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Smart Monitoring Temperature and Humidity Based on Incubator System using IoT

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Abstract: In this study, one of the most important factors to take into consideration in chicken farms is egg fertilization. To make the monitoring of the incubation system easier for the user, the smart incubation system is built to integrate IoT technology with a smartphone. The incubator is first constructed with the setting and the hatcher combined into a single machine, including both still air and forced air incubation, and paying attention to the three parameters of temperature, humidity, and egg-turning system while monitoring the incubator. The prototype is constructed of hardware and software that can connect to the internet and monitor and control the temperature and humidity reading to maintain such conditions. The components that were used in this project included an ESP8266 module to link the microcontroller to the internet, an Arduino MEGA 2560 microcontroller for data processing, a DHT11 sensor for detecting the temperature and humidity of the incubator, a 12 VDC cooling fan and a 40W bulb to control the parameters, and finally, a Blynk app to display the collected data. The results showed that the prototype can regulate the temperature and humidity through the fan and bulb when there is a change in the settings.

Keywords: Temperature And Humidity, Incubator, Iot,

1. Introduction

Wireless communication has had a huge influence on daily life, particularly in the industrial sector. Wireless communication technology appears to have cheap cost, convenience, ease of installation, and great mobility. One significant use is to monitor the temperature and humidity of the surrounding environment without restricting the movement of the user [1].

The need for this system is to reduce the amount of manpower required to manage air temperature and humidity in industries, hence reducing the damaging effects on electronic components. The system will send data to the Blynk application through NodeMCU and monitor the temperature/humidity readings. The humidifier and conditioner then automatically control the temperature and humidity of the environment, which may be adjusted via the switch. The humidity and temperature of the room might be controlled using a DHT-11 sensor, Arduino, and a microcontroller board [2]-[4].

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However, the DHT-22 sensor is accurate and appropriate for temperatures ranging from -40°C to 80°C, with an accuracy of around 2°C [5]-[7]. Many engineers in industries have struggled to understand humidity and temperature, particularly because of temperature. Some electronic components should be tested and stored at specific temperatures to ensure the accuracy of the results and the lifespan of the components. Humans may feel coldness and heat in real life, yet the perfect temperature for certain electronic components cannot be established since they are constructed of different materials. The second issue is caused by humidity. The moisture in the air may enhance the effect of electronic component pins. As a result, it will affect the performance of electronic components and cause financial losses [8].

In this project, the hardware consists of Arduino Mega 2560, a Wi-Fi module, temperature/humidity sensors, LCD, relay, bulb, servo motor, and cooling fan. The coding for the prototype was designed by using Arduino IDE Software and developed into the Blynk App for smart monitoring. A 40-watt bulb to control the temperature and a 12VDC cooling fan to control the humidity of the incubator. The incubator was expected to operate for one hour with the temperature and humidity set to 40°C and 60%, respectively.

2. Materials and Methods

This section will present the methodology used to develop the proposed Smart Monitoring Temperature and Humidity Based on Incubator System using IoT. The first subsection will present the overall block diagram of the prototype, followed by the flow chart of the process, and finally the details of the setup.

2.1 Block Diagram

In almost every project, the primary requirements are inputs, control units, and outputs. The set-up parameter and reading value from the DHT11 sensor are the inputs of the project. The control unit is an Arduino Mega 2560 and a NodeMCU ESP8266, with a relay, LCD, lamp, fan, and servo motors as outputs. Figure 1 illustrates the block diagram of the project.

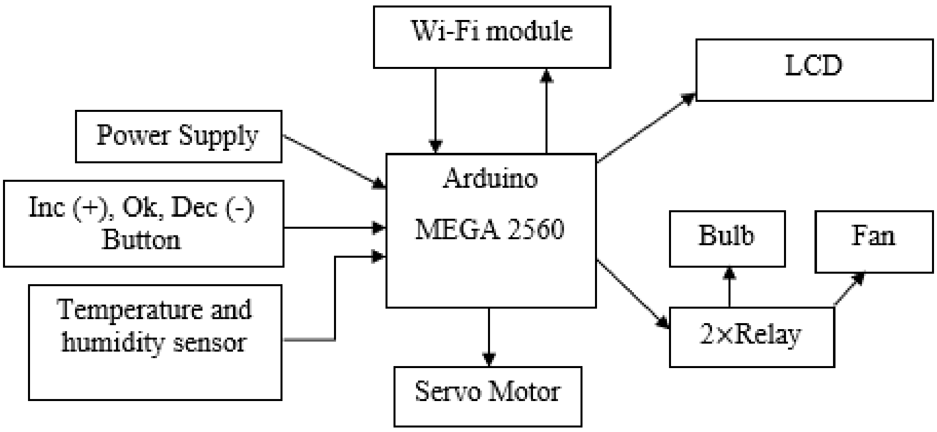


Figure 1: Block diagram of Smart Incubator System

2.2 Process Flow Chart

In this project, the flowchart will give an overview of the steps in the process of the Smart Incubator System based on the prototype and Blynk. The flowcharts for processes are illustrated in Figure 2 and Figure 3.

