
Vertical Planting and Energy Measurement are Designed and Developed using the ESP8266 and the Blynk IoT platform

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Abstract

The concept of urban farming and vertical farming is one of the concepts [1] that has arisen, which has received a lot of attention and has begun research and experimentation in many countries to solve the problems mentioned above. Vertical farming can be carried out all year round, uses limited space, can prevent diseases and pests, saves energy, but produces 5-10 times higher yields than conventional farming when compared to farming in the Samearea Saowani [6]

The research on the design and development of materials for cone growing under automatic control was initiated from this cause, with the following goals: 1. Develop and apply materials for vertical cone growing controlled by Internet of Things technology. 2. Test the performance of the vertical cone growing system controlled by Internet of Things. 3. Study the energy utilization controlled by Internet of Things.

The methodology Create planting materials in the shape of a vertical cone and include Internet of Things technology using the Node MCU ESP8266, which uses a relay and DHT11 to switch the system on and off. Additionally, it may be controlled with a mobile device via the Blynk application. The plants cultivated in cones in the testing room grew well, and it was discovered that the cone-shaped planting materials and the watering and liquid fertilizer system could operate in accordance with the instruction to switch on and off according to the stipulated length of time, which is 100%.

Keywords: Design and development, ESP8266, IOT

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1.Introduction

The world's food security is unavoidably impacted by the growing severity of environmental issues, such as depleted and destroyed natural resources [1], inappropriate land use, and various pollution problems, as well as climate change that affects agricultural areas and hydrological systems, and the world's population is constantly growing. Thus, another significant paradigm change is about to occur in agriculture in the twenty-first century. These developments will take the shape of transforming agriculture to ensure food safety and security for humankind through chemical-free (bio-) and greenhouse (indoor) farming that can regulate environmental conditions. Saowani. [6]

The prototype of a full-scale indoor agriculture system was invented by Professor Dixon Despommier of Columbia University to meet the needs of food production to feed the increasing population in the future and to solve the water and energy crisis of the United States. The vertical farming system that can be controlled via a smartphone application will develop a water pump control system for watering and feeding plants and making vegetables grow well. Chaiyong [2] Vertical agriculture can be operated all year round, uses limited space, can prevent diseases and pests, saves energy, but gives higher yields than conventional agriculture.

The practice of indoor or vertical agriculture, often referred to as building-integrated agriculture, has been practiced in the past. Indoor agriculture used to only entail cultivating plants indoors. In addition to making it more visually beautiful and useful, the objective was to solve the problem of an unsuitable atmosphere for plant cultivation. In contrast, it did not utilize technological advancements to meet the demands of food production to feed the expanding population in the future.

Consistent with the research of Chaiyong [2] on the vertical farming system controlled via a smartphone application, it was found that the system can control watering and feeding of plants, and the research of [8] on the feasibility study of the organic salad vegetable planting project using a smart farm system, it was found that the feasibility of the project is suitable for investment, and the research of Leklai [5] on the development of an environmental control system using Internet of Things technology in a frog breeding house, it was found that the new system is more efficient in terms of automatic water exchange, uses less labor, and takes less time to exchange water than the traditional system.

2.Objectives

2.1 Design and develop a vertical cone-shaped plant-growing system controlled by Internet of Things technology.

2.2 Experiment with the operation of a vertical cone-shaped plant- growing system controlled by Internet of Things technology.

3.Methods and Materials

3.1 Design the control program's operation diagram for the watering and fertilizer system through pipes using a power supply. It is necessary to specify the input and output devices, the structure of the watering and fertilizer system through pipes, the electronic circuit, and the control program.

