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Development of IoT on Irrigation System for Garden

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Abstract: This system research aims to use a Raspberry Pi 3 to develop control and monitoring systems that will automatically sprinkle water on the garden to irrigate it. The soil moisture sensor will determine whether the soil is dry or wet. A user can use the Blynk app on their smartphone to keep an eye on the garden conditions while also employing the camera for direct surveillance by connecting to a Wi-Fi network. It's important to avoid giving plants an uncontrollable amount of water and avoid water waste, especially in agriculture. Two gardens have been used to test two different irrigation systems: A uses an Internet of Things (IoT) irrigation system, while B uses a regular irrigation system. The results reveal that Garden B's irrigation procedure consumes a lot of water in just 14 days, whereas Garden A's conditions show improvement over time when compared to traditional irrigation methods. Therefore, compared to the previous system, this design is more effective at controlling the watering process and keeping an eye on the Garden. It would be better if the existing irrigation system had a Raspberry Pi Touch LCD Display, using renewable energy as a backup power source during power outages, and employing high-pressure water pumps to cover a large area of the garden.

Keywords: Irrigation system, Garden, Internet of Things. Raspberry Pi, Wi-Fi.

1.0 INTRODUCTION

The most important thing to plant in the garden is to water the plant to keep it alive and to keep it lives with nutrients. These days, gardeners often use an ineffective technique to water the plant, so there is a very high possibility of over-watering the plant. Most plants are composed of 90% of water, 60% of which is supplied through the plant root hair from the ground. It is very important to have quality soil with plenty of organic matter to operate like a sponge and encourage almost microscopic roots to pass through porous and well-drained soils to keep the plants safe and well-maintained.

The IoT implementation on the Garden irrigation system is indeed monitoring and customized for controlling watering system that helps to spread water efficiently on plants. The objective of the system is to provide automatic watering plants with efficient usage of water [1]-[3]. Secondly, apply IoT Technology to irrigation systems for gardens, and lastly, monitor the growth of plants through a smartphone [4]-[7]. A water sprinkler is implemented for this system to make the watering operation simpler for most species of plants. The conditions of the garden environment can be tracked, and data can be sent to the raspberry pi which is the microcontroller in this system [8]-[12]. The system consists of a water pump which is used to trigger water upon the ground, depending on the soil's moisturization factors.

Therefore, the Garden Irrigation System comes with IoT to enable the surveillance the plant growth and garden conditions from moment to moment. The system also has a camera feature that allows the user to view live footage mostly in the garden despite stepping into the garden area. These attempts will alert the gardener to what happens in the garden and can take immediate action to deter wildlife animals. This system is also equipped with a user interface that is programmed on a Raspberry Pi and uses the Blynk application which is a key part of user communications with the irrigation system.

2.0 LITERATURE REVIEW

2.1 SYSTEM I : A SMART IOT FUZZY IRRIGATION SYSTEM

George Kokkonis (2017) performs research on an intelligent irrigation system, with a new fuzzy machine algorithm for the agricultural production sector using IOT [13]. The study aims to minimize water usage by using the IoT for the agricultural sector. The research's goal was to reduce water supply use and increase agricultural quantity including crop quality. The methodology for this research is that the best time during plant watering via the IoT is measured without intervention from the user [14].

The suggested IOT irrigation system based on Fuzzy architecture is shown in Figure 1. The outcome of this analysis is an optimized watering system that is capable of regulating the irrigation valve and helping to conserve water usage [15]. The system responds when data obtained from the database have been interpreted to ensure that irrigation is prevented in the case of adverse weather conditions and precipitation.

