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Development of Smart Hydroponics System Using AI-Based Sensing

Septafiansyah Dwi Putra, Heriansyah Heriansyah, Eko Fajar Cahyadi, Kurnia Anggriani, Moh Haris Imron S Jaya

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Participants

Septafiansyah Dwi Putra (septafiansyah)

Messages

Note	From
Dear Mr Septafiansyah, Thank you for submitting the manuscript. Your effort is highly appreciated. Before forwarding to reviewers, please ensure your article meets the following crucial points as follows: **Make sure the article is written correctly using the form we sent below**. Thank you. Regards, Editor bitapargazen, 1139-Article Text-6011-1-18-20240131.docx	bitapargazen Jun 11
Here we attached updated of manuscript following Authors Submission Checklist septafiansyah, 1190-Other-6390-2-18-20240612.docx (2)	septafiansyah Jun 12
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Thank you, we will continue to the process review	bitapargazen Jun 13

Add Message

Septafiansyah Dwi Putra, Heriansyah Heriansyah, Eko Fajar Cahyadi, Kurnia Anggriani, Moh Haris Imron S Jaya:

We have reached a decision regarding your submission to JURNAL INFOTEL, "Development of Smart Hydroponics System Using AI-Based Sensing".

Our decision is: Revisions Required

Please submit your revision file include:

1. Revisions Form download
2. **Please indicate your revision with a highlight in a different color**

--The deadline for submitting the revised results is a maximum of 14 days--

Bita Parga Zen
Institut Teknologi Telkom Purwokerto
bita@ittelkom-pwt.ac.id

Reviewer E:
Recommendation: Revisions Required

A. Relevance: this paper has conformity between its content and offered topics.

Good

B. Contribution: this paper contains originality, novelty and innovation.

Good

C. Grammar: this paper is grammatically correct, uses appropriate dictions, has clear explanation and easily to understand.

Fair

D. Abstract: concise, clear, comprehensive, and readable.

Good

E. Suggestion(s):

If this paper is accepted, improvements should be made.

Reviewer F:
Recommendation: Revisions Required

A. Relevance: this paper has conformity between its content and offered topics.

Good

B. Contribution: this paper contains originality, novelty and innovation.

Good

C. Grammar: this paper is grammatically correct, uses appropriate dictions, has clear explanation and easily to understand.

Very Good

D. Abstract: concise, clear, comprehensive, and readable.

Very Good

E. Suggestion(s):

provide more references regarding Fuzzy.
some text in graphic can not be read.
provide comparison with other methods

Septafiansyah Dwi Putra, Heriansyah Heriansyah, Eko Fajar Cahyadi, Kurnia Anggriani, Moh Haris Imron S Jaya:

We have reached a decision regarding your submission to JURNAL INFOTEL, "Development of Smart Hydroponics System Using AI-Based Sensing".

Our decision is: Revisions Required

Please submit your revision file include:

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2. **Please indicate your revision with a highlight in a different color**

--The deadline for submitting the revised results is a maximum of 14 days--

Bita Parga Zen
Institut Teknologi Telkom Purwokerto
bita@ittelkom-pwt.ac.id

Reviewer B:
Recommendation: Resubmit for Review

A. Relevance: this paper has conformity between its content and offered topics.

Fair

B. Contribution: this paper contains originality, novelty and innovation.

Fair

C. Grammar: this paper is grammatically correct, uses appropriate dictions, has clear explanation and easily to understand.

Fair

D. Abstract: concise, clear, comprehensive, and readable.

Fair

E. Suggestion(s):

The paper is about hydroponics enhanced by a fuzzy inference system. The main Idea can be captured. Some revision suggestions can be found in the comments of the reviewed manuscript. Here are overall recommendations for further paper improvements:
1. I believe using AI to enhance hydroponics has been widely used. Please add up to five more papers about the subject and compare them to your research to highlight your contributions.
2. Language can be improved. Please further proofread your manuscript.
3. Overall image quality can be improved. (the resolution should be at least 330 dpi. Annotations should be readable)
4. Explain the sensor placements to the reader. It could be helpful.
5. A fuzzy inference system is used, but the explanation of the method is minimal. Please increase the explanation about the fuzzy inference system.
6. Table 2 seems redundant. Removing it does not cause any information loss for readers.

