



TERAKREDITASI INSTITUSI B
SK NO. 229/BAN-
PT/AKRED/PT/IV/2015

UNIVERSITAS MUHAMMADIYAH SIDOARJO

DIREKTORAT RISET DAN PENGABDIAN MASYARAKAT

Alamat: Jl. Mojopahit 666 B Sidoarjo 61215, Telp. 031-8945444 psw.130, Faks. 031-8949333

Email: lppm@umsida.ac.id, Website: lppm.umsida.ac.id

Surat Keterangan Tidak Plagiat [Kepangkatan]

Nomor: 568.3/II.3.AU/14.00/C/KET/III/2022

Kepada Yth :

Ibu Indah Sulistiyowati, ST. MT

Di

Tempat

Assalamua'alaikum Wr. Wb.

Sehubungan dengan adanya permohonan Surat Keterangan Tidak Plagiat dengan rincian:

Judul Artikel : Web of Things to control planting seeds and watering plants for indoor smart farm
Nama Pemohon : Indah Sulistiyowati / Teknik Elektro
URL Sinta Pemohon : <http://sinta.ristekbrin.go.id/authors/detail?id=5996233&view=overview>
Nama Penulis : Indah Sulistiyowati
Tujuan : Kepangkatan
Tujuan Kepangkatan : Lektor

Naskah Yang Dimohonkan pengecekan:

<http://dosen.umsida.ac.id/modul/publikasi/filesktp/210400/sktp-10-03-2022%2007:41:07-210400.pdf>

Artikel tersebut DAPAT digunakan untuk proses kepangkatan.

Demikian surat keterangan ini kami sampaikan, mohon untuk digunakan sebagaimana mestinya.

Wassalamu'alaikum Wr. Wb.

Mengetahui,
Wakil Rektor 1
Universitas Muhammadiyah Sidoarjo


Hana Catur Wahyuni, ST., MT

Direktur DRPM

Universitas Muhammadiyah Sidoarjo


Dr. Sigit Hermawan, S.E., M.Si

sktp-10-03-2022_07_41_07- 210400

by Indah Sulistiyowati, St. Mt

Submission date: 11-Mar-2022 10:18AM (UTC+0700)

Submission ID: 1781605527

File name: sktp-10-03-2022_07_41_07-210400.pdf (944.55K)

Word count: 2928

Character count: 15135

PAPER · OPEN ACCESS

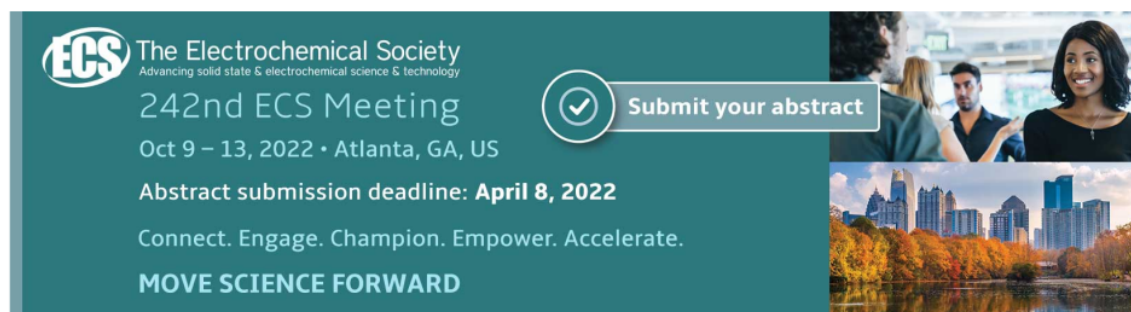
Web of Things to control planting seeds and watering plants for indoor smart farm

To cite this article: M P T Sulistyanto *et al* 2021 *IOP Conf. Ser.: Mater. Sci. Eng.* **1098** 052109

View the [article online](#) for updates and enhancements.

You may also like

- [Development of Solar Powered Sprinkler Robot Based on Watering Plant Using IOT Approach](#)
Lim Xin You, Nordiana Shariffudin and Mohd Zamri Hasan
- [Nature connection, experience and policy encourage and maintain adaptation to drought in urban agriculture](#)
Monika Egerer, Brenda B Lin and Lucy Diekmann
- [Design watering system on greenhouse using microcontroller with matrix based](#)
R Mudiayanti, A Aminudin and L Hasanah



ECS The Electrochemical Society
Advancing solid state & electrochemical science & technology

242nd ECS Meeting
Oct 9 – 13, 2022 • Atlanta, GA, US

Abstract submission deadline: **April 8, 2022**

Connect. Engage. Champion. Empower. Accelerate.

