Implementation And Design Of Iot-Based Aquascape Automatic Water Temperature And Ph Control

1st Reza Ramadhani
Telecommunications Engineering
Faculty of Electrical Engineering
Bandung, Indonesia
rezaaramadhanii@student.telkomuniversity.ac.id

2nd Rendy Munandi
Telecommunications Engineering
Faculty of Electrical Engineering
Bandung, Indonesia
rendymunadi@telkomuniversity.ac.id

3rd Sri Astuti
Telecommunications Engineering
Faculty of Electrical Engineering
Bandung, Indonesia
sriastuti@telkomuniversity.ac.id

Abstract: Aquascapes or artificial ecosystems in aquariums have a high level of sensitivity in terms of maintenance, many factors need to be considered, including water temperature and the level of stability (pH) in the water. The design of this automation system to regulate water temperature and monitoring the pH of the water in the aquascape is based on the problems faced by Aquascape owners who have to pay attention to the level of temperature stability every time, and pH for the survival of the plant ecosystem in the aquascape. The water temperature in the aquascape is very influential for the survival of aquatic plants. Water temperature can be measured using a thermometer. Aquascape water temperature will be ideal if the water temperature is 25 – 28 degrees Celsius. And the ideal pH for an aquascape is 6 to 8. More than or less than that pH, the water conditions in the aquascape are unstable and can cause plants to become unhealthy and cannot grow optimally. From the results of the tests that have been carried out, it is known that the system can work well. Testing QoS (Quality of Service) for sending device data to telegram the delay value obtained is 2282s. In QoS testing for reading data from device to device to telegram. the average throughput obtained is 414.69 bps.

Keywords: Aquascape, aquascape water temperature, sensor

I. INTRODUCTION

Aquascape is a new hobby and is increasingly in demand because people's interest in ornamental water plants is increasing. Because of the many new hobbyists, aquascape is a very promising business opportunity. However, cultivating this plant is quite difficult because there are many things that must be considered, including air temperature. So far, aquascape hobbyists still use manual methods to regulate the temperature in aquascapes. Aquatic plants also need care to keep them looking beautiful and can grow optimally. The object that we must pay attention to is the condition of the water under construction. There are several parameters in determining whether the water is suitable for use these aquatic plants, temperature and, pH of the water. This is because the higher the air temperature, the lower the air's ability to bind gas, which makes plants unable to meet the intake of gas that binds air, causing stress to plants. And the pH of the air can affect the availability of nutrients in the air. Of course the value of these parameters must be in accordance with the specifications of the plants in the aquascape. But our busyness makes and makes us lazy to take care of the Aquascape. In addition, often our plants in a sudden time or plant growth is slow and not optimal without knowing.

For this reason, it is necessary to make an automation tool for aquascape water that can maintain temperature quality while monitoring in our aquascape. Automation In this aquascape, the aim is to be able to activate the air conditioning fan at a temperature of 28º according to the temperature limit above the desired (set). The cooling fan will turn off when the aquascape water temperature is below 25°C or according to the temperature limit below the desired (set). There are several references to designing this tool, the first is the Final Project journal from Muhtadu Syukur Audita [1], but in this study we have not used a cooling device to improve aquascape water quality. While in this final project using air conditioning to improve the quality of aquascape water and using telegram to monitor and also IoT to control the tool remotely. The second is the Final Assignment journal from Unggul Sudrajat Budi Santoso [2], but in this study still using the Arduino Mega 2560 microcontroller as the controller system. While in this final project using the latest microcontroller which is more efficient and easy in its application and also its use, namely the ESP-32. This system is based on the Internet of Things (IoT) to make it easier for users to monitor and control room temperature remotely with the help of a platform, namely telegram.

Therefore, in developing the research conducted previously, this time the researcher will design a tool and implement a tool that can control the temperature and air stability in the aquascape, using sensors whose measurement results will determine the automatic control process. Cooling the aquascape water temperature is automatically carried out if the air temperature is above the normal temperature that has been set by the user. Then

control the pH by giving a dose of pH-lowering drugs or increasing pH levels in a controlled manner. The pH used in this study was in the range of 6-8, while the air temperature used in this study was around 25-28 degrees. The monitoring process is carried out through the data display on the LCD and the Telegram application on the smartphone.

