Analysis and Development of Seawater Density Measurement Algorithms Using Arduino Uno and YL-69 Sensor

by Masdukil Makruf

Submission date: 14-May-2024 03:26PM (UTC+0700)
Submission ID: 2379029895
File name: 1._Jurnal_Resti.pdf (323.48K)
Word count: 4312
Character count: 21148

Accredited by National Journal Accreditation (ARJUNA) Managed by
Ministry of Research, Technology, and Higher Education, Republic Indonesia with Second Grade (Peringkat 2, Sinta 2)
since year 2017 to 2021 according to the decree No. 10/E/KPT/2019.

Published online on the journal's webpage: **http://jurnal.iaii.or.id**

RESTI JOURNAL

(System Engineering and Information Technology)

Vol. 4 No. 5 (2020) 951-956 ISSN Electronic Media: 2580-0760

Analysis and Development of Seawater Density Measurement Algorithm Using Arduino Uno and YL-69 Sensor

Miftahul Walid[1], Hozairi[2], Madukil Makruf[3]
[123]Departement of Informatic, Universitas Islam Madura
[1]miftahwalid@gmail.com, [2]dr.hozairi@gmail.com, [3]masdukil.makruf@gmail.com

Abstract

In this research, an analysis was carried out to develop a measuring instrument for seawater density in salt production using a microcontroller (Arduino Uno) and YL-69 sensor, this sensor was commonly used to measure soil moisture. The experimental method was used in this research to produce initial data in the form of resistance and seawater density values, then calculations are carried out using statistical methods to find equations and produce a constant variable that connects the resistance and seawater density values. The equation was used to compile the algorithm into Arduino Uno. As for the results of this research, From six experiments conducted, two experiments produced the same sea water density value between the actual and the predicted, namely the 2nd and 5th experiments, while for other experiments there was a difference between the actual and predicted values, however, it was not too significant, the difference occurs between the value range 0 ~ 1, to determine the level of error, use the Mean Square Error (MSE) with an error level of = 0.5 and Mean Absolute Error (MAE) with an error level of = 0.6. The contribution of this research is an algorithm that can predict the density value (baume) based on the resistance value obtained from the YL 69 sensor.

Keywords: Seawater density, Salt Production Process, Microcontroller, Arduino Uno, YL-69

1. Introduction

Salt is one of the agricultural commodities spread in various regions in Indonesia, starting from Aceh, Java, NTB, NTT, and parts of Sulawesi. based on data in 2015, salt production is spread across 44 districts/cities with a total production amount of 2.9 million tons, an increase from the previous year which only reached 2.5 million tons [1], however, this increase has not been able to meet the need for salt in domestically, Indonesia still imports salt from other countries, the three largest importing countries are Australia, India and China [2]. data in 2013, namely China, the United States, and India [1]. Based on the above problems, a new innovation is needed to increase salt production so that it can meet national salt needs and improve Indonesia's ranking as one of the salt producers in the world.

The production of salt in Indonesia is still dominated by the evaporation system, where the evaporation method was a process of forming salt crystals by heating using the sun's heat or by boiling it. In the process of forming salt crystals, farmers still use an estimation method based on community habits and some use a sea water density measuring instrument called Baume meter (Be), the Baume meter is being used by farmers today still a conventional measuring instrument where accuracy is needed in seeing the values stated in the measuring instrument, so that an accurate value will be produced, therefore an innovation of the density measurement tool (Baume) was needed which can make it easier to use and has a better level of accuracy, so based on the above problems, in this researched, a sea water density measuring instrument has been developed, There are several tools that have been used in previous research to measure the density of liquid objects, including; volume comparator type VC1005, manufactured by Mettler-Toledo GmbH, Switzerland. In accordance with the manufacturer's specifications, this tool is commonly used to measure the volume and density of solid objects [3], Besides VC1005, ultrasonic sensors has also been used by calculating the time interval required by a signal from the transmitter to the receiver[4], one of the liquids that have been measured using an ultrasonic sensor is a polymer, the ultrasonic sensor has been used to measure the density of polymer melts [5], however, in this research, researchers used a microcontroller which was integrated with YL-69 sensor [6], this sensor is commonly used as a sensor to measure soil moisture [7] By flowing current in the two probes so that there is resistance, the more liquid compared to the dissolved solid, the lower the resistance, while the conductivity will be higher, conversely, if more solids are dissolved than the liquid, the resistance will be higher and the conductivity will be lower. The Yl-69 sensor has been