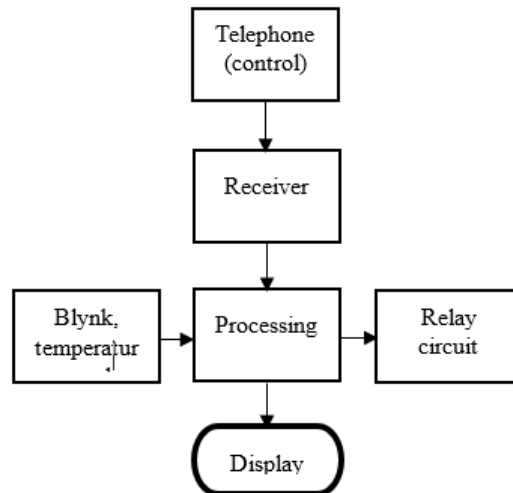


Figure 1 Work Design Flowchart.

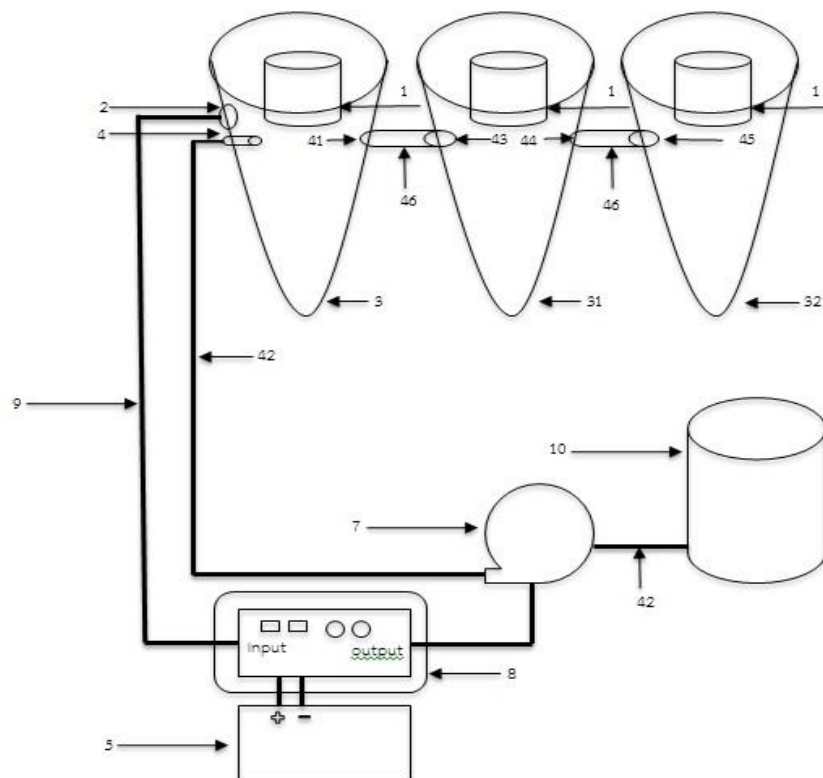


Figure 2 Vertical Planting (Design)

Figure 2 shows another type of vertical plant- growing equipment for controlling the automatic supply of liquid AB fertilizer. On the other side of the receiving cup (3) there is a water outlet (41) for connecting to the water inlet (43) through the water delivery pipe (46) of the receiving cup (31) which is conical in shape to support the planting cup (1). And on the other side of the receiving cup (31) there is a water outlet (44) for sending water out through the water delivery pipe (46) to the receiving cup (32) which is conical in shape to support the planting cup (1). On one side of the receiving cup (32) there is a water inlet (45).

To support water from the outlet channel (44) by connecting through the water delivery pipe (46), the water level sensor (2) is electrically connected to the control unit (8) via the signal cable (9) to receive the AB fertilizer level signal from the water level sensor (2) and measure the AB fertilizer level in the support cup (3). The support cup (31) has at least one support cup connected between the support cup (3) and the support cup (32). The control unit (8) will instruct the water pump (7), which is electrically coupled to the control unit (8), to either operate or stop if the AB fertilizer reaches or falls below the required value.

3.2 Program Design

The program design in the processing part uses the Blynk program and the C, /C++ languages to write the program. The working conditions are to press the on-off button of the humidifier fan on the mobile phone and to send a notification via Line Notify.

