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IOT Implementation Energy consumption for Indoor Orchid Cultivation based on WeMos

Anton Breva Yunanda[1], Agung Kridoyono[2], Mochamad Sidqon[3]

[1,3]Teknik Informatika, Universitas 17 Agustus 1945 Surabaya

Semolowaru No. 45 Surabaya

[1*] antonbreva@untag-sby.ac.id, [2] akridoyono@untag-sby.ac.id, [3] sidqon@untag-sby.ac.id

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Abstract

Orchids are epiphytic plants with high popularity. Orchid is a plant that can process its own nutrients with the help of other media. Parameters that need to be monitored include air temperature, air humidity, and soil moisture. These parameters greatly affect plant growth. Plants can grow well if humidity, temperature, and light intensity are met properly. Good orchid humidity ranges from 50 – 80%. Humidity should not be too high at night and not too low during the day. In addition to humidity, the temperature where you plant orchids must also be maintained. The ideal temperature for orchids is daytime temperatures between 27-30 degrees Celsius and night temperatures between 21-24 degrees Celsius. Based on these problems, a Design and Development Tool for Monitoring Soil Temperature and Moisture on the Growth of Indoor Orchid Plants is Based on WeMos with Indoor Energy. In this design, the results of sensor readings will be displayed in the form of data which will be accessed via the web server on WeMos. To read the temperature, air humidity, and soil moisture, several sensors are used, namely: DHT 22, soil moisture sensor, and a relay connected to a mini water pump using an indoor cultivation method where the energy source uses UV waves by LED light. From the results of the implementation and testing, the growth period will be obtained more faster than the normal cultivation. hopefully, this research will help people who care for orchid plants to be able to monitor their orchid plants efficiently in indoor conditions so that these orchid plants can always be in the best conditions of temperature, light, and soil moisture.

I. INTRODUCTION

The orchid flower family in Latin is called Orchidaceae, which is a type of flower plant with the most diverse and largest members of the type or tribe. This type is widespread from the tropics or wet tropics to the circumpolar region, although its members are found in the tropics, most members of this tribe live are known as epiphytic plants, especially populations originating from the tropics. Orchids in other

[1*] Corresponding Author

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climatic conditions such as those in temperate climates usually thrive in soil media and form tubers as a way of adapting in winter. Organs that tend to be thick and "fleshy" (succulent) are prepared under conditions of minimum water availability. Epiphytic orchids can thrive in conditions of dew and moist air.

Approximately 5000 species of orchids are found in Indonesia**[1].** Of the thousands of species of orchids in Indonesia, several genera have high commercial value, such as the genera Dendrobium, Vanda, Phalaenopsis, Cattleya, Oncidium, Renanthera, Aranda, and Cymbidium. Dendrobium is a type of orchid that is commonly cultivated because it produces charming flowers, distinctive shapes, and various colors, and has a unique flower crown[2].

The Dendrobium orchid comes from the word "which grows on living trees and has about 1,400 species that are very widely distributed throughout the world, from Japan, China, India, the Malacca Peninsula, Indonesia, New Guinea, to Australia. This orchid has charming flowers and its types are also among the most numerous [3] In general, the light requirements of Dendrobium orchids are around 35-65%. Dendrobium orchids require air humidity during the day ranging from 50-80% and during the flowering season around 50-60% [4] Orchid plants will grow well if their water needs are met. So that the frequency and amount of watering are very dependent on the weather (temperature, wind, and light), the type, size of the plant, and the environmental conditions of the plant[5]**.** Excessive watering will cause rot disease caused by bacteria or fungi [6]

The obstacles in our cultivation are used as input as a trial of indoor cultivation in the form of tools for monitoring soil temperature and humidity in orchid plants as well as light energy assistance using IOT-based UV light. In dry humidity, the orchid plant's need for water is difficult to fulfill, and in too dry conditions orchids are also more susceptible to growth disorders such as disease and dehydration. IOT-based electricity consumption is necessary for obtaining the power requirements of the microprocessor and is needed to determine the efficiency and effectiveness of a system against the required energy value**.** [7]

