Automatic Private Weather Station (APWS) Prototype Using Node MCU with Telegram Monitoring

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Automatic Private Weather Station (APWS) is a tool used for weather monitoring in our surroundings. This tool can give us details about the location where this appliance is located, ambient temperature, air humidity, light intensity, rain value, wind speed, and the height position of the tool. The brain of the prototype is the ESP8266 Node-MCU-based Wi-fi module. In this tool, there are five sensors used, namely GPS Neo U-blox, temperature and humidity sensor (DHT11), raindrop module, Light Dependent Resistor (LDR), and Buzzer. In this study, a prototype of a private weather station was developed that can be monitored with commands on a telegram. Thus, access to weather information is more accessible and well-coordinated.
Keywords: IOT, Node-MCU ESP8266, Sensors, Telegram

I. INTRODUCTION

Nowadays, weather is one of the important factors that support the sustainability of human activities outdoors, both social, educational, economic, and so on. Indonesia, which is located at 6ºN-11ºLS and 95ºBT-141ºB T, causes the climate to be tropical and the weather with a tendency to change from time to time. Observation of weather which includes temperature, humidity, rain conditions, and wind speed is very important, considering that this information can be used as an important guideline in decision making [1].

The process of climate and weather monitoring in Indonesia is carried out by a government agency known as the Meteorology, Climatology, and Geophysics Agency or BMKG for short. [2] In carrying out its duties and roles, BMKG uses AWS instruments developed by Colombo universities. At first the instrument still used the universal serial bus (USB) as a data communication pathway, but it continued to be improved until data communication using GPRS technology. One of the shortcomings of this model weather station lies in the censoring area which is still universal in one particular area and not at the desired coordinates and access to information which requires the user to access the official BMKG page.

Given the central role of weather in human activities in various sectors, and the lack of access to weather information in real time and coordinated, it is necessary to develop weather station innovations which has portability and is easily accessible to users. In this study, a prototype of a private weather station was developed that can be monitored with commands on a telegram. Thus, access to weather information is more accessible and well-coordinated.

II. LITERATURE

2.1. Node-MCU

Node-MCU is an integrated microcontroller board with the ESP8266 WiFi module which functions as a network connectivity between the microcontroller and the Wi-Fi network.

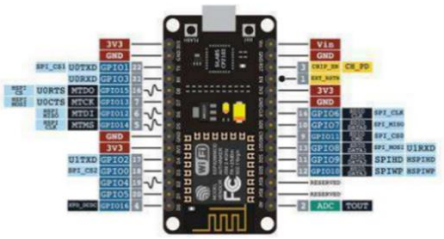

Figure 2.1. Node-MCU

Furqon, Prasetijo, & Widianto (2019) mentioned that nodemcu is a development of the ESP-01 ESP8266 family which is equipped with micro usb ports, push button reset, push button flash, and a larger number of ports [3]. Furthermore, Wicaksono (2017) stated that the Nodemcu ESP8266 has another advantage where this board can be programmed using the LUA language or C language through the Arduino IDE software [4]. The board is supported by the XTOS operating system, 120 K B of internal memory, and 4 MB of storage (Kodali & Mandal, 2016) [5].

2.2. Automatic Weather Station

Figure 2.2. Automatic Weather Station

The World Meteorological Organization defines Automatic Weather Station or (AWS) as a weather monitoring station technology that can automatically sensor and send the

reading data to the data storage system. Rusianto (2022) on the Meteo Nusantara Instrument men page explains that AWS plays a role in the observation, retrieval, and delivery of climate change and weather in certain regions and sends them to the data logger for further processing by users [6]. According to Sucipto, Hartawan, & Setiawan (2017) AWS can be designed according to user needs, where measurement parameters are generally temperature, wind speed, air humidity, and sunlight intensity [7].

2.3. Monitoring IoT Based Telegram Bot

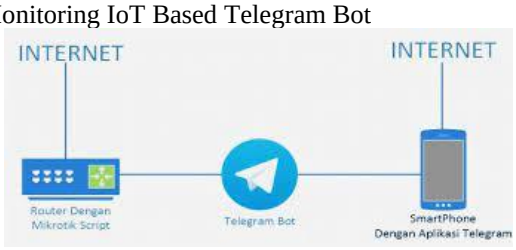

Figure 2.3. Telegram Bot

Monitoring is a process carried out in order to supervise or supervise, observe, and monitor something that is being implemented. According to Guna, Suyadnya, & Agung (2018) the purpose of this process is to get information on changes periodically to be processed and improved on an ongoing basis [8]. In its implementation, monitoring can be done in various ways, one of which is by using Internet media or better known as the Internet of Things. IoT itself is a term for data transmission media used when sending information to users, where distance and time barriers can be ignored (Ramdani, Wibowo, & Setyoko, 2020) [9]. The information that has been transmitted will be displayed on certain media, one that can be used is the telegram application by utilizing the features of third-party bots. Mailoa, Wibowo, & Iskandar (2020) explained that telegram bots are designed as a forum for developers to utilize open APIs and protocols to produce interactive, automated, and easily accessible media for users [10].