II. SYSTEM DESIGN

This automatic temperature control and water stability system is planned to apply Internet of Things (IoT) technology. This tool is used to automate the automatic cooling of the water temperature and adjust the pH of the water in the Aquascape. This tool works when the water temperature reaches the upper or lower threshold, where the threshold can be set manually according to the user's wishes. The appliance will automatically turn on the fan when the water temperature is more than the specified upper threshold, and will automatically turn off the fan when the water temperature reaches less than the lower specified lower threshold. This tool can control the pH of the water if the pH is <6 or >8, the ESP-32 will immediately send a notification message warning that the water pH is too low or the water pH is too high via telegram as shown in Figure 2.1.

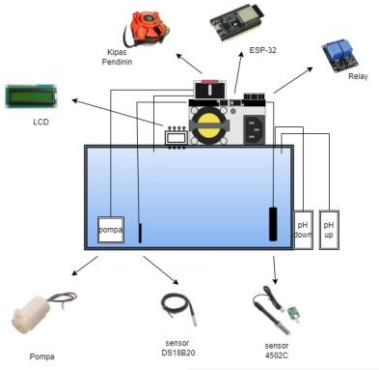


Figure 2. 1 System Design

Based on the drawing of the tool design above, this research is divided into 3 parts, namely: input, process and output. The input to the system is a temperature sensor and a pH sensor to detect aquascape water in real time.

In the process, the ESP-32 will process the data received by the temperature sensor and pH sensor. After that the ESP-32 will process for output. Then finally at the output, the relay will drive the pump, fan and thermoelectric the data obtained from the ESP-32 will be displayed on the LCD and telegram for monitoring and control as shown in Figure 2.2

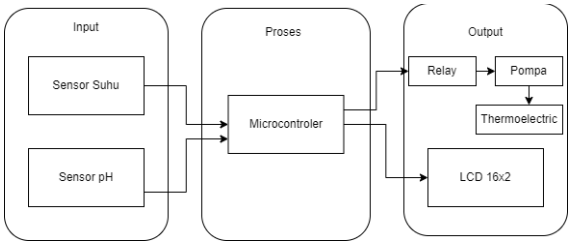


Figure 2. 2 Block diagram of Automatic Water Temperature and Water Stability Control System

A. *System Flowchart*

The system flow scenario of the temperature control and automatic water stability level in the aquascape or can be called the steps that occur in the system if it is run as desired. First, the DS18B20 temperature sensor and the PH-4502C sensor that are used will send information to the ESP32 to provide information whether there are any who have passed the upper or lower threshold limits of the temperature and pH that have been set. If the data received is detected to pass the upper and lower threshold limits that have been set, the microcontroller will activate the reaction system, namely the water pump and cooling fan turn on to cool the water, and turn on the pH dose pump up or down. If the data received is detected past the upper pH threshold limit nor below. As shown in Figure 2.3

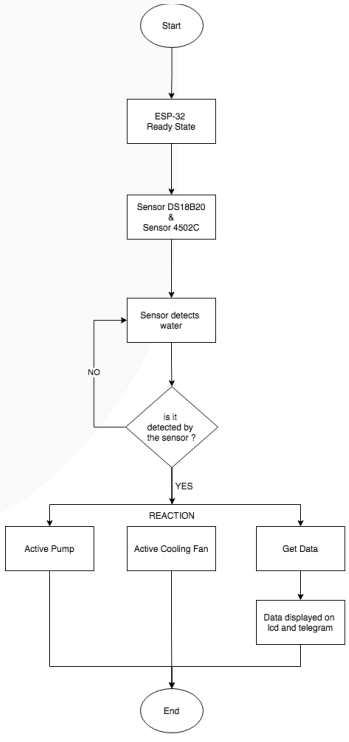


Figure 2. 3 System Flowchart

B. *Telegram App Flowchart*

The explanation of the Telegram application flowchart is shown in Figure 2.4 below:

1. Start
2. ESP32 initiation is a process when the device is first turned on and connected to the internet network.
3. The sensor scanning process is when the sensor starts to monitor and detect if there is something that passes the upper or lower threshold limits of the temperature and pH that have been set.
4. When the sensor successfully detects the situation, the detection data from the sensor will be sent via the telegram application.
5. The data sent is complete information about temperature and pH conditions which will be displayed on the telegram application.
6. Done

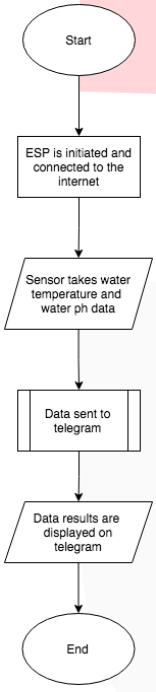


Figure 2. 4 Telegram App Flowchart

III. TESTING ANF ANALYSIS

The final stage of the manufacture of this automatic temperature control and water stability level is by testing the tool in order to find out whether the designed tool can work and function properly or as expected or not. Testing and Analysis of the designed system aims to determine the workings of the overall components of each input component, process component and output component whether the system can work as expected, so that from the results of these tests and measurements, evaluation and improvement of the system can be carried out. in order to obtain maximum results.

Finally, complete content and organizational editing before formatting. Please take note of the following items when proofreading spelling and grammar:

a. System Implementation

Implementation is the stage of applying hardware and software so that the tool can work according to its needs and functions. The hardware will be designed and arranged in such a way that it can be connected to the software. The hardware is divided into several modules and basic electronics components, while the software uses the Arduino IDE and Telegram applications.

b. Connectivity Implementation

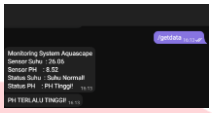
The connectivity used is a WiFi network that comes from a cellphone hotspot, then connects to ESP32 and sends data to Telegram. By configuring the network on the Arduino IDE software, the microcontroller will work and send data automatically or the user sends commands.

c. Tool Implementation Test Results

In testing this tool, the observed output is the success of the tool in carrying out its work. Starting from the ESP32, sensors, and also the logic of the tool's work system. Based on the test, the tool can work well because we get the ideal water temperature and good water stability. Table 3.1 below shows the test results for each.

Table 3. 1 Tool Test Results

Resuts	Description	Photo
DS18B20 sensor can detect water temperature	Success	
PH-4502C sensor can detect the pH of the water	Success	
ESP32 with DS18B20 sensor in ON/OFF water pump, thermoelectric and fan based on detected condition	Success	

ESP32 with sensor PH-4502C in water pump ON/OFF control based on detected conditions and can appear on Telegram	Success	
ESP32 can display realtime water temperature and pH data on Telegram	Success	

d. Test Results of the Implementation of Automation and Controlling Tools

After the sensor is working properly, it will then test the water quality. This test is carried out for 1 day with data displayed every 3 hours from the range of 8 am to 10 pm which is effective when it is activity time and when there is a change in water temperature which is influenced by room temperature. The monitoring results can be seen in table 3.2 below.

Table 3. 2 Monitoring Results

Time	Temperature	pH	Cooler	pH Control	Temperature Status	pH Status
08:00	26°C	9,38	OFF	pH Down	Normal	High
11:00	27°C	6,85	OFF	OFF	Normal	Normal
13:00	30°C	6,84	ON	OFF	Abnormal	Normal
16:00	26°C	6,83	OFF	OFF	Normal	Normal
19:00	26°C	6,84	OFF	OFF	Normal	Normal
22:00	25°C	6,85	OFF	OFF	Normal	Normal

e. QoS (Quality of Service) Testing

This Quality of Service test takes the parameters of delay and throughput during the process of sending and reading data carried out by the tool. Data retrieval is done using the Wireshark application.

