Universitas Hasanuddin

Muhammad Niswar <niswar@unhas.ac.id>

No Reply: Your paper #1570900846 ('Design and Implementation of an Automated Indoor Hydroponic Farming System based on the Internet of Things')

1 message

IJCDS <ijcds-chairs@edas.info> Fri, Oct 20, 2023 at 6:14 PM
To: Muhammad Niswar <niswar@unhas.ac.id>
Cc: Editor In Chief <IJCDS_EditorInChief@uob.edu.bh>, Wael M El-Medany <welmedany@uob.edu.bh>, Ijcds Secretary <IJCDS@uob.edu.bh>

Dear Dr. Muhammad Niswar:
We are delighted to inform you that your paper #1570900846, titled "Design and Implementation of an Automated Indoor Hydroponic Farming System based on the Internet of Things," has been accepted for publication in IJCDS Journal with minor revisions. Your work has shown great promise and potential, and we believe that with some minor adjustments, it will make a valuable contribution to the field. Congratulations on this achievement!

To avoid the delay in publication of your paper, please make sure that the similarities in the revised version should be less than 15%.

Please make sure to submit the revised manuscript using journal template in Latex format, add photos and biodata for all authors, and submit the copyright form signed by all authors, copyright form is available in the following link:
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https://journal.uob.edu.bh/handle/123456789/12?id=author

Please make sure to upload the following files for revised paper submission:

1- Copyright form as pdf file.
2- Response and Action to Reviewer Comments as pdf file.
3- Final manuscript as DPF file generated using Latex.
4- Latex Zip file.

The due date for submitting final version is one week from receiving this email.

The reviews are below or can be found at https://edas.info/showPaper.php?m=1570900846.

We appreciate the hard work and dedication you've put into your research. To help you enhance the quality of the final version of your paper, we have provided a list of comments and suggestions below:

1. Clarity and Organization:
Clarify your research objectives and contributions early in the introduction.
Ensure that the paper flows smoothly from section to section, providing a logical progression of ideas.
Review the paper for clarity, readability, and grammatical issues.

2. Related Work:
Expand the related work section to provide a comprehensive overview of the existing literature relevant to your research.
Discuss the strengths and weaknesses of prior work and how your approach builds upon or differs from them.

3. Methodology and Experiments:
Provide more details on your research methodology to help readers understand how you conducted your experiments or research.
Clearly describe the datasets, tools, and techniques used in your study.
If applicable, present results in a more visual and interpretable format, such as graphs, tables, or figures.

4. Discussion and Conclusion:
Expand the discussion section to provide deeper insights into the implications and significance of your findings.
Clearly state the limitations of your study and potential future research directions.

5. Citations and References:
Ensure that all citations and references follow the appropriate style and formatting guidelines of the journal.

6. Acknowledgment and Funding:

If applicable, acknowledge any grants, funding sources, or individuals who contributed to your research.

7. Figures and Tables:
Ensure that figures and tables are appropriately labeled and referenced in the text.
Verify the quality and resolution of figures to ensure they are clear and easily interpretable.

8. Proofreading and Language:
Carefully proofread the entire paper for grammatical errors and typos.
Ensure consistency in terminology and writing style throughout the paper.

9. Supplementary Material (if applicable):
If you are providing supplementary material, ensure that it is clearly organized and referenced in the main paper.

We kindly request that you address these comments in the revised version of your paper. When you resubmit, please include a detailed response to each comment, indicating the changes you have made. This will help us evaluate the revisions effectively.

You will receive detailed feedback from our reviewers during the next round of review, which will ensure the quality and accuracy of the final version of your paper.

Once again, congratulations on your acceptance, and we look forward to receiving your revised manuscript within one week from receiving this email. If you have any questions or need further clarification on any of the comments provided, please do not hesitate to contact us.

Thank you for your valuable contribution to IJCDS Journal, and we look forward to working with you to bring your research to publication.

Best regards,
Dr. Wael El-Medany
Managing Editor

Universitas Hasanuddin

Muhammad Niswar <niswar@unhas.ac.id>

No Reply: Your paper #1570900846 ('Design and Implementation of an Automated Indoor Hydroponic Farming System based on the Internet of Things')

1 message

IJCDS <ijcds-chairs@edas.info> Sat, Jul 1, 2023 at 5:31 AM
To: Muhammad Niswar <niswar@unhas.ac.id>
Cc: Hessa Al-Junaid <haljunaid@uob.edu.bh>, Wael M El-Medany <welmedany@uob.edu.bh>, Ijcds Secretary <IJCDS@uob.edu.bh>

Dear Dr. Muhammad Niswar:

Your paper #1570900846 ('Design and Implementation of an Automated Indoor Hydroponic Farming System based on the Internet of Things') for IJCDS has been accepted, but requires major revisions and will be published in IJCDS after completing all the required correction, your paper will be reviewed again before final acceptance.

Please make sure to check the similarity index of your revised paper and make sure it is not exceeding 15% with max of 2% from any single source, otherwise your paper will be rejected.
Please submit the revised manuscript using journal template in Latex format, and submit the copyright form signed by all authors, copyright form is available in the following link: https://journal.uob.edu.bh/handle/123456789/12?id=author
IJCDS Latex template can be downloaded from the following link:
https://journal.uob.edu.bh/handle/123456789/12?id=author

Please make sure to upload the following files for revised paper submission:

1- Copyright form as pdf file.
2- Response and Action to Reviewer Comments as pdf file.
3- Final manuscript as DPF file generated using Latex.
4- Latex Zip file.

