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A Prototype Iot Temperature And Humidity Monitoring Esp32 Based Via Thing Speak

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ABSTRACT
Internet of Thingsis one of the latest technologies in real-time data management, especially for temperature and humidity monitoring. This study develops a prototype of an ESP32-based IoT system that is integrated with the ThingSpeak platform for temperature and humidity monitoring. The system uses a DHT22 sensor for data collection, while the ESP32 acts as the main controller that sends data to ThingSpeak via a Wi-Fi connection, and displays data on an OLED Display. Tests were conducted in regular and air-conditioned rooms, showing significant differences in humidity. Air-conditioned rooms show humidity within normal limits (45-65%), while regular rooms reach 70%. The data sent to ThingSpeak is visualized in a graph with details of the data sending time, based on the results of this study it is proven that the designed system can display temperature and humidity data in real-time on ThingSpeak, and has the potential to be applied on a wider scale.

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INTRODUCTION

Monitoring temperature and humidity are often carried out using sensor devices connected to a monitoring system that can provide real-time data. This data can be used to make more informed decisions, such as regulating air conditioning systems, automatic plant watering, or regulating production processes. With the latest technology, this monitoring system is increasingly accurate and efficient, allowing for better management of the environment and existing processes. In addition, temperature and humidity monitoring also plays an important role in mitigating climate change, monitoring the weather, and maintaining ecosystem stability (Ningsih, 2022)

In various aspects of daily life, temperature and humidity monitoring plays an important role. Whether it is in the agricultural industry, industrial server rooms, environmental monitoring, or even in household life. Monitoring temperature and humidity conditions can provide valuable information for making the right decisions. Through the use of this prototype, users will be able to monitor temperature and humidity in real time quickly and easily.

The author uses Internet of Things (IoT) technology that offers innovative solutions to monitor environmental parameters automatically. By using IoT devices, data can be

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accessed and analyzed remotely via an internet connection, thereby increasing management efficiency. One platform that supports IoT implementation is Thing-Speak, which allows real-time data storage and visualization.

In this study, a prototype of an IoT-based temperature and humidity monitoring system was developed using the ESP32 module as the main controller and the DHT22 sensor for data collection. Data obtained from the sensor is sent to Thing-Speak using a Wi-Fi network, so that users can monitor environmental conditions through internet-connected devices. This prototype is designed to provide a simple, effective, and economical solution for monitoring temperature and humidity. The development of this system is expected to contribute to IoT technology innovation in environmental management, especially in applications that require continuous monitoring of environmental parameters.

Literature Review

Ideal Air Humidity

Ideal air humidity, When we talk about good air quality, we usually immediately imagine clean air without pollution. However, there is an important aspect of air quality that is often overlooked, namely humidity. While many people may not realize it, air that is sufficiently humid, neither too dry nor too humid, plays an important role in promoting overall health and well-being.

Maintaining an optimal humidity level between 45% to 65% RH is essential to creating a comfortable and healthy environment. Low humidity can have a negative impact on the respiratory system, skin, and overall comfort. Conversely, air that is too humid can create an environment that supports mold growth and the spread of allergens. Maintaining the right balance is key. (Hygienis Indonesia, 2023)

DHT22 Sensor

The DHT22 sensor is a digital sensor used to measure temperature and humidity. The DHT22 sensor has a high level of stability and reliability in the long term. The DHT22 sensor uses a resistive humidity sensor and an NTC-based temperature sensor connected to an 8-bit microcontroller. So the DHT22 sensor has very good quality, anti-interference capability, fast response and affordable cost.

Figure 1. Physical form of the DHT22 sensor

Detailed specifications of the DHT22 can be seen in table 1.

Table 1. DHT22 specifications

Model	DHT22
Voltage	3.3 – 6 VDC
Output Signal	*Digital signal via single bus*
Sensing Element	*Polymer Capacitor*
Measuring Range	*Humidity*0-100%RH; temperature -40-80 Celsius
Repeatability	*Humidity*+_1%RH; temp +-1Celsius
Humidity hysteresis	± 1&RH
Long-term Stability	±0.5%RH/year
Sensing Period	*Average*: 2s
Interchangeability	*Fully interchangeable*
Dimension	*Size*12*15.5*5.5mm

OLED DISPLAY

Organic Light Emitting Diode(OLED) is a screen technology that uses organic layers as light-emitting materials when electric current flows through them. Unlike Liquid Crystal Display (LCD) screens that require backlight, OLED can produce light independently on each pixel.

