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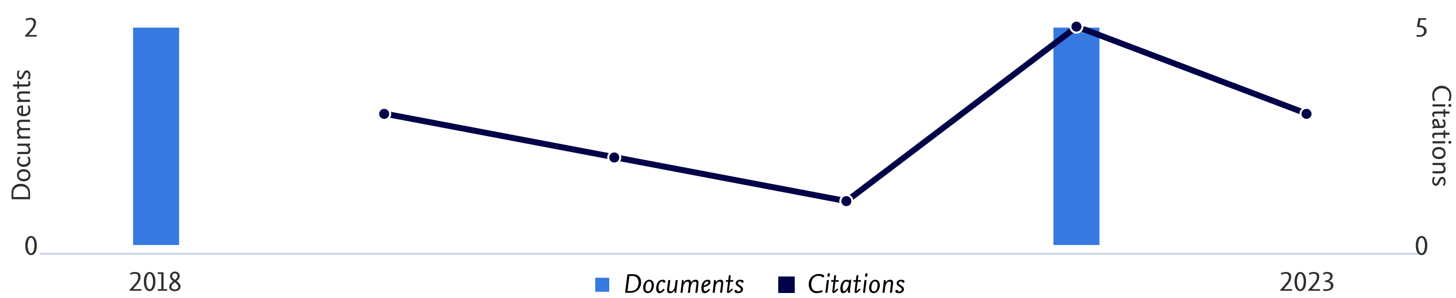

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Contents

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Development of Internet of Things System for Environment Control in Niam Hom (Strobilanthes nivea Craib) House

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***Abstract*—This research aims to 1) Study the use of IoT technology to measure soil moisture and air humidity and control water spraying and brightness values in Niam Hom Houses, and 2) Develop systems and tools for users to monitor and record the house's temperature, soil moisture, air humidity, and brightness values. The development tool uses Arduino MEGA and NodeMCU ESP8266 to connect the sensors to obtain data from a specific environment. Design and control the measurement circuit system in the farmhouse with a size of 4 x 6 meters using black shading nets of 50% and 70%. The IoT system helps to control soil moisture, and the air humidity is good, making onion trees grow well. Good yield and different physiology in black shading net 50% in combination with chemical fertilizer application.**

Keywords— Internet of Things, Niam Hom, NodeMCU, Control system, Temperature, Humidity

I. Introduction

A. Background

Niamh's scientific name is Strobilanthes nivea Craib. Acanthaceae is classified in the family found only in Thailand [1], which is present. Niam Suea (Plectranthus amboinicus) and Niam Om (Chloranthus spicatus) leaves have a pungent odor commonly eaten with the food Laab to deodorize the fishy odor. Niam Soi is grown as an ornamental plant, or The leaves are eaten as fresh vegetables. Niam Hom is a plant with fragrant leaves similar to pandan leaves, but the leaves are darker, more fragrant, and have a pleasant, sweet perfume that lasts for several weeks. A distinctiveness that gives a long aroma when cooked in Thai aromatic spices makes them stand out, such as baking water, seasonings, flour paste, and other fragrances. Suppose there is a shortage of Niam Hom. In that case, the scents mentioned above are incomplete, which makes Thai fragrances different from other perfumes. In addition, the aromatic leaves are used to flavor drinks, including ancient people's tobacco, By putting it in a tobacco box to make it smell good or set in the mortar. When chewing betel nut, there will be an aromatic odor in the mouth. It may also be preserved in alcoholic beverages using a few leaves. Nap Fai soaked in the drink will make it taste smoother and more inviting. Niam leaves are another interesting herbal remedy; they smell like pandan leaves. Fresh leaves are used for dizziness, fainting, and expelling wind in the intestines; some are boiled for women after giving birth to bathe. Used to make a compress and put it in medicine to help reduce bruising and swelling, causing blood to spread. Fresh and dried leaves are brewed as a tea to drink for fever, cough, cold, and asthma.[2] The dried leaves are used to make medicine. The Chinese used the root to treat malaria and to make poultices for abscesses or acne. The decline in Niam Hom is significantly consistent with Thai aromatic spices because Niam Hom will be the main incense. When the popularity declined, Niam Hom also disappeared. Modern Thai people are unfamiliar with the onion plant, which has become relatively rare. Moreover, believed that shortly it may be on the verge of extinction. The selling price per plant in the current market is relatively high.

