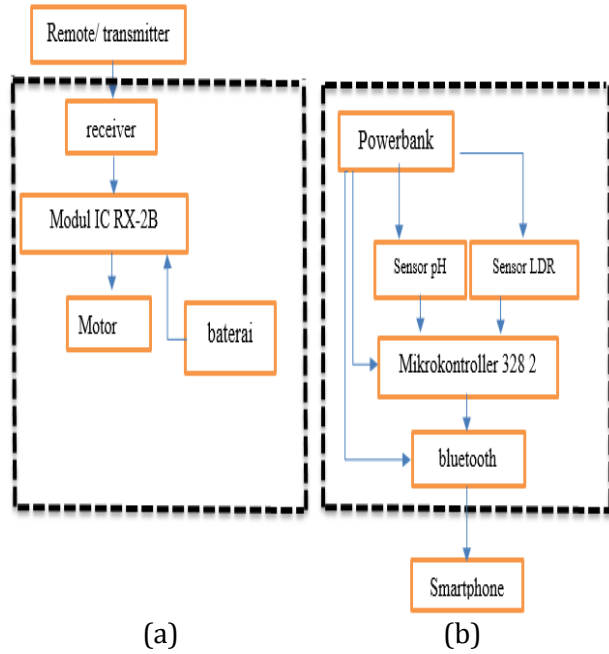

(a)   (b)

Figure 5. Block circuit diagram

In Figure 5 (a) is a block diagram of a series of working systems of a ship. *Remote control* The transmitted remote control transmitter will send a command signal which will then be received by the receiver. Next ic log RX2 1627 will process and then will give command to motor driver, so that motor will move in accordance with command given.

While figure 5 (b) is a block diagram describing the working system of pH meter sensor measurement and LDR sensor in measuring pH level and water clarity level. the measurement results will be sent to the user (the person who controls the robot) via bluetooth communication. The resulting data will be displayed via smartphone to make it easier to read.

Flowchart is a workflow of a process against a system that has been created so that it can be easily understood and explained with symbols that describe the specific sequence of

processes in detail and the relationship between a process (instructions) with other processes in a program.
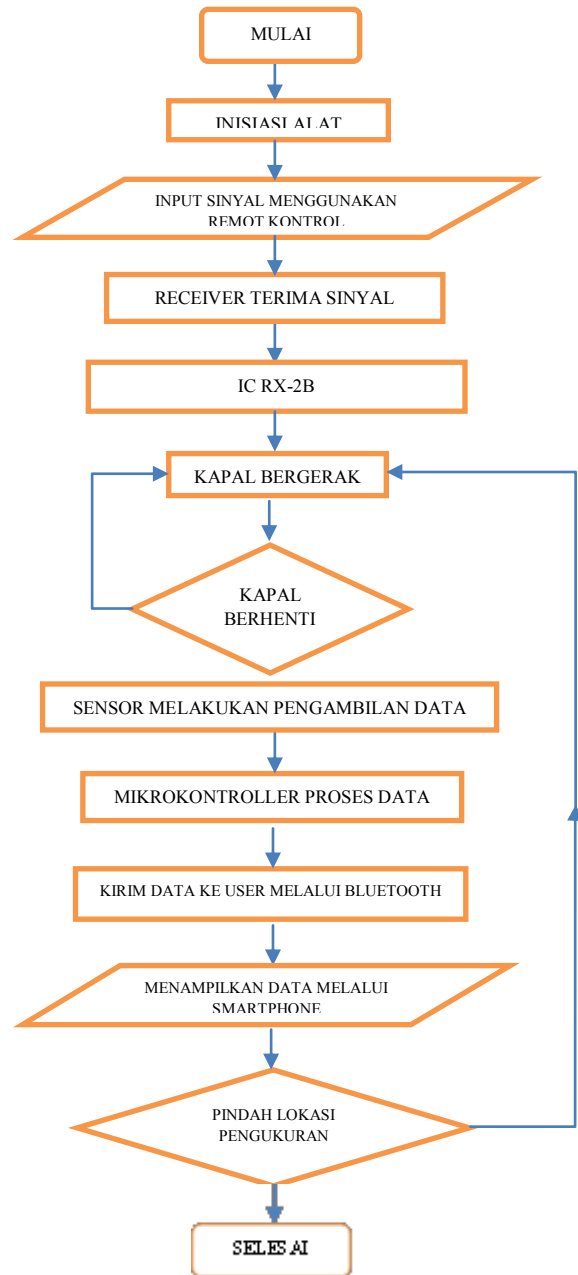

Figure 6. Flowchart working system of ship robot

Figure 6 describes the working system of the ship's robot. Where the robot of the ship can be controlled remotely using remote con-

trol. The measurement results will be sent to the user directly using bluetooth communication. Further data received will be displayed using an android smartphone to facilitate the reading.