- Delay Testing

  The following are the results of the delay testing that has been carried out:

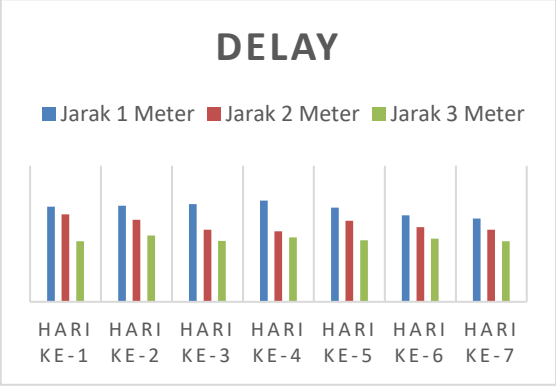


Figure 3. 1 Delay Testing

- Throughput Testing

  The following are the results of the throughput testing that has been carried out:

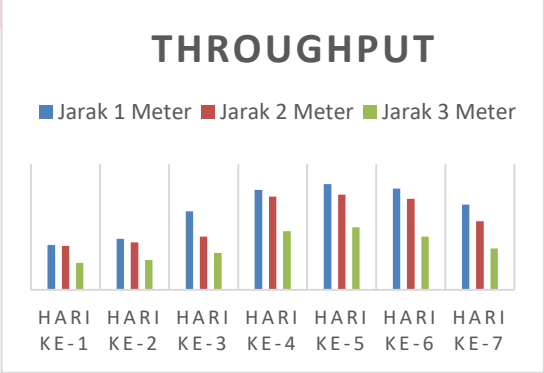


Figure 3. 2 Throughput Testing

- Availability Testing

  The following are the results of the availability testing that has been carried out in formula 3.1 below.

$$Availability = \frac{Uptime}{(Uptime+Downtime)} = \frac{7}{(7+0)} = 1 \quad (3.1)$$

In the availability test, testing was carried out for 7 days which showed that the device to Telegram had good availability, as seen from the results of sending data at random times, telegram was able to receive data well and was 100% accepted.

- Reliability Testing

  The following are the results of the reliability testing that has been carried out in formula 3.2 below.

$$Reliability = \frac{(Uptime-Downtime)}{Uptime} = \frac{(7-0)}{7} = 1 \quad (3.2)$$

The reliability test was tested for 7 days. Based on the results of calculations using formula 3.2, it can be concluded that the reliability of the tool to the telegram gets the number 1, which means that

all data has been successfully sent. This means that the reliability in these conditions is 100%.

- Packet Loss Testing

  The following packet loss test results that have been carried out are shown in Figure 3.3 below.

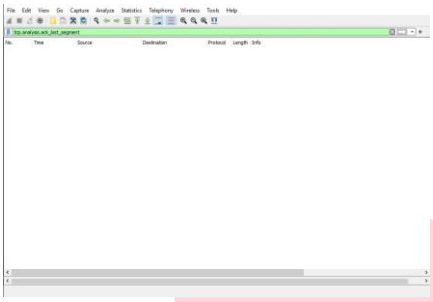


Figure 3. 3 Packet Loss Testing

In this section, packet loss testing uses wireshark, and based on Figure 4.4 above, we get good results, because no data has failed to send.

IV. CONCLUSION

Based on the results of the design that has been done, several conclusions can be drawn, The automatic water temperature control system on the aquascape is running well, the process carried out by the microcontroller can be run according to what is set and the ESP-32 can send data to telegram properly which can then be monitored and controlled by the admin, in testing the results of controlling the pH of the water, it was found that the pH of the aquascape water was stable after the notification in the telegram ordered that the pH be given an UP dose or a DOWN dose, in QoS testing for sending device data to Telegram, the delay value is 2282s, In QoS testing to read data from device to telegram. the average throughput obtained is 414.69 bps. In QoS testing, namely availability testing and reliability testing carried out from the device to telegram. The value obtained during this test is 100% with a predetermined calculation, and in the QoS test, packet loss testing is carried out from the device to the telegram to get good results, because no data has failed to send.

REFERENCES

[1] R. Firmansyah, Pengaruh Suhu Terhadap Pertumbuhan Tanaman, Jakarta: Pusat Perbukuan,DepartemenPendidikan Nasional, 2009.

[2] T. Widjadja, Pesona Taman dalam Akuarium, Jakarta Selatan: PT Argo Media, 2013, p. p.101.