II. RELATED WORKS

A. Arduino Wemos R2

Wemos D1 R2 is a WiFi-based microcontroller unit based on the ESP8266 chip which is used to receive and request data via a radio wave connection where the condition of the orchid planting media will be monitored. The ESP8266 is a system-on-a-chip capable of 2.4 GHz Wi-Fi, 16 GPIO (General-Purpose Input/Output), I2C (Inter-Integrated Circuit), 10-bit ADC (Analog-to-Digital Conversion), SPI (Serial Peripheral Interface), UART and PWM (Pulse-Width Modulation) so that they become a reference for the development of IoT, especially in the agricultural sector in this research. Wemos itself is a derivative of Arduino UNO which is specifically designed for IoT purposes so for this development it also uses tools from Arduino which are added to the wireless communication process library.

B. RH sensor YL-69

The YL-69 soil moisture sensor is a sensor consisting of two probes to pass an electric current through the soil, then read its resistance to obtain a moisture level value. Therefore, when the sensor is inserted into the dry planting medium, its resistance is greater than the value in the soil which has a higher moisture content, so it is used to monitor the humidity of the media in orchid plants.[8]

C. Indoor farming

indoor agricultural cultivation or indoor light intensity [9]. Indoor orchid farming, also known as indoor orchid farming or home orchid farming, is the practice of growing orchids in an indoor environment. This is a popular choice for those who live in areas with climates that do not support the natural growth of orchids or the beauty of orchids indoors.

Important points to consider in indoor orchid farming are:

1. Light: Orchids need proper light to grow either naturally or with the help of UV light. Position the orchid near a window that provides sufficient light, but avoid direct sunlight which can burn the orchid leaves. If natural light is limited, special grow lights to provide sufficient artificial light.

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2. Temperature and Humidity: Orchids tend to do well at a certain temperature and humidity. Most orchids need temperatures around 20-30 degrees Celsius during the day and around 15-20 degrees Celsius at night. Relative humidity of around 40-70% is also important for healthy growth. temperature and humidity gauges and a humidifier to monitor and regulate these conditions.
3. Growing Medium: Orchids need a good growing medium for their growth. Use a mixture specifically designed for orchids, such as cocopeat, fern fiber, or tree bark mixture. Make sure the planting medium has good drainage quality to prevent accumulation of excess water.
4. Watering: Orchid water requirements can vary depending on the species. As a general rule, wait until the growing medium is almost dry before watering the orchid again. Make sure there are no standing water under the orchid pot, as this can cause root damage.
5. Fertilizer: Apply fertilizer wisely to support orchid growth. Use a lower concentration of a specific orchid fertilizer and apply it according to label directions. Fertilizer application is usually done during the active growth of the orchid.
6. Ventilation: Indoor orchids also need good ventilation for healthy air circulation. Make sure there is adequate airflow around the orchid, but avoid high winds or overly dry conditions.

The right light intensity is very important for the growth and health of the orchid plant.

1. Low Light: Some orchid species, such as Phalaenopsis (butterfly orchid), Dendrobium, and Paphiopedilum (shoe orchid), do well in low to moderate light. They usually grow in shady natural habitats in the shade of trees or in low-light environments. For these orchids, simply position them near an east window or a window that provides fairly soft light, but avoids direct sunlight which can burn the leaves.
2. Medium Light: The majority of orchid species require moderate light intensity. They grow well under bright but indirect light. Position your orchid near a south window or one that provides bright, diffused light. If the sunlight is too strong, use blinds or shutters to filter the light.
3. High Light: Some orchid species, such as Vanda and Cattleya, require more intense light. They grow in natural habitats that are exposed to direct sunlight or strong bright light. For these orchids, position it near a south window or use a grow light that provides a high light intensity. Be sure to avoid excessive exposure to direct sunlight, which can damage the orchid's leaves.

