Chapter in Book

Smart Watering

Ahmad Al-Hadi Nadzmi[1], Siti Rohaidah Ahmad[2,*], Nurhafizah Moziyana Mohd Yusop[3], Anis Shahida Niza Mokhtar[4], and Suhaila Ismail[5]

1 zebul124@gmail.com
2 sitirohaidah@upnm.edu.my; ORCID ID : 0000-0001-5045-9803
3 moziyana@upnm.edu.my; ORCID ID : 0000-0003-0394-7710
4 anis@upnm.edu.my; ORCID ID : 0000-0003-1507-4777
5 suhaila@upnm.edu.my; ORCID ID : 0000-0003-4236-2758
* Correspondence; sitirohaidah@upnm.edu.my; +60182737020.

Abstract: *The fertility of the plant declines over time, making it challenging to keep the plant's structure healthy. There are many factors that can reduce plant fertility such as soil quality, pesticide, environmental stress, genetic of pant and water stress. Among all, water stress plays an important role where lack, excessive or irregular watering can cause plants to become stress, which can affect their ability to produce flowers and fruit. Therefore, this project is developed to address the water stress factor that affect productivity of the plants namely smart watering system. A smart watering system is an automated irrigation system that uses sensors and technology to adjust watering schedules and amounts based on various factors such as soil moisture, weather forecasts, and plant type. The goal of a smart watering system is to conserve water and improve the efficiency of irrigation, while still providing sufficient moisture for plants to thrive by producing an automatic watering system based in soil moisture readings. This system is developed using IoT hardware such as the Arduino UNO R3, soil moisture sensors, and so on, which act to detect, update, and display back to the user. This system has been set to a soil moisture level that is suitable for ornamental plants, which is 0–30 cb (kPa) for saturated soil. If the soil moisture reading is greater than 30 cb (kPa), then the system will detect the change and turn on the water pump. The methodology applied in this system is a prototype. Based on this model, the project can be developed in phases. The benefit of the development of this system is that it can promote technology in line with current progress and help solve the problems of growers and water wastage.*

Keywords: Arduino; Irrigation; Smart Watering.

1. INTRODUCTION

Water is required for plants to perform photosynthesis and absorb nutrients from the soil, thus watering strategies and water levels are critical. Conventional irrigation systems can be inefficient, wasting up to 50% of the water utilised, resulting in over-watering and plant dehydration. Watering should have the goal of preserving plant and soil fertility while minimising water waste. Smart irrigation systems have the advantage of conserving water and monitoring watering rates even when users are a long distance away or occupied. Overwatering plants, on the other hand, might produce a shortage of oxygen for plant roots, leading to sterility.

2. METHOD & MATERIAL

The method used for this Smart Watering system is based on a prototype model. The prototype model is one of the software development life cycle models where prototypes are built with minimal requirements. These prototypes are then tested and modified based on feedback received from customers until a final prototype with the desired functionality is developed. The prototype model consists of several phases, which are requirements gathering phase, design sketch, prototype development, user evaluation, system requirements screening and system implementation.