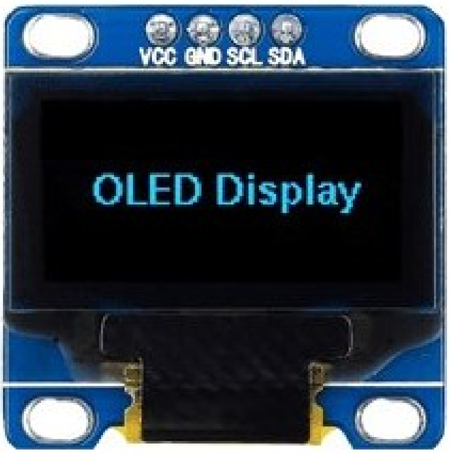

Figure 2. Physical form of OLED DISPLAY

ESP32

ESP32 is a chip with 2.4 GHz WiFi and Bluetooth with a 40nm technology design designed for the best power and radio performance that shows durability, versatility and reliability in various applications and power scenarios. ESP32 is a microcontroller module with dual mode features, namely WiFi and Bluetooth, which is used to make it easier for users to create various application systems and IoT (Internet of Things) based projects. ESP32 is a microcontroller introduced by Espressif System and is the successor to the ESP8266, ESP32 has many additional features and advantages over the previous generation. On the ESP32 there is a CPU core and faster Wi-Fi, more GPIO, and support for Bluetooth 4.2, and low power consumption, making it very suitable for making several Internet of Things based electronic projects. The physical form of the ESP32 Module can be seen in Figure 3 as follows.

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Figure 3. Physical form of the ESP32 module

Specification

ESP32 is included in the ESP32-D0WDQ6 (ESP32-D0WD), ESP32- D2WD, ESP32-S0WD, and system in package (SiP) ESP32-PICO-D4 chips. The microprocessor used by ESP32 is Tensilica Xtensa LX6 dual-core or single-core with a clock rate of up to 240 MHz. With the release of ESP32, Espressif System also offers features embedded in ESP32, where with small dimensions (25.5 x 18.0 x 2.8mm) this module is very easy to use because its components are integrated with built-in antenna switches, RF balun, power amplifier, low-noise receive amplifier, filters, and power management modules. ESP32 has specifications as shown in Table 2.

Table 2. ESP32 specifications

Categories	Item	Specification
Certification	· RF certification	FCC/ CE-RED/ IC/ TELEC/ KCC/ SRRC/ NCC
	· Wi-Fi certification	Wi-Fi Alliance BQB RoHS/REACH
	·Bluetooth certification	
	· Green certification	
Test	Reliability	HTOL/HTSL/uHAST/TCT/ESD
WiFi	· Protocols	802.11 b/g/n (802.11n up to 150 Mbps)
	· Frequency range	A-MPDU and A-MSDU
		aggregation and0.4 μs guard interval support
		2.4 GHz ~ 2.5 GHz
Bluetooth	· Protocols	Bluetooth v4.2 BR/EDR and BLE specification
	· Radio	NZIF receiver with–97 dBm sensitivity Class-1, class-2
	· Audio	and class-3 AFH transmitters
		CVSD and SBC
Hardware	· On-chip module interfaces	SD card, UART, SPI, SDIO, I2C, LED PWM, Motor PWM,
	· On-chip sensors	I2S, IR, pulse counter, GPIO, capacitive touch sensor,
	· Integrated crystal	ADC, DAC
	·Integrated SPI flash	Hall sensor
	·Operating voltage/ Power	40 MHz crystal
	supply	4 MB