2.4. Method

2.4.1. Stages of Research

The steps taken in this study to build an APWS (Automatic Private Weather Station) type proto using Node-MCU with telegram monitoring are as follows:

a. Analyze the problem.
b. Conducting a literature study.
c. Create a software design.
d. Create a hardware design.
e. Software development.
f. Hardware development.
g. Testing.

2.4.2. Creating a Software Design

The creation of a software design begins with creating a working algorithm from APWS to ensure that the logic to be built can be understood by the microcontroller. The algorithm of this tool is shown in figure 2.4.

1. APWS connecting to WiFi.
2. APWS performs sensors around the area with predetermined parameters.
3. APWS stores data periodically in the variables that have been created.
4. APWS waits for input index requests from users via telegram commands.
5. APWS receives commands and sends data according to command requests sent by the user.
6. The user receives the requested data from APWS via a bot telegram named "Weather Station FT Unesa".
7. APWS is ready to receive the next command and continues to update sensor data results.

Figure 2.4. Algorithm of AS

The algorithm is then translated into a flowchart form to make it easier to develop software during the coding process. The flowchart of APWS can be seen in figure 2.5.

Figure 2.5. The flowchart of APWS

2.4.3. Hardware Design

The hardware design of APWS uses the main control in the form of Node-MCU ESP 8266. The sensors and actuators used in weather monitoring are shown in table 2.1. along with the pins used.

Table 2.1. Sensors and Actuators in APWS

Component Name	Sum	Pin
DHT 11	1	D2
GPS Neo U-blox	1	D3, D4
LDR	1	A0
Rain Sensor	1	D1
Buzzer	1	D0

After determining the type, quantity, and pin of each component, the next step is to design the wiring hardware design. This design will be used as a guideline when entering the hardware development stage of APWS. The results of the Wiring APWS design can be seen in figure 2.3.

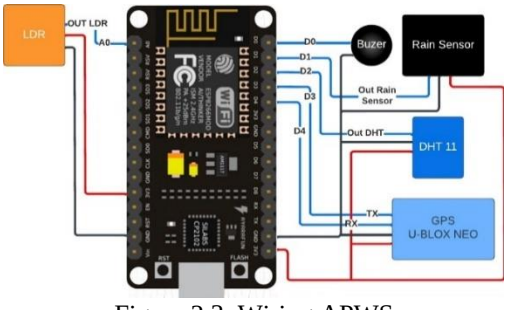

Figure 2.3. Wiring APWS

In the wiring design, the red line is a 5V DC voltage taken from the ESP8266 MCU node, while the black line is ground, and the blue line is I / O.

III. RESULT AND DISCUSSION

3.1. Research Results

The research entitled "Automatic Private Weather Station Prototype Using Node-MCU with Telegram Monitoring" produced a prototype of a small and portable weather station that can be used privately and can be monitored through an application telegram. Automatic Private Weather Station or APWS consists of Node-MCU as a data processing and processing unit, a sensor module as an input sense, and an actuator in the form of a buzzer as a marker for receiving and sending messages from or to telegram. The software development process uses the Arduino IDE and is uploaded to the Node-MCU board using a USB (Universal Serial Bus) connected to a computer / laptop.

The sensors attached to this APWS have different functions. The installed DHT 11 module is used to obtain temperature and humidity data, the LDR module is used to obtain light brightness information, the module Rain Sensor FC-37 is used to determine whether there is rain or not in the APWS installation environment. In addition, there is also a GPS U-blox neo 6m module that is used to obtain coordinate data for the APWS installation location, wind speed data coordinated, and Altitude data. All of these installed sensors use a voltage of 5V DC. This tool is operated with a working voltage of 5V DC obtained from the HP adapter plugged into the power source. The USB port used to upload programs, also acts as a power supply port when finished using it. Thus, it is easier to provide power at the Automatic Private Weather Station. Complete components such as Node-MCU, sensors, and buzzers are attached to the project-type PCB (Printed Circuit Board) board. The board is then inserted into a box made with 3D print, with customized models and component layouts. The shape of the APWS prototype can be seen in figure 3.1.