Accepted by editor: 03-09-2020 | Final Revision: 15-10-2020 | Online Publication : 30-10-2020

implemented, including in the irrigation monitoring system combined with the Internet of Things (IoT) system [8] the IoT system utilizes the ESP8266, a combination with Wireless Sensor Networks has also been carried out for monitoring rainfed rice fields [9], used in a plant growth monitoring system combined with a Wireless Sensor Networks (WSN) system [10], several studies have also been conducted to make moisture sensors with simple but highly accurate tools [11]. The Arduino Uno R3 is a microcontroller was used in this research, because of its ease of installation and use, the combination between the Arduino Uno R3 and the YL-69 sensor has been widely implemented in previous studies, among others, for automatic vegetable seeding, wherewith this system, farmers did not have to do periodic watering in the seeding process. In this system, the Arduino Uno was used as the main controller which integrated with a soil moisture sensor (YL-69 / LM393), and excited DC motor that functions to drive the sprinklers [12]. Another researched, the YL-69 and Arduino sensors have been used to regulated soil moisture in agarwood tree planting media, wherein the research conducted, if the soil moisture is> 80%, then Arduino command the Water Pump to drain water into the planting medium if the humidity is <= 80%, then the Water Pump stops the flow of water. In the research, the YL-69 processor had an accuracy value of 88.76% [6]. Researched by combining the YL-69 sensor, Ultrasonic Sensor and Arduino Uno R3 has been carried out for plant irrigation systems, the Ultrasonic sensor was used to detect water availability in the storage tank, the YL-69 sensor was used to determine soil moisture, the percentage of average error The ultrasonic sensor average was 4.91% while the YL-69 sensor was 3.285% [13]. Other research has also been conducted, where a humidity sensor was combined with a water flow sensor, a temperature and humidity sensor to regulated the irrigation system, a web-based application was used as an interface to facilitate the monitoring [14], a control system used Android applications has also been developed in irrigation systems. this researched aims to simplify and minimize costs incurred in the irrigation process [15]. However, from several studies that have been conducted, the YL-69 sensor has never been used to detect the concentration of seawater in the salt-making process. So based on these problems, in this research, aims to utilize the YL-69 sensor as a sensor to detect the density of seawater by changing the resistance value in the form of ADC (Analog Digital Converter) value generated by the sensor into a Baume (Be) value, The change in value is obtained from a comparison analysis between the resistance value generated by the sensor and the seawater density value generated by manual measurement, where the results of the analysis were used to build a algorithm and then compile it into a microcontroller.

The distribution in the research is to produce a formula or equation to convert the values of the ADC from the YL-69 sensor to a baume (Be) values, which is expected to add a tool as a reference that will be used as a sensor to determine the density values of a liquid, in this case the density of sea water.

The results of this study, the YL-69 sensor integrated with Arduino Uno has been able to measure the density of seawater in the salt production process. Of the 6 experiments carried out, 1 experiment produced the same actual and predicted value, namely the second experiment, while for other experiments there was a difference between the actual value and the predicted value, but not too significant, the difference occurred between the values 0 ~ 1, it was noted. one experiment that has a high enough error value, namely the 12th experiment has an error value = 1.4, the Mean Square Error (MSE) and the Mean Absolute Error (MAE) are used to determine the error rate, using MSE it is known that the error rate = 0.5 while using MAE = 0.6.

2. Research Method

In this research, two methods have been used, first by using experimental methods, this method was used to generate initial data, namely (1) density data and (2) resistance data were generated by the YL-69 sensor in the form of ADC values. The second is statistical methods, this method was used to determine the relationship between the two data above, so that an equation was generated which then converted into an algorithm.

2.1. Data Collection Process

There are several stages in the sample data collection process, starting with the seawater data collection process in salt production land, the seawater criteria used as the initial data must be clear and do not have a mixture of mud particles, if there is a mixture of mud particles, it needs to be deposited so that it is separated between both. After that, the evaporation process of the sample data is carried out, evaporation is a process of forming salt crystals from seawater by means of evaporation, in this research the evaporation process is carried out using the heat of the sun. Finally, the measurement process was carried out on the sample data so that 31 data were produced, there are two tools used, namely the Baume meter to measure the density of sea water, and the YL-69 sensor to determine the resistance value in seawater solutions. Both data are then used as initial data in this research.