[3] R. Wulandari, Analisis Qos (Quality Of Service) Pada Jaringan Internet (Studi Kasus : Upt Loka Uji Teknik Penambangan Jampang Kulon – Lipi), Vol. Vol. 2, J. T. I. D. S. Inf., Penyunt., Doi: 10.28932/Jutisi.V2i2.454., 2016, P. Pp. 162–172.

[4] I. F. a. S. B. U. Y. A. Pranata, Analisis Optimasi Kinerja Quality of Service Pada Layanan Komunikasi Data Menggunakan Ns-2 Di Pt. Pln (Persero) Jember, vol. vol. 20, Sinergi, Penyunt., doi: 10.22441/sinergi.2016.2.009., 2016, p. p. 149.

[5] D. J. T. a. C. J. B. Scharmer, Reliability , Availability , and Maintainability Considerations in the Design and Evaluation of Physical Security Systems, 2012, p. pp. 1–12.

[6] C. Alaoui, Peltier thermoelectric modules modeling and evaluation., International Journal of Engineering (IJE) 5.1, 2011, p. 111.

[7] S. I. Rahmat, Sistem peringatan dini banjir menggunakan sensor ultrasonik berbasis Arduino Uno., Jurnal Manajemen dan Teknik Informatika (JUMANTAKA) 3.1, 2019.

[8] D. Aztisyah, Pengendalian Suhu dan PH Air Pada Aquascape Ikan Guppy Menggunakan Fuzzy., INISTA: Journal of Informatics, Information System, Software Engineering and Applications 4.1, 2021.

[9] Y. a. J. S. Triawan, Perancangan Sistem Otomatisasi Pada Aquascape Berbasis Mikrokontroller Arduino Nano., JTEIN: Jurnal Teknik Elektro Indonesia 1.2, 2020, pp. 76-83.

[10] M. Pratiwi, Pengembangan Tutorial Pembuatan Media Aquascape Berbasis Project Based Learning (PjBL) Pada Materi Ekosistem Siswa Kelas X SMA. Diss., UIN Raden Intan Lampung, 2017.

[11] D. A. Kusumawati, Simulator Uji Sistem Pengukuran Seismic Cone Penetration (Scpt) Menggunakan Sensor Piezoelectric Untuk Mengetahui Perbandingan Nilai Frekuensi Menggunakan Bola Baja Pada Media Uji Besi. Diss., Universitas Gadjah Mada, 2020.

[12] M. W. a. G. W. Kasrani, Perancangan Prototype Pengendali Relay Berbasis Web dengan Ardino Uno dan Ethernet Shield., 2016.

[13] M. a. D. E. M. Aditya, "Sistem Sterilisator Otomatis Berbasis Arduino Uno.", JTEIN: Jurnal Teknik Elektro Indonesia 1.2, 2020, pp. 99-109.

[14] F. R. Nurlianisa, "Kit Aquascape Berbasis Internet of Things Melalui Aplikasi Blynk dengan Arduino Uno Untuk Pemeliharaan Lilaeopsis Brasiliensis.", 2018.

[15] H. Fatari, Sistem Pemantauan Kejernihan Dan Kekeruhanair Dalam Akuarium Menggunakan Sms Berbasis Mikrokontroler Avr Atmega 16. Diss., Politeknik Negeri Sriwijaya, 2016.

[16] M. V. Tarihoran, "Mesin Etching Pcb (Printed Circuit Board) Menggunakan Arduino Nano.", Vol. Vol .1, Seminar Nasional Ilmu Terapan (Sniter)., 2019.

[17] A. S. Thoha, "Monitoring Dan Kontrol Suhu Aquascape Menggunakan Arduino Dengan Sensor Suhu Ds18b20.", Jurnal Ilmiah Mahasiswa Kendali Dan Listrik 2.2, 2021, Pp. 75-83.

Reza Ramadhani graduated from Telkom University majoring in telecommunications engineering. In this study, it develops from research conducted previously, and this system is based on the internet of things to make it easier for users to monitor and control room temperature remotely with the help of a platform, namely Telegram.