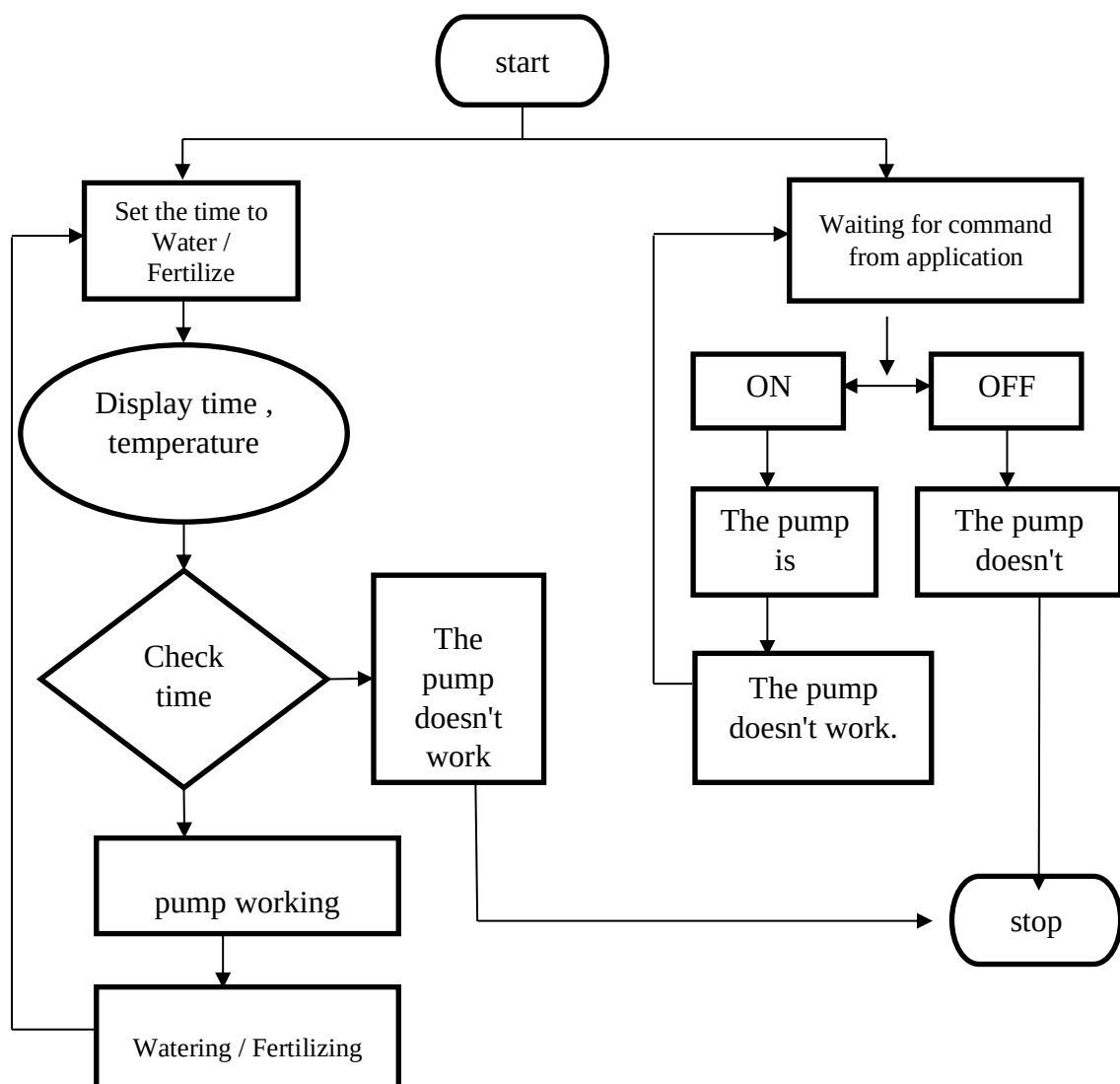


Figure 3 Control Program and Design Diagram.