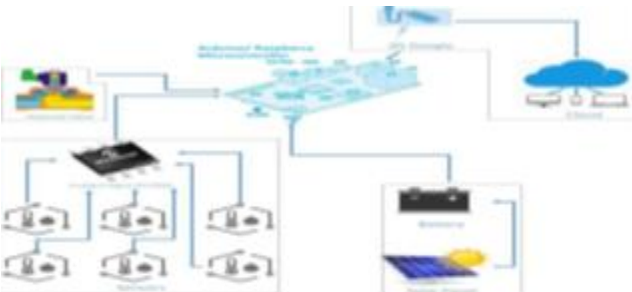

Figure 1: Architecture of A Smart IOT Fuzzy Irrigation System

2.2 SYSTEM II: INTELLIGENT IoT-BASED AUTOMATED IRRIGATION SYSTEM

The research done by Yuthika Shekhar (2017) deals with the evaluation of watering processes for plants depending on KKN (K-Nearest Neighbor) an analysis of results, which is a characterization of the algorithm of IoT machine learning. The purpose of the study would be to adjust water sources efficiently and economically for agricultural production. The research on agricultural surveillance was undertaken to concurrently reduce significant human power and water usage. The approach to this study is to allocate a paddy field irrigated agriculture in a control system that receives a command signal from a central terminal [16]. The results of this analysis are an automated irrigation system based on Intelligent technology of IoT implementations, which involves a system that can communicate with each other, to be effectively irrigated [17].

2.3 SYSTEM III: IOT-BASED CROP-FIELD MONITORING AND IRRIGATION AUTOMATION

The third study is by Rajalakshmi (2016). This analysis is focused on an IOT framework for monitoring and watering crop fields that provides a user interface for surveillance through the website application [18]. The goal of the study is to create a framework for automatic irrigation on a database again after a web application or smartphone application has taken over. The device itself can be used for irrigation and can be controlled by the user via a smartphone app. In conclusion, the irrigation process can be carried out conveniently via the gardener by smartphone using the web application, but the device can also automatically irrigate [19].

2.4 SYSTEM IV: IOT-BASED SMART IRRIGATION MONITORING AND CONTROLLING SYSTEM

Shweta B. Saraf's (2017) thesis regards the IOT-based Smart Irrigation monitoring and controlling system, which is used by android phones for monitoring and regulating drips using the network of wireless sensors [20]. The goal of this study is to adapt the water supply efficiently and economically for agricultural development. The study aims to reduce the intervention of humans and to wirelessly track and regulate the irrigation of plants by using an android phone.

The findings of this analysis are that people are linked to farm surveillance as in Figure 2 for precautionary steps and to manage the irrigation system using an android phone on their mobile phone [21].

Figure 2: Architecture of IOT-Based Smart Irrigation Monitoring and Controlling System

2.5 SYSTEM V: SMART FARM MONITORING VIA THE BLYNK IOT PLATFORM

Peerasak Serikul (2018) conducts a report on intelligent farm surveillance through the Blynk IOT embedded system, which would be a case study for humid data processing and data collection for paddy fields in particular [5]. The purpose of this study was to provide a remedy for an intelligent and sustainable farm application mainly powered only by the Internet of Things. The methodology for this analysis was designed to test the moisture of paddy sacks in various shops by using a clever capsule prototype [6].

To measure the humidity from the crop-farm field, a smart capsule is placed in a paddy bag as in Figure 3 which is the microcontroller, and the humidity sensor is placed inside the capsule.

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Figure 3: Smart Capsule in a Paddy Bag

3.0 METHODOLOGY

3.1 OVERALL BLOCK DIAGRAM

A Block Diagram of the Development of IoT on the Irrigation System for the Garden is illustrated in Figure 4 which shows the overall system from input, the system with the process, and lastly the output of the system.

Figure 4 shows that the Raspberry Pi 3 Model B+ microcontroller used in the system design is associated with 3 sensors which are a soil humidity sensor, a temperature sensor as well as an ultrasonic sensor for the feedback of the watering process.