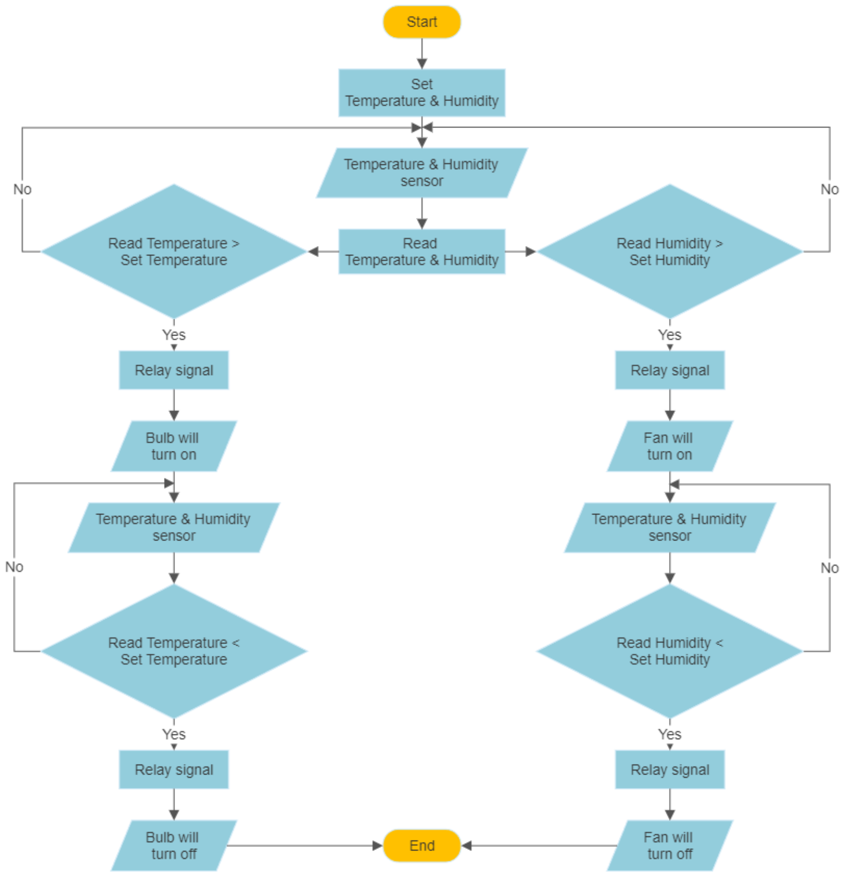


Figure 2: Flowchart for Prototype

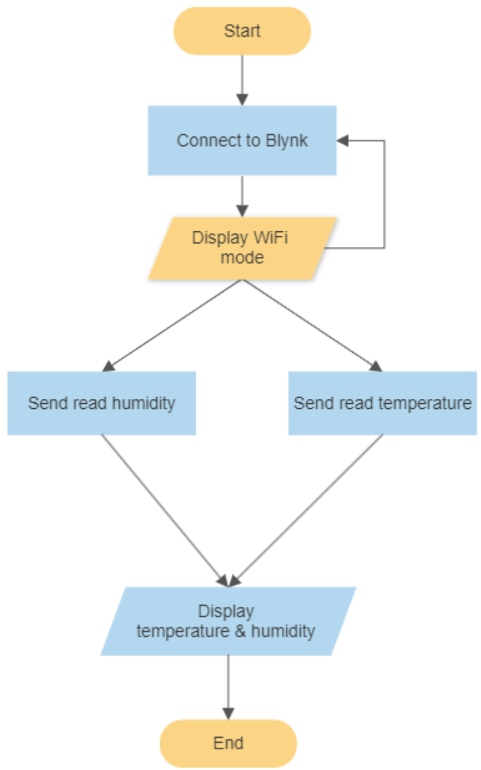


Figure 3: Flowchart for Blynk

2.3 Overall Prototype Setup

In this setup, all the component connections are constructed. Figure 4 illustrates the Smart Incubator System configuration for this project. The components include I2C 16x2 LCD, lamp, fan, servo motors, Arduino Mega 2560, NodeMCU ESP32, and DHT11 sensor. Cardboard is used to hold up the prototype.

