

# Design and Development of Smart Gardening with IOT

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**Abstract:** *Technology has significantly improved every area of life, including farming and business. The evolution of agriculture basically dictates our way of life. Researchers are working to integrate modern technologies in agriculture to develop new methods for enhancing healthy agriculture and output. The "internet of things" branch of computer science provides protocols and techniques for integrating a range of electronic devices to automate physical processes. Due to a shortage of skilled gardeners, people in big cities are finding it difficult to maintain their own gardens. This research study describes an Internet of Things (IoT)-based smart garden monitoring system that uses a NodeMCU microcontroller to allow users to monitor the temperature, humidity, and wetness of their indoor plants and gardens. A prototype has been constructed to show how the recommended approach is used in the real world. A Blynk application has been made to display the real-time profiles of environmental factors including temperature, humidity, and wetness. This technology will let users take better care of the growth and health of the plants in their gardens. The need for gardeners and the challenges of keeping up gardens in big cities are replaced by this scientific endeavour. To build smart cities, this study intends to introduce and promote IoT innovation in our society.*

**Keywords:** Internet of Things (IoT), NodeMCU microcontroller, Blynk application, smart garden

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## 1. Introduction

Agricultural IoT technology has been used extensively in agriculture and is well-known to most farmers worldwide. These days, precision management and other facility control programs are made possible by IoT technology in agriculture. IoT technology enables users to interact with sensors and controllers, which are extensively utilized in the agriculture industry for tasks like weather forecasting and farming. (Nor & Muzirah, 2024). It may successfully raise the quality of agricultural products, lower labour costs, boost farmers' incomes, and genuinely achieve agricultural intelligence and modernization in addition to increasing agricultural output. (Xu et al., 2022). As a result, smart garden design and planning research that incorporates agricultural IoT has the potential to boost industrialization.

This project has goals. First and foremost, the project will produce a gardening product. It seeks to use automation and Internet of Things technology to make gardening smarter. Using wireless sensor networks (WSNs), which assist farmers in gathering pertinent data through sensing devices, various IoT-based sensors and devices monitor all these applications. (Farooq et al., 2020). The gardeners themselves can check all the parameters and compute the readings thanks to smart gardening systems and plant monitoring that use Internet of Things technology.

The second goal of this initiative is to reduce human energy use and consumption. Due to the movement of young people to large cities and the utilization of land for agricultural production for quick development, there are fewer human resources available for agricultural development. (Kassim, 2020). One way to water and care for plants in a garden without using human energy is with this mechanical method. Gardeners who use the manual technique of watering and monitoring must follow a suitable watering schedule and frequently check on their plants to make sure they are getting enough water and soil moisture. IoT technology can be used to monitor several agricultural characteristics, including crop status, weather, and soil moisture. (Pan et al., 2024).

Third, the use of IoT in smart gardening involves fertilizing plants. Due to their sensitivity and high maintenance requirements, growing plants takes a lot of time. Effective use of fertilizer and organic compost, as well as crop selection based on soil conditions, are made possible by soil fertility management techniques. It is also difficult for gardeners to keep an eye on their plants from a distance if they travel. (Abd Rahim et al., 2020). Therefore, with a mobile application, customers may keep an eye on the state of the standards required for their gardening activities. This intelligent gardening system will help customers remotely manage operations from any place and automatically track a variety of plant-related metrics. This will guarantee garden maintenance and care without requiring human involvement at the plant's real site. (Choudhari et al., 2023).

## **2. Problem Statement**

Farmers typically deal with the issue of water shortages due to poor rainfall, and even when there is rainfall, water is squandered since there is inadequate infrastructure for water storage. Creating an efficient water management system is a key component of increasing efficiency. (Karthikeyan et al., 2024). Real-time garden monitoring can be done at home using IoT solutions. Most often, people employ gardeners to take care of their tiny, homegrown gardens. Environmental factors and improper handling frequently cause damage to most plants. To solve this issue, the concept of an internet of things-based automated garden monitoring system is developed.

A regular watering schedule is crucial. However, because of their hectic schedules, many people overlook this watering schedule. Due to a hectic schedule, the owner consistently forgets to water or fertilize the plants. Despite this, the current lifestyle trend includes recreational spaces that allow individuals to get in touch with nature.