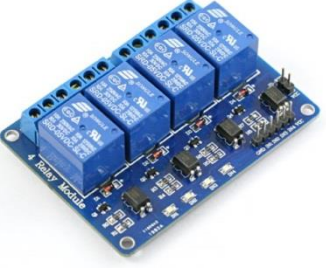
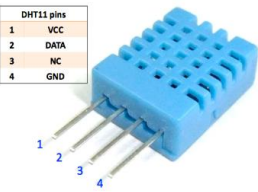
	Solar Cell Charger Solar Charge Controller Solar Charge Controller Solar Battery Charge Controller TIMER Charge Controller
	Relay For use in controlling electrical devices, it can receive up to 10 A of current, can be used with both DC and AC power, and receives a voltage of 5 V directly from the Arduino board. It has an LED to indicate the status of the relay. It is designed to protect the control circuit from the power side by using optical transmission (Optocoupler) in every relay.
	ESP8266 (Wi-Fi) Can be programmed, so it can be used instead of a microcontroller. It has a program space of up to 4MB, leaving plenty of space for writing programs.
	DHT 11 DHT11 is a temperature and humidity sensor. It has an accuracy of approximately $\pm 2^{\circ}\text{C}$ for temperature measurements and $\pm 5\%$ RH for humidity measurements. This sensor can be connected to an Arduino board.

Figure 4 Tool electronic

3.3 The design of the electronic circuit control system for multi-channel timer for electrical equipment uses many electronic circuits together, such as microcontroller circuits, relay circuits, power supply circuits.

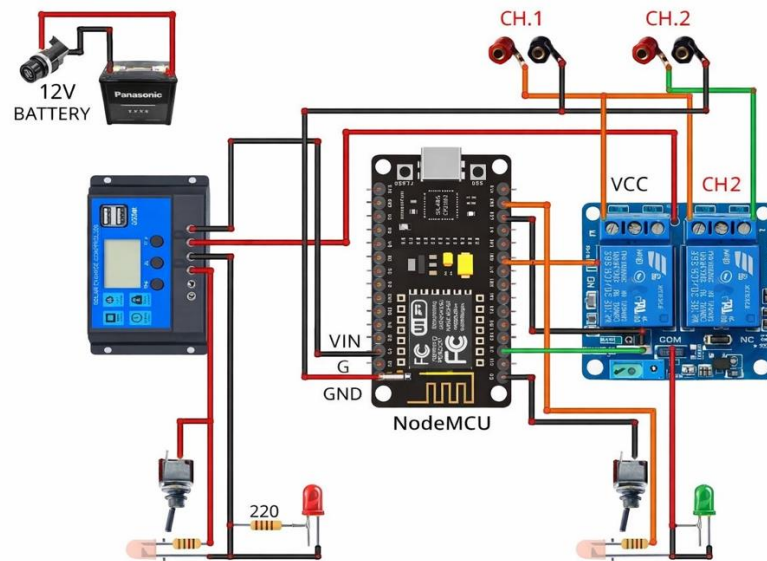


Figure 5 Electronic control circuit.

3.4 Development process Following the design of the electrical equipment's structure, electronic circuits, and multi-channel timer control programs, the whole working circuit, power supply system, and relay circuit must be built and put together.

