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Monitoring the pH and temperature of IoT-based fish farming using Arduino

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Abstract. The Internet of Things (IoT) based intelligent Fish farming refers to the integration of various IoT devices and sensors into traditional fish farming practices to monitor and optimize various aspects of the fish farming environment such as water temperature, pH levels, oxygen levels, and feed schedules. This can help to improve the overall health and wellbeing of the fish, reduce waste, and increase productivity and efficiency. IoT devices can also be used to track the growth and health of individual fish, allowing farmers to make data-driven decisions about when to harvest or move fish to different tanks. The use of IoT technology can also help to detect potential health issues or environmental problems early on, allowing farmers to take preventative measures to minimize the impact on their fish. Overall, smart fish farming using IoT has the potential to revolutionize the way fish are farmed, making the process more sustainable, efficient, and profitable. The project focuses on an IoT-enabled smart fish farming system. In order to deal with them, the system is coupled with an irrigation system. Indonesia's weather is erratic. This system's microcontroller is an Arduino ESP32. The temperature sensor DSb18B20 and the soil moisture sensor DF Robot are used to regulate the environment. Both a computer and a smartphone are used to display the results.

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INTRODUCTION

Ornamental fish is a pet that is favored by many circles because of the expensive price and beautiful shape. The export value of koi fish every year tends to increase every year. According to KKP data (Ministry of Maritime Affairs and Fisheries) in 2021, Indonesia's exports of five types of ornamental fish amount to US$ 26.36 million. This figure is up 11.17 percent from 2020 of US$ 23.72 million. The five main destinations for Indonesia's ornamental fish exports are Japan (14.83 percent), Hong Kong (13.03 percent), Vietnam (9.01 percent), the United States (8.88 percent) and Singapore (5.92 percent).

Several aspects that must be considered in the maintenance of ornamental fish include water quality, acidity level (pH), and temperature.[1][2][3] Koi fish is a freshwater ornamental fish that has the potential for great economic value and also very high demand. Some of the problems encountered as many cultivators are still controlling the pH of the water manually, when the owner of ornamental fish does activities and leave the aquarium at home without its supervision and control that affects the water quality of ornamental fish kept experiencing turbidity and fish cannot survive long aquarium. This causes losses for ornamental fish owners. Process controlling and measuring the pH of water in ornamental fish in aquariums is still being carried out manually, for example measuring the pH of water using a digital pH meter and then if the pH value is outside the tolerance limit, namely between pH 6.0 – pH 9.0, takes a quick effort to neutralize the pH of the water again. Fish farming will work well and fish growth will be more optimal if the pH conditions of fresh water occur in the range of pH 7.0 – pH 8.5

They utilize the concept of quality of information that specifies that it is "any metadata that characterizes sensor or context information in such a way that it may be used to infer the trustworthiness of the received information". The quality of information model has four parameter classes: time, space, dependability, and traceability. [3][4]There are numerous elements to consider in order to achieve the industry of revolution 4.0, one of which is the internet of things (IoT). IoT is defined as a network of devices that allows communication between machines and devices via an internet connection[5][6]. IoT can also be

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defined as a connection that does not require physical touch, either from device to machine or from human to machine, and has various capacities to communicate or receive data through the internet due to its interconnectedness with any people, animals, devices, machines, or things. According to obtaining communication technologies is critical in order to properly construct an IoT system[7][8].

The Internet of Things (IoT) is a network comprised of physical items integrated with sensors, electronic devices, connections, and software. It is required to enable smooth and advanced connections between the device and communication, as well as to handle a variety of protocols, applications, and knowledge bases[9][10][11].

IoT middleware examples include Blynk and Favoriot. These Internet of Things middleware solutions strive to simplify the injection data from diverse sources by utilizing a standard Application Programming Interface (API)[10][12]

IoT based agriculture systems with relevant technologies including cloud computing, big data storage and analytics has also been presented. In addition, security issues in IoT agriculture have been highlighted. A list of smart phones based and sensor-based applications developed for different aspects of farm management has also been presented[13]. Timely reporting using a range of sensors makes the entire operation not only smart but also cost effective due to its precise monitoring capabilities[6][14].