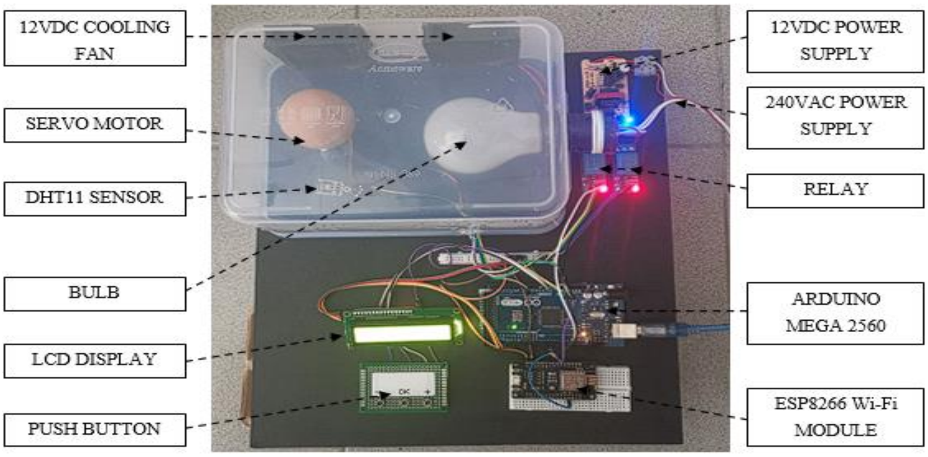


Figure 4: Smart Incubator Prototype Setup

3. Results and Discussion

3.1 Operation of the Prototype

The servo motor with an egg replica, lamp, and fan was also put inside the incubator along with the DHT11 sensor. The fan and lamp will automatically control the temperature and humidity within the relay that was powered by a power supply that was attached and had a 12 VDC and 240 VAC output each. The Wi-Fi module will send the reading data via a Wi-Fi connection to the Blynk website and the LCD will display the reading temperature and humidity of the DHT11 sensor. The microcontroller is positioned outside the incubator and is used to receive data and produce output operations to the hardware via the implementation of coding. The operation time of the testing was within one hour and the incubator set values for the temperature and humidity were 40°C and 60%, respectively as shown in Figure 5.

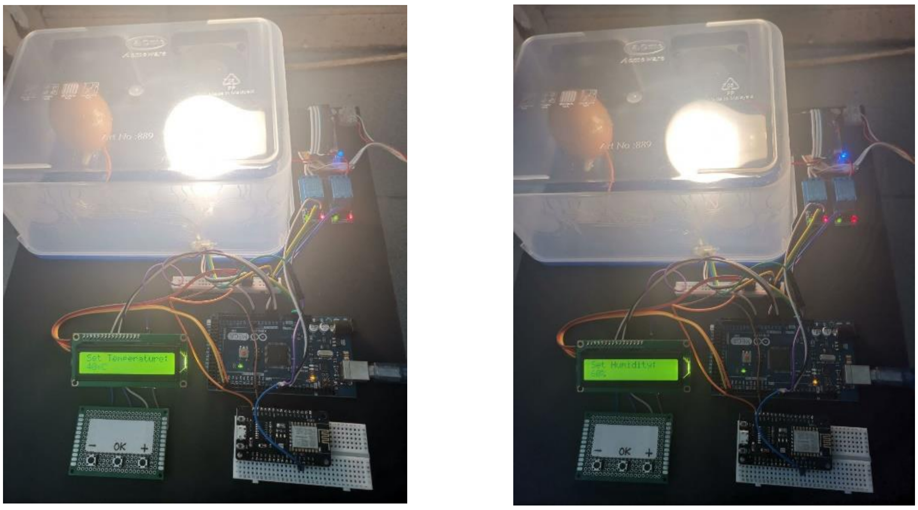


Figure 5: Temperature Setting to 40°C and Humidity Setting to 60%

3.2 Blynk Interface

Figure 6 illustrates the configuration used for the Blynk application interface on the website and mobile phone. The interface consists of two gauges and two charts to monitor the temperature and humidity.