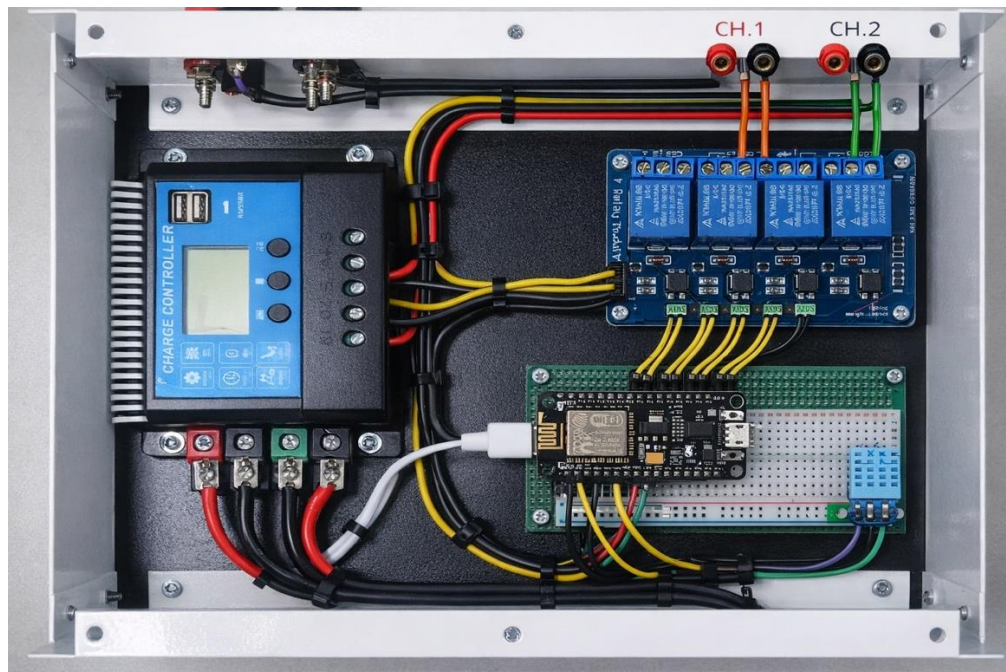


Figure 6 ESP8266 electronic circuit.

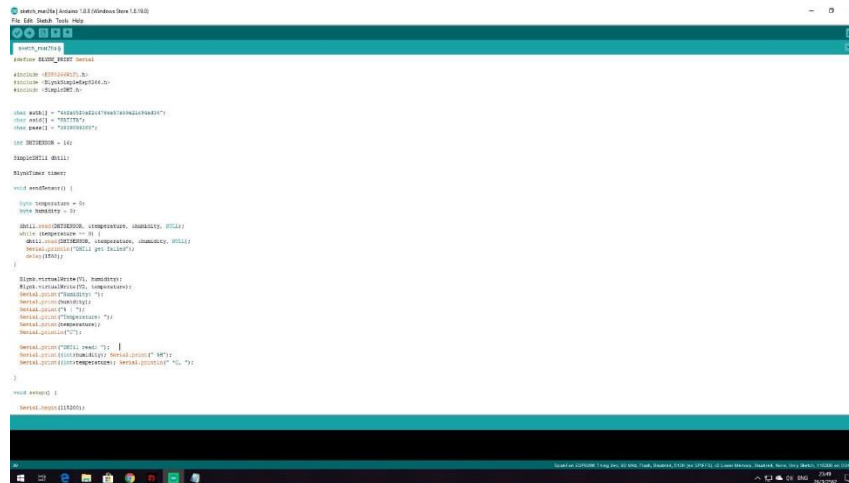


Figure 7 Arduino Program

4. Test results

In testing the multi-channel timing system for electrical equipment, it is divided into 2 parts: testing the electronic circuits in various parts and testing the multi-channel timing system for all electrical equipment. The explanation of each part of the test is as follows: Testing the electronic circuit

4.1 Test the operation of the control system for opening and closing both parts: the electronic circuit box and the application control part. Test the operation of the relay circuit for opening and closing by inputting signals “0” and “1” into the relay circuit.

Test the multi-channel electrical control system

4.2 Test the on-off of electrical equipment with the electronic circuit box by turning on-off the switch from the electronic circuit box

4.3 Test the on-off of electrical equipment with the application by turning on-off from the application on the phone

4.4 Test the on-off of electrical equipment by setting a timer to control the on-off of equipment in channel 1 and channel 2 according to the set time

4.5 The outcomes of the system's operation, which included turning the system on and off, applying water and liquid fertilizer manually, testing the relay circuit's ability to switch on and off, and bringing the finished relay circuit to test its functionality, were discovered. When a logic signal of "0" is input, the relay circuit that was constructed may turn electrical equipment on and off, indicating that the display light is off. The display light turns on when a logic signal of "1" is input. The test findings indicate that the relay circuit is capable of operating normally.