MOVE SCIENCE FORWARD

Submit your abstract

The banner features a teal background with white text. On the right side, there are two images: the top one shows a group of people in a professional setting, and the bottom one shows a city skyline with a lake in the foreground.

Web of Things to control planting seeds and watering plants for indoor smart farm

M P T Sulistyanto^{1,*}, E Febriawan¹ and I Sulistiyowati²

¹ Informatics Study Program, Faculty of Science and Technology, Universitas Kanjuruhan Malang, Jl. S. Supriadi No. 48 Malang Jawa-Timur Indonesia

² Electrical Engineering, Faculty of Science and Technology, Universitas Muhammadiyah Sidoarjo, Jl. Raya Gelam 250, Candi, Sidoarjo, Jawa Timur, Indonesia

* m.priyono.ts@unikama.ac.id

Abstract. With the emergence of the Web of Things (WoT) as Internet of Things (IoT) enhancement in web application, the Industrial Revolution 4.0 has developed very rapidly. Its technology has been commonly used in various fields of life, especially in agriculture. One of the crop plants is often achieved by vegetable farming, as vegetables are the staples of daily life. Aim this study is for plating mustard green seeds and watering plant using WoT. This method begins by doing literature review, requirement analysis, design and implementation. The result shows the developing of prototype to planting mustard seeds and watering plant is successful that it can be remotely operated through WoT. The planting and watering process uses Gcode command to carry out seed picks, planting seeds, and water plants.

1. Introduction

Indonesia is a country where farmers work most of the population. Thus this country is called an agricultural country. Some of the factors that support agricultural development are temperature, fertile soil and tropical climate, therefore that many ornamental plants or vegetables can grow in Indonesia. On the other hand, geographical factors, which are many of the mountains found in Indonesia, support the easy planting of vegetable crops. The mustard greens (*Brassica juncea*) are one of the organic plants or vegetables often cultivated by farmers in Indonesia.

Mustard green is a vegetable commonly eaten as daily food. Farmers commonly develop outdoors in the cultivation of mustard greens. However, growing vegetables outside the room is very susceptible to pests if not regularly treated. As a result, farmers are turning into crop failures and many losses due to the case. Farmers also plant mustard greens using a manual method to spread seeds randomly on the land. Spreading the seeds must be moved to the area where the vegetables are grown. So it takes two times for farmers to grow and look after mustard greens. In order to achieve a good vegetable yield, seeds must be carefully planted in the efficient distances.

Recently the agricultural system continues to be developed towards smart farming. Farmers intensively use current technologies in agriculture, one of them is the WoT that allows real objects through IoT to be part of world wide web [1]. This technology is connected between one device and another through internet networking [2,3]. Indonesia this technology utilizing is low because it is still new in this area.



WoT technology allows users to access devices remotely through the Internet network [4] using web applications [5]. The use of WoT technology can be widely used starting with companies, offices, schools and private homes [6,7]. This technology can also be applied in the agricultural sector, one of which helps the above mentioned problems that monitor and take care of plants remotely thus there is no need for direct checks and data monitoring and analyzing results can be used to improve crop yields [8–10].

Previous researches about smart farm focused on monitoring temperature, humidity, pH, and other physical quantities [11–14]. This study conducts the controlling to plant mustard green seeds and water these plants through WoT. The wide use of website in computer application programs is motivation to authors utilizing this website to be control and monitor app for this smart farm.

This article is arranged in six sections as follows: introduction, methods, results, discussion, conclusions, and acknowledgement.

2. Methods

There are several stages in this method: Literature Review, Requirement Analysis, Design and Implementation. Following is the flow of the phases of the research described in the flow chart as follows.

2.1. Literature review

This review uses data collection technique that can be obtained from a variety of sources, in the form of written and illustrated documents by searching from the Internet. In this study, the authors collected data on the planting of mustard green seeds using Gcode based on the WoT from other researchers' references.