Reviewer E:
Recommendation: Revisions Required

A. Relevance: this paper has conformity between its content and offered topics.

Good

B. Contribution: this paper contains originality, novelty and innovation.

Good

C. Grammar: this paper is grammatically correct, uses appropriate dictions, has clear explanation and easily to understand.

Fair

D. Abstract: concise, clear, comprehensive, and readable.

Good

E. Suggestion(s):

If this paper is accepted, improvements should be made.

Reviewer F:
Recommendation: Revisions Required

A. Relevance: this paper has conformity between its content and offered topics.

Good

B. Contribution: this paper contains originality, novelty and innovation.

Good

C. Grammar: this paper is grammatically correct, uses appropriate dictions, has clear explanation and easily to understand.

Very Good

D. Abstract: concise, clear, comprehensive, and readable.

Very Good

E. Suggestion(s):

provide more references regarding Fuzzy.
some text in graphic can not be read.
provide comparison with other methods

Messages

Note	From
dear mr. septa	bitapargazen Jul 08

Note	From

there are several inputs from reviewers, include:
1. Using AI to enhance hydroponics has been widely used. Please add up to five more papers about the subject and compare them to your research to highlight your contributions.
2. Language can be improved. Please further proofread your manuscript.
3. Overall image quality can be improved. (the resolution should be at least 330 dpi. Annotations should be readable)
4. Explain the sensor placements to the reader. It could be helpful.
5. A fuzzy inference system is used, but the explanation of the method is minimal. Please increase the explanation about the fuzzy inference system.
6. Table 2 seems redundant. Removing it does not cause any information loss for readers.
7. Comparison with other method

Please indicate your revision with a highlight in a different color (ex : red)

If you have finish, please upload it in the review discussion column

Settings

Thank you for your valuable feedback on our manuscript. We have carefully considered your comments and made the necessary revisions to improve the quality and clarity of our work. Below are our responses to each point, with the changes indicated in red in the revised manuscript.

1. **Using AI to enhance hydroponics has been widely used. Please add up to five more papers about the subject and compare them to your research to highlight your contributions.**

Note	From

- We have reviewed and included five additional relevant papers that explore the use of AI in hydroponics. A comparative analysis has been added to the manuscript to highlight how our research builds upon and differs from these studies. This section is now detailed in the "Page 2 Line 17 - 30" intriduction section .

2. **Language can be improved. Please further proofread your manuscript.**
   - The manuscript has been thoroughly proofread to enhance the language quality. We have corrected grammatical errors, improved sentence structures, and ensured the use of clear and precise language throughout the document.
3. **Overall image quality can be improved. (The resolution should be at least 330 dpi. Annotations should be readable)**
   - All images have been updated to ensure a resolution of at least 330 dpi. Additionally, annotations have been made larger and more readable to improve overall image clarity and presentation quality.
4. **Explain the sensor placements to the reader. It could be helpful.**
   - A detailed explanation of the sensor placements within the hydroponics system has been added. This information is now included in the "Table 1. System Architecture and Integration" section, providing a clear rationale for the placement of pH, TDS, and temperature sensors.

5. A fuzzy inference system is used, but the explanation of the method is minimal. Please increase the explanation about the fuzzy inference system.

- We have significantly expanded the explanation of the fuzzy inference system. The revised section now includes detailed descriptions of fuzzification, the rule base, the inference engine, aggregation, and defuzzification processes. This expanded

Note	From

explanation helps readers understand how the FIS contributes to system control. (Page 5 Line 3 -21).