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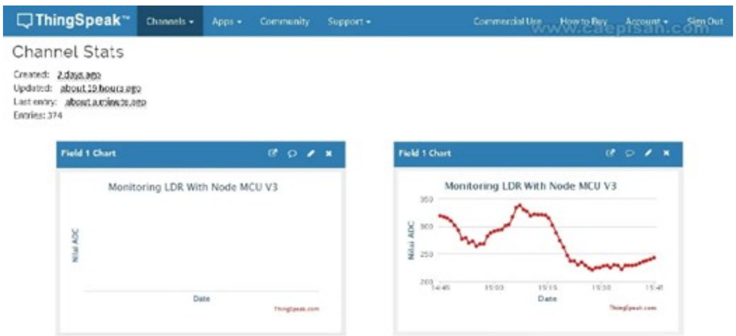
Categories	Item	Specification
		2.7V ~ 3.6V Average:80 mA
	Operating current	500 mA
	· *Minimum current delivered by power supply*	–40 °C ~ +85 °C (18.00±0.10)
	· *operating temperature range*	

ESP32 Advantages

The advantages of the ESP32 microcontroller compared to other microcontrollers, can be seen from its more pin outs, more analog pins, larger memory, there is Bluetooth 4.0 low energy and WiFi is available which allows for the application of the Internet of Things (IoT) with the ESP32 microcontroller. ESP32 Pin Configuration. *Chip*ESP32 has 48 pins with different functions, not all pins can be seen on the ESP32 chip and there are some pins that cannot be used.

*ThingSpeak*is one of the open source platforms for monitoring on the "Internet of Things" applications and APIs to store and retrieve data from things using HTTP over the Internet or via a Local Area Network. Thingspeak.com functions as a data collector originating from node devices in the form of sensors that are already connected to the internet and also allows data retrieval from software for visualization, notification, control and historical data analysis purposes. The main element of ThingSpeak is the channel, which contains data fields, location fields, and status fields. After creating a ThingSpeak channel, we can write data to the process channel and view the data results via MATLAB. From there we can see the reaction to the data with tweets and other alerts. The features of Things peak are as follows:

a. Open Api
b. Real-time data collection
c. Geolocation data
d. Data processing
e. Data Visualizations
f. Device status messages
g. Plugins



Before **After**

Figure 4. Thingspeak display

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METHODS

This research was conducted by conducting a literature study first, followed by component selection, system design, and system testing on sensor nodes. This system is designed using ESP32 as a microcontroller that will receive input signals from the DHT22 sensor in the form of temperature and humidity data for a room, then the data will be processed by ESP32 so that the data can be displayed on the ThingSpeak web via a Wi-Fi network.

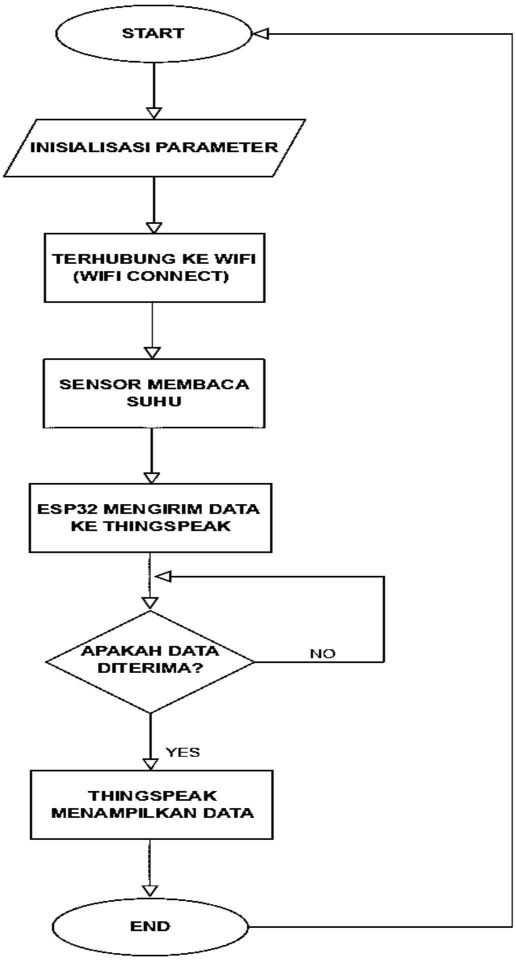

Figure 5. System Flowchart View

This system is designed with the system flowchart guidelines in Figure 6, where the system will first be connected to the WiFi network in order to process the reading and sending of temperature and humidity data to the ThingSpeak platform. The system will resend the latest data to the ThingSpeak platform if the data is not received by ThingSpeak.