Observation data is also carried out systematically and intentionally that obtained from farmers located in Ampeldento Village, Pakis District, Malang Regency. The results of the interview concluded that planting vegetables is still manual and attacked by pests for outdoor agriculture.

2.2. Requirement analysis

According to the data of observation, it can be summarized into hardware need analysis, software need analysis and operational need analysis that can be shown in table 1, table 2 and table 3 respectively.

Table 1. Hardware need analysis.

Hardware Name	Function
Raspberry Pi 3	Web server provider and the main control board in this tool
Arduino Uno R3	Control board that receives the Gcode command from the Raspberry Pi
Nema Motor Stepper 17	Linear mechanical drive
CNC Shield V3	liaison between the DRV8266 stepper driver and Arduino UNO
Stepper driver DRV8255	To regulate the movement and rotation of the nema stepper motor 17
Relay module 5V	Used to activate the seed suction pump
Mini pump 12v	Used for the mechanism of mustard seed extraction
LCD 20x4	To display information and in the form of text
Switching Power Supply	To provide a voltage source to all components
Aluminium Profile 2040	The basis for the movement of the Y and Z Axes
Aluminium Profile 2020	The basis for the movement of the X-axis
Screw rod	Used to go up and down the Z axis
Stepdown Module	Voltage regulator to 5 volts for electronic components

Table 2. Software requirement analysis.

Software Name	Function
Raspian OS	Operating System for Raspberry Pi.
Arduino IDE	IDE for writing program code
Python 3	Programming language for program code in Raspberry Pi
MySQL	Data base system used to save mustard greens status and positions
PHP	Programming language for web program code
Apache Web Server	Web server application installed in Raspberry Pi

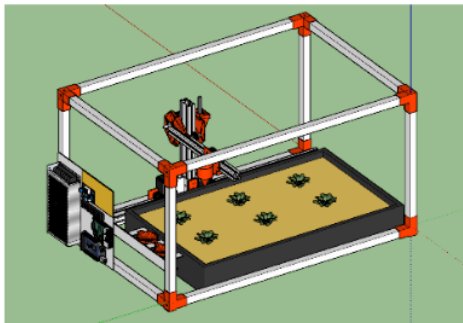
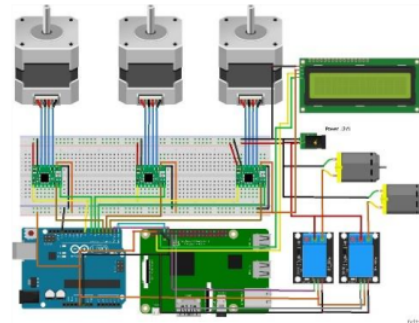
Table 3. Operational requirement analysis.

Material	Function
Mustard green seed	main object in this research
Soil	growth media of mustard green
Plant's pot	place to accommodate the soil

2.3. Design

2.3.1. Systems design. The planting of mustard seeds is controlled through a web site accessed through Raspberry Pi, which acts as a web server. When the user enters a web server, it generates Gcode code directly and is saved in Gcode extension file. In addition, the web server also stores the Gcode code in the MySQL database. The Gcode code is sent to Arduino Uno R3 via UART communication and then read through the GRBL firmware. After reading the Gcode code, the Gcode code will run into the built-in system. The planting system will end until all Gcode codes are executed.

2.3.2. Hardware design. The hardware needed for this research is mechanical and electrical. Before making the prototype system, the researchers designed hardware using 3d cad application program. Here's the design of the sketch and electrical hardware that can be shown in Figure 1 **Error! Reference source not found.**

**Figure 1.** Prototype diagram.**Figure 2.** Electrical system diagram.

This electrical circuit is used to activate the mechanical performance of this circuit device, which requires an electrical power supply. This circuit is used to activate the mechanical movement of the tool. Here's the electrical circuit (Figure 2).

2.3.3. *Software design.* Starts with the user's input point coordinates. Then the input coordinates are changed to a Gcode file. This gcode file will be used to move to the stepper motor coordinates of the seed plant. The process was carried out in the main processing of Raspberry Pi and the Gcode file was sent to Arduino UNO R3 through UART Serial Communication. From this serial communication, Arduino Uno reads and executes the command Gcode. In this Gcode, order the process of planting mustard seeds from the collection of mustard seeds to the laying of mustard seeds at the specified point. The Raspberry Pi G- command also displays notifications and actions performed via an LCD of 20X4 characters.