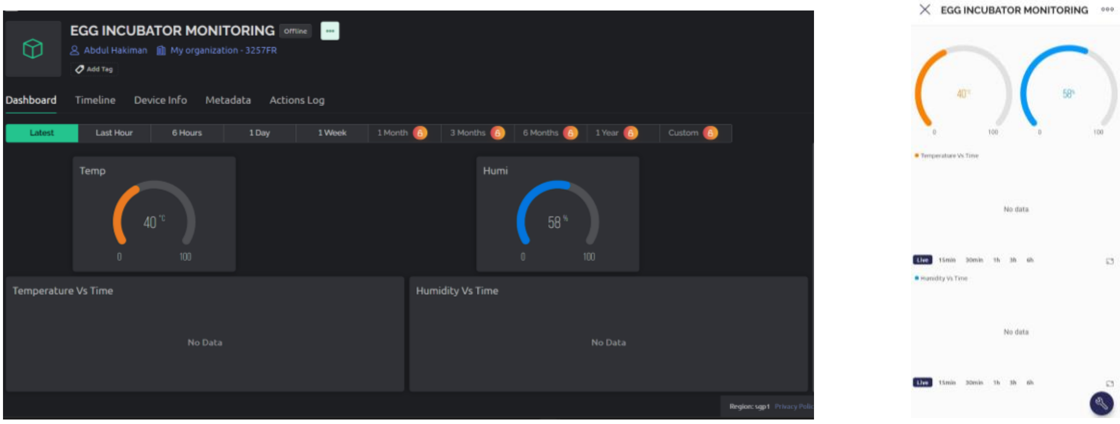
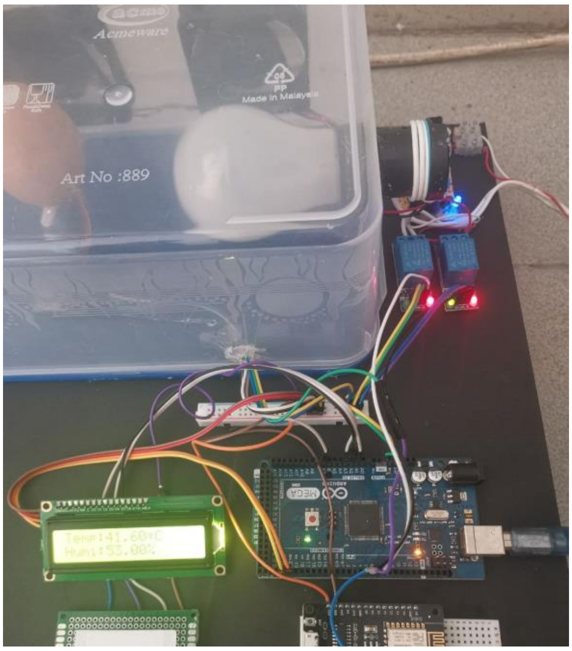


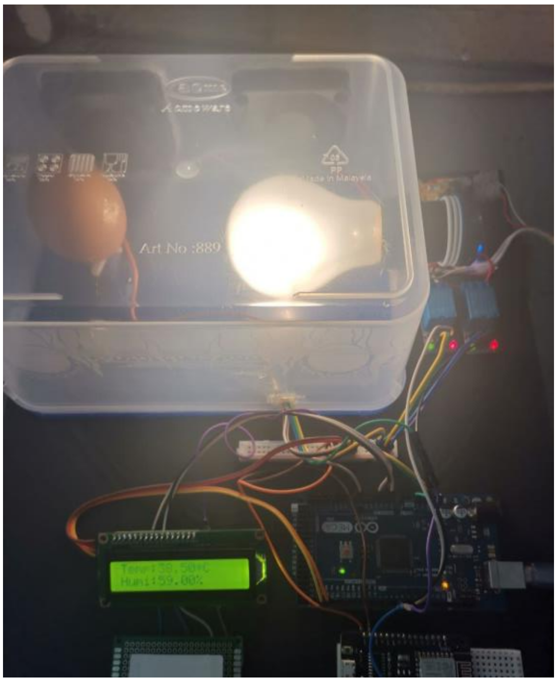
Figure 6: The Blynk application interface on the website and mobile phone

3.3 Result Analysis for Prototype

Table 1 lists the result of the temperature and humidity change.