METHODS

Starting with I/O startup, the following procedure is to read the pH and temperature values. If the data is read, the process of sending data to the web can be resumed. If the data is not read, the procedure will return to the beginning. The following technique, after transmitting data to the web, shows pH and temperature data on the web. And I continued to check pH and temperature via the web. If the pH cannot be monitored over the web, the procedure will return to I/O startup; otherwise, the operation will continue.

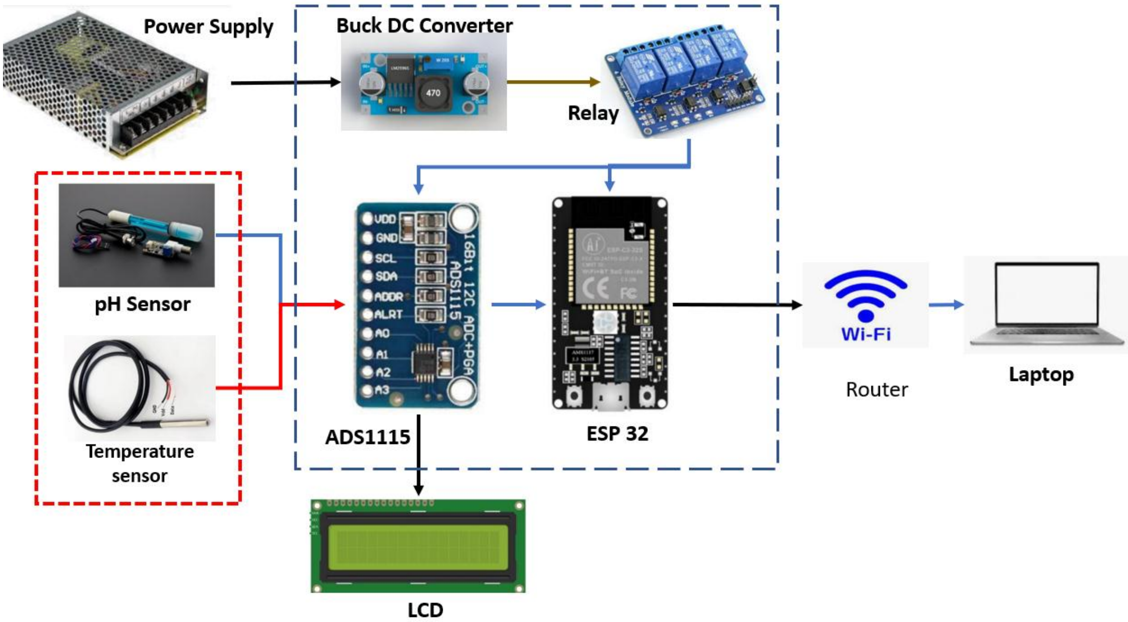

Figure 1 Project Architecture

1. ESP32 is a low-cost, low-power microcontroller developed by Espressif Systems. It is based on the Tensilica Xtensa LX6 microprocessor and features Wi-Fi and Bluetooth connectivity, making it ideal for Internet of Things (IoT) applications.

   The ESP32 has a wide range of features, including:

- Dual core 32-bit LX6 microprocessor
- 520 KB SRAM and 4 MB flash memory
- Integrated Wi-Fi and Bluetooth 4.2
- A rich set of peripherals, including capacitive touch sensors, ADC, DAC, I2C, SPI, UART, and more
- On-board LCD and camera interfaces

These features, along with its low cost and low power consumption, make the ESP32 an attractive solution for a wide range of IoT applications, such as smart home devices, wearable electronics, and industrial automation systems.

Figure 2 ESP 32 Microcontroller

2. DF Robot offers a pH sensor, which is a device used to measure the pH level of a solution. pH is a measure of the acidity or basicity of a solution and is an important parameter in many applications, including water quality monitoring, aquariums, hydroponics, and more.

