Evolution in Electrical and Electronic Engineering Vol. 4 No. 1 (2023) 398-404

EEEE

Homepage: http://publisher.uthm.edu.my/periodicals/index.php/eeee
e-ISSN : 2756-8458

Smart Home Gardening System Powered by Solar

Nur Irdina Damia Mhd Halim[1], Riyaz Ahmad Mohamed Ali[1]*

[1]Faculty of Electrical and Electronic Engineering,
Universiti Tun Hussein Onn Malaysia, Parit Raja, Batu Pahat, 86400, MALAYSIA

*Corresponding Author Designation

DOI: https://doi.org/10.30880/eeee.2023.04.01.047
Received 15 January 2023; Accepted 21 February 2023; Available online 30 April 2023

Abstract: Most plants need water to thrive and maintain their freshness. Therefore, this project outlines a method that individuals may implement in their daily lives nowadays, as gardening has become a highly popular activity at home due to Covid-19. Indirectly, users may care for as well as water the plants more efficiently even when the user is not thereby using a Smart Home Gardening System powered by Solar. With the aid of a moisture sensor and water pump, this system has been created as an automatic watering plant that can be switched on in line with the time specified by Blynk from the smartphone. There is also a feature for keeping track of the humidity and temperature of the area around the user's plant. As long as there is a Wi-Fi connection, the design uses a DHT11, soil moisture sensor, relay board, solar panel, NodeMCU, water irrigation, and water pump to operate the entire system. Based on the testing done during the day, the system will be in operation when the solar system detects sunlight and connects to the moisture sensor. The pump will turn on when the soil dries up, and water will be sent to the ground until it is moist. In contrast, there won't be any watering activity at night because the solar panel and pump will remain off. Additionally, a variety of factors such as the type of pump and the size of the tube from the water irrigation kit that was used, have an impact on how long it takes for the soil to get moist. Lastly, in conclusion, this project has successfully identified and built a system for gardening that has the function and ability to monitor the plants at home and self-irrigate the plants. In general, the system is functioning properly after a certain test.

Keywords: Home Gardening, Monitoring System, Watering System, NodeMCU, Blynk

1. Introduction

Gardening is an activity that is very familiar in this country and it can be enjoyed by people of all ages [1]. There are many types of beautiful plants that can be planted in the garden but plenty of it like roses, azaleas, and orchids need high-maintenance care for them to grow healthy [2]. Besides, vegetables like lettuces, tomatoes, and cucumbers also can be planted in the garden with the help of great knowledge and technique about gardening. In these few years, almost every country in this world

*Corresponding author: riyaz@uthm.edu.my

has faced a phase where everyone needs to stay at home due to the lockdown because of a virus called Covid-19. So, people need to cope with the situation by doing various types of activities that can help them fill in their free time and gardening can be part of it. This activity can help to reduce the cost of food ingredients by planting vegetables yet it also helps to overcome the food shortage that happened [3].

Other than that, studies said that being out in the sun during gardening can help to keep the body's strength when receiving a good amount of vitamin D [4]. Based on research, people find gardening can help to improve their memory when getting older because of some brain nerves that grow during that activity [5]. Gardening sure can bring many benefits to people so to keep this gardening activity sustained in a great phase, the Smart Home Gardening System powered by Solar will be built. This system comes with a lower cost of production that will enhance the quality of gardening at home and is also suitable for anyone that wants to use it for their garden even when there are busy with work or other life commitments.

NodeMCU serves as the primary controller for this Smart Home Gardening System powered by Solar. With the aid of a moisture sensor and water pump and as long as there is Wi-Fi, this system has been created as an automated watering plant that may be active in line with the time specified by Blynk from the smartphone. In addition, there is a monitoring system that can measure the temperature and humidity of the air around the user's plant. To operate the entire system, this design utilized a DHT11, soil moisture sensor, relay board, solar system (solar lamp), NodeMCU, water irrigation system, and water pump. This concept came about as a result as it might be challenging for someone to water their plants throughout the day owing to a lack of time. Other than that, it is because it takes a while to finish a watering session, the sheer number of plants will make it difficult for someone to water the plants. Then, during the manual watering session, plants do not get enough water.