Fig. 1. Strobilanthes nivea Craib

Because the leaves are a species that may become extinct in the future, the researcher came up with the idea to use the Internet of Things to help manage the aromatic herbs in a limited area to get the most benefit from connecting to a microcontroller device that uses receive-send signals to control the on-off command. The water spraying system and on/off switch for the exhaust fan to manage humidity and temperature in the houses. Fields in Niam Hom are sprayed with water to increase their moisture content. It helps gather data and regulate parameters like light intensity, wind speed, and air and soil humidity. This will give thorough, precise, and correct information that can be communicated to the relevant parties. Immediate analysis and assistance with ordering decisions are possible. Including lowering the duration of administration and care to make it more practical and expedient. As with karma, watering, fertilizing, camouflaging, trimming, planting, and harvesting medicinal plants at the right time will stimulate their development. It can boost the production (leaves) and quality of onion plants. The environment is managed by applying the appropriate management technology in the appropriate setting.

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B. *Research objectives*

1) Study the use of IoT technology to measure soil moisture and air humidity and control water spraying and brightness values in Niam Hom Houses.

2) Develop systems and tools for users to monitor and record the house's temperature, soil moisture, air humidity, and brightness values.

II. Literature Review

NodeMCU is an open-source IoT platform. It contains firmware on the ESP8266 WI-FI SoC (System-on-chip) from Espressif Systems Company (from Shanghai, China). It is a 32-bit Microcontroller. It is a 32-bit Microcontroller. In this research, NodeMCU used an ESP8266 module, similar to the Arduino, which has built-in input and output ports and is compatible with Arduino IDE, where programming C++ can write. Compiling and flashing programming codes can be done using a micro USB. NodeMCU has advantages over Arduino, which is smaller and can connect to a WIFI system.[3]

Blynk is the internet of things platform aimed to simplify building mobile and web applications for the Internet of Things. Easily connect 400+ hardware models like Arduino, ESP8266, ESP32, Raspberry Pi, and similar MCUs and drag-n-drop IOT mobile apps for iOS and Android.[4]

Wireless sensor network system and accessories for use in rubber plantations. The system can measure various environmental values such as humidity and temperature in the air, light intensity values, humidity, and temperature inside the soil. It can communicate over long distances using a multi-hop communication method. It can be configured to send data back to nodes for a specified time. Users can check various values through the application. Alternatively, we can check the data within the database if we want to analyze the previous data. [5][6]

This study demonstrated a smart farm application that boosted the yield of the Schizophyllum commune. This study aimed to examine the performance of the smart farm control system and compare the product from greenhouses equipped with the smart farm system (experimental set) and conventional greenhouses (control set). The system was controlled automatically by a programmable logic controller. The system was designed to gather and show temperature and humidity data on the Google platform. The system was subsequently evaluated before installation in the experimental set. After harvesting, the findings demonstrated that the smart farm system operated precisely and effectively. Temperature and humidity error percentages averaged 4.37 and 4.20 percent, respectively. In addition, the yield of Schizophyllum commune from the experimental set was 6,861.29 grams, which was 1.99 times more than the yield from the control set (3,443.20 grams). At the 0.05 level, the weight differential finding was statistically significant. Ultimately, the smart farm system significantly increased the cultivation efficiency of the Schizophyllum commune for farmers. [7]

The versatile controller is developed to monitor and control temperature and relative humidity in different ways to serve different types of use. Control methods can be arranged in different sequences and periods, including timer, hysteresis, and condition control. Eight multifunction output ports are available for actuators or loads. Results from actual implementation are shown. Temperature and humidity in a greenhouse can be controlled in predefined ranges to suit planting processes. Data on the cloud can be monitored in real-time on a PC or mobile application.[8]

This project develops a wireless network system for monitoring real-time data, as well as a user interface and system automation, by leveraging a dynamic website and teaching machine learning to our IoT system to automate the process. The critical difficulties in mushroom farming are irrigation, environmental parameter monitoring, and limited human participation. The Raspberry Pi model B+ also serves as the system's brain, to which various ESP8266 nodes connect to receive real-time data updates. The dynamic website functions as both a user interface and a tool for automating the process. All of the issues can be solved using the approach employed in this study. The Biosensors may be used to detect the presence of microorganisms and the moisture content of the soil.[9][10]

This research aims to prototype a smart Lingzhi mushroom farm that is applied to the internet of things with a sensor to measure and monitor humidity in the Lingzhi mushroom farm. The humidity data is processed through NETPIE. This data was stored in a NET FEED and displayed on mobile devices and computers through NET FREEBOARD. It also automatically controlled sprinkler and fog pumps, and the functional status switched on and off for push notifications through LINE API on the LINE Application. The research results showed that using IOT with the sensor enhanced the prototype of smart farming. [11]

III. Research Methodology

We used the waterfall model of the system development life cycle (SDLC) [12] and 5 steps in this research. Following are the requirement and feasibility study, system analysis, design, implementation, system validation, and maintenance.