In addition to light intensity, light duration is also important for orchids. Most orchids need around 10-12 hours of light each day. use additional grow lights to extend the light duration if needed.It is important to understand that an orchid's light preferences can vary depending on the species.
The intensity of light needed by orchid plants varies depending on the species.

1. Low Light: Some orchid species, such as Phalaenopsis (butterfly orchid), Dendrobium, and Paphiopedilum (shoe orchid), do well in low light. A light intensity of around 1000-1500 foot-candles (about 10000-15000 lux) is considered sufficient for these species. Low to medium light or soft diffused light will give good results.
2. Medium Light: Most orchid species require moderate light intensity. A light intensity of around 1500-3000 foot-candles (about 15000-30000 lux) is considered ideal for these species.
3. High Light: Some orchid species, such as Vanda and Cattleya, require a higher intensity of light. A light intensity of around 3000-5000 foot-candles (about 30000-50000 lux) is considered ideal for these species. These orchids can be placed near a south window or use grow lights that provide intense light. Avoid excessive exposure to direct sunlight, which can damage the orchid leaves.

III. METHODS

A. Technical Specifications

The technical specifications used for this research are to design a Monitoring Tool for Soil Temperature and Moisture in Orchids in a WeMos Web Server-Based Room.

Specifications as follows:

1. The microcontroller used is Arduino WeMos D1 R2.
2. The sensor uses a dht22 sensor which functions to determine the temperature and humidity in the indoor room.
3. The sensor uses a soil moisture sensor YL-69 which functions to detect the humidity level of the planting medium, whether the soil is dry or wet (moist).
4. Mini pump for watering the growing media around the orchid plants.
5. Web Server on WeMos which is used for users to access temperature and humidity data on orchid plants to be monitored.

The use of a microcontroller as a controller and a web server from Wemos as an output for monitoring temperature and humidity. Here using the DHT 22 temperature and humidity sensor, the output from the DHT 22 sensor is already in the form of digital data so there is no need to use a voltage converter from analog data to digital data. The sensor that will be used next is the YL-69 soil moisture sensor which can measure soil moisture with analog data or digital data, with analog data the data will be more detailed than digital data which has a HIGH value if the soil resistance is large (moist) and will be worth LOW if the soil resistance is small (dry). The YL-69 soil moisture sensor will also have an effect on the mini water pump connected to the relay. The YL-69 sensor will read the ground resistance which if it has dry conditions will turn on the mini water pump connected to the relay.

Wemos with an onboard WiFi module is used as a connection from the user to access Wemos. Wemos will later process data from the DHT 22 and YL-69 sensors, which will later be displayed on a Web Server like Wemos. The user will access the IP address obtained from Wemos by means of a WiFi connection. Then the user will open a browser and access the IP address obtained then the temperature and humidity values of the orchid media will appear on the web.

