Universiti Teknologi MARA

The 11th International, Invention, Innovation & Design 2022

INDES 2022

Ushering in the Age of Endemic

THE 11TH INTERNATIONAL INNOVATION, INVENTION & DESIGN COMPETITION INDES 2022

EXTENDED ABSTRACTS BOOK

e ISSN 2756-8733

Perpustakaan Negara Malaysia Cataloguing in Publication Data

No e-ISSN: e-ISSN 2756-8733

eISSN 2756-8733

9 772756 873009

Cover Design : Nazirul Mubin Mohd Nor
Typesetting : Wan Nurul Fatihah binti Wan Ismail

The 11th International Innovation, Invention and Design Competition 2022

Organised by

Office of Research, Industrial Linkages,
Community & Alumni Networking (PJIM&A)
Universiti Teknologi MARA Perak Branch

and

Academy of Language Study
Universiti Teknologi MARA Perak Branch

SMART IRRIGATION AND SOIL MONITORING SYSTEM FOR TARO YAM CULTIVATION

Azril Abdul Rahim, Amirul Amin Abd Halim, Roslina Mohamad

College of Engineering Studies, Universiti Teknologi MARA Shah Alam

Email: azrilabdulrahim5@gmail.com

ABSTRACT

The cultivation of taro yam, which began in Southeast Asia and Malaysia, has continued to expand to the present day. It is one of the crops contributing to the world's food supply and as a decorative plant. However, agricultural activities encounter issues such as a monitoring system for soil composition that is not directly integrated with the irrigation system and the inability of the irrigation system to record water usage. Hence, this research aims to develop a smart irrigation and soil monitoring system for taro yam cultivation using the internet of things. The first method to fulfill the aims is to construct the soil composition and irrigation device using NodeMcu ESP8266 to control the irrigation system autonomously. The second method consists of developing real-time monitoring systems using the Blynk 2.0 application to provide a platform for farmers to monitor the state of agricultural areas online. The following method is developing the soil composition and monitoring system operating devices and applications and experimenting with the successfully created devices. From the results, the irrigation and soil monitoring system saves around 32.5% of water usage. The usage was recorded at 3.6 litre per day before applying the irrigation and soil monitoring and was reduced to 2.43 litre per day after using the project device. In conclusion, the developed device can conveniently display the ambient air's humidity, temperature, and soil moisture conditions on smartphones and desktops. In addition, this system can maintain soil moisture according to the value of soil moisture that has been set, which can prevent excessive water use for taro yam cultivation.

Keywords: Irrigation system; internet of things; soil monitoring; taro yam

1. INTRODUCTION

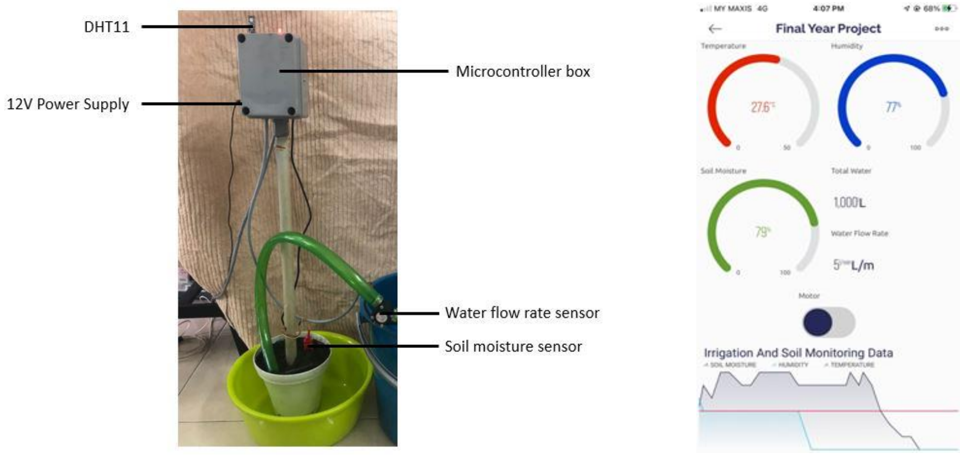
Various technologies have been implemented in agricultural systems, but problems still arise in existing irrigation systems. Environmental consideration such as using clean water resources is recommended while implementing technology in agriculture today (Marcu et al., 2019). The agriculture industry should utilise clean water to its full potential without being squandered. Irrigation systems should give an amount of water corresponds to the needs of plants, such as taro yam (colocasia esculenta), in which water should be kept at a depth of 2.5 to 5.0 cm when new roots are developing and the first leaves appear (Sari et al., 2020). Crops require a specific amount of water, hence the existing system cannot supply the correct amount of water to the crops.