Scheme of pH level measuring robot circuit and water clarity level.

In making robot ship used two circuit device. The first circuit is a circuit used to run and control the ship's robot using a modified remote control. Furthermore the authors add a series of pH meter sensors and LDR sensors to measure the acidity and clarity of the water. For communication in data transmission, the author adds bluetooth module in the circuit. For more details can be seen in figure 7.
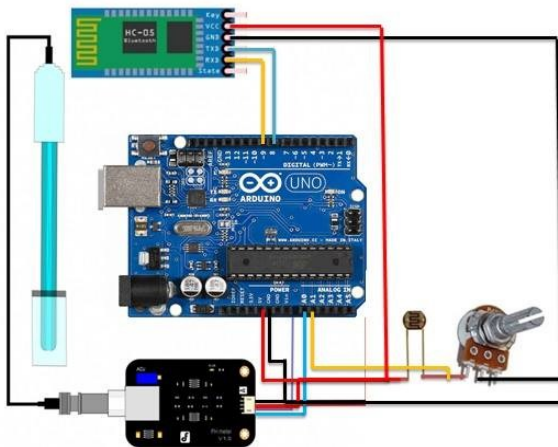

Figure 7. pH level measurement and water clarity.

RESULT AND DISCUSSION

In the test system this time, the authors use the test system by comparing the measurement results with different water samples. the test system on the acidity gauge and the water clarity level is carried out in the following manner:

Testing system of acidity gauge

The following is a pH gauge test on a predetermined water sample.

Figure 8. testing of acidity gauge

Sensory Clarity Tests System

Figure 9. placing the sensor distance using the ruler

PH Sensor In Determining Levels of Acidity on Water

Before the author installed a pH sensor on the robot ship. The first experiment was performed by comparing the SKU pH sensor: SEN1069 to be installed on the ship robot with pH type pen sensor with PH-009-A series. The results of these two sensors can be calculated error value using the equation as follows:

$$Error = \frac{NS}{Value\ of\ Manufacturer\ Tool} \times 100\%$$

NS = Value Difference between the measurement of the design tool and the comparison tool

Testing is done by using 5 water samples, such as: water PDAM (on faucet A2K4), Water Vinegar Eating, Coffee Water, Liquid Detergent, Water Soap Bath.

The measurement results of both sensors will be loaded in the form of tables and diagrams to make it easier to analyze. For more details can be seen in the table and graphic images below.

Table 1. Measurement results and accuracy level on water level acidity measurement sensors

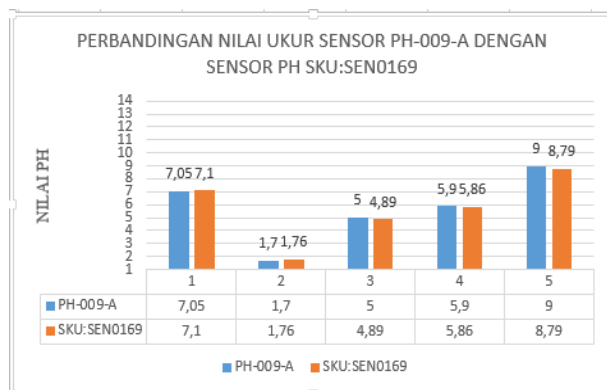| No	Water Type	PH Meter PH-009-A	PH Meter SKU:SEN 1069	Error (%)
1	PDAM Water (kran A2K4)	7.05	7.10	0.70
2	Vinegar Water	1.70	1.76	0.06
3	Coffee Water	5.00	4.89	2.2
4	Liquid Detergent	5.90	5.86	0.68
5	Soapy Water	9.00	8.79	2.33

Figure 10. Graph comparing pH sensor results

Table and graph of PH-009-A sensor value measurement with pH sensor SKU: SEN0169 above explains that the result of measurement to the two sensors have difference of value from 0.06-2.33%. Differences in pH sensor measurement results are caused by several things. Among the water volume, supply voltage, and water conditions at the time of measuring. If the measurement results are not in accordance with the standard then immediately recalibrate.

Note: water is an object that has a value that is not fixed. The measurement results are caused by several things including temperature, water flow, algae growth in water and so forth.