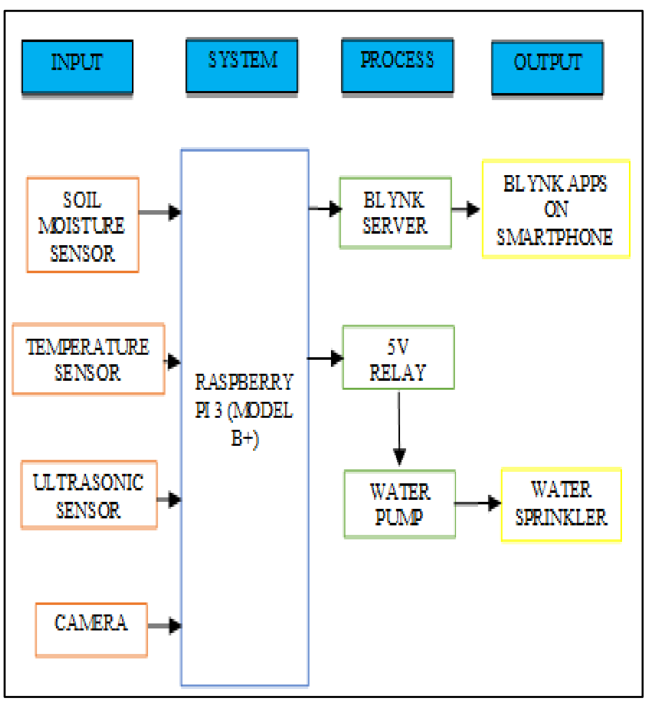

Figure 4: Overall Block Diagram

Furthermore, an irrigation system is connected to the camera component that provides real-time live garden conditions. Until the microcontroller analyses the plant's conditions, each sensor can operate along together to gather situational information about the garden. The Blynk server would be an IOT site for the gardener to connect to the system. It was a cloud provider in the form of networking devices for all types of smartphones that can use the Blynk application. The outcomes of the system would be a water sprinkler as well as the Blynk application for smartphones user.

The Raspberry Pi 3 Model B+ as illustrated in Figure 5 is a multifunction microcontroller that is a smart minicomputer that can function as the system's brain. It will collect all the data and process it, then the data will be sent to the Blynk Server for the IoT process.

Figure 5: Raspberry PI 3 Model B+

Usually, water is pumped by a pipe system as from a fluid pump. Then, as shown in Figure 6, the headwater sprinkler is sprinkled and divided into small droplets of water that descend on the soil. Therefore, it is important to build up the water pump and operating conditions effectively, to allow uniform spraying of water on the garden plants.

Figure 6: Headwater Sprinkler

The ultrasonic sensor is a wave propagation measurement unit for measuring the distance from an object shown in Figure 7. The sensor measures the distance of the water level in the water tank by measuring delays between both sending and receiving processes of the wave signal. It is being used on the top cover of the water tank to calculate the water level, to retain the water level, is necessary for the plant to irrigate with a sufficient water source.

Figure 7: Ultrasonic Sensor

To determine soil volumetric water in the medium of soil, a soil moisture sensor as in Figure 8 is utilized. The module sensor into the ground and measures a proportion of the amount of soil moisture.

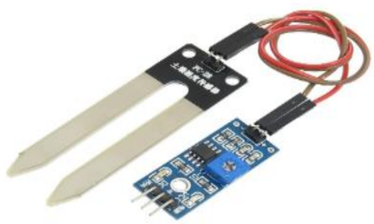

Figure 8: Soil Moisture Sensor

The temperature sensor as in Figure 9 is called DHT11 and is a two-function module. The temperature range can be detected in units of degree Celsius (° C) and another feature is to detect temperatures or humidity by volume (percent) of the surrounding area.