A. *Requirement and Feasibility study*

This research required a study to compile documents and equipment used in a research project on developing temperature, humidity, and brightness control systems in a house using Internet of Things technology focused on receiving values from sensor devices. Various related and send that value through the Internet to Blynk System for control and storage. Such research has chosen NodeMCU ESP8266 and Arduino MEGA to be used with the sensor AM2315 Module can measure temperature and humidity in the same device Capacitive Soil Moisture Sensor 1.2 to measure soil moisture Module SI1145 Digital UV/IR/Visible Light Sensor capture as for the load control of various electrical appliances. The need to measure the environmental conditions can be summarized as controlling soil moisture, air humidity, light intensity, drip irrigation, and spraying water through the application. Turn on-off Automatic or manual can save data. Soil moisture value and air humidity value can be obtained through a cloud system and display soil moisture value, air humidity value, temperature value, and light intensity value via mobile phone.

For this research, we selected tools and software shown in Figures 2-3 and table 1-2.

TABLE I. HARDWARE AND PURPOSE OF THE USE

Hardware	Purposes of use
NodeMCU ESP8266	Control devices and send data into Internet via WIFI connection
Arduino MEGA	Control devices and send data.
Digital Temperature and Humidity Sensor (AM2315)	to measure digital temperature, and air humidity in the same device
Capacitive Soil Moisture Sensor 1.2	to measure soil moisture
SI1145 Digital UV / IR / Visible Light Sensor	a dynamic light sensor digital UV / IR / Visible Light Sensor
LCD screen I2C Interface	an easy-to-use display module
Relay 2-Channel DC 5V 30A 220v	Connect the circuit like a switch by controlling the operation with an electrical Relay
Fog Pump	Make a fine mist spray to add humidity to the environment in the house.
Solenoid Valve	used to control the on-off of the water system.

TABLE II. SOFTWARE AND PURPOSE OF THE USE

Software	Purposes of use
Arduino IDE	The open-source Arduino Software (IDE) does write and upload code to the board quickly.
C++ on Arduino IDE	Programming language on NodeMCU
Blynk Application	to control Arduino, ESP8266, Raspberry Pi, and the like over the internet.

B. *System Analysis and Design*

This design for a control circuit system in a 4 x 6-meter farmhouse employs 50% and 70% black shading net. This research has chosen NodeMCU ESP8266 and Arduino MEGA to use the sensor. AM2315 Module to measure digital temperature and humidity in the same device Capacitive Soil Moisture Sensor 1.2 to measure soil moisture Module SI1145 Digital UV/IR/Visible Light Sensor capture for the load control of various electrical appliances. They controlled soil moisture, air humidity, light intensity, drip irrigation, and spraying water through the application to turn on-off automatically or manually to save data obtained through a cloud system and display value to Blynk System via mobile phone.

