Multidisciplinary Applied Research and Innovation Vol. 4 No. 2 (2023) 273–279

MARI

Journal homepage: http://penerbit.uthm.edu.my/ojs/index.php/mari
e-ISSN : 2773-4773

Arduino-based Irrigation System for Mung Bean Sprouts Cultivation

Muhammad Fitri Hakim[1], Muhammad Abraar[1], Muhammad Aliff Alfurqan[1], Zainab Zainal[1*], Md Nor Ramdon Baharom[2]

[1]Department of Electrical Engineering, Centre for Diploma Studies, Universiti Tun Hussein Onn Malaysia, Pagoh Higher Education Hub, 84600, Pagoh, Johor, MALAYSIA

[2]Department of Electrical Engineering Technology, Faculty of Engineering Technology, Universiti Tun Hussein Onn Malaysia, Pagoh Higher Education Hub, 84600, Pagoh, Johor, MALAYSIA

*Corresponding Author Designation

DOI: https://doi.org/10.30880/mari.2023.04.02.037
Received 01 October 2022; Accepted 30 November 2022 Available online 15 January 2023

Abstract: Mung bean sprout is popular amongst people in South East Asia region due to its high in nutrients and antioxidants, which may provide health benefits. This causes a huge demand for mung bean sprouts in the market. Traditionally, the cultivation of the mung bean sprout only uses a vessel filled with water. Sometimes it has been left for a few days without proper watering. The proper irrigation system for mung bean sprouts cultivation can eliminate the unpleasant smell and produce good quality sprouts. This project aims to develop a working prototype of an automatic irrigation system for mung bean sprout cultivation using Arduino as a controller. To prevent the bean sprouts from soaking in water, the system uses a rinse-and-drain technique where the mung beans are placed on a filter platform. The automatic watering system is activated according to the user-set time. The water at the bottom of the vessel will be pumped and forced through the water sprinkler each time the device is activated. The system is connected to the NodeMcu ESP8266 wifi module so that it may be easily used and monitored using a mobile phone. Within four days, this system can produce mung bean sprouts that are both odourless and fresh. It may be used at home, and if it is connected to numerous vessels, it can create large quantities of good sprouts.

Keywords: Automatic Irrigation System, Mung Bean Sprouts, Arduino, Nodemcu ESP8266

**Corresponding author: zainab@uthm.edu.my*

1. Introduction

The legume plant mung bean, sometimes referred to as green gramme or moong, belongs to the Fabaceae family. Around 5.3 million tonnes of mung beans are produced worldwide each year, with the majority of the crops being farmed in China, Myanmar, India, the United States, Canada, and Brazil (2015-17) [1]. *Taugeh* or mung bean sprouts can be consumed raw or cooked and is high in minerals and antioxidants [2]. However, the traditional cultivation method, which typically requires the mung bean to be soaked in unchanged water in a closed vessel, can cause the mung bean sprout purchased from a local market to have an unpleasant odour. Watering during cultivation is very important where overwatering will result in moulded and bad odour bean sprouts and underwatering produces thin sprouts [3].

Technology development has played an important role in mung bean sprout cultivation. In [4], a microcontroller-based irrigation system was developed to cultivate healthy mung bean sprouts in an experimental set-up of vessels with dimensions of 4.5 x 6 inches each. A similar system with the Internet of Things (IoT) control was developed in [5][6]. Lighting is used in this system as an additional efficient variable to ensure the best possible growth of mung beans. The mung bean grew more effectively than in the typical planting technique, indicating that their proposed methods were beneficial. The IoT and microcontroller-based ideas are both used in this project, together with the addition of a filter platform as a special feature.