The due date for submitting final version is four weeks from receiving this email.

The reviews are below or can be found at https://edas.info/showPaper.php?m=1570900846.

======= Full Review 1 =======

> *** Strengths/Weakness: What are the major reasons to accept/reject the paper? [Be brief.]

In this paper, it is a conceptually good idea to implement a hydroponic farming model using Internet of Things technology in the real world. However, it is necessary to provide a more detailed narrative regarding the novelty of the approach and analyze the parameters associated with the Internet of Things.

> *** Contribution/s & Detailed comments: What are the major issues addressed in the paper? Do you consider them important? Comment on the degree of novelty, creativity and technical depth in the paper. Please provide detailed comments that will be helpful to the TPC for assessing the paper, as well as feedback to the authors.

Some comments below that need to be added
1. There are no weaknesses in this article, so other researchers will find it difficult to develop. Please add the weaknesses of this article
2. By default, Node-red has no security, so when someone else knows the address of Node-red, they can change the flows that have been created. Please add security to Node-red.
3. In Figure 1 about the system architecture that has a database and internet connection, what is the database used for in this article? then where is the internet connection? How is the connection or relationship between the MQTT broker (Raspberry) and the internet?
4. In Figure 2.b why are there 2 microcontrollers, isn't it possible to only use 1. This will result in the procurement of devices being expensive or data being sent longer. Please explain in detail the reasons
5. This is fatal. As you see from Figure 6, why is access still using localhost(127.0.0.1)? So there is no need to use Internet of Things technology or it can be said to be just a control system.
6. You discussed Quality of Service(QoS), add analysis with numbers if the QoS value is not only 0 but uses 0, 1, and 2.
7. There is no detailed explanation of the power requirements or source of electricity for 1 prototype.

> *** Originality: New or Novel contribution

Weak Accept (6)

> *** Significance of Topic: Relating to knowledge contribution
Neutral (5)

> *** Presentation: Clarity and Organisation of Content
Accept (8)

> *** Recommendation: Overall view and recommendation
Accept (8)

======= Full Review 2 =======

> *** Strengths/Weakness: What are the major reasons to accept/reject the paper? [Be brief.]

The paper proposes adopting an IoT-based hydroponic farming model, which is considered a promising idea. However, it is crucial to offer a more detailed description of the approach's uniqueness and conduct a thorough analysis of IoT-related factors to improve the paper's overall quality

> *** Contribution/s & Detailed comments: What are the major issues addressed in the paper? Do you consider them important? Comment on the degree of novelty, creativity and technical depth in the paper. Please provide detailed comments that will be helpful to the TPC for assessing the paper, as well as feedback to the authors.

Below are some suggestions for your consideration:
1. The related works is well detailed. However, to let the lecturers follow the logical sequence of the article, you can add a table containing the comparative study that you have presented between the different solutions. This is to highlight the strengths and weaknesses of each solution and to present the added value of your model compared to the others before starting the third part.
2. Some figures are unclear, such as figures 3, 5 and 6, which need to be modified.
3. If the displayed data is the same for both medium-scale and small scale scenarios, then you should add the humidity gauge to node-red flow diagram in figure 3.
4. The web dashboard presented in figure 1 is accesible through internet while the example presented in figure 6 is captured locally. You should highlight the way users access to dat

> *** Originality: New or Novel contribution
Weak Accept (6)

> *** Significance of Topic: Relating to knowledge contribution
Accept (8)

> *** Presentation: Clarity and Organisation of Content
Accept (8)

> *** Recommendation: Overall view and recommendation
Accept (8)

======= Full Review 3 =======

> *** Strengths/Weakness: What are the major reasons to accept/reject the paper? [Be brief.]

The paper proposes the implementation of an IoT-based hydroponic farming model. This approach shows potential for traditional farming methods and addressing the challenges of modern agriculture. However, to further elevate the quality of the paper and strengthen its credibility, it is important to provide more detailed and comprehensive explanation of the proposed approach.

> *** Contribution/s & Detailed comments: What are the major issues addressed in the paper? Do you consider them important? Comment on the degree of novelty, creativity and technical depth in the paper. Please provide detailed comments that will be helpful to the TPC for assessing the paper, as well as feedback to the authors.

It would be beneficial to include a table comparing the different solutions presented in the related works section. Improving the clarity of certain figures would enhance the visual understanding of the system architecture.

> *** Originality: New or Novel contribution
Accept (8)

> *** Significance of Topic: Relating to knowledge contribution
Accept (8)

> *** Presentation: Clarity and Organisation of Content

Accept (8)

> *** Recommendation: Overall view and recommendation
Accept (8)

Regards,
Managing Editor
Dr. Wael El-Medany
welmedany@uob.edu.bh

Universitas Hasanuddin

Muhammad Niswar <niswar@unhas.ac.id>

[IJCDS] #1570900846 has been uploaded

3 messages

IJCDS <ijcds-chairs@edas.info> Wed, Apr 5, 2023 at 8:06 PM
To: Muhammad Niswar <niswar@unhas.ac.id>

Dear Dr. Muhammad Niswar:

Thank you for uploading your paper 1570900846 (*Design and Implementation of an Automated Indoor Hydroponic Farming System based on the Internet of Things*) to **Inter Journal of Computing and Digital Systems**. The paper is of type application/msword and has a length of 37888 bytes.