The first problem identified is that the existing soil composition monitoring system only focuses on monitoring the readings from the sensors for analysis without being connected to the irrigation system (Sumual & Seke, 2019). For example, the system does not channel water to the plants when the soil moisture sensor detects low humidity readings. Instead, the irrigation system should channel water to the plants according to a set time. The second problem is irrigation systems cannot determine the amount of water that has been used in agriculture (Rao & Sridhar, 2018). Water consumption must be identified to avoid waste when using clean water sources. Pipe leaks in the irrigation system can be detected when a massive monthly increase in water consumption readings is detected. In addition, farmers can also detect water leakage in irrigation systems if the amount of water is recorded. Water wastage will also increase crop production costs (Nagaraja et al., 2019). Hence, this research aims to develop an irrigation and soil monitoring system using the internet of things (IoT) for taro yam cultivation. The first objective is to develop soil composition and irrigation devices using NodeMcu Esp8266. Then, to develop a real-time monitoring and detection system for agricultural soil and irrigation using Blynk apps. Finally, to analyse water flow rate and soil moisture to estimate an ideal water supply for taro yam.

2. FINDINGS

As shown in Figure 1(a), a completed prototype comprises of three physical components: microcontroller box, probing rod, and water pump. The grey box at the top of the microcontroller contains a NodeMcu microcontroller, digital humidity and temperature sensor (DHT 11), a solid-state relay (SSR-20A), the battery, and the connection wires for each component. A 12V power source is also linked to the device through this box. A red light-emitting diode (LED) indicator on top of the box indicates the device's wireless fidelity (Wi-Fi) connection to the Blynk App 2.0 server. When the gadget is initially attached to a power source, the LED flashed rapidly to signal that NodeMcu is ready to connect to Wi-Fi. The LED will blink dimly and slowly when the Wi-Fi connection is successfully established. The DHT 11 sensor is placed at the very top to obtain more accurate readings of ambient temperature and air humidity because, at the top, the DHT 11 sensor is more exposed without being covered by other components.

In contrast, the sensor is partially covered by a rod probe at the bottom. On the rear of the grey box there is a 3-pin 13A socket switch. This switch socket supplies electricity to the water pump. This switch has been connected to the SSR-20; to receive a digital signal from the NodeMcu, allowing the water pump power source to provide electricity. The wire connection between the NodeMcu and capacitive soil moisture sensor can also be found inside this stem. Since only two-thirds of the capacitive soil moisture needs to be injected into the soil for an accurate reading, capacitive soil moisture is not entirely injected into the soil. On the green pipe, which distributes water from the water pump to the plant, a water flow rate sensor is installed between the pipes to measure the water flow rate and the amount of water delivered to the plant.



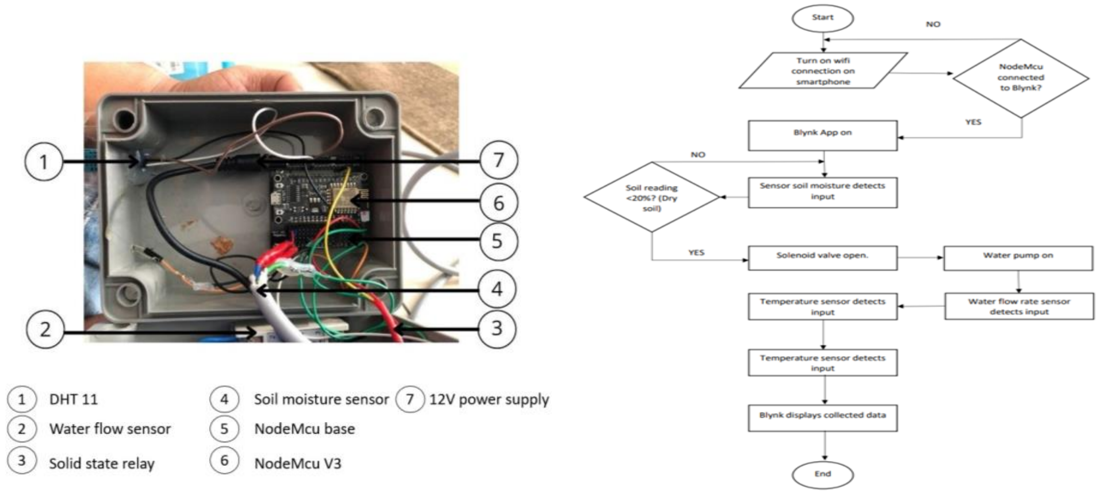
(a) (b)

Figure 1 Smart Irrigation and Soil Monitoring System (a) Prototype, (b) Interface for Smartphone

Figure 1(b) shows the interface displayed on a smartphone. The data displayed on this smartphone interface is the same as on the desktop. A chart combines all the data output in the form of a graph. Users must first download the Blynk 2.0 application on a smartphone to use the interface in Figure 1(b). Data for temperature, air humidity, and soil moisture are displayed as gauges on both the desktop and smartphone interfaces. Additionally, manual water pump control switches are on both user interfaces.

3. METHODOLOGY

Figure 2(a) depicts a complete NodeMcu microcontroller with all attached components. The connection for the DHT 11 sensor is displayed on label 1. The DHT 11 sensor has three terminals; the positive terminal is connected to the power source, the data terminal is connected to digital port 2 on the NodeMcu, and the ground terminal is connected to the sensor's ground. Label 2 denotes a solid-state relay (SSR), and its positive terminal is attached to NodeMcu port D8. NodeMcu port A0 is coupled to a capacitive soil moisture sensor identified by label 3. The cable labelled with the number 4 is connected the water flow rate sensor to the NodeMcu D7 port. Label 5 depicts the NodeMcu V3 base that serves as the connection's point of origin, and label 6 is a NodeMcu microcontroller used to regulate the entire system. Label 7 indicates a connection for a 12-volt power source.