Furthermore, a lot of plants with shallow roots and recently planted trees and shrubs experience water stress. Water stress is indicated by wilting, which is followed by browning of the leaf tips and edges. Give the plants a weekly soaking instead of light watering every day. Feel the area of soil where many roots are found to see if irrigation is taking place.

Finally, the way gardeners' water their plants is improper. It is unknown if the plant receives too much or too little water when being irrigated. On the other hand, some people water their plants excessively and frequently until they drown. An excess of water in the soil raises the oxygen content, which harms the root system. This issue can be resolved by garden owners measuring and detecting soil moisture in their plantations with the Internet of Things. (Hadi et al., 2020).

### 3. Methodology

#### 3.1 Project Design

##### 3.1.1 Implementation Method/Procedure/Technique

This research study suggests an Internet of Things (IoT)-based method for smart garden monitoring that uses a NodeMCU (ESP32) microcontroller that shown in Figure 1 to assist users in determining the current humidity, wetness, and temperature characteristics of their tiny garden and plants.

A prototype has been put into use to demonstrate the actual implementation of the suggested methodology. The real-time profiles of environmental parameters including temperature, wetness, and humidity are shown in a Blynk application. This technology will enable users to better manage the growth and health of their plants in their gardens.

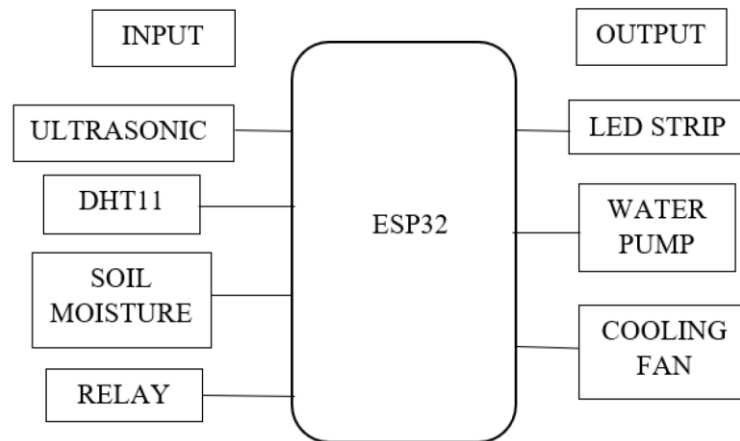
Finally, this idea will replace garden requirements and problems encountered when maintaining gardens in large cities. The aim of this study is to present and advance IoT innovation in the direction of smart cities in our society.



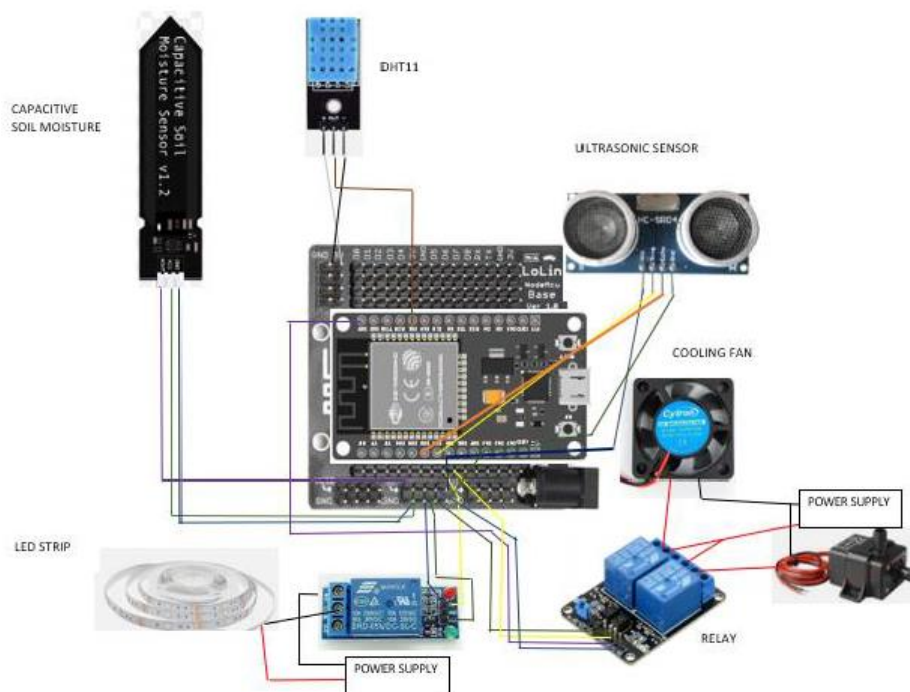
**Figure 1: ESP32 and Blynk Application**

#### Block Diagram

A block diagram, as seen in Figure 2, is a crucial tool for developing, elucidating, and visualizing the workflow and procedures of hardware or software systems. A soil moisture sensor, DHT11, and ultrasonic are used as inputs in this project. Figure 3 illustrates the output, which includes an LED strip, a water pump, and a cooling fan.