You can modify your paper at 1570900846 and see all your submissions at https://edas.info/index.php?c=26939 using the EDAS identifier niswar@unhas.ac.id

Regards,
Dr. Wael El-Medany
Managing Editor

IJCDS <ijcds-chairs@edas.info> Thu, Apr 6, 2023 at 6:59 AM
To: Muhammad Niswar <niswar@unhas.ac.id>

Dear Dr. Muhammad Niswar:

Thank you for uploading your paper 1570900846 (*Design and Implementation of an Automated Indoor Hydroponic Farming System based on the Internet of Things*) to **Inter Journal of Computing and Digital Systems**. The paper is of type application/msword and has a length of 37888 bytes.

You can modify your paper at 1570900846 and see all your submissions at https://edas.info/index.php?c=26939 using the EDAS identifier niswar@unhas.ac.id

Regards,
Dr. Wael El-Medany
Managing Editor

IJCDS <ijcds-chairs@edas.info> Thu, Apr 6, 2023 at 9:04 AM
To: Muhammad Niswar <niswar@unhas.ac.id>

Dear Dr. Muhammad Niswar:

Thank you for uploading your paper 1570900846 (*Design and Implementation of an Automated Indoor Hydroponic Farming System based on the Internet of Things*) to **Inter Journal of Computing and Digital Systems**. The paper is of type application/pdf and has a length of 1253589 bytes.

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Regards,
Dr. Wael El-Medany
Managing Editor

Response and Action to Reviewer Comments (Uploaded through EDAS)

Response and Action to Reviewer Comments

======= Full Review 1 =======

> *** Strengths/Weakness: What are the major reasons to accept/reject the paper? [Be brief.]

In this paper, it is a conceptually good idea to implement a hydroponic farming model using Internet of Things technology in the real world. However, it is necessary to provide a more detailed narrative regarding the novelty of the approach and analyze the parameters associated with the Internet of Things.

Response:

The paper presents a novel approach to urban farming by designing and implementing an IoT-enabled indoor hydroponic farming system. The novelty of this approach lies in several aspects:

- **I propose two IoT scenarios for hydroponic farming that can be implemented in the urban area. A small-scale hydroponic system is intended for use in limited areas, such as homes or apartments. In contrast, a medium-scale hydroponic system is intended to be used when multiple sensor nodes exist, often installed in vast indoor or greenhouse facilities.**
- **The system can automate and optimize the delivery of nutrients and water to plants, providing an efficient and precise control mechanism. This automation reduces the manual labor involved in traditional hydroponic systems, making it more feasible and scalable for urban farming applications.**
- **The system utilizes a range of sensors, including temperature, humidity, pH, and Total Dissolved Solids (TDS) sensors, to continuously monitor the environmental conditions of the hydroponics. This real-time monitoring allows for proactive decision-making and prompt adjustments to ensure that the plants receive optimal growing conditions.**
- **The use of the Message Queuing Telemetry Transport (MQTT) protocol as the communication backbone enhances the system's efficiency and scalability. The Raspberry Pi acts as an MQTT broker, efficiently distributing the sensor data to various subscribers.**

> *** Contribution/s & Detailed comments: What are the major issues addressed in the paper? Do you consider them important? Comment on the degree of novelty, creativity, and technical depth in the paper. Please provide detailed comments that will be helpful to the TPC for assessing the paper, as well as feedback to the authors.

Some comments below that need to be added

1. There are no weaknesses in this article, so other researchers will find it difficult to develop. Please add the weaknesses of this article

Response:

The weakness of our system lies in the absence of a redundancy system to handle technology component failures. Furthermore, I have not yet implemented a machine-learning algorithm to predict future crop behavior and health using historical sensor data.