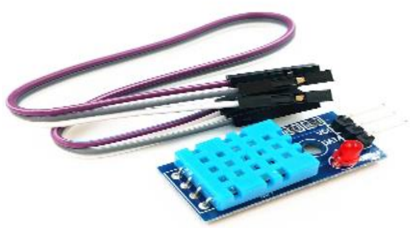

Figure 9: Temperature Sensor

Figure 10 is an optical device or camera for continuing to take videos or pictures in the environment of the garden, a camera component is used for the raspberry pi microcontroller. The camera has a circular shape that enables light to acquire a picture in a low-sensitive light environment.

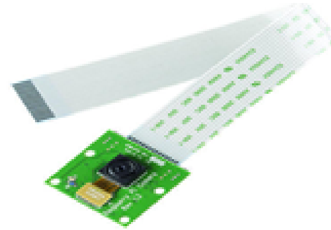

Figure 10: Camera component for Raspberry Pi

Figure 11 shows that the indeed of Blynk is a mobile app that has the capability for developing a database system for monitoring and management. The Blynk server is a cloud infrastructure for all communications from smartphones to tablets. Blynk can submit data gathered by each sensor which is viewed securely by the smartphone user.

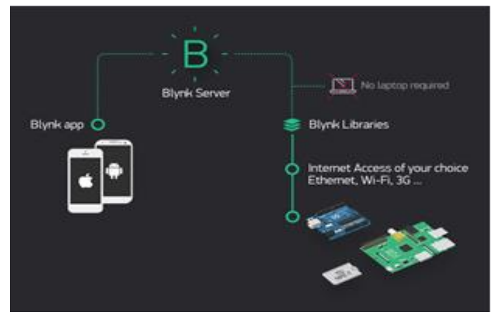

Figure 11: Infographics of the Blynk Architecture System for IoT

4.0 RESULTS AND DISCUSSION

4.1 RESULT I: DESIGNING USER INTERFACE ON THE BLYNK APPLICATION

The Blynk application has been designed as in Figure 12 to ease users for controlling and monitoring the Garden using the IoT platform. This will ease users, especially gardeners to control the irrigation process automatically even from a far distance from the Garden. The Blynk application is also equipped with the details of the Garden and also with live video.

Figure 12: Interface using the Blynk Application

Also in Figure 12 shows that the top part of the user interface is the live video that will happen in the garden in real-time with a delay of around 3 seconds. The several boxes show the conditions of the garden consisting of air temperature, air humidity, "Dry Conditions", "Good Conditions" and "Water Tank Indicator". Email and user twitter notifications with the "Reports" button also is equipped for sending information to the Blynk company if there are malfunctions in the Blynk applications. Moreover, for controlling the irrigation process, the user also is provided with a button for turning off or on at the Blynk application.

4.2 RESULT II: THE WATER CONSUMPTION

In this section, all the data recorded for water consumption that has been used for the irrigation process is recorded in Table 1.

Table 1: The Water Consumption for the Irrigation Process

Days	Garden A	Garden B
Day 1	19 ml of water used	30 ml of water used
Day 2	15 ml of water used	30 ml of water used
Day 3	14 ml of water used	30 ml of water used
Day 4	16 ml of water used	30 ml of water used
Day 5	15 ml of water used	30 ml of water used
Day 6	15 ml of water used	30 ml of water used
Day 7	14 ml of water used	30 ml of water used
Day 8	15 ml of water used	30 ml of water used
Day 9	16 ml of water used	30 ml of water used
Day 10	15 ml of water used	30 ml of water used
Day 11	16 ml of water used	30 ml of water used
Day 12	14 ml of water used	30 ml of water used
Day 13	14 ml of water used	30 ml of water used
Day 14	16 ml of water used	30 ml of water used
Total water used	**214 ml of water used**	**320 ml of water used**

For Garden B in which the traditional way of the irrigation system was implemented, the syringe is used for fixing the quantity of water during the irrigation process about 30 ml per day. While Garden A used the data collected from the ultrasonic sensor to measure the water consumed for the irrigation process via the IoT of the system. For calculating the water consume in Garden A, the ultrasonic which is placed on the top cover of the water tank will measure the water left after the water sprinkler with the water pump does the irrigation process as shown in Figure 13.