Concept diagram

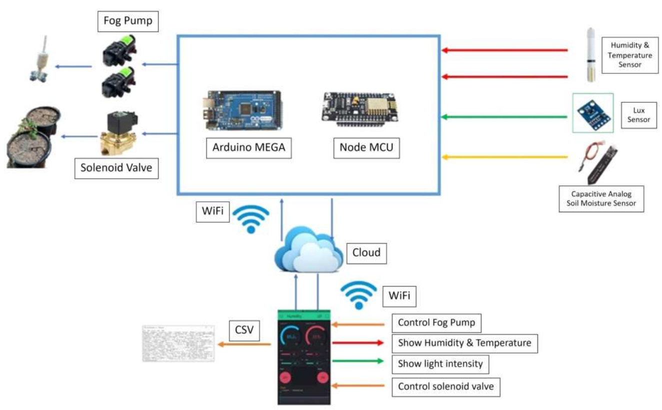

Fig. 2 System Conceptual Diagram

System circuit

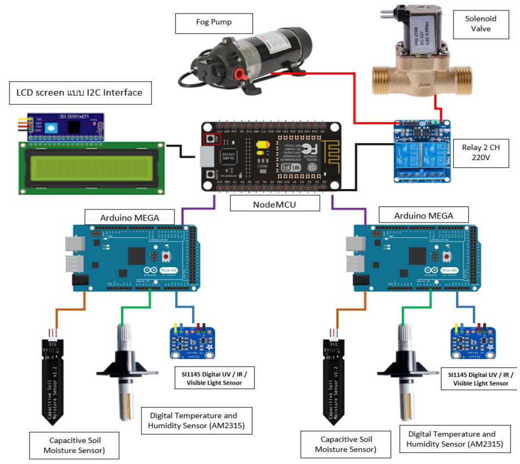

Fig. 3. System circuit for connecting microcontroller devices

This design is a diagram of the sensor system unit at 2 points. The first point will be installed in the center of the house, about 2 meters from the entrance door, and the second point will be installed in the center. The distance of the entrance door will be about 4 meters. The two sensors point will connect the signal to the microcontroller device in the control cabinet in front of the house, as shown in Figure 4.

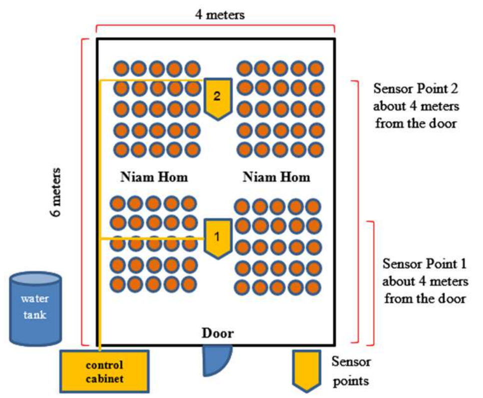

Fig. 4. Diagram of the sensor system in Niam Hom house.

This design of fogging equipment consists of 2 sets of small water pumps for spraying 15 bar mist, water pipes, and four 4-way fog sprayers. The house has four fog spraying points covering the Niam Hom tree. 25 onions, as shown in Figure 5.

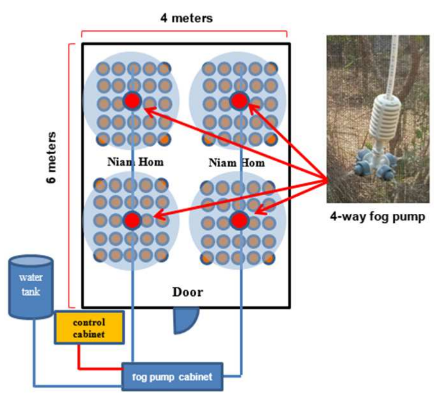

Fig. 5. Diagram of the mist spray irrigation system

This design of a drip irrigation system consists of a solenoid valve device. The main pipe is a 4 PE pipe, a dripping pipe (micro cable), and 100 drip heads. The function of the drip irrigation system is to provide moisture to the soil in the aromatic pots. Suppose the soil moisture content is less than specified. In that case, the control cabinet will immediately order the Solenoid Valve to open the valve The water from the water tank is sucked through the pumps along the lines. The water flowing through the drip pipes is dispersed into the Niam Hom pots, as shown in Figure 6.

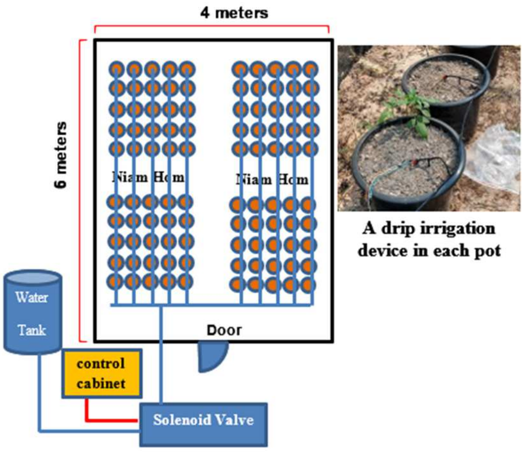

Fig. 6. Diagram of drip irrigation system in Niam Hom house

C. Implementation

an overview of system design and factors affecting the growth of Niam Hom plants. The researcher has designed a set of temperature sensors, soil moisture sensors, air humidity sensors, and water pumps, as shown in the following figures 7-9.