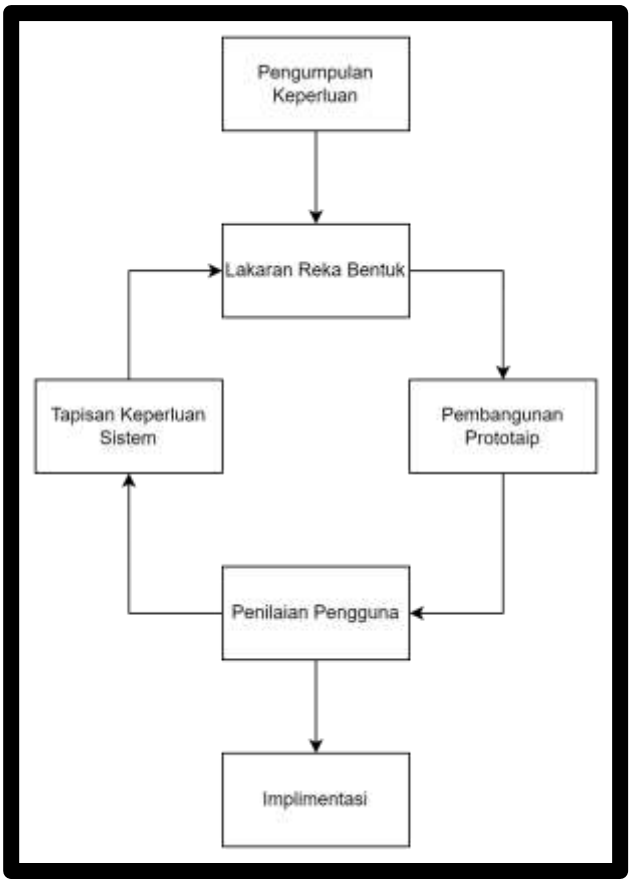

Figure 1. Prototype Methodology for Smart Watering

1. User

    a. Ornamental plant growers and those who are busy with daily affairs at the same time want to take care of the fertility of their plants.

2. Software

    a. MySQL

    b. Arduino IDE

3. Hardware

    a. Arduino UNO R3 board

b. *Arduino prototype shield board*

c. *Soil moisture sensor*

d. *Relay Channel*

e. *12v DC water pump*

f. *Jumper wire*

g. *Power supply and battery holder*

h. *LED lights (Red, Yellow and Blue).*

i. *USB Cable (Type A to Type B)*

j. *ESP8266 ESP-01 board*

3. FINDINGS

Smart Watering system that was developed is to preserving plant and soil fertility while minimising water waste. In this system, user can log in using ***default*** username and password for first time log. They can change it in the setting later. The level of soil moisture sensor can be change, updated, and store into MySQL database. It will be used for notification and the sensor itself. Interface design is used to enable user to access the system.

3.1 Interface Design

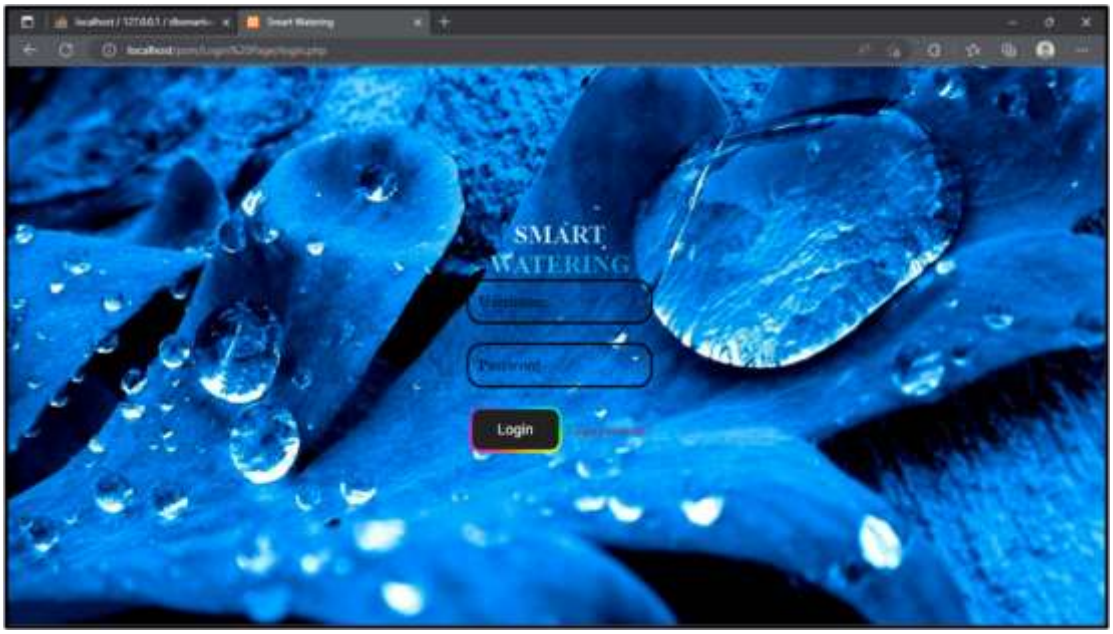

Figure 2. Log in Interface Design

Figure 2 show interface design for user to login and allow them to access the system that allow them to change username, password, and level of soil moisture sensor.