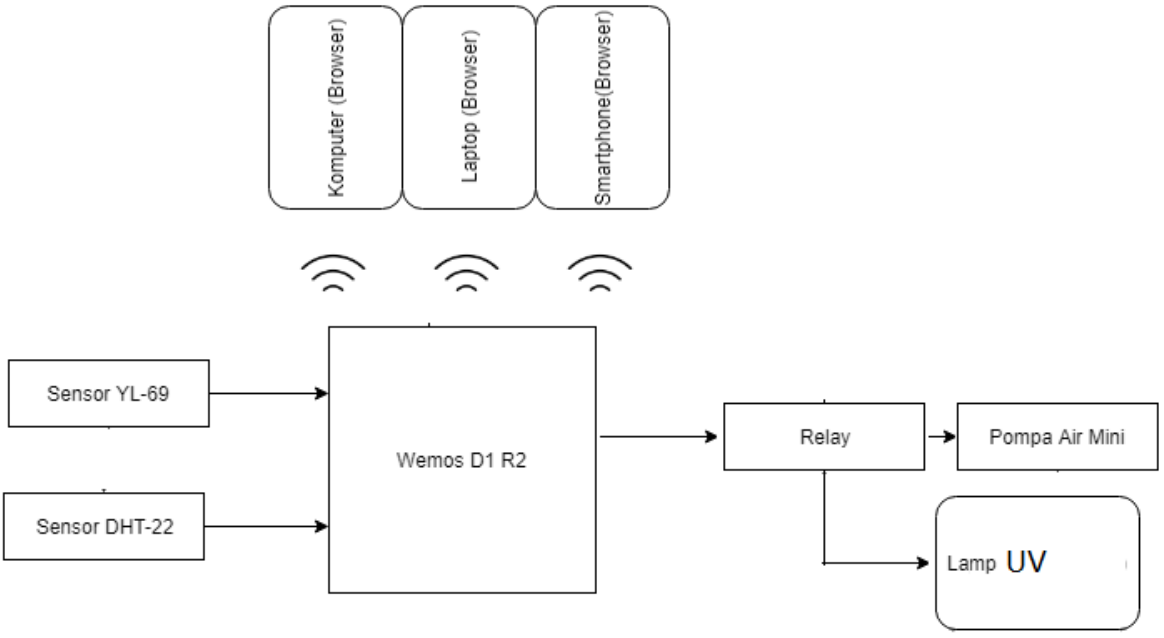

Figure 2. Block diagram of a mobile-based orchid monitoring control system

Figure 2 shows Wemos as the brain of the system, all devices connected to Wemos. internet wave wireless communication using the Arduino Integrated Development Environment or Software IDE base. Arduino IDE to carry out the process of monitoring orchid plants by reading input and responding to issuing the process as output.

The DHT22 sensor and YL-69 sensor will read the temperature and humidity in the orchid plants. The temperature and humidity data obtained will be processed by Wemos. In Wemos there is a Web Server feature where later the temperature and humidity data will be displayed on the web. The connection used is wireless using WiFi on Wemos. After WiFi on Wemos is activated, the user will log on to that WiFi and access the IP provided by Wemos. Users access it with a browser from their gadget and then information about temperature and humidity on their orchid plants will appear in real time.

B. Schematic Circuit

Making the hardware consists of making a schematic circuit, namely the connection between Wemos and the DHT22 sensor and Wemos with the YL69 sensor.

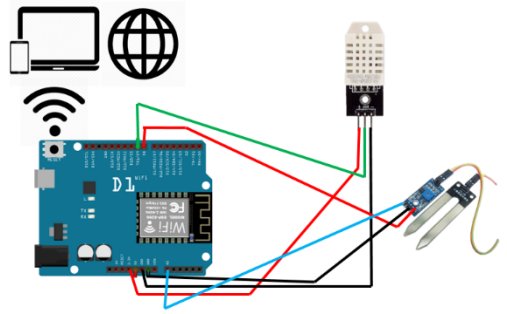

Figure 3. Circuit diagram

The figure 6 shows design of the tool, which includes Wemos with the DHT 22 module, Wemos with the YL-69 Sensor, and Wemos with the user using a WiFi connection, then the user accesses the IP provided by Wemos so that it can be accessed via a browser.

IV. Results And Discussion

At this stage an analysis of system requirements is carried out. A needs analysis is carried out to gather information about soil temperature and humidity in order to start the water pump.

The use of this tool controls a wide variety of components and for components such as DHT 22 sensors, YL-69 soil moisture sensors, relays and mini water pumps.

1. The DHT 22 component functions to determine the temperature and humidity of the air around the orchid plant.
2. The YL-69 soil moisture sensor component functions to determine the soil moisture level.
3. The relay component functions as a switch to turn on a mini water pump which will water the orchid plants if the soil around the orchids becomes dry.

The method of use in the series that has been described will produce a tool for monitoring soil temperature and humidity in orchid plants which will help orchid plant nurses in monitoring their orchid plants.