6. **Table 2 seems redundant. Removing it does not cause any information loss for readers.**

- Table 2 has been removed from the manuscript as it was deemed redundant. The essential information has been integrated into the relevant sections of the text to maintain clarity and cohesiveness. Now the content in table 2, the fuzzy membership function

- **Comparison with other methods.**
  - This comparison highlights the advantages and potential limitations of our approach, providing a comprehensive view of our research's contributions in page 5

We hope these revisions address your concerns and improve the manuscript. Thank you for your thoughtful suggestions, which have greatly enhanced the quality of our work.

Sincerely,

septafiansyah, Rev_paper2.docx

Data Collection and Transmission	Real-time sensor data collection transmitted wirelessly to a MQTT broker via secure Wi-Fi network. Stored in a cloud-based database for scalability and accessibility.
Fuzzy Algorithms	Developed fuzzy logic controllers to manage nutrient pumps based on real-time readings of electrical conductivity (EC) and temperature.
Control Mechanism	Automated dosing pumps adjusted nutrient levels based on fuzzy logic controller recommendations. Operated in a closed-loop manner, continuously monitoring sensor data and making adjustments to maintain optimal conditions.
User Interface	Web-based dashboard for real-time visualization of sensor data, fuzzy logic decisions, and system status. Users could monitor and control the system remotely, receive alerts, and access historical data for analysis.

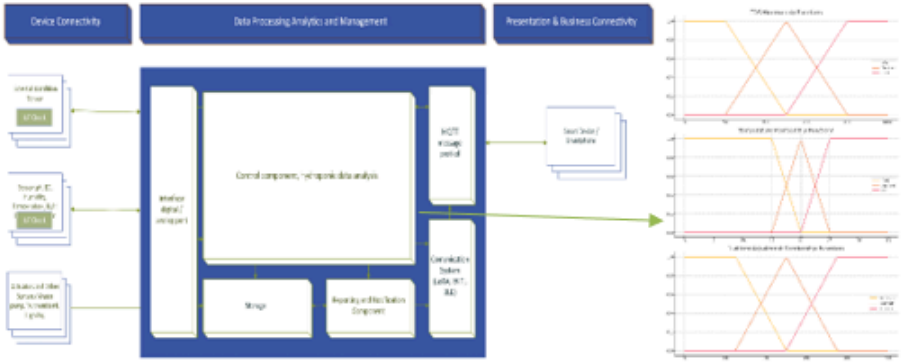

Fig. 1. The Proposed Architecture and Fuzzy Membership for Hydroponic System

The core of the system's intelligence lay in the fuzzy logic controllers, which were developed to manage the nutrient pumps based on real-time readings of EC and temperature. Fuzzy logic algorithms were chosen for their ability to handle the inherent uncertainty and variability in environmental conditions. These controllers were integrated with the system through MQTT broker-client access, allowing for real-time data analysis and decision-making. The fuzzy logic controllers continuously analyzed the sensor data and made precise

AG **AJI GAUTAMA PUTRADA**
Image quality is poor. I can not read the notations

AG **AJI GAUTAMA PUTRADA**
I suggest separating the block diagram and the fuzzy input diagram

4. Results and Discussion

4.1. The experimental results

The temperature values in the dataset range from 27°C to 35°C, with an average temperature of approximately 30.82°C. This indicates consistent environmental control within the specified range, ensuring optimal conditions for hydroponic growth. The set pH range for all entries is uniformly between 6 and 7, maintaining a stable and suitable pH environment for the plants. The TDS meter values span from 611.61 to 843.16. The first 15 rows exhibit TDS values between 611.61 and 796.29, while the last 5 rows have values exceeding 800, prompting the system to switch off the pumps to prevent potential over-nutrification. The average TDS value for the first 15 rows is approximately 695.43, whereas for the last 5 rows, it is around 821.92. This clear threshold around TDS values of 800 highlights the system's effectiveness in managing nutrient concentrations.