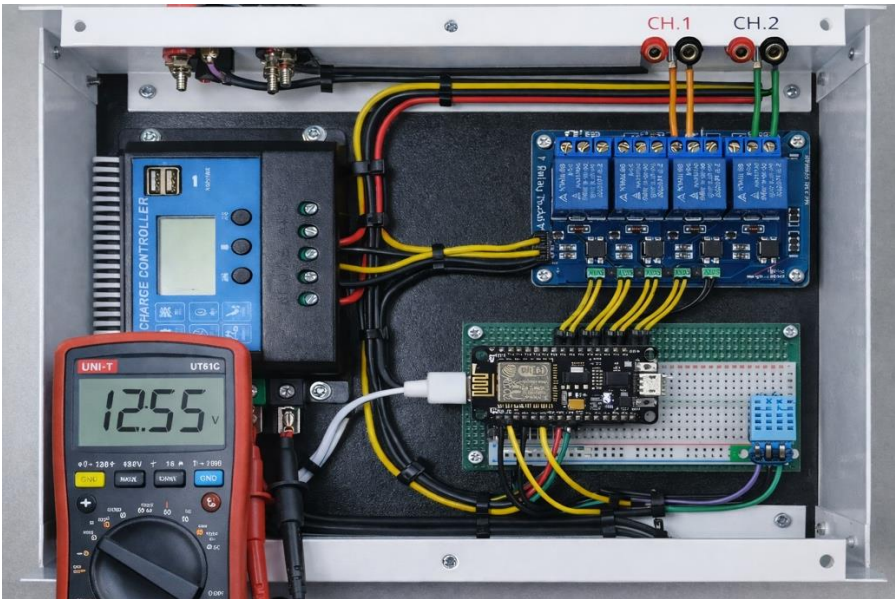


Figure 8 Testing the relay circuit in ON-OFF mode.

4.6 Test results of manual device on-off by turning on-off the toggle switch to control the on-off of the device. Record the results in Table 1.

Table 1 Test on-off

Times	Count time	Channel		Status
		Channel 1	Channel 2	
1	07.00-07.10	On	Off	100%
2	17.00-17.10	On	Off	100%
3	07.00-07.10	On	Off	100%
4	17.00-17.10	On	Off	100%
5	07.00-07.10	On	Off	100%
6	17.00-17.10	On	Off	100%
7	07.00-07.10	On	Off	100%
8	17.00-17.10	On	Off	100%
9	07.00-07.10	On	Off	100%
10	17.00-17.10	On	Off	100%
11	07.00-07.10	On	Off	100%
12	17.00-17.10	On	Off	100%
13	07.00-07.10	On	Off	100%

14	17.00-17.10	On	Off	100%
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Table 2 Check Energy in the battery

DAY	10 /5/2567	15 /5/2567	20 /5/2567	25 /5/2567	30 /5/2567	5 /6/2567
Time	Battery voltage 12 Volts.	Battery voltage 12 Volts	Battery voltage 12 Volts	Battery voltage 12 Volts	Battery voltage 12 Volts	Battery voltage 12 Volts
07.00	12.6	11.6	11.5	11.3	11	10.5
08.00	12.6	11.6	11.5	11.3	11	10.5
09.00	12.6	11.6	11.5	11.3	11	10.5
10.00	12.6	11.6	11.5	11.3	11	10.5
11.00	12.6	11.6	11.5	11.3	11	10.5
12.00	12.6	11.6	11.5	11.3	11	10.5
13.00	12.6	11.6	11.5	11.3	11	10.5
14.00	12.6	11.6	11.5	11.3	11	10.5
15.00	12.6	11.6	11.5	11.3	11	10.5
16.00	12.6	11.6	11.5	11.3	11	10.5
17.00	12	11.6	11.5	11.3	11	10.5
18.00	12	11.6	11.5	11.3	11	10.5
19.00	12	11.6	11.5	11.3	11	10.5