After the irrigation process is done, the measured values will be shown on the shell of Thonny Python Program IDE software. All the measured value is rounded off and represented in graph as shown in Figure 14.

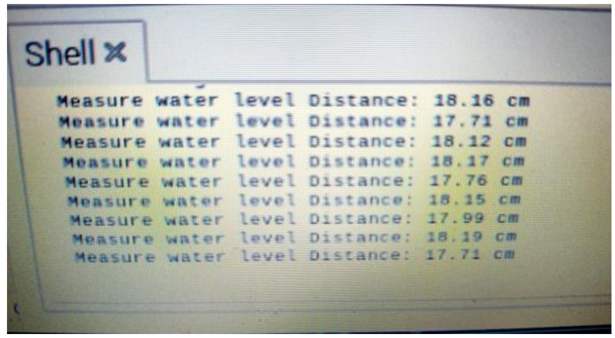

Figure 13: The Water Level Values on Shell of Thonny Python Program IDE

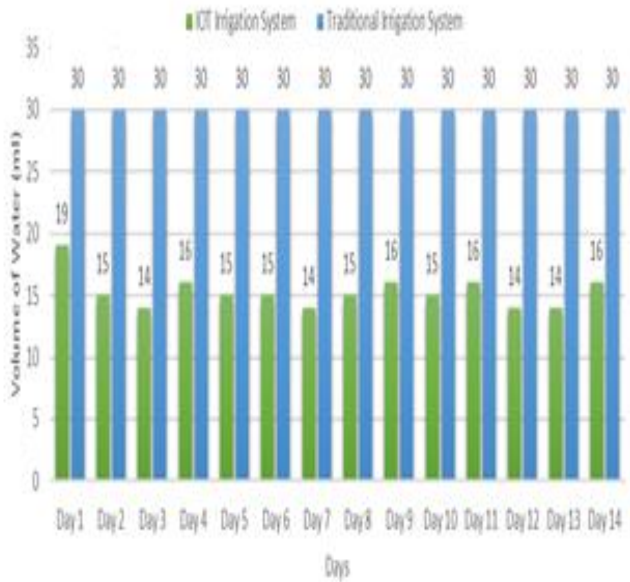

Figure 14: The Graph Results of Water Consumption for Irrigation Process in 14 Days

Therefore, results from Table 1 and Figure 14 shows that the Garden A can save water resources for the irrigation process using the IOT of the irrigation system. Water conservation is one of the main issues to enhance the utility and usage for gardeners in the irrigation process for plants.

4.3 RESULT III: THE CONDITIONS OF THE GARDEN

Table 2 shows that the data collected from observation after 14 days has been experimented with using 2 different ways of irrigation systems. Table 2 shows the results of Irrigation System that uses IoT equipped with sensors helps the plants to keep growing as expected and prevent the plants from getting wilt. Plants in garden A grow healthy compared to garden B.

Table 2: The Conditions of Plants for both Gardens

Days	Garden B	Garden A
1	No growth of Plant	No growth of Plant
2	No growth of Plant	No growth of Plant
3	Plant started growing	Plant started growing
4	Plant started growing	Plant started growing
5	A few plants are dead and wilt	Plant started growing
6	Plant started growing	Plant started growing
7	A few plants are dead and wilt	Plant started growing
8	Plant started growing	Plant started growing
9	Plant started growing	A few plants are dead and wilt
10	Plant started growing	Plant started growing
11	A few plants are dead and wilt	Plant started growing
12	A few plants are dead and wilt	Plant started growing
13	Plant started growing	Plant started growing
14	Plant started growing	Plant started growing

4.4 DISCUSSION

Based on the above results obtained shows that the system has 4 aspects that make the irrigation system using IoT the best way for controlling the irrigation process and monitoring the growth of plants via IoT technology. All the results obtained are summarized in Table 3.

