ISSN: 2460 – 7223

INTERNET OF THINGS (IoT): DESIGN AND BUILD MICRO CLIMATE SYSTEM CONTROL IN GREENHOUSE

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Abstract- **Conventional *greenhouse* technology has been replaced by the development of *Smart Farming*. In green house that use *smart farming* technology, there is monitoring and control system. The measurable growth factors for *tomato* are temperature, room humidity and soil moisture. Regional characteristics and climate factors are often unpredictable and cause these factors to inhibit the growth of tomato. In this system, it is made by *monitoring* and *controlling* room temperature, soil moisture according to the needs of tomato. In this system, to detect temperature and soil moisture, the DHT11 sensor is used, while the soil moisture sensor is used to detect soil moisture. NodeMCU ESP8266 acts as the main brain or microcontroller in the Micro Climate System. This monitoring system can measure temperature, room humidity and soil moisture levels, and can control the system to match the appropriate parameters.**

Keywords- **Internet of Things, tomato, Smart farming, Greenhouse, Controlling, Monitoring.**

I. INTRODUCTION

Indonesia has horticultural commodities which are seen as a source of new growth in the agricultural sector, because they have high market potential. Along with the increase in Indonesia's population, public demand for horticultural products in the country is expected to increase. Horticultural commodities consist of vegetables, ornamental plants and medicinal plants and fruits, these four parameters have an important role in fulfilling community nutrition and economic potential in Indonesia[1]. According to the Ministry of Agriculture, the demand for vegetables and fruits is very high, the horticulture sub-sector grew 7.85 percent in the fourth quarter of 2020 in Indonesia[2]. The large appleimport of horticultural products, especially fresh fruit, shows that domestic production has not been able to contribute to meeting their needs. To encourage the increase in domestic fruit production and quality, over the last few years the Directorate General of Horticultural Production has launched a program to establish production center areas and increase crop production in Indonesia by utilizing technology that can overcome the problems of crop production in Indonesia. Only by producing high-quality fruit in sufficient quantities can Indonesia stem the entry of imported fruit. Tomatos as one of the fruits that are dependent on imports are the most needed commodities by the community, this can be seen from the high import value of tomatos compared to other imported fruits. In increasing the production of tomatos, it cannot be applied in any area because each area has different land characteristics[3]. One way to determine a suitable location for the development of tomato is to pay attention to the agro-climatic parameters, namely climatic factors which include air temperature, air humidity and soil moisture [4]. These three factors greatly determine the growth, development, and production of plants because the tomato fruit plant. With the rapid development of technology, Indonesia is forced to follow these developments in the agricultural sector, one of which is by following the sophistication of Internet of Things (IoT) technology. The development of agricultural systems to be automated and connected to the internet can be called the Smart Farming system[5]. To overcome the above problems, an innovation is needed that aims to help increase the production of tomatos to be much easier, economical (cost-effective), minimize labor costs and increase crop yields and provide better production, by using a Smart Farming system that can see from 3 parameters, namely controlling and monitoring air temperature, air humidity and soil moisture[6]. then formed the system "Micro Climate System (MIS)". Where the system will be built based on a website and able to make the stability of air temperature, air humidity, and soil moisture more monitored and controlled.

II. METHOD

A. Diagram of System

From the accompanying image the input grooves are temperature sensors and air moisture (DHT11), soil - moisture sensors. The complete sequence of processes in the system of processing data that are read by sensors which microcontroller esp8266 as both control and client and initially enabled will seek wi-fi connections. Nodemcu will send the value of air temperature, air humidity, and soil humidity to the server so it will be shown on web in real time. At the output or output contains lights for lighting and heating, fans for air circulation, water pumps for watering plants, and LCD as an indicator viewer on the device. can be seen in Figure 1.

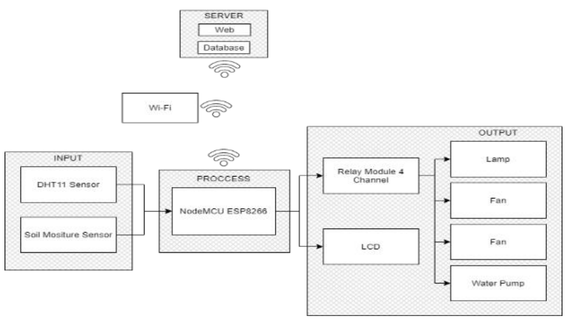

Figure 1. Microclimate System Hardware Design

The operating system of the entire set above is that the device has web control input and monitors accessible on smartphones, computer personnel and devices that support the web browsers. Web controls and monitors will be used if nodemcu is online and then nodemcu can be used as a relay control that is used to power lights, water pumps, and fans. DHT11 sensors are used to measure air temperature and air humidity on smart green house while soil levels are used to measure soil humidity on smart green house in which both sensors can be monitored in real time on the website.