2.2. Data Analysis

The data that has been obtained from the data collection process was analyzed using statistical methods to determine the relationship between seawater density and resistance. The analysis process is carried out by looking at the data that has been converted into curves in order to make it easier to see the relationship between the two data. This process produces an equation that connects the density and resistance values, then this equation is used to create an algorithm in the microcontroller system (Arduino Uno). To find out the accuracy of the predicted value generated by the algorithm that has been made, a comparison of the predicted value with the actual value is carried out, where the actual value is obtained by making direct measurements using Baume meter (Figure 1). Meanwhile, to determine the error rate of the prediction results, the Mean Square Error (MSE) and Mean Absolute Error (MAE) equations are used.

$$MSE = \frac{\sum (A_t - P_t)^2}{n} \quad (1)$$

Where ;

MSE = Error rate
A_t = Actual value
P_t = Predicted value
n = Amount of data

$$MAE = \frac{\sum |A_t - P_t|^2}{n} \quad (2)$$

Where ;

MAE = Error rate
A_t = Actual value
P_t = Predicted value
n = Amount of data

Figure. 1. Baume Meter

2.3. Tools and Materials

There are several tools used in making the system, including (1) the YL-69 sensor with the LM393 Comparator Chip which functions as a sensor to determine the seawater density based on its resistance value, (2). The microcontroller, in this case, uses the Arduino Uno R3, (3) Power Supply or a battery as the input voltage, the required voltage is between 3.3 ~ 12 volts on the microcontroller, (4) i2C as a converter tool as well as simplifying the circuit to connect the microcontroller to the LCD (5) LCD 14x2 as a tool to display the seawater density and resistance values. these tools can be seen in the image below.

2.4. System Design

In this research, a tool to measure the seawater density in salt production land is produced. The tool made is still a prototype and can be developed further. system design can be seen in the figure 7.

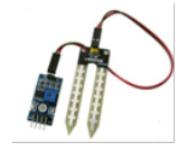

Figure. 2. Sensor YL-69

Figure. 3. Arduino R3

Figure. 4. Power Suply

Figure. 5. I2C LCD 14x2

Figure. 6. LCD 14x2

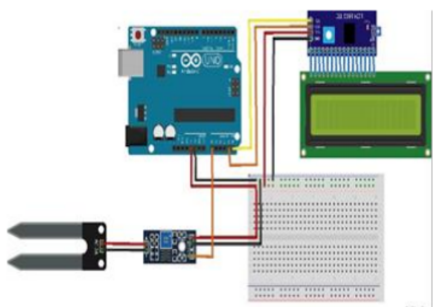

Figure 7. System Design

In the system design figure 7, it is explained that 4 tools communicate with each other, including (1) the YL-69 sensor. There are two pins with positive and negative currents, the function of these pins is as a medium for connecting with the probe, in addition to the two pins in, there are four pins out, including (1) the VCC pin is charged with a positive current with a voltage of 3 ~ 5 volts, (2) pin Ground, for negative current, (3) pin D0 for digital signal output and pin A0 for analog signal output. In this research, the pinout signal used is A0, because the expected output is an analog value with a value range of 0 ~ 1023. The function of the YL-69 sensor is to take the resistance value presented in the form of ADC (Analog

Digital Converter) and then the value is converted into the seawater concentration value, Arduino Uno R3 with IC ATMega328P is a microcontroller whose job is to convert this value. There are three pin clusters in the Arduino Uno R3, including (1) the power pin, which consists of a 3.3 volt, 5 volts, GND pin and Vin pin for external power, (2) 14 digital pins, including pins that have dual functions as PWM, namely pins 3,5,6,9,10 and 11. (3) 6 analog pins, functions to receive analog signals (A0 - A5). In this research, the function of the Arduino Uno R3 is to process the resistance value generated by the YL-69 sensor and convert it into a concentration value, the unit used is Baume (Be), the algorithm used to perform the conversion is based on the equation results from the analysis of the relationship between concentrations. seawater and resistance, finally, both values are displayed on the screen (3) LCD 14x2, has a total of 16 pins, 8 pins for data communication (pins 7-14), 2 pins for power and ground (pins 1 and 16), 3 pins to control LCD operation (pins 4-6), 1 pin to adjust LCD screen brightness (pin 3), pins 15 and 16 to power the backlight. To simplify the communication circuit between the Arduino Uno and the 14x2 LCD, (4) I2C model LCM1602 IIC is used as a bridge

2.5. Flowchart

In Figure 8, it describes the system flowchart that is inserted into the microcontroller (Arduino Uno).