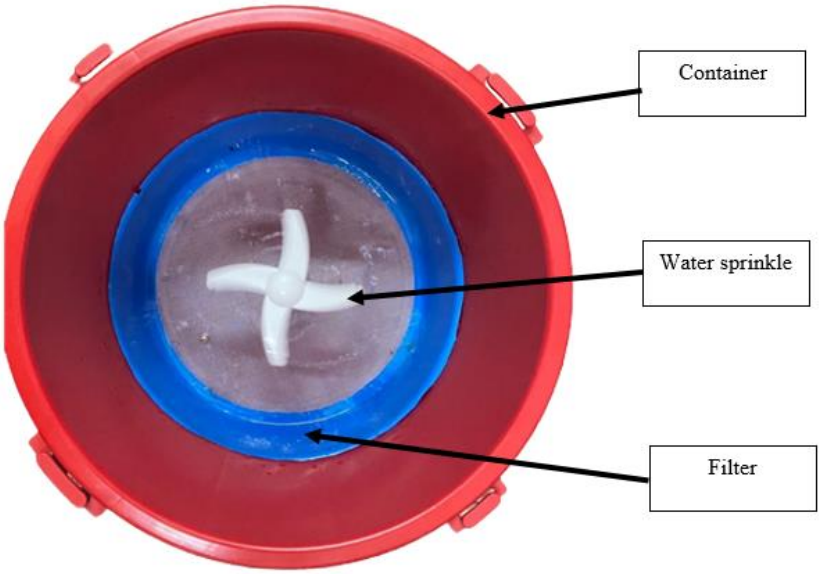
2. Materials and Methods

2.1 Materials

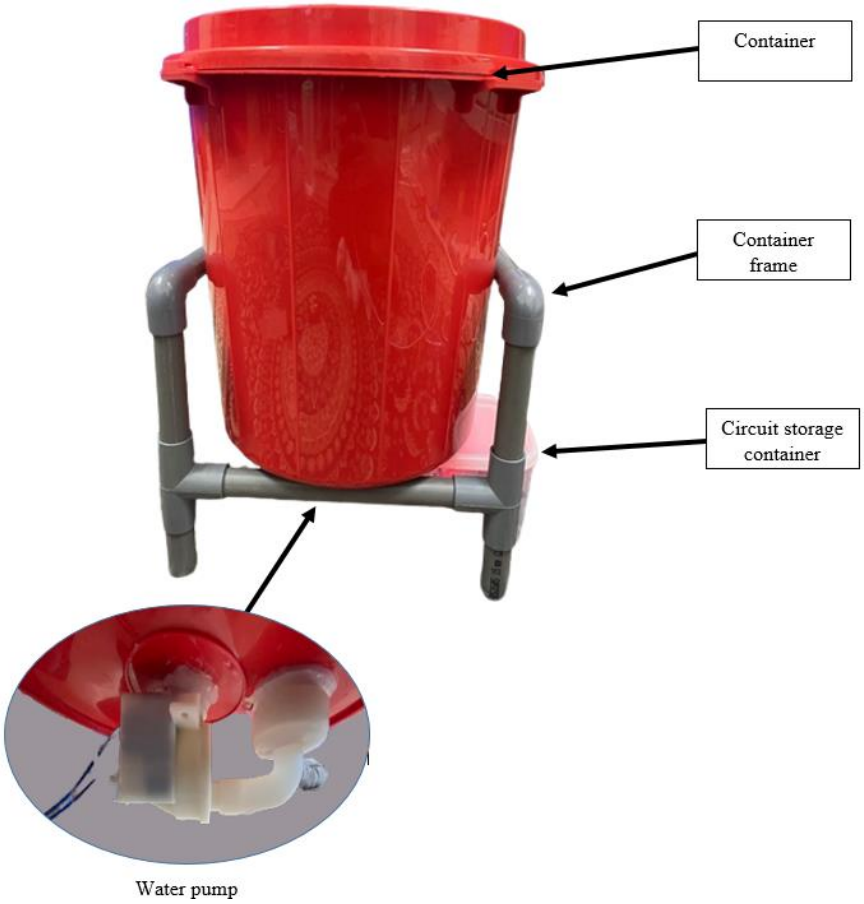
Figure 1 shows the overall system prototype of the Arduino-based irrigation system for mung bean sprouts cultivation. **Table 1** listed the components and its functions. The controller circuit for the system as shown in **Figure 2** is placed in the circuit storage container.

Table 1: Hardware and software functions

Hardware And Software	Function
Nodemcu esp8266	WiFi development board
Water pump	Pumping the water from above to water sprinkle
Male-female jumper wire Male-male jumper wire	Connected all components without soldering
Relay 1 channel module	Controlling voltage
Container	As a holder to the system and all operation happens inside it.
Filter	To separate green beans and water
Water sprinkle	Spread water thoroughly
Arduino IDE	Coding and extracting code into Arduino board.