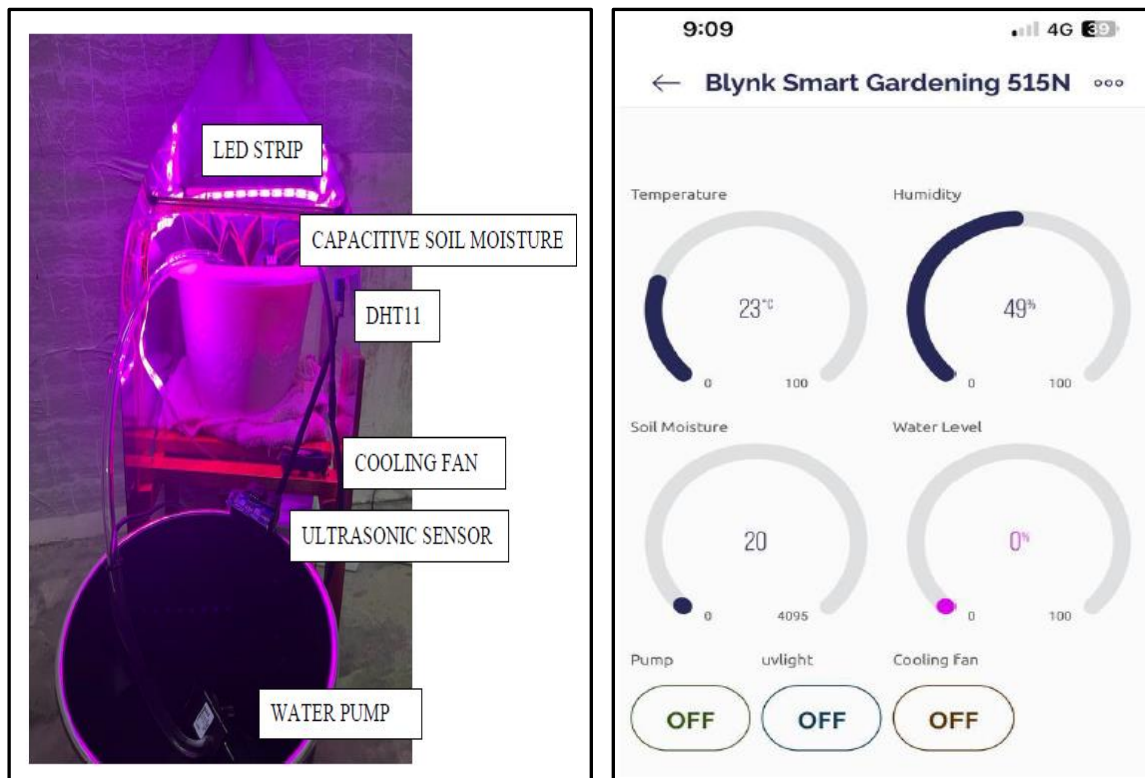
**Figure 2: Block diagram**



**Figure 3: Circuit diagram**

## 4. Result and Discussion

As a result, the design and development of “Smart Gardening with IoT” was successfully established. It was made up of the aggregate capability of all the hardware components used. For the unit to function as best it can, every module's location and existence have been carefully considered. Figure 4 displays the final prototype design and the results of the Blynk application. Extensive testing was done on the system to make sure it will work on its own. Moisture sensors are used to measure the turmeric plant's soil moisture content. A signal from the moisture sensor to the microcontroller triggers the water pump and provides water to the appropriate plant when the moisture level falls below the preset threshold.



**Figure 4: Final prototype design and the outcome of the Blynk application**

The device automatically shuts down and turns off the water pump when the necessary moisture level is attained. The software will also alert the user if the temperature or humidity levels change. Users can monitor and control the devices from any location at any time. Furthermore, clients can design a watering schedule that works for them, eliminating the need for human intervention and allowing the plant to be watered automatically based on the moisture content of the soil. The IOT device is controlled by a smartphone app that also lets people water the plant by hand.