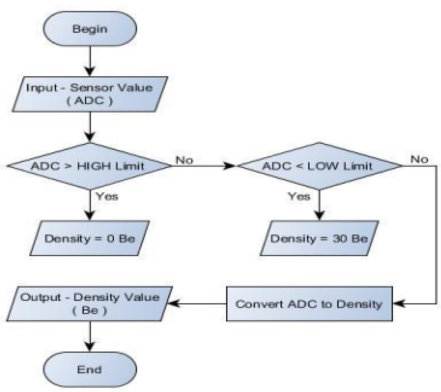

Figure. 8. Flowchart System

In the flowchart figure 8 above, it can be explained that there are several steps to determine the value of seawater density. (1) seawater density data was collected using the YL 69 sensor. This value is compared with the higher and lower limit values of the calibration results, (2) if the resistance value is higher than the upper limit, the density value = 0. (3) if the value The resistance is lower than the lower limit, the density value = 30. (4) If the resistance value is between the higher and lower limits, equation 3 is used to determine the density values.

3. Result and Discussion

Table 1. Data Of Seawater Density (Baume) and Resistance (ADC)

Baume Values	Resistance (ADC)
0	96
1	93
2	88
3	89
4	77
5	75
6	74
7	71
8	69
9	68
10	68
11	66
12	66
13	67
14	59
15	55
16	52
17	51
18	52
19	44
20	36
21	35
22	35
23	31
24	30
25	28
26	24
27	23
28	20
29	16
30	8

To produce an equation that is used to create an algorithm whose system is able to predict the density value of seawater accurately, it is necessary to enter a constant into the equation, and to produce this constant a statistical analysis is performed. by making a comparison of the density value of seawater generated from the Baume meter (Be) with the resistance value in the form of an ADC generated by the YL-69 sensor. There are 31 data from manual measurements consisting of the Baume meter values and resistance values which are used as data for analysis. The measurement results are presented in Table 1.

The measurement results are presented with a curve can be seen in the image (Figure 9).

Based on the data in Table 1 and Figure 9 above, it can be seen that the relationship between the sea water density value (Baume) generated from measurements with conventional Baume meters (be) is inversely proportional to the resistance value generated by the YL-69 sensor, the higher the density value. , the lower the resistance value, thus forming a downward linear curve, this equation is often used for representation systems in fuzzy logic [16] (equation 3). Therefore, the equations used to construct the algorithm are uploaded to the microcontroller using a downward linear curve. In this equation, the constant value = 30 is added because the expected predicted value is between 0-30 as shown below in equation 4.

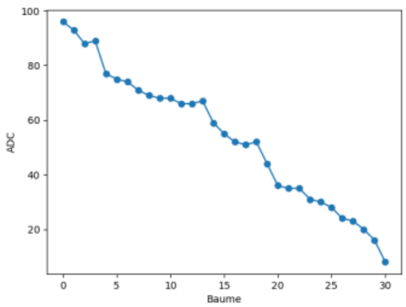

Figure. 9. Comparison of Values Between Resistance (ADC) and Density (Baume)

Table 2. The Actual and Predicted Seawater Density (Baume) Measurement Results are Based On The Resistance Values

Resistance (ADC)	Baume (Actual)	Baume (Predicted)
97	0	0.7
93	2	2.0
82	6	5.8
77	7	7.5
69	11	10.2
56	14	14.7
50	16	16.7
45	19	18.4
37	21	21.1
28	25	24.2
25	26	25.2
24	28	25.6

$$\mu(x) = \begin{cases} 1 \leq a \\ \frac{(b-x)}{(b-a)} \quad a \leq X \leq b \\ 0 \geq b \end{cases} \tag{3}$$

where

$\mu(x)$ = Linear Curve Down
b = Max Value
a = Min Value
x = Actual Value

$$(Be) = \begin{cases} 1 \leq LR \\ \frac{(HR-R)}{(HR-LR)} \; x \; k \; , LR \leq R \leq HR \\ 0 \geq HR \end{cases} \tag{4}$$