Tabel 2. Values of pH SKU sensor reading: SEN0169 with voltage

No	Water Type	PH Meter (SKU:SEN0169)	Voltage	Result
1	PDAM Water (A2K4)	7.10	2.05	Neutral
2	Vinegar Water	1.76	0.42	Acid
3	Coffee Water	4.89	1,17	Acid
4	Liquid Detergent	5.86	1,26	Acid
5	Soapy Water	8.79	2.45	Alkaline

Table 2 is a table showing the multimeter readings on the result of the measured voltages of the specified samples. From table 2 it can be seen that the voltage is directly proportional to the pH value. So the higher the pH value the greater the voltage read. From the table above also explains about the acidity levels that exist in the sample. Where water of water taps (on faucet A2K4) has pH 7.10 which mean neutral, Vinegar Water, Coffee Water, Liquid Deter-

gent has pH value 1.76, 4.89, 5.56 which mean ACID, while the soap water soap has pH value of 8.79 which means alkalis.

LDR Sensor In Determining Water Clarity Level

In determining the water clarity level, the authors conducted tests on 3 water samples to be measured based on a predetermined distance. Testing is done to see the change of lux value in determining the clarity level in water. Lux value is the value obtained from light scattering at the time of measurement.

In the first sample test was conducted on PDAM water samples. Water PDAM is categorized as water JERNIH. The results of sensor readings will be displayed on android smartphone via bluetooth communication as in the following picture.
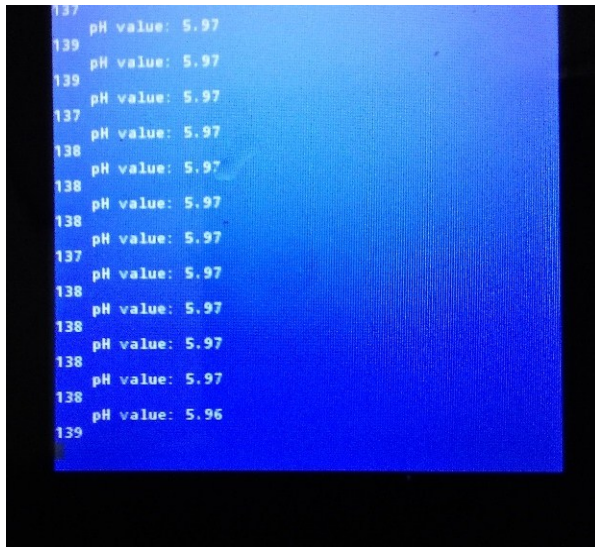

Figure 12. Display measurement results on android smartphone

PDAM water testing is performed to see the change in the value of lux from the measurement of the sensor of clarity based on the distance specified. For more details please see the following table.

Table 3. The value of the lux at PDAM water upon the distance of 1-5 cm

No	Distance (cm)	The value of lux at PDAM water	Voltage (Volt)
1	1	538	0.22
2	2	428	0.29
3	3	362	0.40
4	4	245	0.49
5	5	190	0.67

Table 3 explains that the results of clarity sensor measurements based on distance get different results. The farther the distance is used to measure the clarity of water, the smaller the value of lux will be read. The difference in the value of lux on PDAM water from a distance of 1-5 cm averages around 55-117. Comparison of measuring results can be seen in the following graph.

Figure 13. Graph of sensor clarity measurement results on PDAM water samples

On the graph it can be seen that the farther the distance of the sensor placement used, the smaller the value of lux will be read. The measurement results may change based on time and place of measurement.

In the second sample, the authors tested using soapy water. Soap water is used as a water sample for the whole any kind category. The results of the sensory sensor measurements of lux. Where data will be displayed on the smart phone via bluetooth communication as in the following picture.
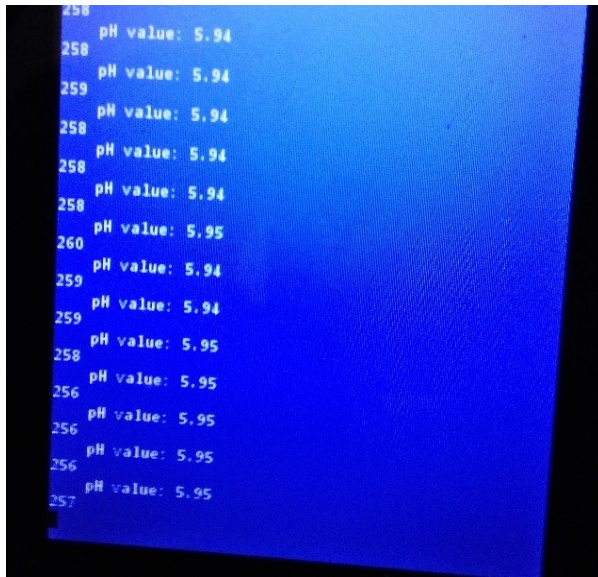

Figure 15 Display measurement results on android smartphone

This test is performed to see the change in the value of lux from the measurement of the sensor of clarity based on the distance that has been determined. So that the measurement results can be seen in the following table.

