

Communication Network System (CNetS) Research Group

UTM-MIMOS Laboratory

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MEMORANDUM

To: Digital Communication Laboratory Students

From: Dr. Muhammad Ariff bin Baharudin

Subject: Proposal Submission for Aquaponics IoT Project

Date: 17 March 2024

Dear scholars,

I hope this memo finds you well. I am writing to inform you about an exciting opportunity to contribute to an ongoing project in collaboration with Innates PLT, focusing on integrating IoT technologies into aquaponic systems.

Innates PLT has approached my team to provide expertise and guidance in addressing specific challenges in optimising aquaponics systems using IoT solutions (refer to **Appendix A**). The challenges identified include:

1. Optimising Nutrient Cycling
2. Controlling Water Quality
3. Managing Disease and Pest Control
4. Energy Usage and Failure Alert.

Therefore, this memo provides guidance on preparing the project report proposal for the Aquaponics IoT Project Collaboration with Innates PLT, as mentioned in Appendix A. You have one week to submit your proposal and three weeks to complete the prototype. Table 1 provides suggestions for your project planning.

Table 1: Project planning

Week	In-Lab Session (3 hours)	Out-Lab Session
Week 1	<ol style="list-style-type: none">1. Understanding the problem with guide from the facilitator2. Brainstorming, giving ideas to solve problem3. Identifying available resources and tools with guide from the facilitator4. Identifying what you know and what you need to know in solving the problem5. Divide work among group members6. Group verify the availability of equipment and tools to conduct the project	<ol style="list-style-type: none">1. If needed, get more resources to help understand the problem and completing the proposal2. Design and simulate your system in Cisco Packet Tracer.3. Prepare for the next lab session (ex: prepare for Raspberry Pi setup, sensors interfacing with raspberry pi, coding for reading data from sensors and sending data to cloud and prepare to use Wireshark)4. Finalize and submit the proposal

	7. Need to submit draft of the proposal to the facilitator before end of the lab hours to get feedback	
Week 2	<ol style="list-style-type: none"> 1. Group discusses the execution of the project with the facilitator. 2. Develop and integrate the system (hardware and software) and collect data from the implementation. 3. Analyse the network using Wireshark. 4. All the activities should be supervised by the facilitator for any feedback on the project. 	<ol style="list-style-type: none"> 1. Group finalized architecture diagram, single line diagram (or schematic diagram) and flow chart. 2. Groups starts preparing project report from the proposal 3. Groups starts preparing slide presentation and demo 4. Preparing for the individual report.
Week 3	<ol style="list-style-type: none"> 1. Group finalizes the project report, slide presentation and demo within the first 2 hours. 2. Groups present and demo their project in the final hour. 	<ol style="list-style-type: none"> 1. Project report submission by one week after the demo.

The available equipment in the IoT Laboratory is listed below:

1. Raspberry Pi
2. Arduino/NodeMCU
3. The sensors:
 - a. Soil sensor
 - b. DHT11/22 (humidity/temperature)
 - c. PIR sensor
 - d. Ultrasonic sensor
 - e. PH sensor

Your final technical report should follow this outline:

1. Title Page
 - a. Project title
 - b. Names of project team members
 - c. Date of submission
2. Introduction
 - a. Brief overview of your project
 - b. Background information explaining the context and significance of the project
 - c. Objectives of the project
3. Scope and Deliverables:
 - a. Description of the scope of the project
 - b. List of deliverables expected from the project (e.g., project report, slide presentation and demonstration)
4. Project Plan:
 - a. Timeline: Schedule outlining key milestones and deadlines.
 - b. Roles and Responsibilities: Assignment of tasks to team members.
 - c. Resources: Equipment, simulator, and tools required for the project.