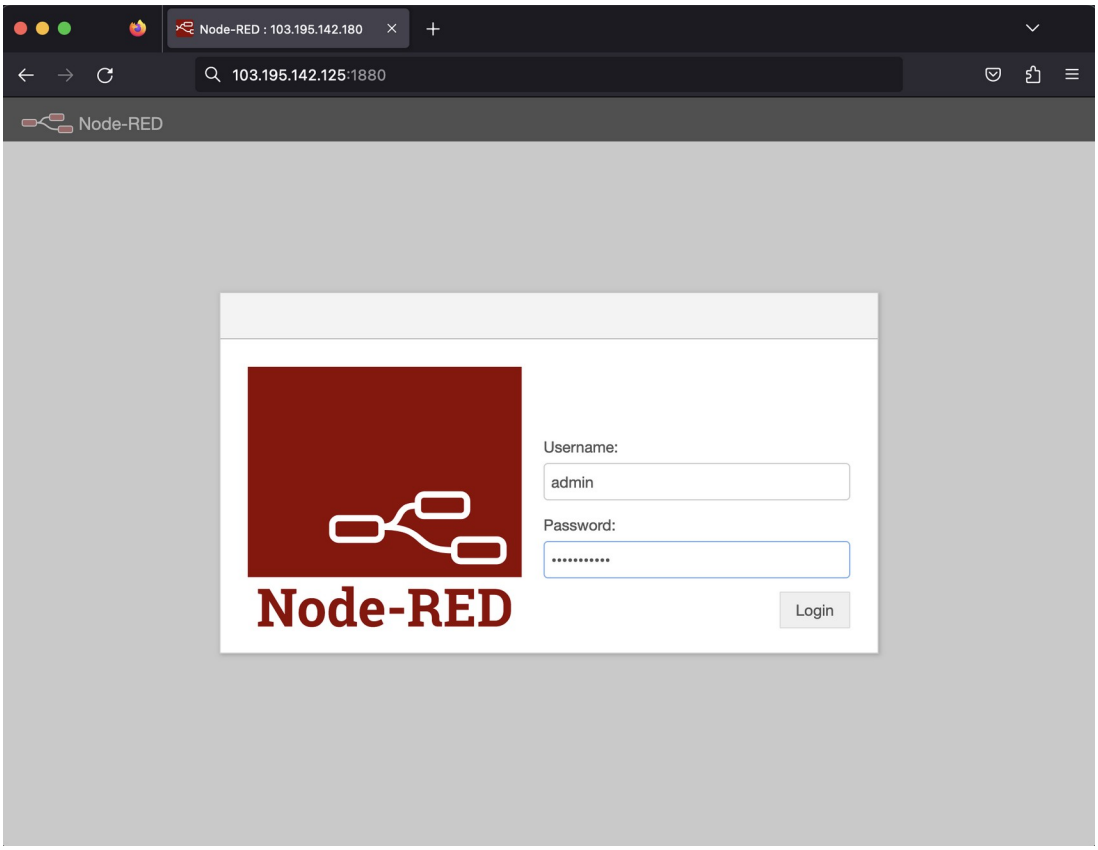
I have added the weakness of the proposed system and future work in the Conclusion:

"However, the system relies heavily on technology, including the sensors, MCU, SBC, and network connectivity. If any of these components fail or experience issues, it could disrupt the functioning of the hydroponic system and affect crop production. Therefore, to deal with component failure, we should implement redundancy for critical components and network connectivity to avoid disruptions. Furthermore, our system has not yet adopted advanced algorithms such as Machine learning to predict future crop behavior and health based on historical sensor data. This capability helps in proactive decision-making, such as adjusting nutrient levels or water supply in anticipation of potential issues. In the near future, we will adopt the machine learning technique to predict the crop yields."

2. By default, Node-red has no security, so when someone else knows the address of Node-red, they can change the flows that have been created. Please add security to Node-red.

Response:

I enabled user authentication to access and modify the flows in the Node-RED to prevent potential malicious access. Our Node-Red can be accessed through http://103.195.142.125:1880/, and the login page will appear when this URL is accessed; therefore, only authorized users can access and modify the Node-Red flow diagram. Only selected ports required for application usage are opened to enhance security, while the rest are closed.



Screenshot of node red web interface in Raspberry pi

I added a security description to Node-RED in Sub-section 3.C "Node-RED"

"The Node-RED runs on Raspberry Pi and is secured with user authentication to access and modify the flow diagram to prevent malicious access. Additionally, only selected ports required for application usage are opened, while the rest are closed to enhance security."

3. In Figure 1 about the system architecture that has a database and internet connection, what is the database used for in this article? Then where is the internet connection? How is the connection or relationship between the MQTT broker (Raspberry) and the internet?

Response:

MongoDB, a NoSQL database, is configured on the cloud server to store sensor data. The use of a NoSQL database allows for easy scalability and expansion, as there is no need to define the database schema beforehand. The sensor data stored in MongoDB can be processed and analyzed to produce valuable information and for future reference. The database can be accessed in the cloud server through http://smartfarm.unhas.ac.id.

An Internet connection is needed when a Raspberry pi (MQTT broker) sends sensor data to the cloud server over the Internet and stores the sensor data in the MongoDB. I added the MongoDB node in our flow diagram (Figure 3), allowing Raspberry pi to store the sensor data on a cloud server over the internet. Moreover, with an internet connection, the system administrator or engineer can access the Raspberry pi remotely for monitoring, configuration, and troubleshooting the system.