Another example is when a user takes a lengthy holiday and the plant is ignored; as a result, the plant may not receive enough water and perish. So long as there is a Wi-Fi connection, this irrigation system will assist the user in finding a solution to this issue. Consequently, the project's aim is to identify and build a system for gardening that has the function and ability to monitor the plants at home and self-water irrigate the plants. Lastly, it is to perform a test on the system until it can function properly.

2. Materials and Methods

2.1 Materials

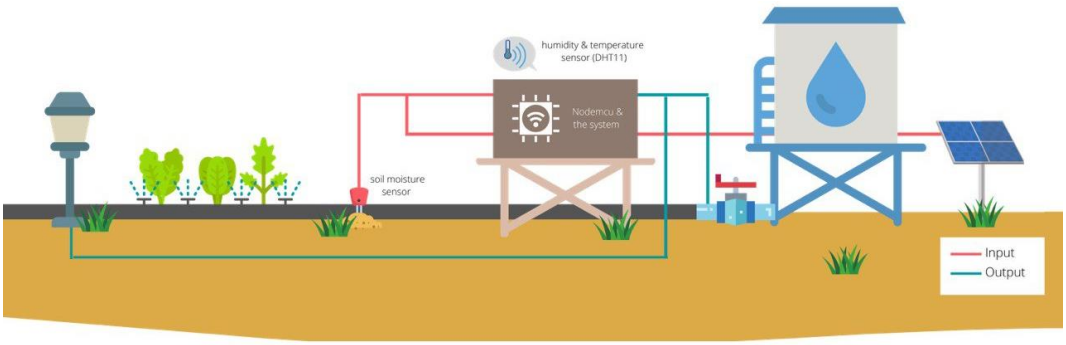

Figure 1: An overview of the project

The overview of this project is shown in Figure 1. The complete list of hardware and software used in this project in given in Table 1.

Table 1: List of the hardware and software

Hardware	Software
Solar Lamp	
DHT11 Sensor	Arduino IDE Application
Soil Moisture Sensor	
NodeMCU	
Relay	Blynk Application
Solenoid Valve	

2.2 Methods

A flow chart for the algorithm-defined automated control is shown in Figure 2.