Table 3: The Summarized Irrigation System

Aspects	Garden A (Irrigation System via IoT)	Garden B (Traditional Irrigation system)
Performing the Irrigation Process	• Blynk application via smartphone. • Accessible for users to control the irrigation process if have a good connection to the internet.	• Manual using syringe • Limited access and users need to stay in the Garden area.
The medium used for monitoring the Garden	• Blynk Application and Blynk Server • Microcontroller of Raspberry Pi 3 with the Camera component • UV4L Server platform	• Limited access and users need to stay in the Garden area.
Water Consumption	Efficiently usage of water resources	Not efficiently usage of water resources
Conditions of Garden	Consistently growth of plants	Inconsistently growth of plants

The creation of the IoT on Irrigation Systems of Garden is an excellent platform for people to track the garden environment and their plants effectively and take better care of it. By updating the garden status in real-time, the smart irrigation mechanism can also be managed via the Blynk application on the smartphone as well as the owner can also manage the irrigation system. Thus, it can be said that this system is a more efficient way of controlling the irrigation process and monitoring the Garden compared to the traditional system.

5.0 CONCLUSION

Based on the results obtained, factually achieved the objective of the system which is to monitor the growth of plants through the user's smartphone. A user can use a camera that is attached to raspberry pi to view the garden's live situation on the application. Other details of the garden conditions on the Blynk application are also provided such as humidity, temperature, water tank indicator, and conditions of the garden soil. Moreover, using Blynk Server with the application indeed achieved the objective which is to apply IoT Technology to irrigation systems for gardens. This smart irrigation system can be controlled by the user through the Blynk app on the smartphone by controlling the watering process and monitoring the updated conditions of the garden in real-time from a far distance. Other than that, using IoT of the Irrigation system with the Blynk application the objective of providing automatic watering plants with efficient usage of water is being achieved. For future recommendation on the existing irrigation system and enhancing system design, it would be better if it is equipped with a Raspberry Pi Touch LCD Display, use renewable energy as a backup power supply during a power outage, and used a high-pressure water pump to cover a wide area of the garden.

REFERENCES

[1] G. Kokkonis, S. Kontogiannis & D. Tomtsis, "A Smart IOT Fuzzy Irrigation System," Power (mW), 100(63), 25, 2017.

[2] Shekhar, Y., Dagur, E., Mishra, S., & Sankaranarayanan S., "Intelligent IoT Based Automated Irrigation System," International Journal of Applied Engineering Research, 12(18), 7306-7320, 2017.

[3] Rajalakshmi, P., & Mahalakshmi, S. D., "IOT-based crop-field monitoring and irrigation automation," 10th International Conference on Intelligent Systems and Control, ISCO, pp. 1-6, 2016.

[4] Saraf, S. B., & Gawali, D. H., "IoT-based smart irrigation monitoring and controlling system," 2nd IEEE International Conference on Recent Trends in Electronics, Information & Communication Technology, RTEICT, pp. 815-819, 2017.

[5] Serikul, P., Nakpong, N., & Nakjuatong, N., "Smart Farm Monitoring via the Blynk IoT Platform: Case Study: Humidity Monitoring and Data Recording," 16th International Conference on ICT and Knowledge Engineering, ICT&KE, pp. 1-6, 201

[6] Lekjaroen, K., Ponganantayotin, R., Charoenrat, A., Funilkul, S., Supasitthimethee, U. and Triyason, T., 2016, December. IoT Planting: Watering system using a mobile application for the elderly. In *2016 international computer science and engineering conference (ICSEC)* (pp. 1-6). IEEE.

[7] Sambath, M., Prasant, M., Raghava, N.B. and Jagadeesh, S., 2019, November. It is based garden monitoring system. In *Journal of Physics: Conference Series* (Vol. 1362, No. 1, p. 012069). IOP Publishing.