Table 2. The Results for TDS Control

No.	Temperature (°C)	Set Range pH	TDS Meter Value	Action (Output)	Time (Second)
1	30	6-7	645,85	Pump A and Pump B ON	24,94
2	34,61	6-7	676,06	Pump A and Pump B ON	19,68
3	32,86	6-7	731,19	Pump A and Pump B ON	22,8
4	31,79	6-7	707,99	Pump A and Pump B ON	23,2
5	28,25	6-7	672,81	Pump A and Pump B ON	17,77
6	28,25	6-7	752,96	Pump A and Pump B ON	29,54
7	27,46	6-7	634,87	Pump A and Pump B ON	26,63
8	33,93	6-7	673,04	Pump A and Pump B ON	29,09
9	31,81	6-7	691,59	Pump A and Pump B ON	28,42
10	32,66	6-7	714,02	Pump A and Pump B ON	23,97
11	27,16	6-7	796,29	Pump A and Pump B ON	28,83
12	34,76	6-7	649,92	Pump A and Pump B ON	16,33
13	33,66	6-7	728,56	Pump A and Pump B ON	17,94
14	28,7	6-7	748,1	Pump A and Pump B ON	15,68
15	28,45	6-7	611,61	Pump A and Pump B ON	19,88

AG **AJI GAUTAMA PUTRADA**
Table 2 should be mentioned in this paragraph. It helps the readers to find extra explanation of the table.

AG **AJI GAUTAMA PUTRADA**
I cannot find any impactful information from this table

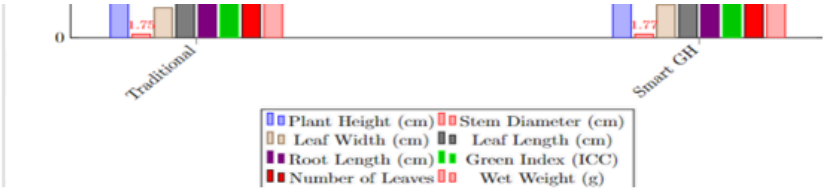

Fig. 3. Comparative Analysis of Plant Growth Metrics

The comparative analysis of plant metrics between traditional and smart hydroponic systems demonstrates the clear benefits of adopting smart technologies. The smart system consistently outperforms the traditional system across all metrics, highlighting the advantages of precise environmental control and nutrient management. This

AG **AJI GAUTAMA PUTRADA**
Image quality is poor. Please increase the resolution (330 dpi is minimum)

AG **AJI GAUTAMA PUTRADA**
Because of scale differences. I suggest separating ea metric comparison or using other ways to compare them, such as using a table.

results in healthier, more robust plants with greater biomass, emphasizing the potential of smart hydroponic systems to enhance agricultural productivity and sustainability.

5. Conclusions

In simpler terms, the study shows that using artificial intelligence (AI) in hydroponics is much better than traditional methods. Here's why: AI helps create the perfect environment and feeding plan for plants, which makes them grow faster, healthier, and stronger (taller plants, wider leaves, longer roots). This AI system also saves water, nutrients, and other resources by constantly checking and adjusting things. Since the plants are healthier, they produce more and the food is higher quality. Finally, AI automates a lot of the work, so farmers don't have to spend as much time babysitting the plants. This frees them up to focus on other important farm tasks. The AI-based hydroponics management system demonstrated several key benefits over traditional methods. Improved growth rates were observed due to the system's ability to maintain optimal nutrient levels and environmental conditions consistently. The system's real-time adjustments minimized resource wastage, enhancing overall resource efficiency. Additionally, the automation reduced the need for manual intervention,

AG **AJI GAUTAMA PUTRADA**
Remove this phrase due to conciseness

AG **AJI GAUTAMA PUTRADA**
Qualitative expression, please remove

Dear Editor and Reviewer,

Thank you for your thorough review and valuable feedback on our manuscript titled "Development of Smart Hydroponics System Using AI-Based Sensing." We have carefully considered your comments and made the necessary revisions to improve the quality and clarity of our paper. Below, we provide detailed responses to each of your comments and describe the changes we have made.