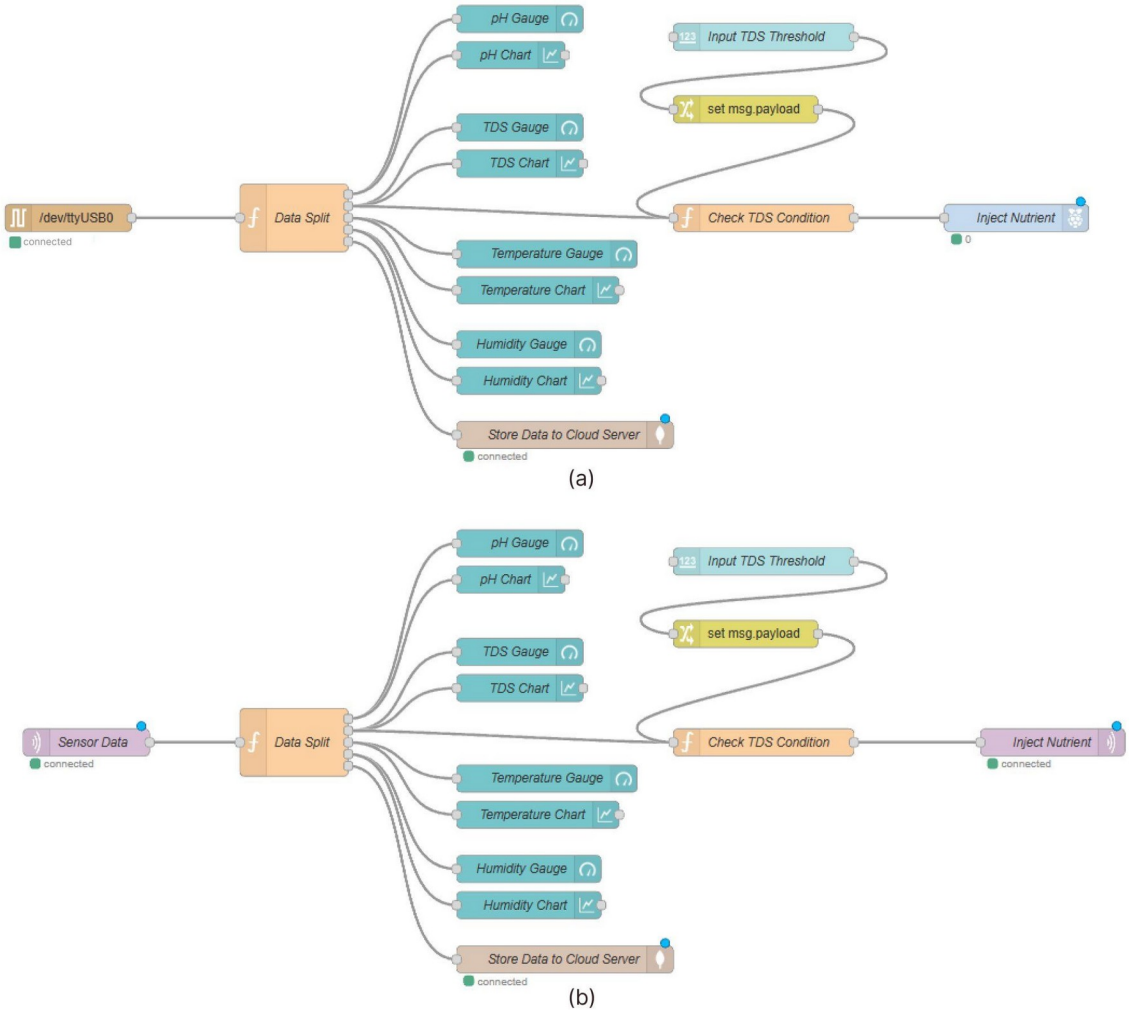


Figure 3

I have revised Figure 1 to show the role of internet connection clearly and added the description of the database in the first paragraph of Section 3 " System Design":

"MongoDB, a NoSQL database, is configured on the cloud server to store sensor data sent by the MQTT broker over the internet. The sensor data stored in MongoDB can be

processed, analyzed to produce valuable information and for future reference. The sensor data can be **accessed in the cloud server through http://smartfarm.unhas.ac.id. *”***

.

4. In Figure 2.b why are there rocontrollers, isn't it possible to only use 1. This will result in the procurement of devices being expensive or data being sent longer. Please explain in detail the reasons

Response:

The NodeMCU ESP8266 microcontroller provides only one analog input pin (A0) for connecting analog sensors. Our system used two analog sensors (pH and TDS) that cannot interface with ESP8266 simultaneously. If I need to connect multiple analog sensors simultaneously, I may need to use external analog multiplexers or other microcontrollers with more dedicated analog input pins. Using external analog multiplexers introduces the need for additional circuitry and potentially increases the complexity of the software to handle the multiplexing process. At first, for the sake of speed, I combined the use of Arduino UNO and ESP8266. I used Arduino UNO with six dedicated analog input pins (A0 to A5) handle sensor interfacing. On the other hand, NodeMCU ESP8266 handles network-related tasks, i.e., transmitting data via a Wi-Fi connection. However, this increases the hardware complexity and cost.

For the sake of simplicity and cost-effectiveness, I revised our system (Figure 2.b) by removing Arduino UNO and using only ESP8266 interfacing with multiple sensors through an analog multiplexer. The analog multiplexer approach is likely more cost-effective since our system only interfaces with two analog sensors. Analog multiplexers are simple and inexpensive.