The IoT device's special feature enables it to assess a plant's health by looking at its leaf colour, ambient temperature, and humidity levels. To identify whether the plant is healthy or not, we also used several preset datasets with the help of the elements. As an extra feature, we installed a security system that monitors animal movements in the vicinity of the facility and notifies people when necessary. To scare the animal away, the lights and alarm are activated when an unexpected action is observed. Consequently, the overall system's functioning has been carefully analysed and is thought to be reliable. Figures below illustrate the overall results of the Blynk application, including soil moisture, UV light, water level, water pump, and cooling fan.

## Water level

When water level is 0%.

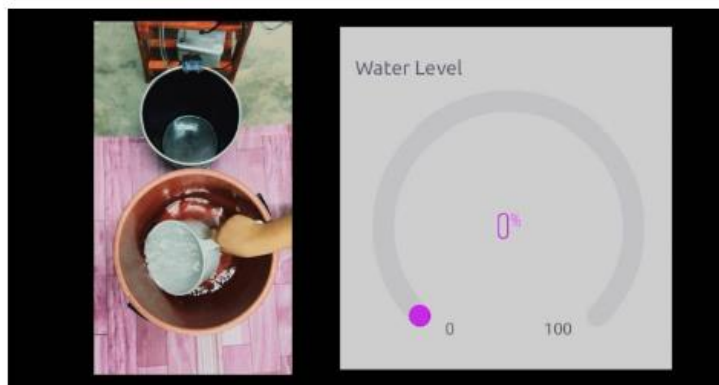


Figure 5: When water level is 0%

When water level is 66%.



Figure 6: When water level is 66%

## Water Pump

When the value soil moisture is high, water pump will be ON.

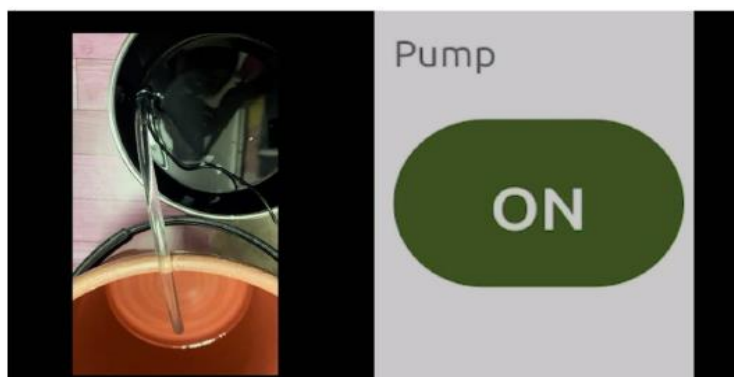
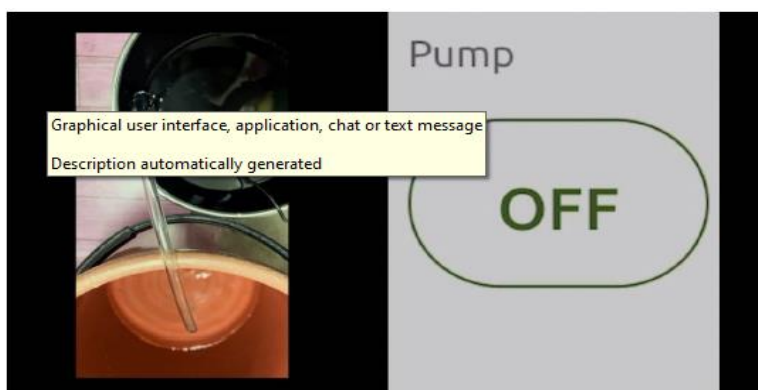


Figure 7: When pump is ON



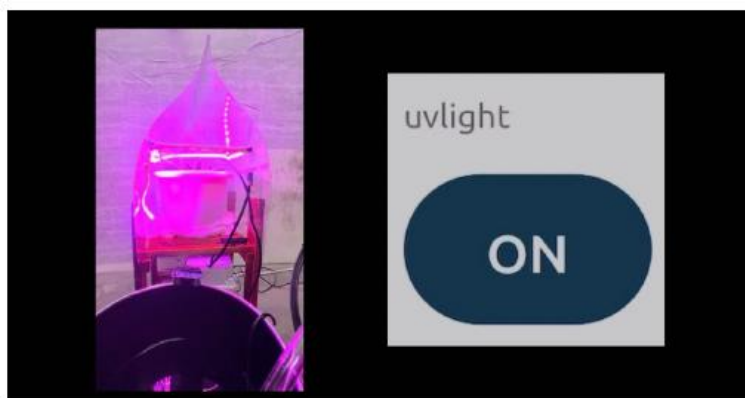
When the value of soil moisture is low, water pump turns OFF.