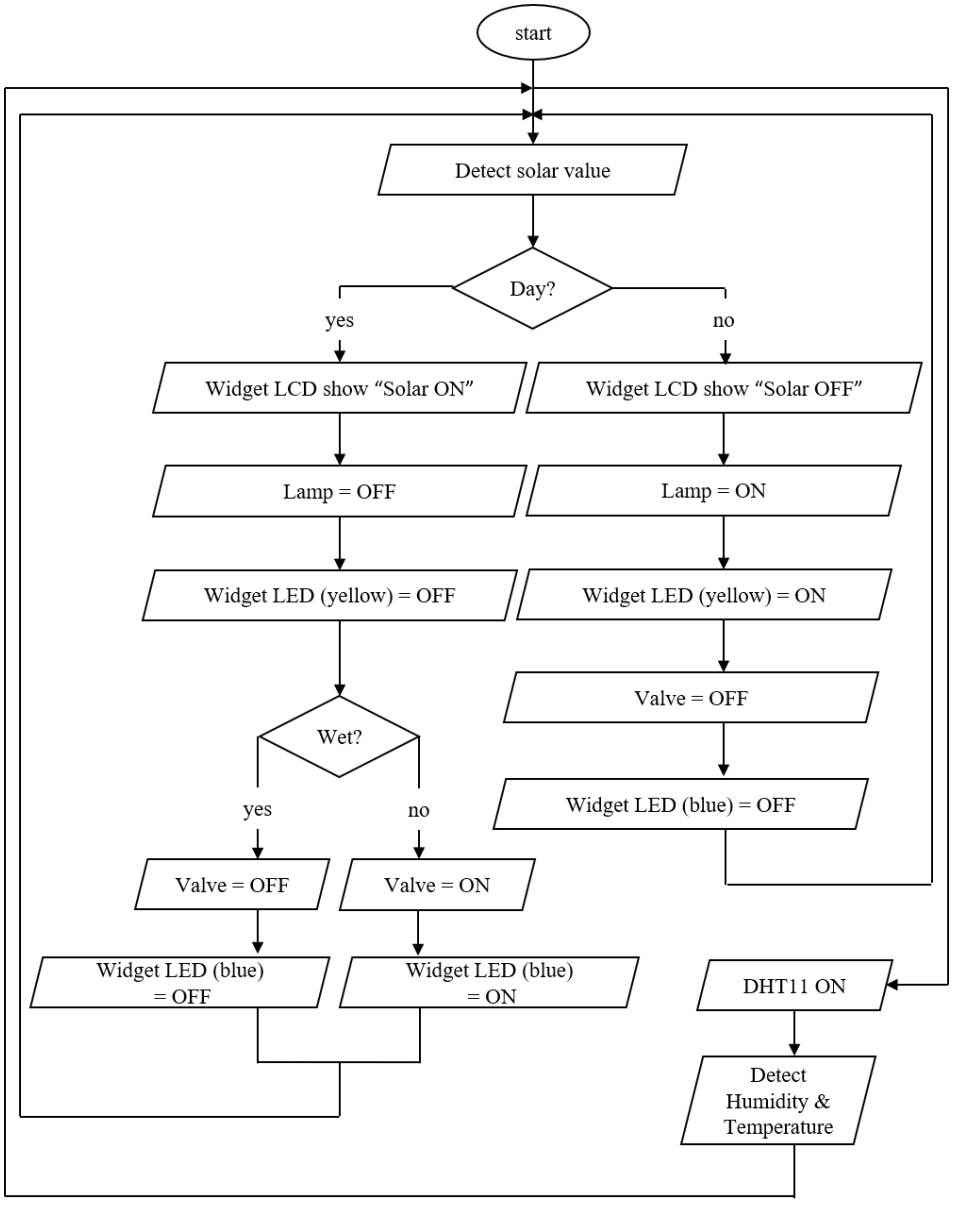

Figure 2: The flowchart of the project design

Figure 3 shows a block diagram divided into two parts namely the smartphone application and the main control unit (MCU). The system was developed using the Blynk app. It is an open-source web application provided. The software uses a graphical interface that allows applications to be built and run on smartphones. The app is used as a device for users to know the lighting, humidity, temperature, and soil moisture as well as the functionality of lights and pump for the entire system. To develop this program, software code and an internet connection are required. The solar, DHT11, and soil moisture sensors used in the project will detect the temperature also humidity, as well as the moisture response on the soil and the reception of sunlight, which will be sent to the NodeMCU. Solar condition readings and soil moisture sensors will be displayed on the LCD in the Blynk app. Based on the data received, the lamp and pump will start operating through their connection with the relay. There is also the widget gauge at the Blynk to show the parameter of both sensors used which are DHT11 and soil moisture sensors that detect temperature, humidity, and soil moisture.