Where;

Be = Density value (*Baume*) of Seawater
HR = Highest resistance limit (ADC)
LR = Lowest resistant limit (ADC)
R = Actual Resistance (ADC)
k = 30 (Constant Value)

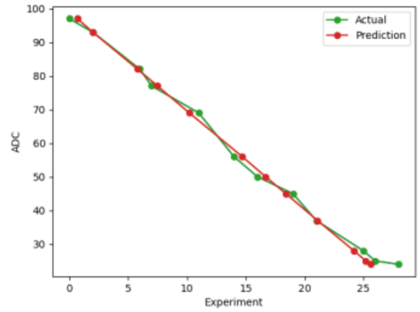

Fig. 9. Comparison of Actual and Predicted Seawater Concentration (Baume) Measurement Results.

From table 2 above, it can be seen that there are three variables, namely the resistance variable, the actual sea water density and the predicted results, each variable having 12 data. Baume data (Actual) in column two is the result of measurements using a conventional seawater density measurement tool and used as comparative data, while Baume (Prediction) in column III is the measurement result of a tool that has been made, the way the tool works is by changing the resistance value to density value. There are several differences in values between the actual and predicted sea water concentration measurements, but the difference is not too significant, there is a difference between 0 ~ 1 from the actual value. the biggest difference occurred only in the 12th experiment. Figure 9 was presented the measurement results using a curve.

To find out the error level from the experimental results, the Mean Absolute Error (MAE) and Mean Square Error (MSE) are used, which are presented in the table below.

Table 3. Calculate the Error Rate Using MAE and MSE

Baume (Actual)	Baume (Predicted)	error	Abs error	Error [2]
0	0.7	-0.7	0.7	0.5
2	2	0	0	0
6	5.8	0.2	0.2	0
7	7.5	-0.5	0.5	0.3
11	10.2	0.8	0.8	0.6
14	14.7	-0.7	0.7	0.4
16	16.7	-0.7	0.7	0.5
19	18.4	0.6	0.6	0.3
21	21.1	-0.1	0.1	0
25	24.2	0.8	0.8	0.6
26	25.2	0.8	0.8	0.6
28	25.6	1.4	1.4	2.1
		total	7.3	5.9

By using the equation $MAE = \frac{\sum|A_t - P_t|^2}{n}$ the error rate was generated, MAE = 7.3/12 = 0.6, Using the equation $MSE = \frac{\sum (A_t - P_t)^2}{n}$ the error value was generated, MSE = 5.9/12 = 0.5

4. Conclusion

The results of this study, the YL-69 sensor integrated with Arduino Uno is able to measure the density of sea water for salt-producing materials, due to changes in resistance with different density levels (Baume). Of the 12 experiments conducted, 1 experiment produced the same value between the manual density measurement value (actual value) and the measurement result using the algorithm that was made (predictive value), namely the 2nd experiment, while for other experiments, there was a difference between the actual value and predictive value, but not too significant, the difference occurs between 0 ~ 1.The error above number 1 only occurs in the 12th experiment with a value of 1.4, to find out the error rate, Mean Square Error (MSE) and Mean Absolute Error (MAE) are used, with known error MSE rate = 0.5 with MAE error rate = 0.6. Some further research is needed to produce an equation that will produce a predictive value that has a smaller error value, so that it will increase the accuracy value generated by the tool being developed, besides this research focuses on discussing the tools used as a conductor needed. into seawater, which is better and stronger against corrosion caused by saline solutions.

The inconsistency that often occurs in the ADC values generated by the YL-69 sensor affects the predicted results, an innovation is needed to make the YL-69 sensor have a better consistency values.

The purpose of this research results is to help salt farmers to produce seawater density values that is more precise than conventional measuring instruments. In addition, to the development of a digital-based density measuring device so that it is easier to develop in this digital era.

References

[1] T. Ardiyanti, *Info Komoditi Garam*, Ist ed. Jakarta, 2016.