Table 1: Result of temperature and humidity change

Scenario	**Sensor Reading**		**Relay**	
	Temperature (°C)	Humidity (%)	Bulb	Fan
1	41.60	53.00	**OFF**	**ON**
				

	38.50	60.00		
2			**ON**	**OFF**

3.4 Blynk configuration analysis

Figure 7 shows the Blynk interface for the website on the PC/laptop to analyze the graft data sent by the sensor to evaluate the third project objective. Figures 4.12 and 4.13 illustrate the peak temperature and humidity with 44°C and 68%, respectively. After one hour of testing, the lowest values for the temperature and humidity were 36°C and 45%, respectively. Since the system unexpectedly rebooted, the temperature and humidity readings taken at 6:55:45 PM and 6:56:09 PM were incorrect because the relay function was still ON for the bulb and fan in their initial state. As a result, the temperature and humidity significantly decrease and increase, respectively. We can see from the graft from the Blynk that the statistics were quite consistent after the procedure began. It was achievable to maintain the temperature and humidity with luminous accuracy from the set parameter value.

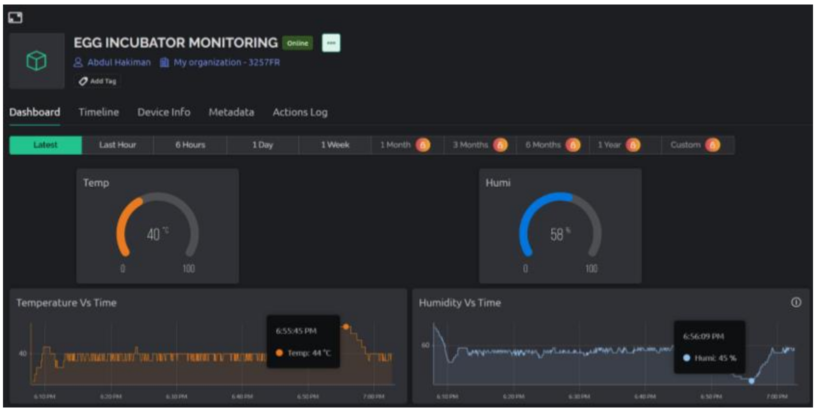


Figure 4.3: Highest Temperature and Lowest Humidity Value

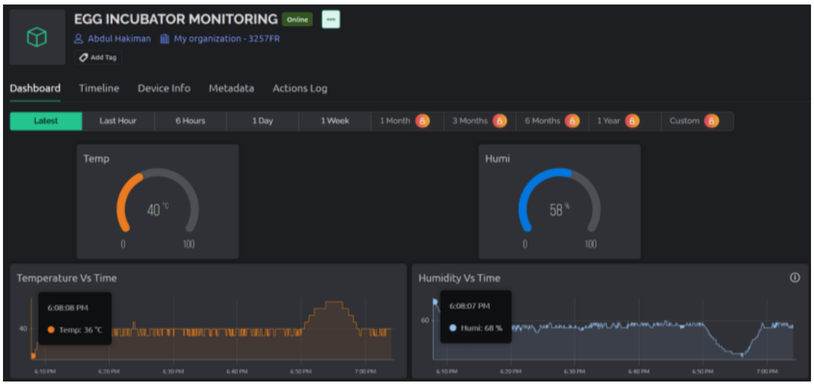


Figure 4.4: Lowest Temperature and Highest Humidity Value

3.2 Discussions

From this prototype, the temperature and humidity are closely regulated, which will lead to a healthy incubation environment for the egg. The prototype can operate on any incubation usage because the hardware used has the threshold temperature and humidity to set and maintain the parameter. Instead, for the incubation requirement, the temperature and humidity must be stated correctly. The prototype has terminus of the temperature and humidity controlling accuracy since the sensor has a bit high reading precision. This prototype may be used in any facility where farm animals are bred specifically chickens, which are in high demand in Malaysia.

4. Conclusion

In terms of project conclusion, the development and performance of Smart Monitoring Temperature and Humidity Based on Incubator System Using IoT has been completed, and the prototype result was quite satisfying. The hardware, which consists of an Arduino MEGA 2560, an ESP8266 Wi-Fi module, a temperature and humidity DHT11 sensor, a 5V relay, a 40Watt lamp, a 12VDC cooling fan, and a servo motor, is fully functional. The hardware command worked properly when the temperature was set to 40°C and the humidity was set to 60% since the incubator system was capable of automatically controlling and maintaining the command input minus 2 for temperature andnd $\pm$5% for humidity. The work has also shown the efficiency of the Smart Incubator System to reduce operating costs and enable users who do not have access to the incubation system to get involved. Because it addresses several challenges in daily life, the Internet of Things is producing a revolution in the world of electronics. Furthermore, remote monitoring of the incubator (Blynk application) allows users to monitor and gather data from the incubator system easily at any time and from anywhere.

Acknowledgement

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