[8] Kamaruddin, F., Abd Malik, N.N.N., Murad, N.A., Latiff, N.M.A.A., Yusof, S.K.S. and Hamzah, S.A., 2019. IoT-based intelligent irrigation management and monitoring system using Arduino. *TELKOMNIKA (Telecommunication Computing Electronics and Control)*, *17*(5), pp.2378-2388.

[9] Baluprithviraj, K.N., Madhan, M.M., Devi, T.K., Bharathi, K.R., Chendhuran, S. and Lokeshwaran, P., 2021, August. Design and Development of Automatic Gardening System using IoT. In *2021 International Conference on Recent Trends on Electronics, Information, Communication & Technology (RTEICT)* (pp. 750-754). IEEE.

[10] Hadi, M.S., Nugraha, P.A., Wirawan, I.M., Zaeni, I.A.E., Mizar, M.A. and Irvan, M., 2020, September. It is based smart garden irrigation system. In *2020 4th International Conference on Vocational Education and Training (ICOVET)* (pp. 361-365). IEEE.

[11] Astutiningtyas, M., Nugraheni, M. and Suyoto, S., 2021. Automatic plant watering system for a small garden.

[12] Jain, R.K., Gupta, B., Ansari, M. and Ray, P.P., 2020, July. IoT-enabled smart drip irrigation system using web/Android applications. In *2020 11th International Conference on Computing, Communication and Networking Technologies (ICCCNT)* (pp. 1-6). IEEE.

[13] Munir, M.S., Bajwa, I.S. and Cheema, S.M., 2019. An intelligent and secure smart watering system using fuzzy logic and blockchain. *Computers & Electrical Engineering*, *77*, pp.109-119.

[14] Kwok, J. and Sun, Y., 2018, January. A smart IoT-based irrigation system with automated plant recognition using deep learning. In *Proceedings of the 10th international conference on computer modeling and simulation* (pp. 87-91).

[15] Samonte, M.J.C., Signo, E.P.E., Gayomali, R.J.M., Rey, W.P. and Serrano, E.A., 2019, March. PHYTO: An IoT urban gardening mobile app. In *Proceedings of the 2019 2nd International Conference on Information Science and Systems* (pp. 135-139).

[16] Karunakanth, M., Venkatesan, R., Jaspher, G. and Kathrine, G., 2018. IoT-based smart irrigation system for the home-based organic garden. *International Journal of Pure and Applied Mathematics*, *119*(12), pp.16193-16199.

[17] Cheema, S.M., Khalid, M., Rehman, A. and Sarwar, N., 2018, October. Plant irrigation and recommender system–IoT-based digital solution for the home garden. In *International Conference on Intelligent Technologies and Applications* (pp. 513-525). Springer, Singapore.

[18] Thamaraimanalan, T., Vivekk, S.P., Satheeshkumar, G. and Saravanan, P., 2018. Smart garden monitoring system using IoT. *Asian Journal of Applied Science and Technology (AJAST)*, *2*(2), pp.186-192.

[19] Jimenez, J., Zambrano, M. and Minango, J., 2022. Prototype Development for Automation of Irrigation System Based on IoT for Small and Medium Rural Producers. In *International Conference on Innovation and Research* (pp. 229-239). Springer, Cham.

[20] Ali, M., Kanwal, N., Hussain, A., Samiullah, F., Iftikhar, A. and Qamar, M., 2020. IoT-based smart garden monitoring system using NodeMCU microcontroller. *International Journal of Advances in Applied Sciences*, *7*(8), pp.117-124.

[21] Lidyawati, L., Kristiana, L., Darlis, A.R., Jambola, L. and Susana, R., 2020. Remotely garden irrigation for residential areas based on the internet of things (IoT). *REKA ELKOMIKA: Jurnal Pengabdian kepada Masyarakat*, *1*(1), pp.35-44.