[2] T. R. A. A. Supangkat, B. Sulistyo, B. M. S, and H. Amrullah, *Buku Pengembangan Usaha Terpadu Garam dan Artemia Pusat*. Jakarta: Pusat Riset Laut dan Sumber daya Non Hayati, 2007.

[3] G. F. Popa and B. Pantelimon, "Another method for measuring the density of the liquid in the volume comparator VC1005," in *2013 - 8th International Symposium on Advanced Topics in Electrical Engineering, ATEE 2013*, 2013, pp. 0–3, doi: 10.1109/ATEE.2013.6563370.

[4] B. K. Roy and M. Ieee, "Measurement Using Ultrasonic Transducers," in *ICICES2014*, 2014, no. 978, pp. 5–8.

[5] R. Kazys *et al.*, "Ultrasonic density measurement of polymer melts in extreme conditions," in *IEEE International Ultrasonics Symposium, IUS*, 2013, no. September 2015, pp. 186–189, doi: 10.1109/ULTSYM.2013.0048.

[6] A. G. Mardika and R. Kartadie, "Mengatur kelembaban tanah menggunakan sensor kelembaban tanah yl-69 berbasis arduino pada media tanam pohon gaharu," *JOEICT (Jurnal Educ. Inf. Commun. Technol.*, vol. 03, no. 02, pp. 130–140, 2019.

[7] Gunawan and M. Sari, "Rancang Bangun Alat Penyiram Tanaman Otomatis Menggunakan Sensor Kelembaban Tanah," *J. Electr. Technol.*, vol. 3, no. 1, pp. 13–17, 2018.

[8] G. Tarani, G. Shital, K. Sonali, P. Gouri, and V. S.R, "Smart Drip Irrigation System," *Int. J. Trend Sci. Res. Dev.*, vol. Volume-2, no. Issue-4, pp. 1560–1565, 2018, doi: 10.31142/ijtsrd12888.

[9] M. Walid, S. Hafiah, and B. Bakir, "Penerapan Wireless Sensor Network (WSN) Untuk Sistem Pemantauan Sawah Tadah Hujan," *NJCA (Nusantara J. Comput. Its Appl.*, vol. 4, no. 2, p. 140, 2019, doi: 10.36564/njca.v4i2.149.

[10] R. K. Kodali and A. Sahu, "An IoT Based Soil Moisture Monitoring on Losant Platform," *Int. Conf. Contemp. Comput. Informatics*, pp. 764–768, 2016.

[11] M. S. Kumar, T. R. Chandra, D. P. Kumar, and M. S. Manikandan, "Monitoring moisture of soil using low cost homemade Soil moisture sensor and Arduino UNO," *ICACCS 2016 - 3rd Int. Conf. Adv. Comput. Commun. Syst. Bringing to Table, Futur. Technol. from Arround Globe*, pp. 4–7, 2016, doi: 10.1109/ICACCS.2016.7586312.

[12] E. N. Prasetyo, "Prototype Penyiram Tanaman Persemaian Dengan Sensor Kelembaban Tanah Berbasis Arduino," Universitas Muhammadiyah Surakarta, 2015.

[13] A. W. Dani and Aldila, "Rancang Bangun Sistem Pengairan Tanaman Menggunakan Sensor Kelembaban Tanah," *J. Teknol. Elektro, Univ. Mercu Buana*, vol. 8, no. 2, pp. 151–155, 2017.

[14] P. Singh and S. Saikia, "Arduino-based smart irrigation using water flow sensor, soil moisture sensor, temperature sensor and ESP8266 WiFi module," *IEEE Reg. 10 Humanit. Technol. Conf. 2016, R10-HTC 2016 - Proc.*, 2017, doi: 10.1109/R10-HTC.2016.7906792.

[15] A. N. Arvindan and D. Keerthika, "Experimental investigation of remote control via Android smart phone of arduino-based automated irrigation system using moisture sensor," *2016 3rd Int. Conf. Electr. Energy Syst. ICEES 2016*, pp. 168–175, 2016, doi: 10.1109/ICEES.2016.7510636.

[16] O. E. Putra, "Application of Fuzzy Logic in Making Automatic Labeling Stamping," *SinkrOn*, vol. 4, no. 1, pp. 155–163, 2019, doi: 10.33395/sinkron.v4i1.10166.