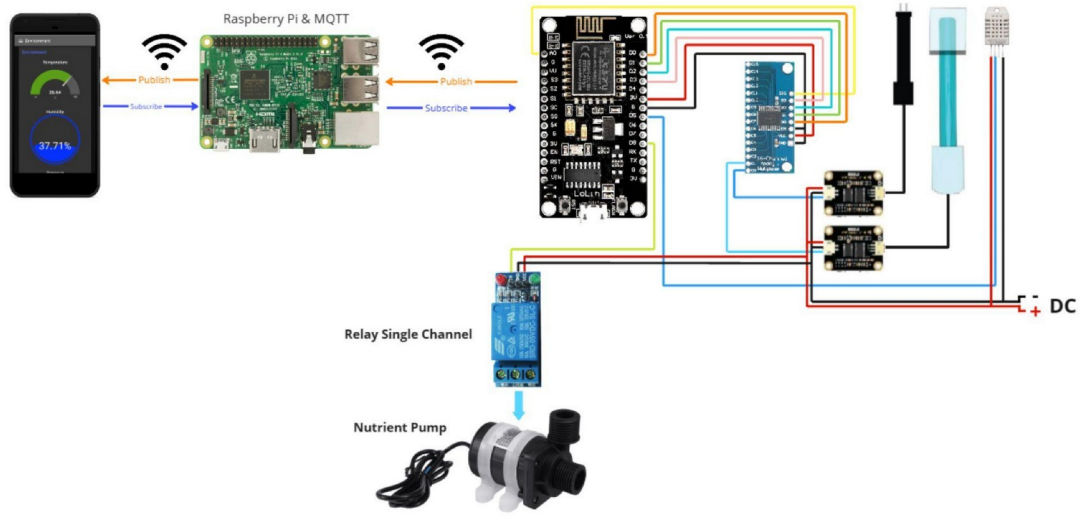


Figure 2.b

5. This is fatal. As you see from Figure 6, why is access still using localhost(127.0.0.1)? So there is no need to use Internet of Things technology or it can be said to be just a control system.

Response:

I have revised Figure 6. I assigned IP public to the raspberry pi so that it can be accessed and controlled remotely over the internet (http://103.195.142.125:1880). User can connect to it from anywhere with an internet connection and subscribe to an MQTT topic.

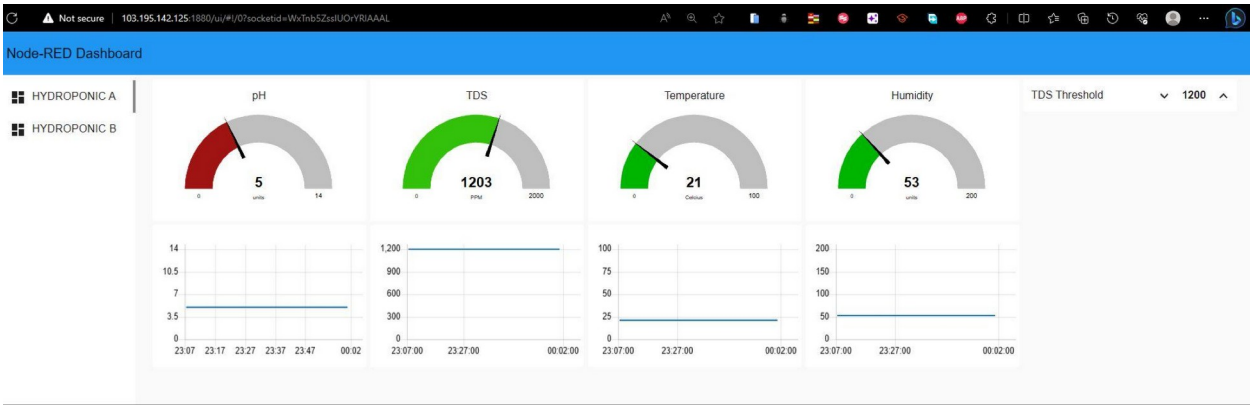


Figure 6

6. You discussed Quality of Service(QoS), add analysis with numbers if the QoS value is not only 0 but uses 0, 1, and 2.

Response:

I have added discussion on MQTT QoS levels 0,1, and 2 in Subsection ” 3.B. MQTT Broker” as follows:

- ***QoS 0 (At most once) provides the lowest level of reliability. In QoS 0, messages are delivered once, but there is no guarantee of delivery. The sender publishes a message to the broker, and the broker delivers it to the connected subscribers.***

- ***QoS 1 (At least once) ensures that messages are delivered at least once, but there might be duplicates. When a publisher sends a message at QoS 1, it will be acknowledged by the broker. If the broker receives the message, it returns an acknowledgment to the publisher. If the publisher does not receive the acknowledgment, it re-sends the message. The broker then delivers the message to the subscribers, and if a subscriber is not currently connected, the broker will hold the message until the subscriber reconnects.***

- ***QoS 2 (Exactly once) guarantees that messages are delivered exactly once. It provides the highest level of reliability but also introduces more overhead in terms of processing and network traffic. QoS 2 involves a four-step handshake***

process between the publisher, the broker, and the subscriber to ensure message delivery and de-duplication. This ensures that each message is delivered only once, regardless of network interruptions or failures."

7. There is no detailed explanation of the power requirements or source of electricity for 1 prototype.

Response:

I have added "Table II", which describes in detail component specification with power consumption in operating mode. Furthermore, I added explanation of power requirement/consumption as well as source of electricity in the first paragraph of section 4 (Result and Discussion):

" The hydroponic system is powered with electricity from our laboratory building, which is backed up with a uninterrupted power supply (UPS) to maintain the electricity supply to the hydroponics during power outages. In terms of power requirements, our indoor hydroponic system requires 165 watts of power to run all components as shown in table II."

======= Full Review 2 =======

> *** Strengths/Weakness: What are the major reasons to accept/reject the paper? [Be brief.]