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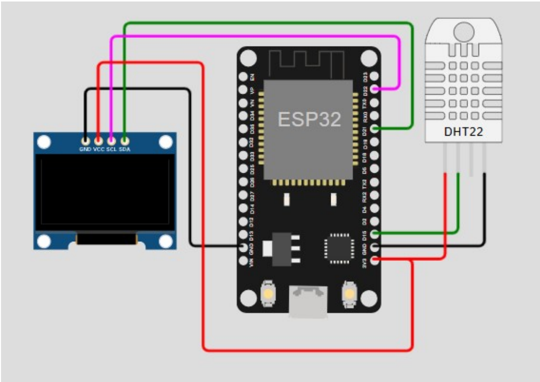

Figure 6. Circuit schematic

In the schematic design of the circuit as shown in Figure 7, the Oled Display and DHT22 will be connected at a voltage level of 3.3 Volts on the ESP32. The serial Data pin on the DHT22 sensor will be connected to the Digital pin on the ESP32, namely pin D15 for reading temperature and humidity data from the DHT22 sensor. While the serial data and serial clock pins on the OLED will be connected to pin D21 and pin D22 on the ESP32 respectively in order to display temperature and humidity data that has been read by the ESP32.

RESULTS

Testing is done after the circuit is assembled and the program has been uploaded to the ESP32 and has been connected to Wi-Fi and DHT22. After connection, DHT22 will immediately send temperature and humidity data to be processed on the ESP32 as the main controller of the sensor node so that the data can be displayed on the Oled and Thingspeak platform as a place to store and visualize data. Oled and ThingSpeak will then display room temperature and humidity data as shown in Figure 7.

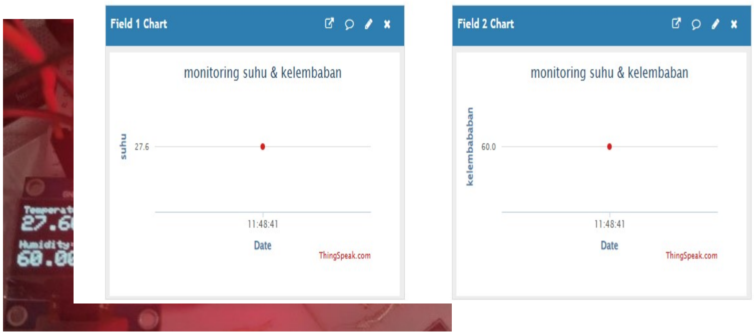

Figure 7. Trial of sending temperature and humidity data on OLED and ThingSpeak

Further testing was carried out by observing data in 2 different rooms. It can be seen in table 4 for delivery trials 3 to 6 which were taken in a regular room, apart from the delivery trials the author took data indoors with conditions*Air Conditioner*(AC) is on. The significant difference seen from the temperature that has been read by the sensor node is the humidity value in the room with Air Conditioner (AC) is still within normal limits, while in

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a normal room the humidity value is recorded at 70% where this value exceeds the normal humidity value of a room. This result occurs because Air Conditioner (AC) is an electrical device that has a working system to regulate the temperature and humidity of a room so that it is within normal limits.

Table 4. Test Results

Trial Delivery	Read Data	
	Temperature	Humidity
Trial Delivery 1	20.7 C	45%
Delivery Trial 2	22.7 C	50%
Delivery Trial 3	24.6 C	63%
Delivery Trial 4	25.7 C	70%
Delivery Trial 5	25.3 C	70%
Delivery Trial 6	24.5 C	65%
Delivery Trial 7	23.1 C	45%
Delivery Trial 8	23.9 C	53%
Delivery Trial 9	21.1 C	42%
Trial Delivery 10	22.8 C	43%

The above test data will then be received and stored on the ThingSpeak platform, which will then display a data graph as can be seen in Figure 8, where each graph shows the temperature and humidity data received from the sensor node by ThingSpeak, and the data matches the data read by the sensor node.