Figure 3. Setting Interface Design

3.2.2 Algorithm System Design

Input: nama pengguna, kata laluan	
if	nama pengguna DAN kata laluan sah
	papar menu utama;
else	papar ralat log masuk;
	ulang proses 1;

Figure 4. Algorithm design for Login

Input: nama pengguna baru, kata laluan baru, nama penuh pengguna	
if	pengguna masukkan nama pengguna baru, kata laluan baru, nama penuh pengguna
	paparkan proses kemas kini berjaya;

Figure 5. Algorithm design for update user information

3.2.3 Circuit Design

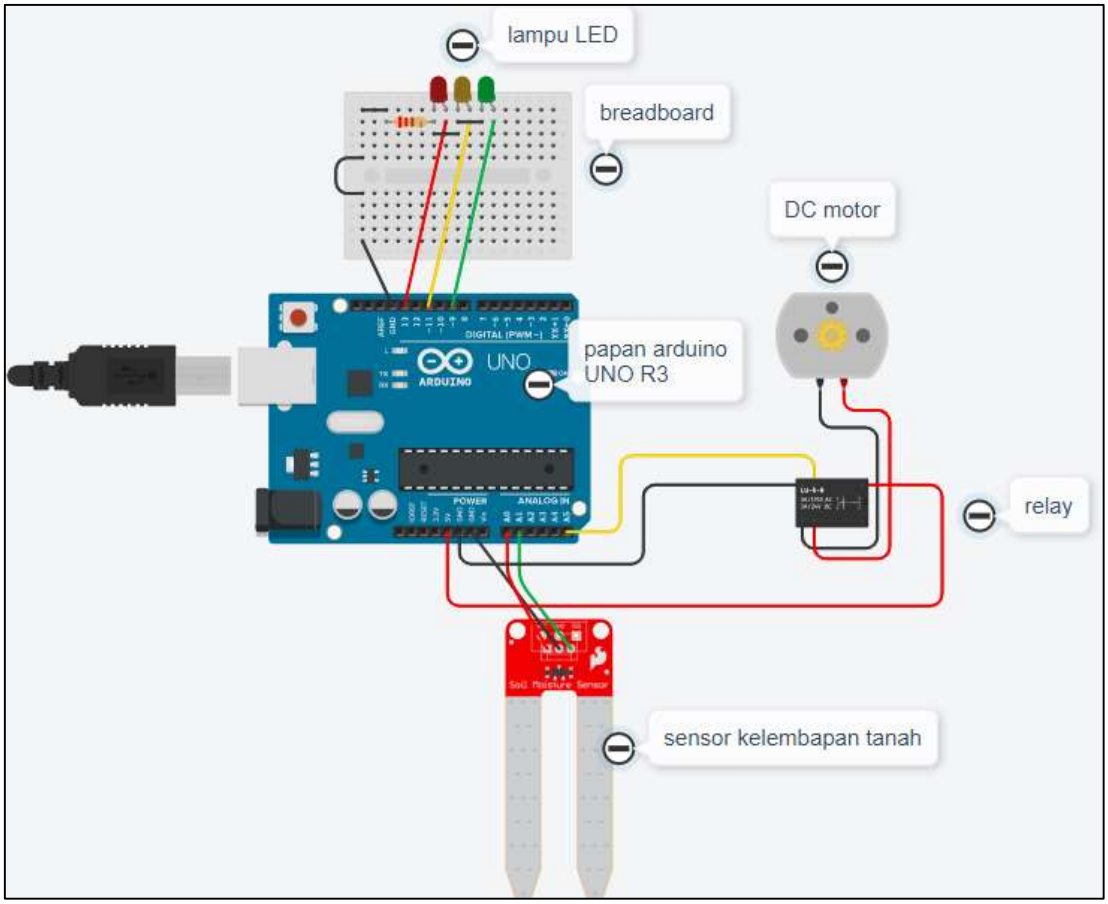

Figure 6. Circuit Design

Figure 6 shows the assembly and circuit arrangement of the prototype system. This is so that users understand the connection from one appliance to another appliance. The main hardware in the diagram is the Arduino UNO R3 board. This is because the board will be coded with a programming language and other hardware will be connected and function according to the code that has been set. Data from soil moisture sensor will be send to Arduino UNO R3 through microcontroller and store in the MySQL database. Water pump will activate when soil moisture sensor are low. At the same time, LED light (RED) will turn on. The pump will stop if the level of soil moisture sensor reach the value that being set in the Arduino UNO R3 and LED light (BLUE) will be activated.