(a) (b)

Figure 2 (a) Smart Irrigation and Soil Monitoring Device Connection, (b) Operation System Flowchart

The operation of the proposed system is shown in Figure 2(b). The operation starts when the microcontroller receives soil moisture sensor input if the Wi-Fi connection is successful. The microcontroller makes a predetermined choice. Colocasia esculenta-type plants require more than 60% water, according to research conducted by (Sari et al., 2020). As a result, plant growth was not hindered. Therefore, the soil moisture threshold value is set at 75%; if the soil moisture is read below 75%, the water pump will deliver water to the plants. The water flow rate sensor detects the water entering the ground. The input is then passed to the temperature sensor. On the Blynk application, the data gathered by the water flow rate, temperature, and soil moisture sensors are shown. Blynk cloud service is utilised to store and analyse all system-collected data.

4. CONCLUSION

After completing the irrigation and soil monitoring system, it can be concluded that this system can automatically distribute water to plants based on soil moisture measurements. The system also responds by automatically channeling water supply to plants based on the data obtained to control the soil moisture level according to the crop's suitability while saving water consumption without overwatering to reduce water use in agricultural irrigation systems. The results show that water consumption can be reduced by 32.5% per day compared to water consumption using traditional irrigation methods. With this developed IoT system, farm owners can reduce human resource costs. Among the future improvements that the present work can make is to increase the number of soil moisture sensors on the device so that system can obtain the reading of the entire soil area in more detail. In addition, the researchers can place a sensor to detect the amount of water in the water storage tank.

REFERENCES

Marcu, I. M., Suciu, G., Balaceanu, C. M., & Banaru, A. (2019). *IoT based system for smart agriculture.* Paper presented at the 2019 11th International Conference on Electronics, Computers and Artificial Intelligence (ECAI).

Nagaraja, G. S., Soppimath, A. B., Soumya, T., & Abhinith, A. (2019, 20-21 Dec. 2019). *IoT Based Smart Agriculture Management System.* Paper presented at the 2019 4th International Conference on Computational Systems and Information Technology for Sustainable Solution (CSITSS).

Rao, R. N., & Sridhar, B. (2018, 19-20 Jan. 2018). *IoT based smart crop-field monitoring and automation irrigation system.* Paper presented at the 2018 2nd International Conference on Inventive Systems and Control (ICISC).

Sari, L., Susetio, M., Efendi, D., Wulansari, A., & Ermayanti, T. (2020). *Growth evaluation of Taro CV. Bentul (Colocasia esculenta L.) diploid and tetraploid in the greenhouse in response to different soil water content for selection of drought tolerant plants.* Paper presented at the IOP Conference Series: Earth and Environmental Science.

Sumual, H., & Seke, F. (2019). *Control System based Photocell, Timer and Temperature Sensor.* Paper presented at the Journal of Physics: Conference Series.

Pejabat Perpustakaan
Librarian Office

Universiti Teknologi MARA
Cawangan Perak
Kampus Seri Iskandar
32610 Bandar Baru Seri Iskandar,
Perak Darul Ridzuan, MALAYSIA
Tel: (+605) 374 2093/2453 Faks: (+605) 374 2299

UNIVERSITI TEKNOLOGI MARA

Surat kami : 700-KPK (PRP.UP.1/20/1)
Tarikh : 20 Januari 2023

Prof. Madya Dr. Nur Hisham Ibrahim
Rektor
Universiti Teknologi MARA
Cawangan Perak

Tuan,

PERMOHONAN KELULUSAN MEMUAT NAIK PENERBITAN UiTM CAWANGAN PERAK MELALUI REPOSITORI INSTITUSI UiTM (IR)

Perkara di atas adalah dirujuk.

2. Adalah dimaklumkan bahawa pihak kami ingin memohon kelulusan tuan untuk mengimbas (*digitize*) dan memuat naik semua jenis penerbitan di bawah UiTM Cawangan Perak melalui Repositori Institusi UiTM, PTAR.

3. Tujuan permohonan ini adalah bagi membolehkan akses yang lebih meluas oleh pengguna perpustakaan terhadap semua maklumat yang terkandung di dalam penerbitan melalui laman Web PTAR UiTM Cawangan Perak.

Kelulusan daripada pihak tuan dalam perkara ini amat dihargai.

Sekian, terima kasih.

setuju.

"BERKHIDMAT UNTUK NEGARA"

27.1.2023

Saya yang menjalankan amanah,

PROF. MADYA DR. NUR HISHAM IBRAHIM
REKTOR
UNIVERSITI TEKNOLOGI MARA
CAWANGAN PERAK
KAMPUS SERI ISKANDAR

SITI BASRIYAH SHAIK BAHARUDIN
Timbalan Ketua Pustakawan

nar