Figure 3 DF Robot pH Sensor

The DF Robot pH sensor typically uses an electrode to measure the pH level of a solution. The electrode generates a voltage that is proportional to the pH level, which can then be read by a microcontroller such as an Arduino.

3. The DS18B20 is a digital temperature sensor produced by Maxim Integrated. It is widely used for temperature measurement in a variety of applications, including HVAC systems, refrigeration units, and process control applications.

Figure 4 DS18B20 temperature sensor

The DS18B20 operates on a 1-Wire bus, meaning that it only requires a single data line for communication, making it ideal for applications where multiple sensors need to be connected in a small space. The sensor provides a 12-bit resolution, allowing it to measure temperatures with a high degree of accuracy. It also has a wide operating temperature range, from -55°C to +125°C, making it suitable for use in a variety of environments.

The DS18B20 is compatible with many microcontroller platforms, including Arduino, and is easy to interface with using a simple digital input/output (GPIO) pin. The sensor can be used to measure the temperature of a wide range of objects, including liquids, air, and surfaces, making it a versatile solution for many temperature measurement applications.

4. The ADS1115 is a low-power, 16-bit analog-to-digital converter (ADC) produced by Texas Instruments. It is designed for use in applications that require high-precision, low-noise conversion of analog signals to digital data.

Figure 5 ADS1115 Analog to Digital Converter

The ADS1115 has several key features, including:

- 16-bit resolution, providing high-precision measurement capabilities
- Four input channels, allowing it to convert multiple analog signals at once
- On-board programmable gain amplifier (PGA), allowing it to handle input signals with a wide range of amplitudes
- I2C interface, allowing it to be easily interfaced with a variety of microcontroller platforms, including Arduino

The ADS1115 is commonly used in applications such as data acquisition, process control, and instrumentation. It provides a simple, cost-effective solution for converting analog signals to digital data, and its compact size and low power consumption make it ideal for use in portable or battery-powered devices.

5. The LM25965 is a popular step-down (buck) DC-DC converter produced by Texas Instruments. It is used to convert a higher voltage DC input into a lower voltage DC output. One of the key features of the LM2596 is its high efficiency, which is typically in the range of 82% to 92%, depending on the operating conditions.
The LM25965 has a wide input voltage range, from 4.5V to 40V, and can produce a regulated output voltage in the range of 1.23V to 37V. It also has a high output current capability, up to 3A, making it suitable for a wide range of applications

Figure 6 LM25965 Buck DC to DC converster

6. The MDU1043 4-Channel 5V Optical Isolated Relay Module is a digital relay module designed for use in industrial control, automation, and electrical protection applications. The module has four relay channels, each of which can be controlled independently using a digital signal. The relay outputs are rated for up to 250V AC and 10A, making them suitable for a wide range of electrical loads.

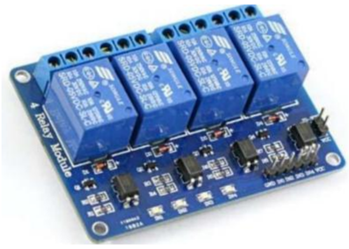

Figure 7 MDU1043 4 Channel Relay

The MDU1043 module is powered by a 5V DC power supply, and has an input signal voltage range of 3.3V to 5V. It can be easily interfaced with a microcontroller or other control device using its digital input signals,

RESULT AND DISCUSSION

The prototype's desired conclusion is that all sensors work properly and reliably identify the parameters, and that data is transferred to a Arduino and exported.