The paper proposes adopting an IoT-based hydroponic farming model, which is considered a promising idea. However, it is crucial to offer a more detailed description of the approach's uniqueness and conduct a thorough analysis of IoT-related factors to improve the paper's overall quality**.**

Response:

The paper demonstrates a practical and efficient solution to tackle the challenges faced in urban farming. Our proposed system provides automation, connectivity with other device, real-time monitoring, and remote access capabilities over internet. I propose two IoT scenarios for hydroponic farming that can be implemented in the urban area. A small-scale hydroponic system is intended for use in limited areas, such as homes or apartments. In contrast, a medium-scale hydroponic system is intended to be used when multiple sensor nodes exist, often installed in vast indoor or greenhouse facilities. I have added comprehensive explanation of the proposed system in the article.

> *** Contribution/s & Detailed comments: What are the major issues addressed in the paper? Do you consider them important? Comment on the degree of novelty, creativity and technical depth in the paper. Please provide detailed comments that will be helpful to the TPC for assessing the paper, as well as feedback to the authors.

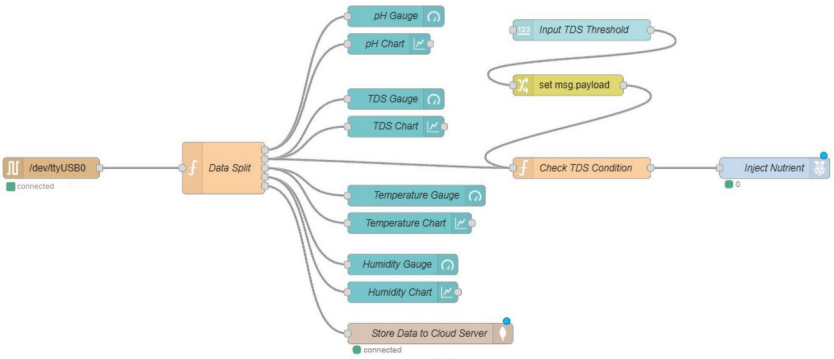
Below are some suggestions for your consideration:
1. The related works is well detailed. However, to let the lecturers follow the logical sequence of the article, you can add a table containing the comparative study that you have presented between the different solutions. This is to highlight the strengths and weaknesses of each solution and to present the added value of your model compared to the others before starting the third part.

Response:
I have added Table I showing the comparison of existing solutions.

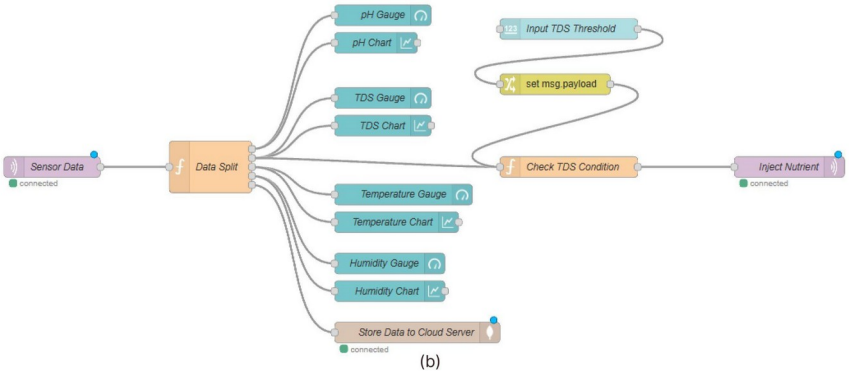
2. Some figures are unclear, such as figures 3, 5 and 6, which need to be modified.

Response:
I have improve the clarity of the figure 3, 5, and 6. Please, see the article.

3. If the displayed data is the same for both medium-scale and small scale scenarios, then you should add the humidity gauge to node-red flow diagram in figure 3.
Response:
I have added the humidity gauge into the node-red flow diagram in figure 3.



(a)

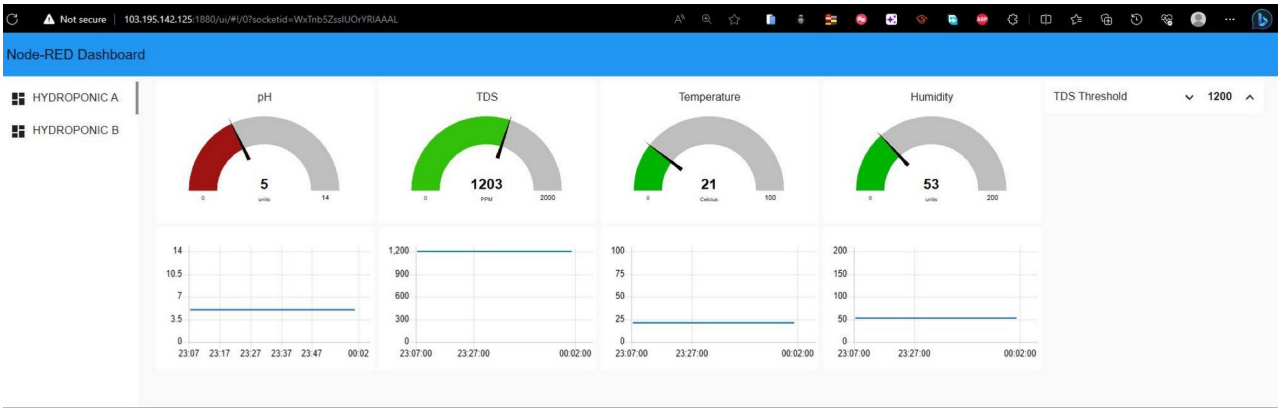


(b)

4. The web dashboard presented in figure 1 is accesible through internet while the example presented in figure 6 is captured locally. You should highlight the way users access to data

Response:

I have revised Figure 6. I assigned IP public to the raspberry pi so that it can be accessed and controlled remotely over the internet (http://103.195.142.125:1880). User can connect to it from anywhere with an internet connection and subscribe to an MQTT topic.