2.3.3.1 *Planting system design using gcode.* This research on web-based during the process of planting mustard seeds using Gcode. Gcode is a command code commonly used on machines such as CNC (Computer Numeric Control) machines. The Gcode code in this research tool is to move the Stepper to the X, Y and Z axes. In addition, it is also used for the activation of mustard green seeds and water sprinklers. In this study, Gcode uses the GRBL firmware on Arduino Uno R3.

GRBL is a library that is commonly used for open source engraving machines. Thus this study utilizes Arduino code to include this library to run the stepper motor in its operation. The following are Gcode commands when planting mustard (see Table 4).

Table 4. Gcode command.

Command	Function
X	Command to move in X-axis direction
Y	Command to move in Y-axis direction
Z	Command to move in Z-axis direction
G91	To open motion.
G90	To close motion.
F	Used to adjust the speed of the machine's movements.
M8	Activate the sucking pump.
M2	Deactivate the sucking pump.
G90	Used for linear stepper motor movements
G21	Used to recognize machine units

3. Results

3.1. Hardware result

The implementation of 3-dimensional hardware design (Figure 1) that is the object of research application of mustard seed planting research using Internet-based Gcode can be shown in Figure 3.



Figure 3. The overall prototype in perspective view.

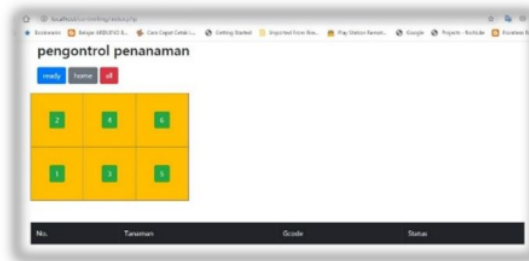


Figure 4. Web application for controlling to plant seed and water plant.

3.2. Software result

Software is utilized to empower hardware to make it easier for users to interact with hardware easily. This prototype must use controls to automatically control the planting of mustard seeds. Here are the results of the design of the controller for planting mustard seeds that can be seen in Figure 4.

4. Discussion

4.1. Gcode testing

Internet of indoor-based smart farm research testing is carried out in a planting area 60cm x 30cm. There are 6 planting points in this area with a distance of 15cm between the plants. The distance is included as an ideal distance because the ideal distance is between 10cm and 20cm from observation data. The results of the planting mapping generate the Gcode at each point as following code.

```
M8
G91
G0 Z43 F1000
G0 X-2 Y78 F1000
G0 Z-75 F1000
G90
M2

G91
G0 Z75 F1000
G0 X2 Y-78 F1000
G0 Z-44 F1000
G90
```

The Gcode is used until the planting status. Each user input data will be stored in the database. The results of storing data in the database are then displayed on the web page of the planting control. The purpose is to display the results of the input planting data to the user. The figure 5 shows nozzle of sucking pump for planting mustard green seeds and sprayer for watering plants. In our experiment, even though the response of microcontroller to receive and execute Gcode from Raspberry Pi is always successful; however, Gcode fate-rate should be tuned to compensate hardware response and accuracy.

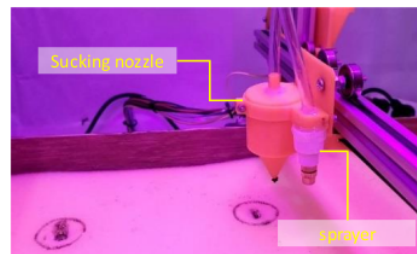


Figure 5. Nozzle of sucking pump and sprayer.

5. Conclusions

The prototype of controlling seed plant and watering through web of things is successfully developed. In safe optimization, it uses a distance of 15 cm for each point plant. This prototype use GRBL library on Arduino Uno that makes it easy to read Gcode. Besides this firmware, other machines can be used on a multi-platform. Optimization of Gcode can be achieved by tuning fate-rate parameters. In this prototype, Raspberry Pi 3 acts as a server tool so that it can operate independently.

For the next research, it needs to extends the area of plant and to modify sucking pump for other vegetable seeds. It also can be integrated with other decision systems for analysing crop result [15].

Acknowledgement

This study is supported by Informatics Study Program Universitas Kanjuruhan Malang.