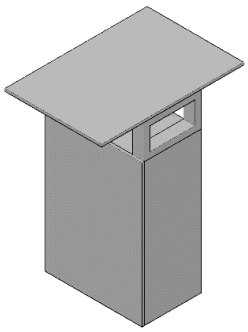

Figure 3.1. APWS Prototype

3.2. Device Discussion

3.2.1. Dimensions Automatic Private Weather Station

This Automatic Private Weather Station is made by prioritizing the principle of small and portable. This principle can be seen from the relatively small dimensions of the tool compared to AWS used by BMKG as a weather station for a particular area. The dimensions $p \times l \times t$ possessed by APWS are successively 15cm x 10cm x 5cm. The design form of the APWS that we have made can be seen in figure 3.1. The design of the upper part of the tool is made as a cross-section of the rain sensor and LDR sensor so that it can come into direct contact with rainwater and sunlight. The DHT 11 sensor is placed on the top of the box but protected by the roof. This is done so that the sensor can take data to the maximum from the temperature and humidity of the environment around the installation. The antenna from the GPS is placed next to DHT 11, because the antenna is directly related to the satellite so it requires safe outdoor placement. Other components such as node-MCU, buzzer, and driver of each sensor are inside the box. The resulting tool is expected to be a private weather station with a compact shape.

3.2.2. Telegram-Based Monitoring

The tool we developed uses the telegram application for interface monitoring because of the ease of access that telegram itself has when compared to accessing websites such as on AWS's BMKG. The advantages of being integrated with the AWS BMKG website, among others, are that it has a simpler system and appearance, is very efficient when compared to typing the website address and more real-time (monitoring time is only a few seconds).

Figure 3.2. Result of The APWS Monitoring

Based on the results of the APWS monitoring trial using the telegram application, data was obtained as in the following table 3.1.

Table 3.1. Data from The APWS Monitoring

Command	Data	Delay (s)
1	GPS	6,4
2	Temperature	5,9
3	Moisture	9
4	Lux Light	7,6
5	Rainy Conditions	8,9
6	Wind Speed	11,8
7	Altitude	9,3

There is a difference in delay even though it uses the same sensor, which is influenced by the buzzer that we use as an indicator that our APWS tool has received a monitoring command so that the delay length depends on how many times the buzzer sounded. As for us classifying the buzzer sound as in the following table 3.2.

Table 3.2. Classifying Buzzer Sound

Command	Data	Number of Sounds
1	GPS	2x
2	Temperature	3x
3	Moisture	4x
4	Lux Light	5x
5	Rainy Conditions	6x
6	Wind Speed	7x
7	Altitude	8x

3.2.3. Censoring By Coordinates

After we conducted several experiments in different places, the monitoring results were obtained as in the following table 3.3.

Table 3.3. Monitoring Result

Result Trial	Trial To-				
	1	2	3	4	5
GPS	unesa.me/alamat1	unesa.me/alamat2	unesa.me/alamat3	unesa.me/alamat4	unesa.me/alamat5
Temperature	29.00°C	27.80°C	30.60°C	31.40°C	29.00°C
Moisture	95.00%	95.00%	95.00%	72.00%	95.00%
Lux Light	1024 Lux	1024 Lux	615 Lux	1024 Lux	694 Lux
Rainy Conditions	Not Rain	Not Rain	Not Rain	Not Rain	Not Rain
Wind Speed	0.18 m/s	0.00 m/s	0.51 m/s	0.11 m/s	0.10 m/s
Altitude	17.50 mdpl	21.10 mdpl	30.30 mdpl	65.10 mdpl	37.00 mdpl

IV. CONCLUSION

4.1. Conclusion

From the research we have conducted, it can be concluded as follows:

- APWS or Automatic Portable Weather Station has a compact and portable design of p x l x t 15 x 10 x 5 dimensions. Monitoring can be done more easily and in real-time via telegram.
- Censoring from APWS is also more coordinated based on the place of installation, because the sensors are installed compactly with the board on the design.

4.2. Suggestion

The advice we can give based on this research is that APWS still has sensors that are limited to some parameters, and can be further developed. In addition, monitoring can be developed using other more efficient bases or protocols.

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