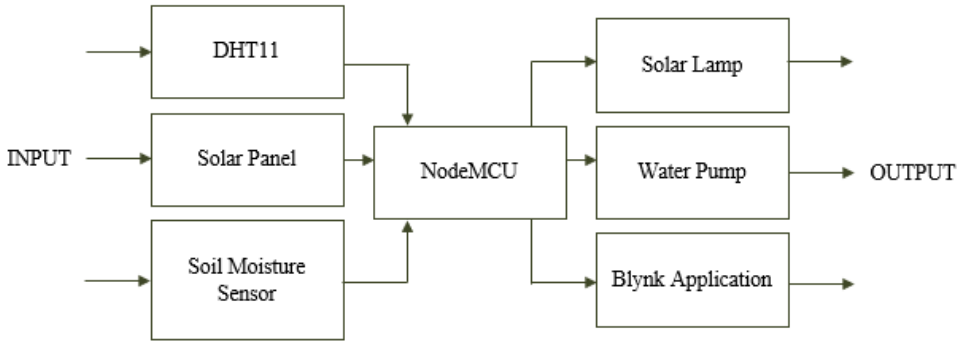

Figure 3: The block diagram of the project

3. Results and Discussion

3.1 Monitoring System

Table 2 shows the temperature and humidity in Parit Raja, Johor, Malaysia on June 23, 2022, every three hours from 4 am to 4 pm am (based on *The Weather Channel* website) and this information is used to measure the accuracy of the DHT11 sensor that is used in this project. Then, compare to data from the widget at Blynk App that will also be collected every three hours when the system is activated. In order to allow for a comparison between the data from the DHT11 sensor and the data from the reference website, this process should be done. This approach will assist in observing if the two sets of data are compatible or incompatible with one another based on the percentage of accuracy.

Table 2: The Data for the Temperature and Humidity

Time	Data based on T*he Weather Channel* website		Data from the Monitoring system	
	Temperature (℃)	Humidity (%)	Temperature (℃)	Humidity (%)
4 am	24	94	24	95
7 am	24	95	26	95
10 am	27	87	27	90
1 pm	27	73	31	78
4 pm	30	72	30	82

3.2 Watering System

Figure 4 shows the LCD at the Blynk when the solar is on and the moisture sensor that detects the soil is dry. This statement occurred when it was daylight and the soil that was detected is free from water. After both operations are done, the pump will be on (active) and it will drain the water from the tank thoroughly to the irrigation system and then to the plants. The blue widget LED of the water pump also will be on to show that the water pump is working and automatically switched off when the soil becomes wet or the water pump stops working.

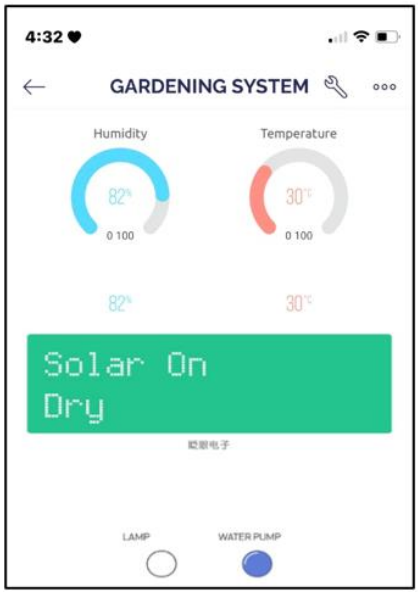

Figure 4: LCD at the Blynk that stated the solar is on and the soil is dry. The blue LED is on to show the water pump is working

Next, Figure 5 shows the LCD at the Blynk when the solar is still on but the moisture sensor that detects the soil is wet. That happened when it was daylight but the soil contained a sufficient amount of water. So, there is no other operation that occurred after that and make both widgets LED off.

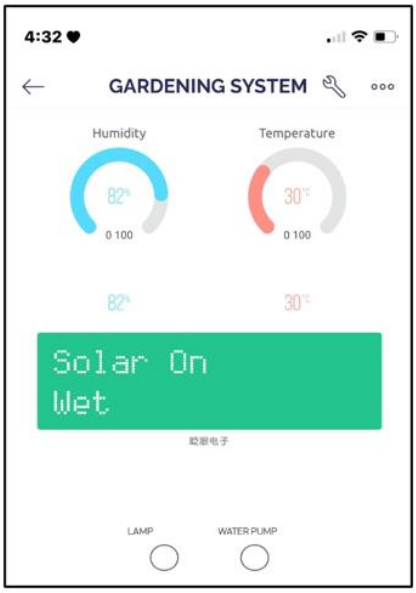

Figure 5: LCD at the Blynk that stated the solar is on and the soil is wet. Both LED is off to show there is no operation occurring

Then, Figure 6 shows when the solar is off, there will be no watering operation exist. It is mean that the moisture sensor will not have functioned and the pump will be off. Indirectly when the solar is off, the lamp will be on and make the yellow widget LED on.