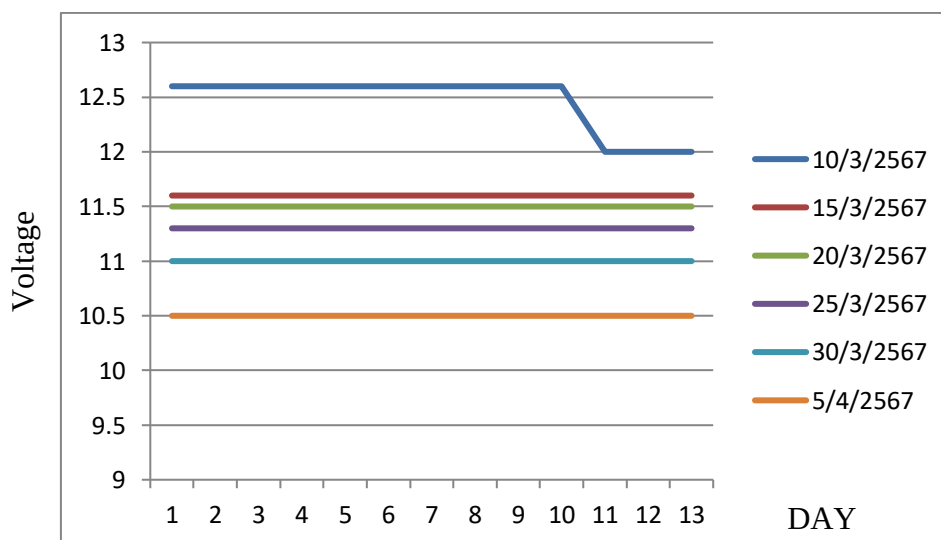


Figure 9 Energy in the battery

5. Conclusion and Suggestions

Advantages: Precise Control and Measurement: The use of ESP8266 and the Blynk IoT platform enables accurate control and monitoring of the environmental conditions within the vertical planting system. It allows remote access to data and control, making the system more efficient and user-friendly.

Cost and Time Efficiency: The integration of IoT technologies reduces the need for manual labor, making the process of monitoring and managing the planting system more cost-effective. Moreover, it saves time by automating various functions, thereby improving the overall workflow.

Increased Flexibility and Convenience: The Blynk IoT platform offers the flexibility to remotely control the system via a smartphone, providing users with ease of access and adjustments based on real-time data.

Enhanced Productivity: With continuous monitoring of energy usage and environmental conditions, the system optimizes resource usage, helping farmers or users improve plant growth and agricultural output.

Disadvantages: Dependence on Technology: The reliance on IoT and internet connectivity might pose risks if network failures or technical issues arise. Such disruptions could halt the system's functionality, affecting the planting process.

Installation and Maintenance: The installation of IoT systems and connectivity setup may require time, expertise, and costs. Regular maintenance and troubleshooting are also necessary to ensure the system operates effectively.

Security Risks: The use of cloud-based IoT platforms and internet connectivity exposes the system to potential cyberattacks or data breaches, particularly if sensitive information regarding plant conditions or production is stored online.

Benefits: Sustainable Agriculture: The use of IoT ensures efficient resource management, such as water and energy consumption. This promotes sustainability in farming by reducing waste and encouraging eco-friendly practices.

Better Decision-Making: By collecting and analyzing data from the system, users can make informed decisions on how to manage and optimize their agricultural practices. This leads to better productivity and risk management.

Advancement in Agricultural Technology: The research highlights the potential of IoT technologies in agriculture, paving the way for more advanced innovations that will contribute to better crop management and reduced environmental impact.

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