**Figure 8: When pump is OFF**

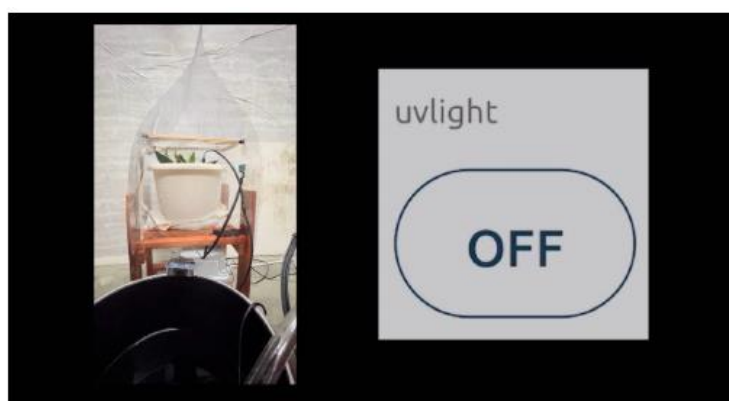
### **LED Stripe/UV light**

UV light is on about 16 hours of light per day.



**Figure 9: When UV light is ON**

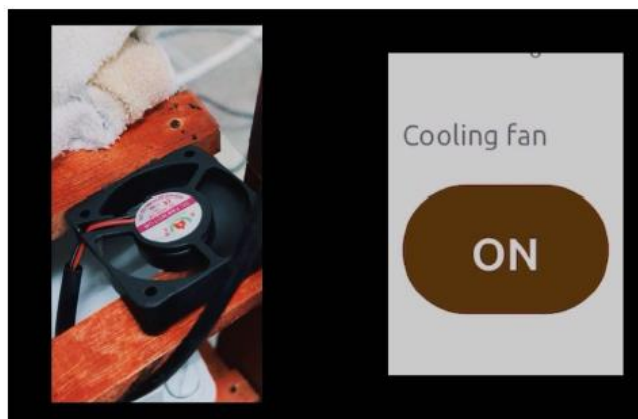
UV light turns off about 8 hours of darkness per day.



**Figure 10: When UV light is OFF**

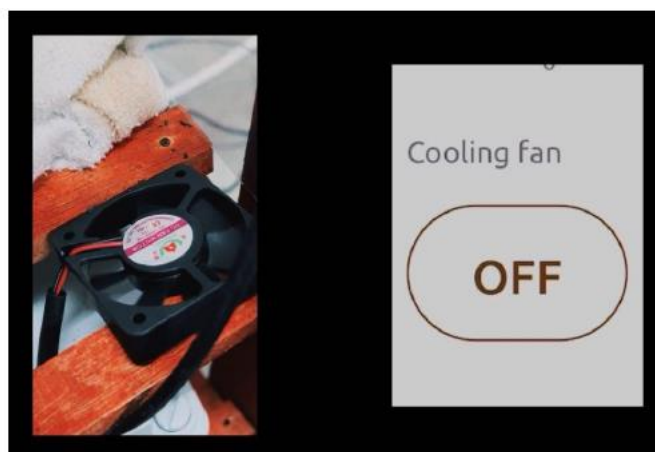
## Cooling Fan

When the temperature is high, users will turn on the cooling fan.



**Figure 11: When cooling fan is ON**

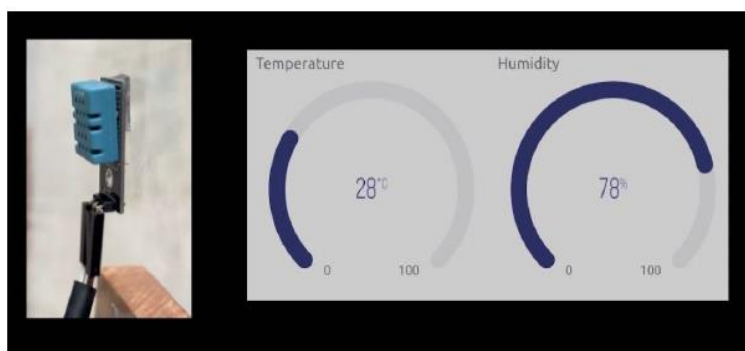
When the temperature is low, users will turn off the cooling fan.