Analysis and Development of Seawater Density Measurement Algorithms Using Arduino Uno and YL-69 Sensor

ORIGINALITY REPORT

16%	7%	8%	10%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	Submitted to Telkom University Student Paper	5%
2	Anggy Pradiftha Junfitrhana, Muhammad Labib Langlangbuana, Wahidin Abdul Fatah, Susilawati. "Developing potential agriculture land detector for determine suitable plant using Raspberry-Pi", 2017 International Conference on Computing, Engineering, and Design (ICCED), 2017 Publication	2%
3	journal.umy.ac.id Internet Source	2%
4	Héctor Iván Tangarife Escobar, Sandra Ximena Toro Meléndez, Cindy Vanessa Carmona Cadavid. "Sistemas automatizados para el control del recurso hídrico y variables ambientales bajo invernadero: aplicaciones y tendencias", Entre ciencia e ingeniería, 2020 Publication	1%

5	Denny Kurniawan, Rizki Jumadil Putra, Agung Bella, Muhammad Ashar, Khen Dedes. "Smart Garden with IoT Based Real Time Communication using MQTT Protocol", 2021 7th International Conference on Electrical, Electronics and Information Engineering (ICEEIE), 2021 Publication	1 %
6	Submitted to Institute of Research & Postgraduate Studies, Universiti Kuala Lumpur Student Paper	1 %
7	journal.um-surabaya.ac.id Internet Source	1 %
8	www.scirp.org Internet Source	1 %
9	belajarmikrokontroler-2018.blogspot.com Internet Source	<1 %
10	Shifa Helena, Maura Aulia Finirsa, Muhammad Farhan Rahmat, Syarif Irwan Nurdiansyah, Rahmawati Rahmawati. "Kualitas Perairan Desa Sebubus Kecamatan Paloh Kabupaten Sambas Sebagai Kandidat Industri Garam Baru", Jurnal Laut Khatulistiwa, 2022 Publication	<1 %
	ejournal.unuja.ac.id	

11	Internet Source	<1 %
12	Muhammad Raafi'u Firmansyah, Risanuri Hidayat, Agus Bejo. "Comparison of Windowing Function on Feature Extraction Using MFCC for Speaker Identification", 2021 International Conference on Intelligent Cybernetics Technology & Applications (ICICyTA), 2021 Publication	<1 %
13	journal.unnes.ac.id Internet Source	<1 %
14	repository.uim.ac.id Internet Source	<1 %
15	link.springer.com Internet Source	<1 %
16	Li Li, Qingyun Yu, Kuo-Yi Lin, Yumin Ma, Fei Qiao. "Data-Driven Scheduling of Semiconductor Manufacturing Systems", Springer Science and Business Media LLC, 2023 Publication	<1 %
17	www.polgan.ac.id Internet Source	<1 %
18	Suresh Muthusamy, Santhiya Pandiyan, Muneeshwari Paramasivam. "A method for	<1 %

automated drip irrigation and fertigation of crops", Research Square Platform LLC, 2022
Publication

19	Majid Emami Javanmard, S.F. Ghaderi. "Energy demand forecasting in seven sectors by an optimization model based on machine learning algorithms", Sustainable Cities and Society, 2023 Publication	<1 %
20	Rini Sovia, Abulwafa Muhammad, Syafri Arlis, Guslendra Guslendra, Sarjon Defit. "Analysis of sales levels of pharmaceutical products by using data mining algorithm C45", Indonesian Journal of Electrical Engineering and Computer Science, 2021 Publication	<1 %
21	"Green Intelligent Transportation Systems", Springer Science and Business Media LLC, 2019 Publication	<1 %
22	ro.uow.edu.au Internet Source	<1 %
23	pureadmin.unileoben.ac.at Internet Source	<1 %
24	studentsrepo.um.edu.my Internet Source	<1 %

25	Neelisetty Sumadhur Royal, Williams Parre, Sreeram Chowdary Bandarupalli, Murumalla Rabikanta Achary et al. "Internet of Things (IoT) and Machine Learning based Optimized Smart Irrigation System", 2023 5th International Conference on Smart Systems and Inventive Technology (ICSSIT), 2023 Publication	<1 %

Exclude quotes	Off	Exclude matches	Off
Exclude bibliography	Off		