5. Methodology:
 - a. Description of the approach or methodology to be used in completing the project.
 - b. Architecture / Single Line Diagram (or schematic diagram) / flow chart.
 - c. Explanation of any research methods, experiments, simulation or data collection techniques to be employed.
6. Outcomes:
 - a. Anticipated results or findings from the project.
 - b. Potential impact or benefits of the project outcomes.
7. Conclusion:
 - a. Describe how your project can contribute to Innates PLT

Some questions that need to be considered throughout this project are:

1. What is IoT?
2. What are the key components and the layers in an IoT system?
3. Explain the functions of those key components.
4. How will these components interact and communicate within the system?
5. What are the advantages and limitations of your proposed system?
6. How will data flow through the system from sensors to the server, and how will it be processed and analyzed?
7. What testing and validation methods will you employ to ensure the reliability and functionality of your solution?
8. What is the throughput received at the server?
9. How can you improve the throughput/packet receive rate?
10. How reliable is your data transfer?
11. How will you document and communicate your methodology and findings throughout the project lifecycle?

Your contribution to this project is invaluable, and I appreciate your dedication and effort in advancing our collaboration with Innates PLT.

Best regards,

Dr. Muhammad Ariff bin Baharudin

Head of Digital Communication Laboratory

APPENDIX A
EMAIL FROM INNATES PLT

Subject: Collaboration Opportunity: Solving Aquaponics IoT Challenge

Dear scholars,

We hope this email finds you well. We are contacting you through Dr. Muhammad Ariff bin Baharudin, Head of the IoT Laboratory, regarding an exciting collaboration opportunity.

As an IoT solutions provider specialising in projects related to agriculture and sustainability, we are currently working on an innovative project focusing on integrating IoT technologies into aquaponics systems. Our goal is to develop a smart aquaponics solution that optimizes efficiency and productivity while promoting environmental sustainability.

As we delve deeper into this project, we have encountered specific challenges that could benefit from your expertise and insight. The challenge revolves around the following:

1. **Optimising Nutrient Cycling:** The efficient cycling of nutrients between the fish and plant components of an aquaponic system is crucial for maximizing productivity and minimizing resource inputs. However, achieving optimal nutrient balance while avoiding nutrient deficiencies or toxicities presents a significant challenge.
2. **Controlling Water Quality:** Maintaining optimal water quality parameters such as pH, dissolved oxygen levels, ammonia, nitrite, and nitrate concentrations is essential for the health and well-being of both fish and plants in an aquaponic system. However, fluctuations in water quality due to factors such as fish waste, feed inputs, and microbial activity can pose challenges in achieving and maintaining ideal conditions.
3. **Managing Disease and Pest Control:** Aquaponic systems are susceptible to various diseases and pests that can affect fish and plant health, reducing productivity and crop losses. Developing effective disease prevention and pest control strategies that are environmentally sustainable and compatible with aquaponics principles presents a significant challenge.
4. **Energy Usage and Failure Alert:** IoT systems in general will be deployed to location depending on the needs of the industry. In this projects case, it will be for aquaponics. Nevertheless, for it to be a reliable system, the users need to be able to keep track of the energy usage and detecting for any system failures for quick response. Developing a system with energy usage tracking and failure alert is a must.

Given your passion for learning and your potential in the field of IoT, we believe that your fresh perspective and innovative ideas could be instrumental in overcoming these challenges and advancing our project. We are particularly interested in exploring potential solutions that leverage your creativity and understanding of IoT technologies to address the identified problems effectively.

We invite you to collaborate on this project by proposing innovative solutions to one of the identified challenges. Your proposal should include:

1. A clear problem statement outlining the selected challenge.
2. Your proposed IoT solution.
3. Use of Cisco Packet Tracer to simulate data packet transmission to the cloud.
4. A list of equipment required for the proposed solution.
5. Any findings related to the proposed solution.

Please submit your proposal to your supervisor by the second meeting. We are excited about the possibility of working with you and look forward to seeing your innovative ideas contribute to the success of our project.

Thank you for considering this collaboration opportunity.

Best regards,

Dr. Mohd Adib Sarijari
CEO/Founder
Innates PLT
<https://www.innates.my>