Fig. 7. Placement of drip irrigation system and placement of Niam Hom pots

Fig. 8. control cabinet and fog pump cabinet

Fig. 9. Controller devices

D. System Validation and Maintenance

The researcher has programmed the microcontroller board to receive and control devices from various sensors, temperature and humidity, soil moisture, and light sensors. Iterates when working according to the program posted on the microcontroller board until it stops supplying power to the board for programming and uploading the program to the microcontroller board. Use the program Arduino IDE to connect to the Blynk Application. User interface design and development of the screen interface will consist of the following:

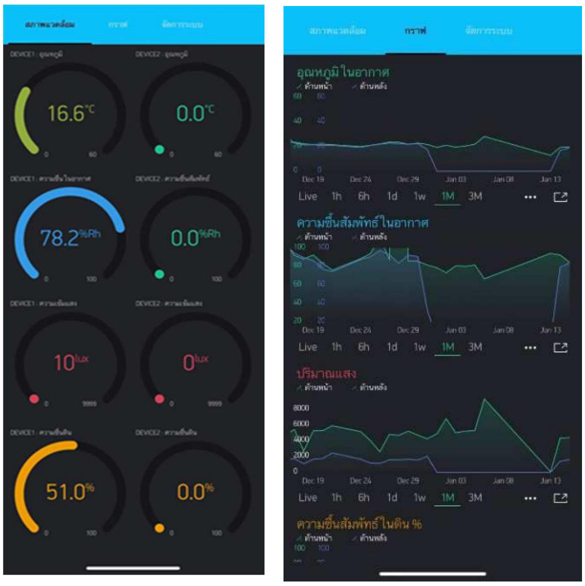

Fig. 10. The screen shows various Niam Hom House chart values.

In system testing, we have tested the system as follows.

1) Test the system on-off switch by the user.

This system testing by turning on-off 2 devices is the operation of the solenoid valve to water the onion plants. A water pump sprays mist to increase the humidity of the air controlled by the user through the application, which is when users turn on - off the water pump or ventilation fan. If it usually works, it will put the number 1, and if it works abnormally, it will put the number 0.

2) Test the automation of the Solenoid Valve.

This system testing by the soil moisture value of less than 40 percent. Solenoid Valve, which, if the device works, will show the word "On"; if the device does not work, it will show the phrase "Off."

3) Test the automatic operation of the water pump.

This system testing by making the humidity in the air less than 60 percent. If the device is working, Solenoid Valve will show the word "On"; if the device does not work, it will show the phrase "Off."

IV. Experimental Results

The researcher tested the system and equipment by measuring the temperature, humidity, and light. The study and conduct of this research show the results the researcher has designed. The research results are as follows.

1. System results

The test results are as follows. 1) Connection to the Blynk System can be connected using a wireless network signal (Wi-Fi). 2) Sending sensor temperature, air humidity, light intensity, and soil moisture values from the sensor. Values can send and displayed through Blynk.

2. The results of testing the on-off system switch by users

The results are that 50 applications were switched on-off by the device 44 times, accounting for 88% of solenoid valves turned on, and 44 of the solenoid valves turned off, accounting for 88%. The water pump turned on 45 times, accounting for 90%. The water pump turned off 45 times, accounting for 90%, and did not respond to the work 3 times, accounting for 6%.

3. The results of testing the on-off Solenoid valve automation

The test results are that when the soil moisture decreases by less than 40%, the control cabinet will order the solenoid valve to open the water valve from the water tank. The water flowing through the drip pipe will spread into the onion plant pot until the soil moisture level is more than 50%. Then, the control cabinet will order the solenoid valve to stop the water supply

4. The results of testing the operation of the automation of the water pump

The test results are air humidity is the humidity level in the air suitable for the houseplant, which is between 60 - 70 RH (Relative Humidity). When the air humidity is below 60%, the water pump will spray mist to increase the moisture inside the house. The pump will stop working when the humidity is greater than 75%.

V. Conclusion and Future Research

The results and problems found in operation were [11] installing panel equipment to control work NodeMCU ESP8266 connect to Wi-Fi via the Blynk System and to connect to the sensor device, the DHT21/AM2315 Module to measure air temperature and humidity will work with 2 sets of 15 bar pressure diaphragm pump used to increase the moisture in the air, the humidity between 60-70 RH (Relative Humidity). When the humidity is less than 60 RH, the pump will work to increase the humidity of the air. The device to measure soil moisture uses a capacitive soil sensor. The Moisture Sensor 1.2 works with the solenoid valve when the soil moisture content suitable for plants is 40 – 50% RH. If the soil moisture is less than 40% RH, the solenoid valve will work to increase. The humidity in the plant pot and the solenoid valve will stop working when the soil moisture exceeds 50% RH. An optical sensor was also installed to measure and transmit the light intensity to Blynk System. In addition to Future work, There are future development suggestions. It must either install more sun-shading devices or increase the distance between onion plants. The SD card has a backup device in case there is no internet connection. Increase the number of misting nozzles to spray a consistent mist.

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