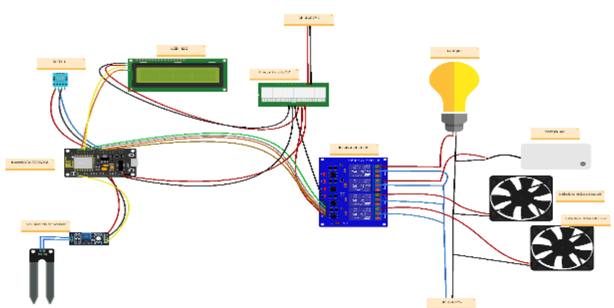

Figure 2. Micro climate System Circuit

B. Principles and System Work

The DHT11 sensor circuit is used to measure air temperature and humidity where the sensor measurement results will be processed by the NodeMCU so that it will be displayed on a web page in real time. The image of the DHT11 sensor circuit and its layout can be seen in the following figure 3.

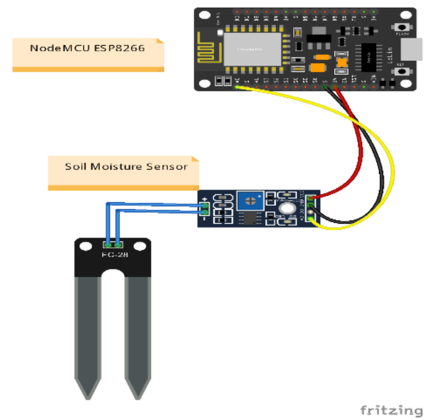

Figure 3. Soil Moisture Sensor Diagram

In the DHT11 sensor circuit the VCC pin (red wire) is connected to the power pin (3v), the GND pin (black wire) is connected to the DHT11 pin, the DATA pin (blue wire) is connected to the D6 pin on the NodeMCU.

the output of the soil moisture sensor changes its value from 0-1023. so that it can be converted to a percentage, you can use the following equation:

$$\text{Soil\_Moisture} = (100 - (\text{ADC value}/1023) \times 100)$$

The Soil Moisture Sensor circuit is used to measure soil moisture where the sensor measurement results will be processed by the NodeMCU so that it will be displayed on a web page in real time. The image of the soil moisture sensor circuit and its layout can be seen in the following figure.

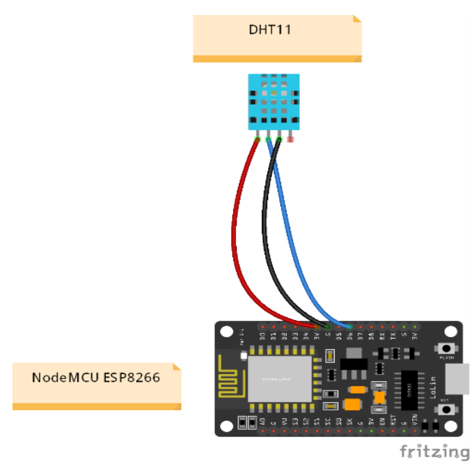

Figure 4. DHT11 Sensor Diagram

In the soil moisture sensor circuit the VCC pin (red wire) is connected to the power pin (3v), the GND pin (black wire) is connected to the soil moisture sensor pin, the DATA pin (yellow wire) is connected to pin A0 on the NodeMCU. This is because the data to be taken on the soil moisture sensor is analog.

Users can control and monitor from afar using the website as in Figure 5. There are three options on the controller's menu with two on/off switches that are used to control lights, water pumps and fans. The monitoring menu has three measured parameters of air temperature, room humidity and soil humidity. To get a good measurement, the calibration of the sensor can be done first.