Reviewer Number	Original comments of the reviewer	Reply by the author(s)	Changes done on page number and line number
1	Abstract Move the last sentence as a test condition followed by the test results.	Already move to the last sentence	Page 1, Line 36 to 39
2	Introduction: The main contribution: (ii) The development of a user-friendly interface for farmers using the Smart-Hydroponic application, which enables hybrid monitoring and control of hydroponic farms. Add the results of research, testing and analysis	Already following the comments from reviewer	Page 2, Line 39 to 42
3.	Improve Fig. 1. The Proposed Architecture and Fuzzy Membership for Hydroponic System so that the image caption is legible	Already following the comments from reviewer	Page 4, Line 3
4.	In Figure 2, it is best to place the legend in the same position, with boundaries so that it is not confusing	Already following the comments from reviewer and change to the table format	Page 5, Line 1
5.	All the citations should be listed in the references. It is expected that the citations are at least 30 sources within 2018-2023	Already following the comments from reviewer	Page 9, Line 4

We believe these revisions have significantly improved the manuscript, and we are grateful for your constructive feedback. We hope that the revised manuscript meets your expectations and look forward to your positive response.

Thank you for your consideration.

Annex

Abstract:

Comment: Move the last sentence as a test condition followed by the test results.

Response: We have revised the abstract to move the last sentence, "The results showed a significant improvement in plant growth outcomes with precise control over the nutrient solution," to follow the test conditions. The revised abstract is now as follows: "This paper proposes a smart hydroponic system that operates automatically using a fuzzy logic algorithm integrating IoT functionalities to support smart agriculture. The system allows for remote monitoring and control via the internet providing real-time data on water levels, pH levels, temperature, and nutrient solution temperature. Precise dosing and temperature control are critical for optimal plant growth, and the system schedules temperature measurements to ensure stability. Unstable temperature can affect pH levels, thereby impacting nutrient absorption. The proposed system employs sensors to continuously monitor the electrical conductivity (EC) and pH levels of the nutrient solution. Fuzzy control is utilized to regulate the nutrient solution pump automatically, adjusting EC and pH levels to promote optimal plant growth. This approach reduces the time burden on producers and provides more precise control over the nutrient solution, resulting in improved growth outcomes. Test conditions included maintaining stable temperature and pH levels, which are critical for nutrient absorption. The results showed a significant improvement in plant growth outcomes with precise control over the nutrient solution. Additionally, a comparative analysis between smart and conventional hydroponics based on morphological results demonstrated the superiority of the smart system."

Introduction:

Comment: Add the results of research, testing, and analysis.

Response: We have revised the introduction to include the main contributions and the results of our research, testing, and analysis. The updated introduction now includes detailed descriptions of the system's performance and comparative analysis with conventional hydroponics.

Figures:

Comment: Improve Fig. 1 to ensure the image caption is legible and place the legend in Figure 2 in the same position with boundaries to avoid confusion.

Response: We have improved Figure 1 by enhancing the legibility of the image caption. Additionally, we have revised Figure 2 to place the legend in the same position with boundaries, ensuring it is not confusing.

References:

Comment: All citations should be listed in the references, and it is expected that the citations are at least 30 sources within 2018-2023.

Response: We have ensured that all citations are listed in the references section. We have also verified that our citations include at least 30 sources from the period 2018-2023.

[INFOTEL] Editor Decision

2024-07-17 02:20 AM

Septafiansyah Dwi Putra, Heriansyah Heriansyah, Eko Fajar Cahyadi, Kurnia Anggriani, Moh Haris Imron S Jaya:

Letter of Acceptance (LoA)
==========

On behalf of the Editor, we are pleased to inform that your submission to JURNAL INFOTEL, "Development of Smart Hydroponics System Using AI-Based Sensing" **is Accepted**

Here are some important things we would like you to do in relation to manuscript acceptance:

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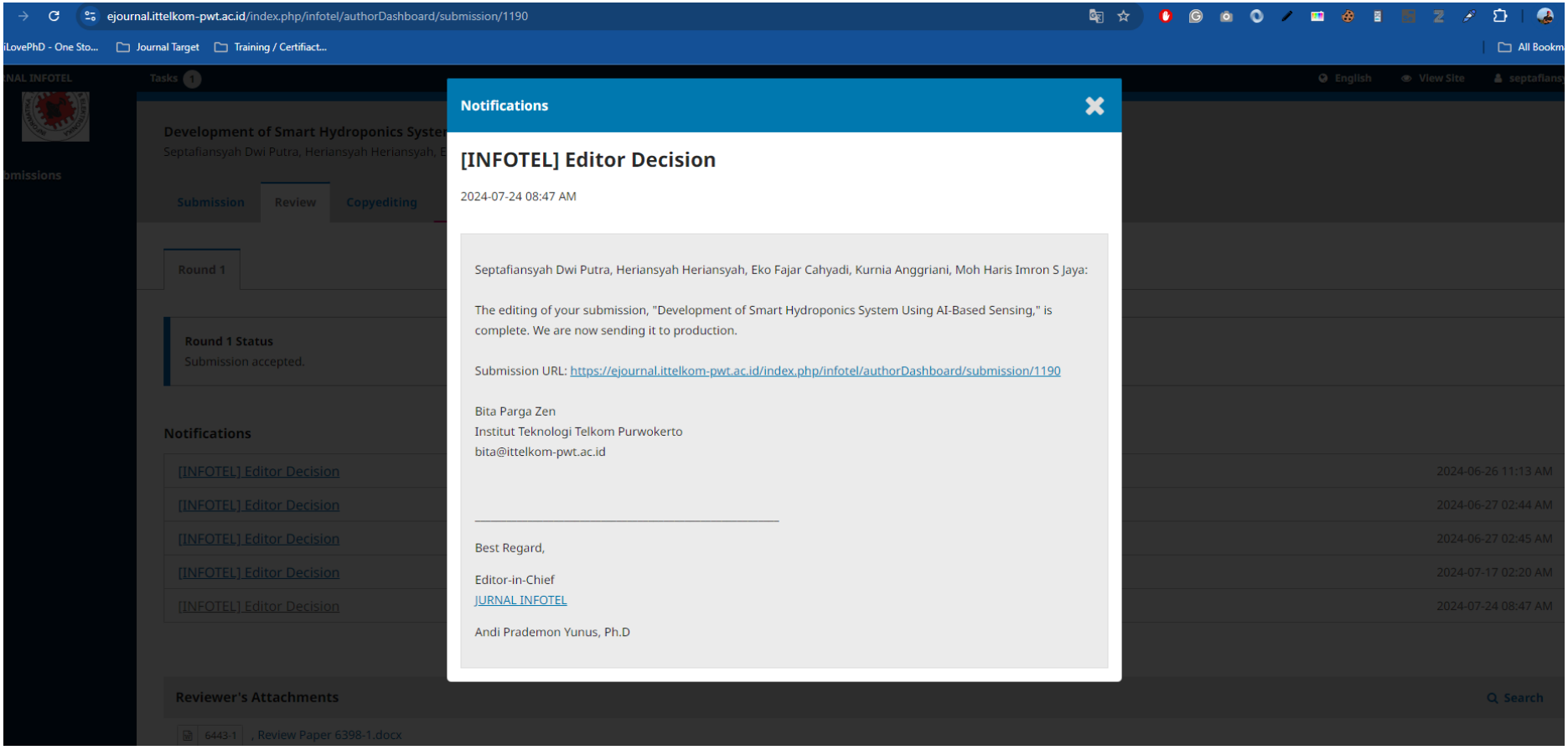
4. Please send all **high-resolution figure files** of your article to email infotel@ittelkom-pwt.ac.id

We thank you a lot for your participation and again congratulate for your achievement, we are looking forward to seeing you at the next issue

Bita Parga Zen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The editing of your submission, "Development of Smart Hydroponics System Using AI-Based Sensing," is complete. We are now sending it to production.
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Informatics

Development of Smart Hydroponics System Using AI-Based Sensing

Septafiansyah Dwi Putra Politeknik Negeri Lampung
Heriansyah Heriansyah Johannes Kepler University of Linz, Austria
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