4. DISCUSSION

After going through various stages of testing, the framework can finally be set up efficiently. In any case, the transition from a manual framework to digitization has its pros and cons. A slow upgrade should be made for this framework to become a robust framework, with the aim of allowing the following frameworks to be fully used. In this section, each question about the benefits and weaknesses of the framework, as well as the challenges and needs encountered throughout the framework improvement interaction, will be addressed in more depth. Furthermore, the notion of improving the framework is expressed with the aim of redesigning the framework and making it operate more successfully in the future.

5. CONCLUSION

Smart Watering system review can aid in the development of the system by focusing on stated objectives, considering its pros and cons, and implementing suggestions for improvement to enhance its efficiency and user-friendliness. The goal is to address system errors and user concerns, ultimately making the Smart Watering system more comfortable and secure for users.

Acknowledgments:

Special thanks to the Faculty of Defense Science and Technology, National Defense University of Malaysia for supporting this project and the Student Affairs Department for the sponsorship to participate i3DC 2023.

References

Admin. (2022). *Soil moisture sensor: Soil moisture sensor working: Soil sensor*. Retrieved December 18, 2022 from: https://techatronic.com/soil-moisture-sensor-working-explanation-schematic/

Artificial Intelligence (n.d.) Encyclopædia Britannica, inc. Retrieved December 18, 2022 from: https://www.britannica.com/technology/artificial-intelligence

Benzi, B. (2010). *What is User Interface (UI) design? The interaction design foundation.* Retrieved December 28, 2022 from: https://www.interaction-design.org/literature/topics/ui-design

Browning, K. (2022, May 27). *Why do we need smart irrigation? (All you need to know).* Climatebiz. Retrieved December 28, 2022 from: https://climatebiz.com/why-do-we-need-smart-irrigation/

I1.wp.com on images (2021) WordPress.org Forums. Retrieved December 18, 2022 from: https://wordpress.org/support/topic/i1-wp-com-on-images/

IBM, I. B. M. (n.d.). What is Artificial Intelligence (AI) ? IBM. Retrieved December 28, 2022 from: https://www.ibm.com/my-en/topics/artificial-intelligence

Lee, H. (2016) How to make a rain barrel, AHBE LAB. Retrieved December 18, 2022 from: https://ahbelab.com/2015/07/16/how-to-make-a-rain-barrel/

Lee. (2022) Empire-s3-production.bobvila.com at website informer. Retrieved December 18, 2022 from: https://website.informer.com/empire-s3-production.bobvila.com

Magdy, S. (2022, August 16). *What are sensors and how do they work?* Retrieved December 28, 2022 from: https://www.techtarget.com/whatis/definition/sensor

Malcare. (2021). WP-content: A beginner's guide to wordpress' most important directory Retrieved December 18, 2022 from: https://www.malcare.com/blog/wp-content-uploads/

Marlin, L. (2022, November 21). *About Us. Green Coast.* Retrieved December 28, 2022 from: https://greencoast.org/about-us/

Setyosari, S. (2017). Literary studies. Retrieved December 28, 2022 from: https://mcl.as.uky.edu/literary-studies#:~:text=Literary%20Studies%20is%20the%20study,as%20a%20more%20complex%20matter

Stanislaw. (2020). *System Analysis*. Retrieved December 28, 2022 from: https://www.igi-global.com/affiliate/stanislaw-wrycza/1675

Team, T.A. (n.d.) Uno R3: Arduino documentation. Retrieved December 18, 2022 from: https://docs.arduino.cc/hardware/uno-rev3

Teja, R. (2022) What is a sensor? Different types of sensors, applications. Retrieved December 18, 2022 from: https://www.electronicshub.org/different-types-sensors/