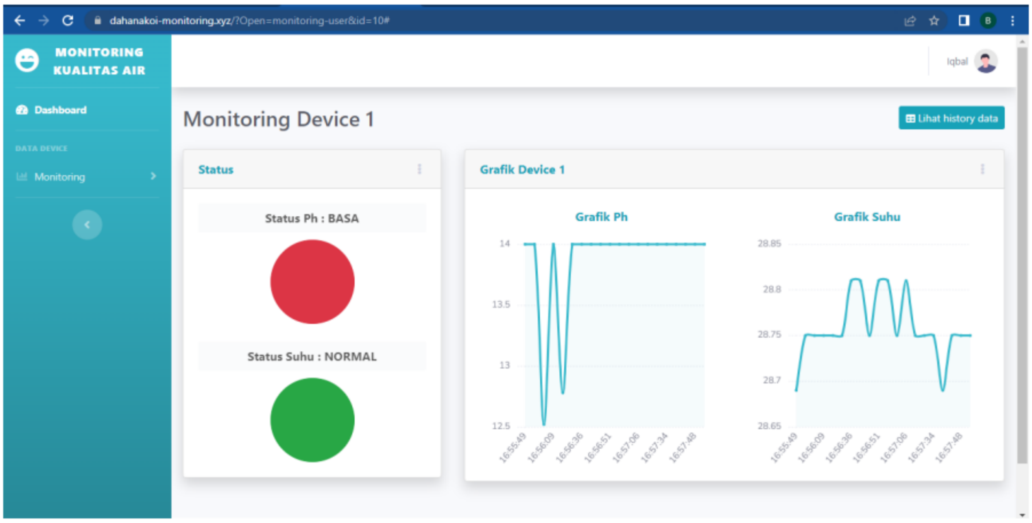

Figure 8 Web page interface desain

Wi-Fi connects to the server. Figure above depicts the value detected by the sensor, and the data is presented in the common line interface. The data collected by the Arduino will then be sent to the server through Wi-Fi and displayed in real time on the dashboard.

Table 1 pH testing accuray

Test	**Web**	**Digital pH meter**	**Diff**	***Dev*** (%)
07.00.	6.2	6.15	0.05	0.81
08.00.	6.89	6.9	0.01	0.14
09.00	6.5	6.5	0	0
10.00	6.88	6.90	0.02	0.28
11.00	6.55	6.5	0.5	0.76
12.00	6.23	6.25	0.02	0.32
13.00	5.85	5.90	0.05	0.84
14.00	6.10	6.15	0.05	0.81
15.00	6.5	6.5	0	0
16.00	6.05	6	0.05	0.83
		Average (%)		**0.27%**

Monitoring was carried out for 1 hour, testing was carried out from 07.00 am to 16.00 pm with an initial pH of 6.2 and an initial temperature of 29 degrees Celsius monitored on the website..

Table 2 Temperature Testing Accuracy

Test	**Web**	**Sensor DS 18B20** (℃)	**Difference**	***Dev*** (%)
07.00	28.75	29.00	0.25	0.86
08.00	28.25	29.00	0.75	2.59
09.00	28.00	28.00	0	0
10.00.	27.75	28.00	0.25	0.89
11.00	28.25	28.00	0.25	0.89
12.00	27.75	28.00	0.25	0.89
13.00	27.50	28.00	0.50	1.78
14.00	28.25	29.00	0.75	2.59

15.00	28.00	29.00	1	3.45
16.00	27.75	28.00	0.25	0.89
	Average (%)			**1.48%**

This system is very dynamic and can be constructed in a simple and acceptable way for different types of fish and ponds to be adjusted without human effort. This technique primarily reduces human intervention while also conserving energy. Furthermore, it requires little upkeep and is less expensive.

In this study produced a model that can be implemented and tested trials on real ponds, testing this model produces an error value of 0% with an accuracy value reach 100% for pH. In testing the temperature of the fish pond, there was a significant deviation at around 3 pm, but overall, this model has close to good accuracy.