Table 4. The lux value on soapy water is based on a distance of 1-5cm

No	Distance (cm)	The lux value on soapy water	Voltage (Volt)
1	1	254	0.39
2	2	190	0.44
3	3	155	0.86
4	4	124	1.20
5	5	108	1.24

Table 4 above explains that the measurement results of the clarity sensor based on the above samples yield different data. the results of different data influenced the placement of the LDR and LED sensors on the clarity level gauge. The average lux value of the measurements in this soapy water is categorized as aggregate from 16-67 based on distance from 1-5 cm. Comparison of measuring results can be seen in the following graph.

Figure 16. Graph of sensor clarity measurements on soap water samples

Fig. 16 is a graph of difference of measurement results based on sensor placement distance. Where can be seen the farther distance used on the sensor, the smaller the value of lux read. The measurement results may change based on time and place of measurement.

In the third stage, the test uses mixed or diluted water clay. Where this water will be categorized as water KAW. Test results will be displayed on the smart phone via bluetooth communication as shown below.
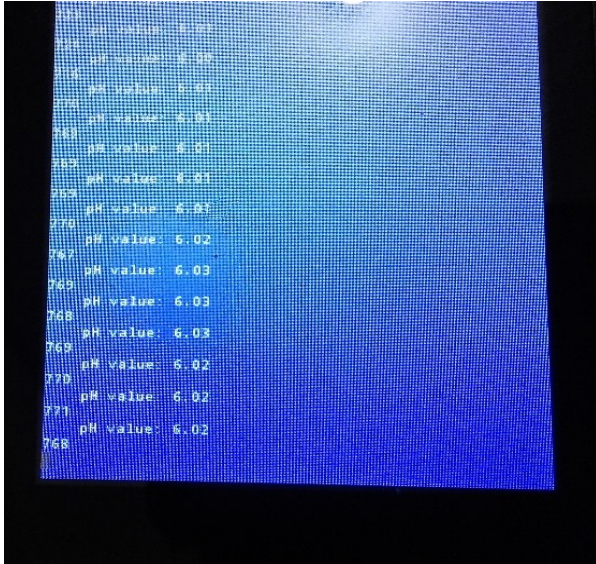
Figure 18 Display measurement results on android smartphone

This test is done to see the change of lux value from result of measurement based on distance 1-5 cm. From the measurement results obtained the following results.

Table 5. Lux value on soil solution based on distance 1-5 cm

No	Distance (cm)	The value of the Lux in soil solution	Voltage (Volt)
1	1	164	1.31
2	2	115	2.53
3	3	62	3.21
4	4	27	3.54
5	5	13	3.64

Table 5 explains that the measurements of soil solution have different lux values. the following ADC values are caused by differences in the distance of the sensor used. The measured lux value of the clay solution has an average of 14-49. Comparison of measuring results can be seen in the following graph.

Figure 16. Graph of sensor clarity measurement results on soil solution water sample

From the graph above can be seen that, the further distance used to measure the level of water purification, the smaller the value of lux read. The measurement results may change based on time and place of measurement.

CONCLUSION

Based on the results of research can be concluded that SKU pH sensor: SEN0169 is a pH sensor that has a high accuracy, the average error value of the measured result between SKU pH sensor: SEN0169 with PH-009-A pH meter type ranges from 0.06-2.33%.

Measurement level of clarity based on Lux value, the higher the value of Lux then the higher the clarity level. Conversely, the lower the Lux value, the lower the clarity level.

The sensor placement distance can affect the measurement results. The farther away the placement of the LDR sensor with the LED, the greater the value of the Lux value.

Before this tool is applied to the community and made in bulk, it needs to be done more in-depth testing in order to produce maximum results. This is because the supply voltage greatly influences the measurement result,

so to get accurate result it takes stable and durable voltage. LDR sensor is a sensor that is very sensitive to water, so to get accurate measurement result is required safety on the sensor so as not to exposed to water. Data measurement results are sent via bluetooth communication, where this bluetooth can only send signal / measurement result with distance ± 10 meter. So to get maximum results can use radio communications, sms, or internet network.

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