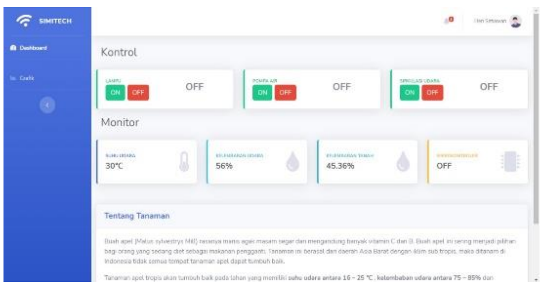

Figure 5. website desktop display

C. System Control Algorithm Design

From Figure 6 above, it is explained that the process flow starts from the initialization of the microcontroller with Wifi, if the on button is pressed then the lights, water pump (nozzle), water pump (drip hose), and fan will turn on by displaying the status on the ON status web page, if the off button is pressed then the lights, water pump and fan will turn off by displaying the status on the OFF status web page.

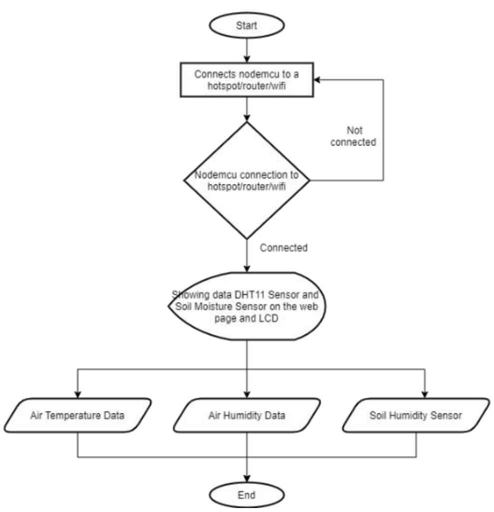

Figure 6. flowchart controlling of system

From Figure 7 above, it is explained that the process flow starts from the initialization of the microcontroller with Wifi and then displays the DHT11 sensor data and the Soil Moisture Sensor in the form of room temperature data, room humidity, and safe soil moisture. This data is displayed on the website and LCD.

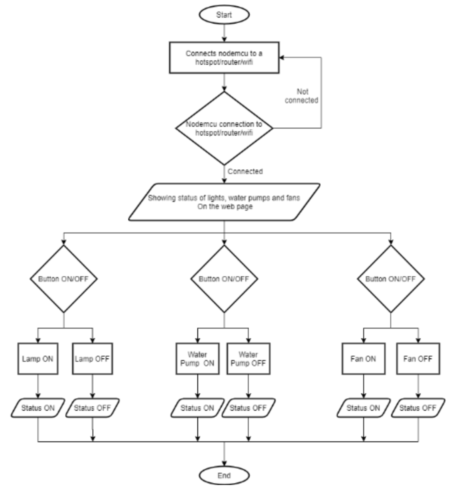

Figure 7. Flowchart Monitoring of System

III. RESULT AND ANALYSIS

A. Application Testing

These tests are performed to test and know that the created applications can be connected and run properly. This tests were performed by sending commands through the smart green house application with the push of the button on the application intelligence on websites that contain commands to turn on or off electrical appliances. In this test the smart green house android app provided some guidance to link into the system. The following guidelines including:

1. Press the keys-to connect the application to the system.
2. Press the button-disconnect button for applications with systems
3. Press the button ON "lamp" - to turn the light on.
4. Press the button OFF "lamp" - to turn the light off.
5. Press the button ON "water pump" - to turn the water pump on .
6. Press the button OFF "water pump" - to turn the water pump off.
7. Press the button ON "fan" - to turn the fan on .
8. Press the button OFF "fan" - to turn the fan off.

If a user immediately presses the button to turn on or off an electrical device without pressing connect the first button, then the notice will appear.

B. Testing Tool

To get accurancy of monitoring and controlling home electronic equipment with feedback form controlled devices via sensors that produce status on website as a sign, displayed in the form of measurement tables as follows

Table 1 accuracy of monitoring and controlling

No	Controlling	Time Feedback(second)	Monitoring
1	Button Lamp on	5	Lamp on
2	Button Fan 1 on	5	Fan 1 on
3	Button Fan 2 off	5	Fan 2 off
4	Button Pump on	5	Pump on

Time average feedback=$\frac{(5+5+5+5)}{4}$

Time average feedback = 5 second

IV. CONCULSION

The control system design works according to orders given through the Internet using websites. Able systems control the three electrical appliances that are the lights, the water pump and the fan. System testing may work just fine, command to turn on or off electrical appliances goes on in just a few seconds and feedback from the system to the status of the website is Life or death goes well for 5 seconds.

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