References

- [1] Médini L, Mrissa M, Khalfi E M, Terdjimi M, Le Sommer N, Capdepuy P, Jamont J P, Occello M and Touseau L 2017 Building a Web of Things with Avatars: A comprehensive approach for concern management in WoT applications *Managing the Web of Things: Linking the Real World to the Web*
- [2] Lohchab V, Kumar M, Suryan G, Gautam V and Das R K 2018 A Review of IoT based Smart Farm Monitoring *Proceedings of the International Conference on Inventive Communication and Computational Technologies, ICICCT 2018*
- [3] Sulistyowati I, Findawati Y, Ayubi S K A, Jamaaluddin J and Sulistyanto M P T 2019 Cigarette detection system in closed rooms based on Internet of Thing (IoT) *J. Phys. Conf. Ser.* **1402** 044005
- [4] Sulistyanto M P T, Harianto W, Nugroho D A, Retandi R E, Akbar A K and Tjahjanti P H 2018 The controlling and monitoring system in oyster mushroom cultivation using fuzzy logic through web technology integrated with Internet of Things ed A G Abdullah and A B D Nandiyanto *MATEC Web Conf.* **197** 15002
- [5] Gyrard A, Patel P, Datta S K and Ali M I 2017 Semantic Web Meets Internet of Things and Web of Things *Proceedings of the 26th International Conference on World Wide Web Companion - WWW '17 Companion* (New York, New York, USA: ACM Press) pp 917–20
- [6] Sulistyanto M P T, Pranata K B, Afandi A N, Sendari S and Sulistyowati I 2019 Monitoring electrical energy in electronic energy audits through internet of things technology *J. Phys. Conf. Ser.* **1402** 077067
- [7] Sulistyanto M P T, Pranata K B and Solikhan 2017 Preliminary study of utilizing Internet of Things for monitoring energy use in building to support energy audit process *2017 4th International Conference on Computer Applications and Information Processing Technology (CAIPT) (IEEE)* pp 1–7
- [8] Balducci F, Impedovo D and Pirlo G 2018 Machine learning applications on agricultural datasets for smart farm enhancement *Machines*
- [9] Gangwar D S and Tyagi S 2017 Internet of Things Connected Smart Farm Solutions for Sustainable Agro-ecological and Rural Development *Int. J. Eng. Futur. Technol.*
- [10] Barrientos-Avenidaño E, Rico-Bautista D, Coronel-Rojas L A and Cuesta-Quintero F R 2019 Smart farm: Defining of infrastructure based on internet of things, IpV6 and software defined networks *RISTI - Rev. Iber. Sist. e Technol. Inf.*
- [11] Sulistyanto M P T, Pranata K B and Solikhan 2018 Preliminary study of utilizing Internet of Things for monitoring energy use in building to support energy audit process *Proceedings of the 2017 4th International Conference on Computer Applications and Information Processing Technology, CAIPT 2017*
- [12] Serikul P, Nakpong N and Nakjuatong N 2018 Smart Farm Monitoring via the Blynk IoT Platform: Case Study: Humidity Monitoring and Data Recording *2018 16th International Conference on ICT and Knowledge Engineering (ICT&KE) (IEEE)* pp 1–6
- [13] Chiochan O, Saokaew A and Boonchieng E 2017 IOT for smart farm: A case study of the Lingzhi mushroom farm at Maejo University *Proceedings of the 2017 14th International Joint Conference on Computer Science and Software Engineering, JCSSE 2017*
- [14] Mythili R, Kumari M, Tripathi A and Pal N 2019 IoT Based Smart Farm Monitoring System *Int. J. Recent Technol. Eng.* **8** 5490–4
- [15] Budianto A E and Yunus E P A 2017 Expert system to optimize the best goat selection using topsis: Decision support system *2017 4th International Conference on Computer Applications and Information Processing Technology (CAIPT) (IEEE)* pp 1–5

ORIGINALITY REPORT

8%

SIMILARITY INDEX

7%

INTERNET SOURCES

9%

PUBLICATIONS

7%

STUDENT PAPERS

PRIMARY SOURCES

1

Submitted to Universitas Negeri Jakarta

Student Paper

5%

2

earchive.tpu.ru

Internet Source

2%

Exclude quotes On

Exclude matches < 2%

Exclude bibliography On