A. DHT Sensor Calibration and Measurement

Tests and measurements in this circuit aim to find out and compare the accuracy level of the Humidity Sensor (DHT 22) with standard temperature sensors that are sold in the market. The test and measurement steps are to insert the DHT 22 sensor into the humidity control box.

Table 1. DHT 22 Temperature Sensor Block Test Results

DHT 22 (Celcius)	Standar (Celcius)	Error %	Accuracy Ketelitian %
29,00	27,60	1,9	98,1

B. Web appearance testing

Testing the display on this web to find out whether the web server on Wemos is working properly. Testing is carried out by accessing the IP Address assigned to the user to be accessed via a web browser.

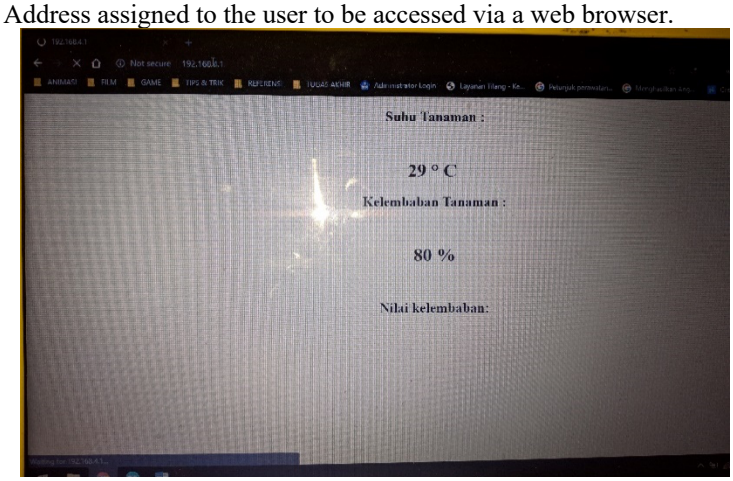

Figure 6. The value of temperature and humidity via web

C. Testing of Relay and Pump Circuits

This test is carried out to find out whether the relay will work with a water pump as output. Where there are conditions if the ground is dry then the relay will turn on and turn on the pump.

Figure 7. Hardware appearance indoor orchid cultivation

power consumption in kilowatt-hours (kWh) for each IoT device for one week are as follows:

Table 2. Power consumption table

Day	Temperature and humidity sensors	Lighting control	Water pump
1	0.05 kWh	0.1 kWh	0.08 kWh
2	0.04 kWh	0.12 kWh	0.07 kWh
3	0.05 kWh	0.11kWh	0.08 kWh

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4	0.04 kWh	0.09 kWh	0.06 kWh
5	0.06 kWh	0.13 kWh	0.09 kWh
6	0.05 kWh	0.11 kWh	0.08 kWh
7	0.04 kWh	0.1 kWh	0.07 kWh

Temperature and humidity sensors:

Difference = [-0.001, -0.011, -0.001, -0.011, 0.009, -0.001, -0.011]

The mean squared difference = 0.00012857

Standard deviation = root(0.00012857) ≈ 0.01133 kWh/day

Lighting control device:

Difference = [-0.008, 0.012, 0.002, -0.018, 0.022, 0.002, -0.008

D. Results in orchid cultivation

From the results is working very well but at the indoor cultivation of the orchid plant there is a change in water level with the provision of UV light for illumination where the result is drier to the edge then to the center of the growing stem.

V. CONCLUSIONS AND RECOMMENDATIONS

From the results of calculating the standard deviation of the power consumption of IoT devices, we can draw the following conclusions:

The temperature and humidity sensors have a standard deviation of about 0.01133 kWh/day. This shows that the power consumption of these devices tends to be consistent and has relatively small variations from the daily average.

Lighting control devices have a standard deviation that has not been calculated, but by looking at the power consumption data provided, we can see that the variation in power consumption of these devices is more significant compared to temperature and humidity sensors. This may be due to differences in the required light intensity on certain days.

The water pumps also have an uncalculated standard deviation, but based on the power consumption data provided, there appears to be relatively little variation in the power consumption of these devices.

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