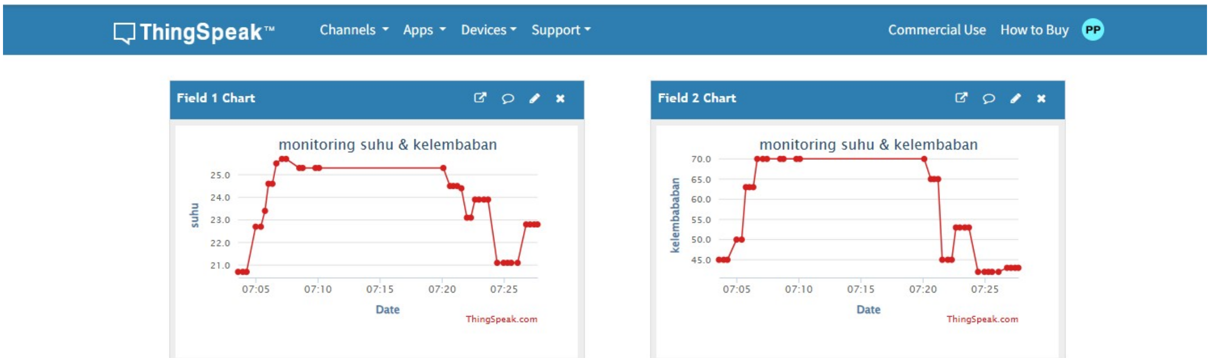

Figure 8. Test Result Graph on ThingSpeak

In Figure 9, when the cursor is directed to the red dot on the ThingSpeak data graph, you can see the details of the data that has been received and stored. These details include the time received, the day, and what data was sent by the ESP32. These details will also store data on when changes in temperature and humidity of a room occur.

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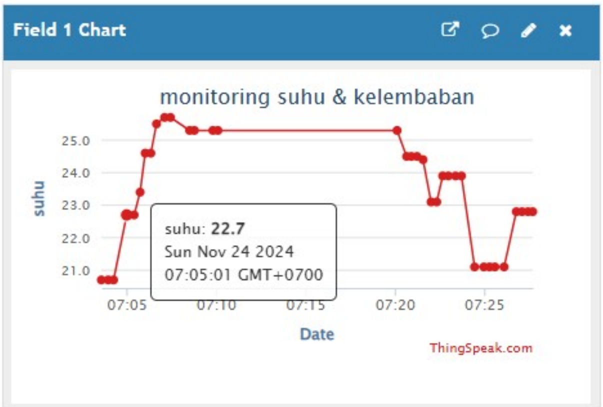

Figure 9. Details of Delivery Time and Incoming Data on ThingSpeak

CONCLUSION

The device designed by the author successfully measures and displays temperature and humidity data accurately, and is able to send information to the ThingSpeak online platform. The use of an IoT platform such as ThingSpeak successfully visualizes data and facilitates data monitoring by providing real-time data. This system is expected to support the development of applications in IoT-based industries with the advantages of accessibility and reliability of the data displayed. For further research, it is recommended to conduct tests in extreme environmental conditions to ensure its reliability in various situations, such as high humidity, extreme temperatures, or Wi-Fi signal interference. Meanwhile, for a more accurate monitoring system, it is recommended to conduct tests on various types of temperature and humidity sensors to compare and determine the level of accuracy of temperature and humidity sensors other than DHT22.

REFERENCES

Aryza, S., Efendi, S., & Sihombing, P. (2024). A ROBUST OPTIMIZATION TO DYNAMIC SUPPLIER DECISIONS AND SUPPLY ALLOCATION PROBLEMS IN THE MULTI-RETAIL INDUSTRY. *Eastern-European Journal of Enterprise Technologies*, (3).

Aryza S dkk (2024) EFEKTIVITAS SIMULASI TERHADAP ANALISA KEHANDALAN TENAGA LISTRIK BERBASISKAN INTERNET OF THINK (IOT). *ESCAF*, 1226-1231.

Abdurrohman, RM (2023). Real-time Temperature and Humidity Monitoring Prototype. ICTEE Journal, 4(2), 29-36.

Satria, B. (2022). IoT Monitoring of Air Temperature and Humidity with ESP8266 MCU Node. sudo Informatics Engineering Journal, 1(3), 136-144.

NINGSIH, OV (2022). UV MONITORING AND STERILIZER SYSTEM IN PHARMACY WAREHOUSE BASED ON IOT USING THINGSPEAK (Doctoral dissertation, Indonesian Digital Technology University).

Nizam, MN, Yuana, H., & Wulansari, Z. (2022). Esp 32 Microcontroller as a Web-Based Door Monitoring Tool. JATI (Informatics Engineering Student Journal), 6(2), 767-772.