**Figure 12: When cooling fan is OFF**

## Soil Moisture

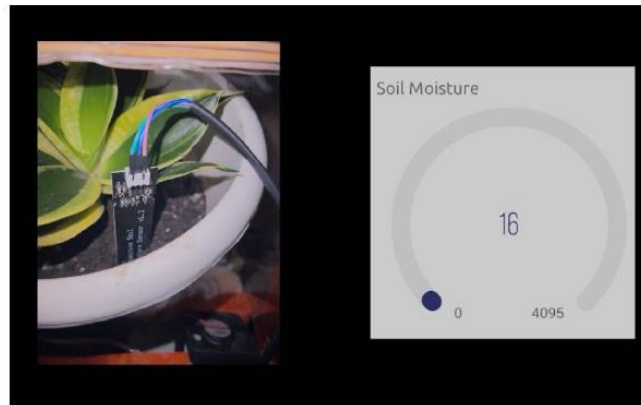
Temperature here was room temperature in night.



**Figure 13: When in room temperature at night**



Here the soil was moist.



**Figure 14: When the soil was moist**

## 5. Conclusion

Thus, the design and construction of this prototype project was accomplished successfully. A prototype has been constructed to show how the recommended approach can be used in real-world situations. Using a smartphone and Wi-Fi, the suggested IoT smart gardening concept with an ESP32 is put into practice. The system in place is capable of tracking and gathering gardening data to notify users about their gardens.

## Acknowledgement

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## References

- Choudhar, G. R., Dagale, P. A., Dashetwar, I. S., Desai, R. R., & Marathe, A. A. (2023). IoT-based Smart Gardening System. *Journal of Physics: Conference Series*, 2601, 3rd International Conference on Intelligent Robotics, Mechatronics and Automation Systems (IRMAS 2023).
- Karthikeyan, G., Mahalakshmi, P., Varshini, T., & Thangalakshmi, T. (2024). Smart Gardening using IOT. *International Conference on Trends in Quantum Computing and Emerging Business Technologies*, Pune, India, pp. 1-6
- Xu, J., Gu, B., & Tian, G. (2022). Review of agricultural IoT technology. *Artificial Intelligence in Agriculture*, 6, 10–22.
- Kassim, M. R. M. (2020). IoT Applications in Smart Agriculture: Issues and Challenges. 2020 IEEE Conference on Open Systems (ICOS), Kota Kinabalu, Malaysia, 2020, pp. 19-24, doi: 10.1109/ICOS50156.2020.9293672.
- Hadi, M. S., Nugraha, P. A., Wirawan, I. M., Zaeni, I. A. E., Mizar, M. A., & Irvan, M. (2020). IoT Based Smart Garden Irrigation System. 2020 4th International Conference on Vocational Education and Training (ICOVET), Malang, Indonesia, 2020, pp. 361-365
- Farooq, M. S., Riaz, S., Abid, A., Umer, T., & Zikria, Y. B. (2020). Special Issue Internet of Things (IoT)-Based Wireless Health: Enabling Technologies and Applications.

- Abd Rahim, N. H., Ahmad Zaki, F. N., & Noor, A. S. M. (2020). Smart App for Gardening Monitoring System using IoT Technology. *International Journal of Advanced Science and Technology*, 29(04), 7375 – 7384.
- Abdul Ghafar, N. I., & Kassim, M. (2024). IoT Smart Gardening on Herbal Plant and Analytic Virtualization Platform System. *International Journal on Informatics Visualization*, 8(3), 1390-1397
- Aarathi, R., Sivakumar, D., & Mariappan, V. (2023). Smart Soil Property Analysis Using IoT: A Case Study Implementation in Backyard Gardening. *Procedia Computer Science*, 218(2023), 2842–2851.
- Tang, P., Liang, Q., Li, H., & Pang, Y. (2024). Application of Internet-of-Things Wireless Communication Technology in Agricultural Irrigation Management: A Review.