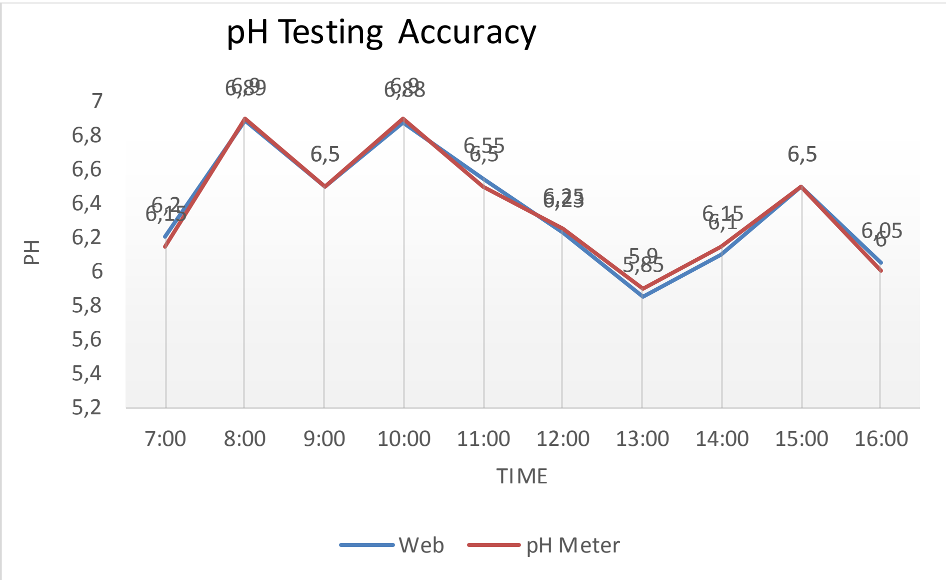

Figure 9 pH Testing

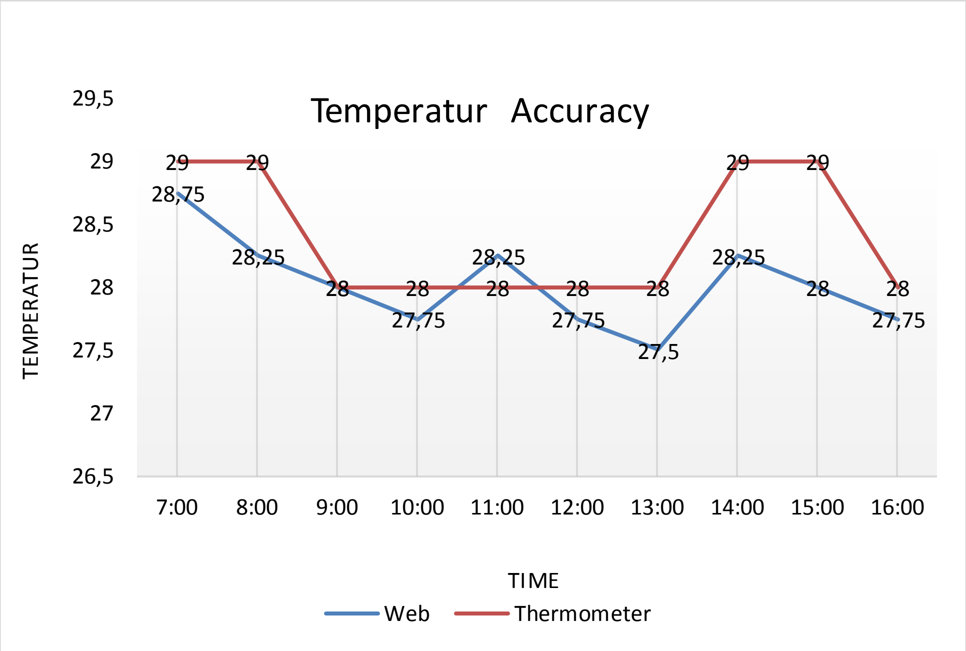

Figure 10 Temperature Testing

CONCLUSION

This paper designs an automatic monitoring system via the web. In this case we have used Arduino that makes it possible collects sensor information from sensor nodes continuously, store it in database and provide web interface to the user. This system monitors pH and temperature Pool water is used to analyze water feasibility parameters, this helps maintain water quality. By providing a web interface and user automation can easily monitor the system and it will minimize human interference. Apache web server created easily displays the contents of sensor data.

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