======= Full Review 3 =======

> *** Strengths/Weakness: What are the major reasons to accept/reject the paper? [Be brief.]

The paper proposes the implementation of an IoT-based hydroponic farming model. This approach shows potential for traditional farming methods and addressing the challenges of modern agriculture. However, to further elevate the quality of the paper and strengthen its credibility, it is important to provide more detailed and comprehensive explanation of the proposed approach.

I propose two IoT scenarios for hydroponic farming suitable for urban environments. The small-scale hydroponic system is designed for limited areas like homes or apartments, while the medium-scale hydroponic system is suitable for larger indoor or greenhouse facilities with multiple sensor nodes. I have added comprehensive explanation of the proposed system in the article.

> *** Contribution/s & Detailed comments: What are the major issues addressed in the paper? Do you consider them important? Comment on the degree of novelty, creativity and technical depth in the paper. Please provide detailed comments that will be helpful to the TPC for assessing the paper, as well as feedback to the authors.

It would be beneficial to include a table comparing the different solutions presented in the related works section. Improving the clarity of certain figures would enhance the visual understanding of the system architecture.

<u>Response:</u>
I have added Table 1:" Comparison of Existing Solutions" in the article and improve the clarity of figure 3, 5, and 6.

TABLE I. Comparison of Existing Solution

Ref.	Contribution	Sensor Parameter	Drawbacks
[4]	A comprehensive overview of the potential of hydroponics	Temperature, Humidity, pH	Lack of discussion on the IoT for hydroponics
[5]	IoT-Edge-AI-Cloud concepts to monitor strawberry hydroponic	pH, DO, TDS, Ultravi-olet, Temperature, Hu-midity, CO2	Complex and expensive
[6]	Utilizes wireless sensor networks and data fusion techniques to streamline information exchange and improve control efficiency	water level, humidity, and temperature	No discussion on how the data is stored and how the communication between the sensor and the web server.
[7]	A comparative analysis of six hydroponic methods and focuses on researching saffron growth factors	Temperature, pH, Mois-ture	Not implemented yet
[8]	Integration of solar panel applications and IoT to lower the installation cost of solar panels in smart hydroponic farms.	transpiration leaf	Limited focus on Power consump-tion. Lack of discussion on how IoT improve the lettuce cultivation
[9]	An automation system for the hydroponics system and a smart solar power plant unit.	light intensity, voltage, electrical current, and solar panel output	Limited focus on Power consump-tion, No discussion on cultivated plant.
[10]	Systematic review of IoT-based greenhouse applications, sensors/devices, and commu-nication protocols.	Soil Moisture, pH, Airflow, humidity, Accoustc, GPS, CO2	Lack of discussion on the practical challenges.
[11]	Reviews the existing greenhouse cultiva-tion techniques and the latest advancements in IoT technologies for smart greenhouse farming	Unspecified	Lack of discussion on how IoT affect the plant growth
[12]	Utilizes a Petri Nets (PN) model for green-house environment monitoring.	Temperature	Limited focus on temperature con-trol.
[13]	Proposes an optimal greenhouse water sup-plement mechanism that focuses on effi-cient energy consumption.	Water, soil moisture	The system was run in an experiment-tal environment in the lab instead of a real greenhouse.
[14]	Intelligent and low-cost IoT-based control and monitoring system designed for hydro-ponic greenhouses.	Temperature, pH, wa-ter Electrical Conductiv-ity (EC) and Dissolved Oxygen (DO)	No discussion on the data analysis and decision-making processes based on the collected sensor data.
[15]	Evaluates the performance of an auto-mated hydroponic system using cluster-based wireless sensor networks in compar-ison with a multihop-based system.	Temperature, humidity, EC, and pH	Simulation-based and focuses on simulation results, without exten-sively discussing the practical imple-mentation challenges
[16]	Focuses on designing and implementing an IoT-based automated monitoring system for hydroponic farming	Humidity, temperature, light intensity, pH, and EC	Lack of discussion on how IoT im-prove the lettuce cultivation.
[17]	Introduces the NFT-I hydroponic system	temperature, water level, and pH	Lack of discussion on how IoT im-prove the lettuce cultivation. No dis-cussion on how data is stored and accessed
[18]	Design and implementation of an auto-mated smart hydroponics system using the IoT	pH, Humidity, tempera-ture, lighting	Lack of discussion on how IoT im-prove the lettuce cultivation. No dis-cussion on how data is stored and accessed.
[19]	Propose a pH sensor that is designed to automatically detect and rectify imbalances in the nutrient solution's pH levels through calibration.	pH	lack of evaluation of crop perfor-mance and outcomes achieved with the smart system.
[20]	IoT-based automatic water level and EC monitoring system designed for the NFT	water level, EC	Lack of discussion on how the data is stored, the type of database used in the web server
[21]	Improvement of [14] by adding a fuzzy inference engine determines plant irrigation duration	Temperature, pH, EC and DO	No discussion on the data analysis and decision-making processes based on the collected sensor data.