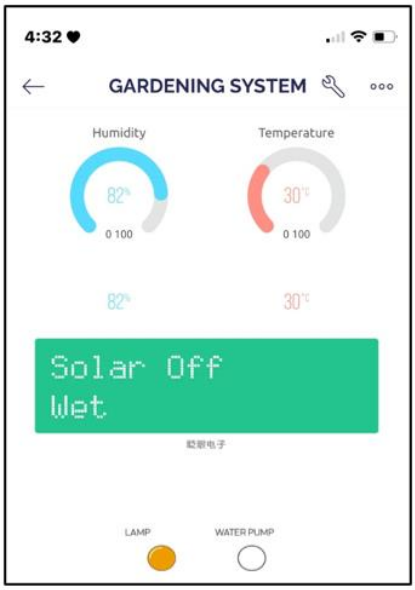

Figure 6: LCD at the Blynk that stated the solar is off and the soil is dry. The yellow LED is on to show the lamp is on.

On top of that, it is possible to draw the conclusion from the project's findings that the plant successfully avoided dehydration and continued to develop without any issues since the sensor installed in the plant monitored the soil's moisture content and managed the water pump. The system functions by using sensor technologies to measure the soil's moisture levels, and a microcontroller to operate the water pump so that the plant may use enough water when it is needed. The usage of a watering system may also be employed to address issues like having to leave plants at home alone while on vacation. The method makes it possible for plants to receive the precise quantity of water they require and avoids inconsistent watering, which causes soil mineral loss. This technique may be particularly beneficial in agriculture since it harvests the greatest number of plants with the least amount of loss from water evaporation and runoff, making it excellent for reasons like having wide gardens, plantations, or particular plants with their own watering demands. Table 3 shows an output data for automated mode operation of water irrigation.

Table 3: Output data for automated mode operation of water irrigation

INPUT		OUTPUT	
Day	Wet	Lamp	Pump
YES	YES	OFF	OFF
YES	NO	OFF	ON
NO	YES	ON	OFF
NO	NO	ON	OFF

4. Conclusion

There are a variety of benefits for this project from different perspectives. One may, for instance, keep an eye on and water the plant at home from a distance by only using a smartphone. Future applications of this study might include the integration of microcontrollers that can control modern agricultural technologies. The usage of an environmentally friendly irrigation and lighting system will be shown, and the precise timing of the water supply will be communicated along with the action of watering the plant. Last but not least, this research was effective in identifying and developing a gardening system that can self-irrigate plants and monitor them at home. Next, a certain test indicates that the system has been operating properly.

Acknowledgement

The authors would like to thank the Faculty of Electrical and Electronic Engineering, Universiti Tun Hussein Onn Malaysia for its support.

References

[1] J. Haskins, "Gardening: A fun hobby that's good for your health," *The Nation's Health*, vol. 47, no. 5, pp. 17–17, Jul. 2017, https://www.thenationshealth.org/content/47/5/17#:~:text=Being%20outside%20in%20the%20fresh

[2] D. Murray, "These Are the 20 Most High-Maintenance Plants – Can You Handle Them?," *HGTV Canada*, Nov. 04, 2019. https://www.hgtv.ca/most-high-maintenance-plants/.

[3] R. J. Stanborough, "10 Benefits of Gardening, Plus Helpful Tips & Recommendations," *Healthline*, Jun. 17, 2020. https://www.healthline.com/health/healthful-benefits-of-gardening#helps-fight-disease

[4] S.-A. Park, A-Young. Lee, H.-G. Park, and W.-L. Lee, "Benefits of Gardening Activities for Cognitive Function According to Measurement of Brain Nerve Growth Factor Levels," *International Journal of Environmental Research and Public Health*, vol. 16, no. 5, p. 760, Mar. 2019, doi: 10.3390/ijerph16050760.

[5] D. G. Hoel, M. Berwick, F. R. de Gruijl, and M. F. Holick, "The risks and benefits of sun exposure 2016," *Dermato-Endocrinology*, vol. 8, no. 1, p. e1248325, Jan. 2016, doi: 10.1080/19381980.2016.1248325.