(a) Top view



(b) Front view

Figure 1: Overall system prototype

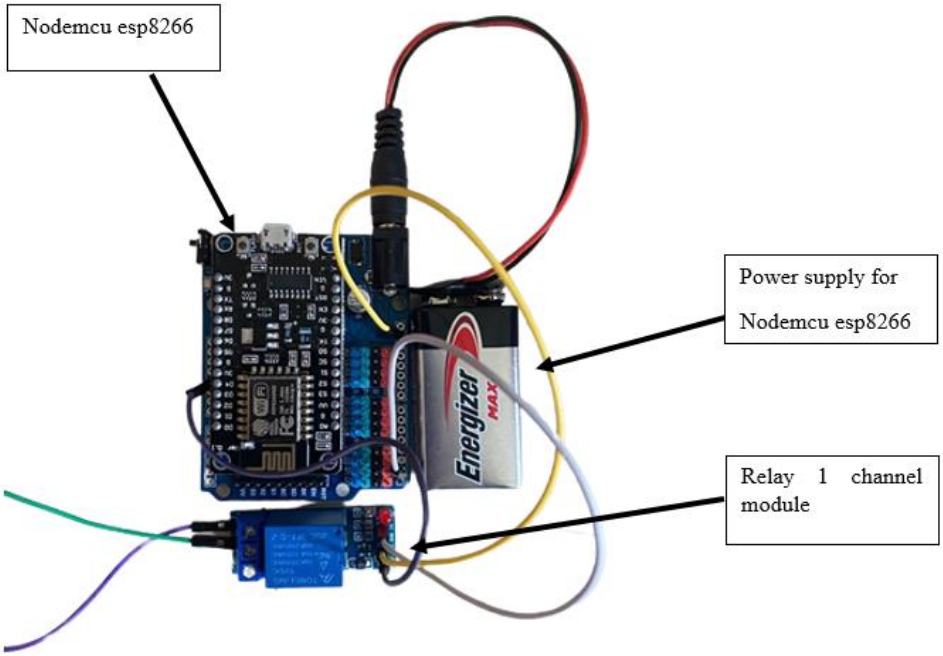


Figure 2: Controller circuit for the system

2.2 Methodology

Figure 3 below shows a block diagram as a graphical representation of the system that gives an overview of the working principles of a functional project, provide a clearer understanding of the functioning system and help establish interconnections within it. The 12VDC battery is the power supply for the whole system. The controller then connected to the relay to control the 'ON' and 'OFF' of the water pump to regulate the water in the vessel through the sprinkler.

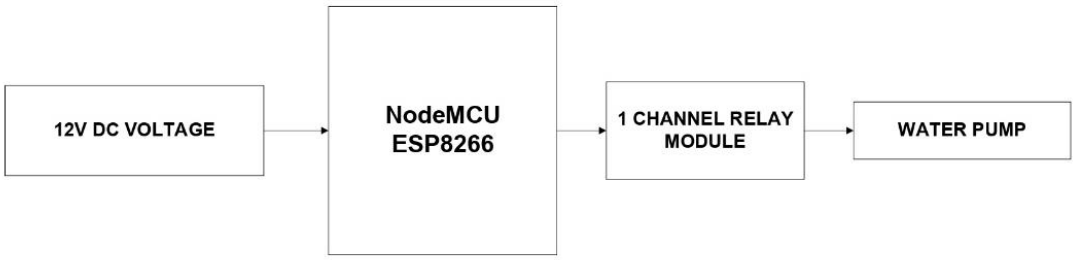


Figure 3: System block diagram

Figure 4 shows the overall flow chart of the system. The water will be filled manually into the vessel at the beginning. During the cultivation periods, the same water will be pumped through the water sprinkler with user-set frequency.

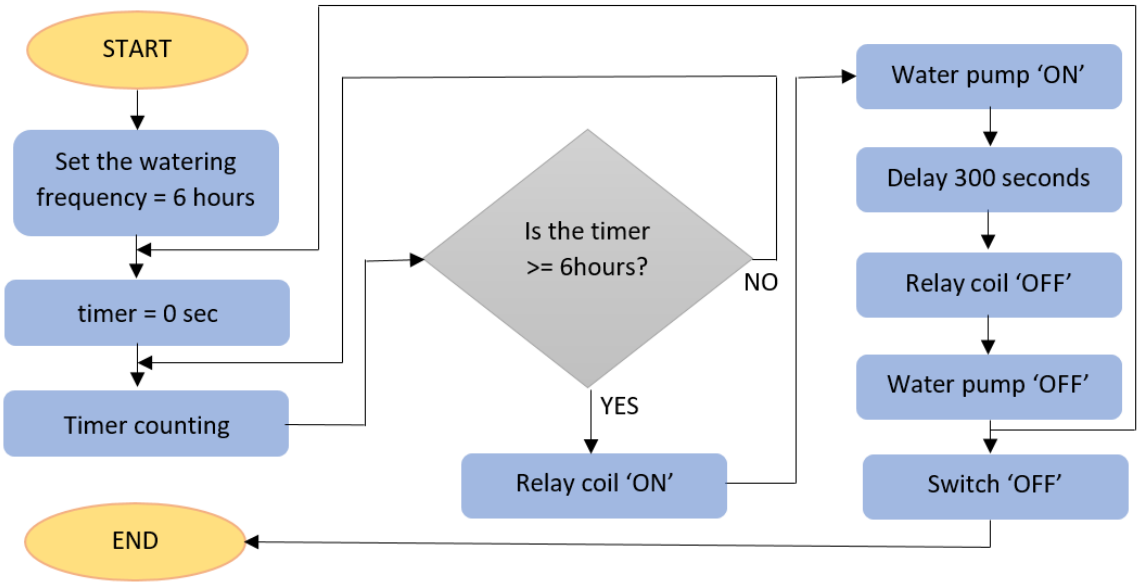


Figure 4: Flow chart of the overall system

The amount of water is calculated using the **Eq. 1** suggested in [4] as:

$$R1 = 171.13 + 10.25^{*}B - 16.13^{*}C \qquad \textbf{Eq. 1}$$

Where, $R1$ is the weight of mung beans, B is the amount of water, and C is the watering frequency.

$$R = \frac{R1}{1000} \qquad \textbf{Eq. 2}$$

Table 2: Value of parameters

Parameter	Name	Units	Set Value
R	Weight of mung beans	grams (g)	20.5
B	Amount of water	millilitre (mL)	2000
C	Watering frequency	Hour (hr)	6

Table 2 listed the value of the parameter used in the system setting. However, the final calculated amount of weight of mung beans is divided by 1000 in this project to give a reasonable value, as in **Eq. 2** above.

3. Results and Discussion

This section will discuss the result and discussion of the Arduino-based irrigation system for mung bean sprouts cultivation based on the 7 days period. The bean sprouts are measured using a manual measurement technique as in **Figure 5**.

Figure 5: Method of measuring the length of bean sprouts

Table 3: Comparison length of bean sprout cultivated manually with the proposed system

Day	Manually length (cm)	Proposed system length (cm)
1	4.9	5.8
2	5.5	7.1
3	5.7	6.2
4	**6.8**	**8.2**
5	6.7	7.0
6	6.6	7.3
7	6.4	6.5
8	6.1	6.4
9	5.7	5.9
10	5.1	5.6
Mean	4.7	5.5

The comparison of the length of the bean sprouts cultivate in a traditional way, soaked in a vessel and using the proposed system are shown in **Table 3**. The results in shows the increment of the mung bean sprouts length start from Day 1. The maximum length for both cultivation are at Day 4. After that, it start to bend and the length reduced. The same pattern can be seen for both cultivation method but clearly the proposed system produced healthier mung bean sprouts.

4. Conclusion

As conclusion, the prototype of the proposed Arduino –based irrigation system for mung bean sprouts cultivation was successfully built. This system proved to produce bigger size and odourless sprouts within 4 days. Furthermore, using this system, no human interaction in the bean cultivation process during the whole process as it is fully controlled automatically. Further enhancement to the system features can be implemented such as adding the automatic temperature control, water acidity (pH) monitoring system, compact size for small household usage or larger design for small mung bean sprout business owners. This will benefits the community as part of the idea to reduce costs due to the global food crisis.

Acknowledgements

The authors would like to thank the Centre for Diploma Studies, Universiti Tun Hussein Onn Malaysia for its support.

References

[1] Akibode, C.S. and Maredia, M.K., "Global and regional trends in production, trade and consumption of food legume crops", *(No. 1099-2016-89132)*, 2012.

[2] Hou, D., Yousaf, L., Xue, Y., Hu, J., Wu, J., Hu, X., Feng, N. and Shen, Q., "Mung bean (Vigna radiata L.): bioactive polyphenols, polysaccharides, peptides, and health benefits". *Nutrients*, 11(6), p.1238, 2019.

[3] Lee, S. Y. and Lee, C. S., "Some factors affecting the production and quality of bean sprouts," *Malaysian Agricultural Research and Development Institute*, vol. 20, no. 1, pp. 85-92, 1992.

[4] Bual, C. L. C., Cunanan, R. D., Bedruz, R. A. R., Kerwin R., Billones C. and Vicerra, R. R. P. V., "Microcontroller-based Irrigation System for Experimental Design of Mung Bean Sprouts Cultivation," *2019 IEEE 11th International Conference on Humanoid, Nanotechnology, Information Technology, Communication and Control, Environment, and Management (HNICEM)*, pp. 1-6, 2019.

[5] Habibi, M. A. et al., "Automatic Watering And Lighting For Optimizing Mung Bean Growth Via Soil Moisture IoT Control," *2021 7th International Conference on Electrical, Electronics and Information Engineering (ICEEIE*), pp. 1-5, 2021.

[6] Norhanan, N. M., Ali, Z., Azmi, N. N. N., & Raymedin, A. F., "Sistem Tanaman Pintar IoT", *Multidisciplinary Applied Research and Innovation*, 3(1), 459–465, 2022.