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International Community Service: Implementation of a Smart Farm Based on Internet of Things in the Salikneta Farm, Philippines

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Abstract

Salikneta Farm is located in Bulacan, Philippines. On that farm, many monitoring tasks were conducted conventionally, which might be labour-intensive and error-prone. Only physical appearance might be considered while monitoring the farm. This international community service developed an IoT-based land monitoring system to help farmers monitor their farms. The IoT system was designed as a suitcase for portability, and it could send the data to a server for further analysis. Upon testing the IoT system, it was then delivered to Salikneta Farm. A workshop was then conducted onsite, covering the IoT system and how to use it in the field. According to 15 participants, the workshop was insightful and helped the participants to understand the IoT system and its usage. The interview with the supervisor of the farm supported this. After the workshop, the IoT system was used on the farm. The supervisor occasionally reported the conditions and consulted on some issues. There was some data reported from the IoT system to a special server. To sum up, the system was considered beneficial for the farm and it is being used.

Keywords: *agriculture, farm, IoT, land monitoring system*

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Introduction

The World Bank estimates the growth of the human population to 9.7 billion in 2050, potentially doubling the food needs (World Bank, 2025). Consequently, many countries focus on their agricultural sectors, aiming for food security (Clapp et al., 2022). The Internet of Things (IoT) is a promising technology to support agriculture (Farooq et al., 2020). It can automate the monitoring process and thus prevent many agricultural issues, such as those introduced by pests and bad weather. IoT is often employed to monitor the water irrigation system (Et-taibi et al., 2024), air quality (Gabriel et al., 2024), plant growth (Srinivasan et al., 2024), crop diseases (Sravanthi & Moparthi, 2024), and soil moisture (Custódio & Prati, 2024).

Due to its vast benefits, IoT is installed in many agricultural sectors as part of community service activities. Budiyanto et al. (2025) developed an IoT system to monitor water quality and included it as part of a student workshop. The system could identify pH, total dissolved solids, and temperature. Satria Yudha Kartika et al. (2024) helped durian farmers at Wonosalam to use IoT in monitoring the durian plants. They conducted several training sessions, and at the end of the series, farmers had a more positive attitude toward IoT implementation in farming. Sagala et al. (2025) introduced IoT to high school students for monitoring their hydroponic plants. After the community service, students seemed to have a deeper awareness of the knowledge. Artha (2025) supervised people at Wanagiri village to automatically water their plants through IoT. The activity might improve people's technical skills in developing IoT for a smart plant watering system. Djoni & Lim (2024) developed an IoT-based urban farming system. The system could automatically add fertilizers, water the plants, and monitor plant conditions. It seemed to help the organization manage its hydroponic plants.

Due to their similar geographical and weather conditions, Indonesia and the Philippines share similar agricultural environments and needs. Further, the governments are focused on food security and agriculture. Salikneta Farm is located in Bulacan, Philippines, about a two-hour drive from Manila. The farm grows various crops, including cassava, mustard, and spinach. It also produces eggs and meat. Salikneta Farm is a place for agricultural students from De La Salle Araneta University, Philippines, to have real farm-related experience. Students spend a few months there, learning how to manage a farm.

At Salikneta Farm, many monitoring tasks are conducted conventionally. It thus might be labour-intensive and error-prone. Further, their observation might be limited to the physical appearances of the environment. For improvement, a community service team developed an IoT-based land monitoring system to automate some monitoring tasks. The system is designed as a portable suitcase so that it can be uninstalled and installed easily. The team developed the IoT system based on the stakeholders' needs, conducted a workshop for the stakeholders (or potential users), and provided post-installation discussions via e-mail exchange.

Methods

The community service started with a series of online and onsite meetings among the authors and the stakeholders. The first meeting was held in July 2024 between authors from Maranatha Christian University and Telkom University. The team discussed what technology can be utilized to support agriculture in general. The second meeting was held one month later with an author from De La Salle University, Philippines, discussing a target farm. The third meeting was held two weeks after the second meeting with an author from De La Salle Araneta University, Philippines. The discussion was about asking Salikneta Farm whether they are interested in our solution.

The farmers usually monitor their farm manually, which might be labour-intensive. One week later, authors from De La Salle Araneta University offered the solution to the supervisor of the Salikneta Farm and discussed their needs. Finally, the requirements of the Salikneta Farm were sent to the authors from Maranatha Christian University and Telkom University. They started to develop the IoT-based land monitoring system based on the requirements. Most meetings were online, except for a meeting with the supervisor of Salikneta Farm. It was conducted onsite at the farm. During this period, the team occasionally exchanged emails for communication. Due to high development costs, the team could only develop one land monitoring system. Since Salikneta Farm is quite large, the team designed the system to be portable, like a suitcase that can be moved anywhere. The design of the suitcase can be seen in Figure 1. The system could detect land conditions by sticking the sensor to the ground. The sensor looked like a fork that could be easily attached to the soil. Upon sticking the sensor to the soil in approximately one minute, it could report six metrics of land fertility: Nitrogen (N), Phosphorus (P), Potassium (K), pH, humidity, and temperature.

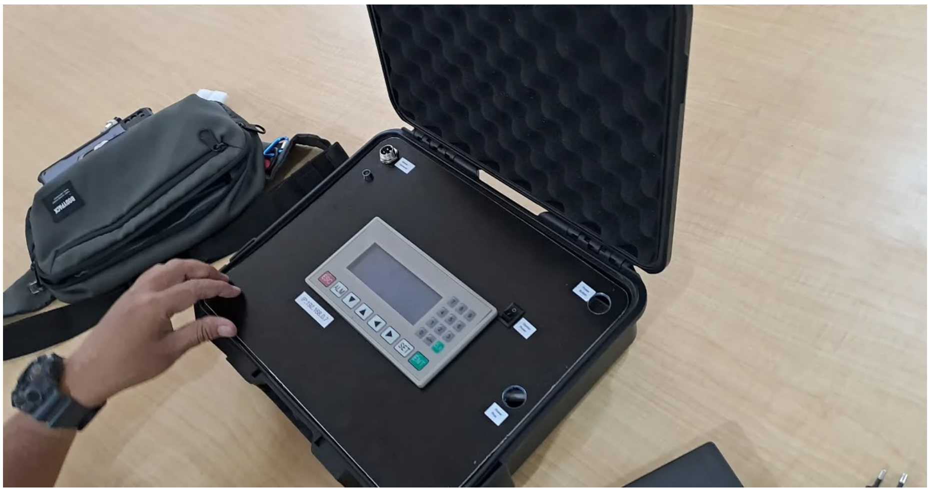

Fig. 1. The portable IoT-based land monitoring system

N is the key component of the three parts of photosynthesis: protein, nucleic acids, and chlorophyll. A sufficient amount of N can promote vegetative growth. P supports root development, flowering, and fruit production. It is involved in energy transfer in the plants. K plays a role in promoting overall health and the quality of the plants. A sufficient amount of K can regulate water balance, protect plants from diseases, and promote nutrient transportation. pH affects the availability of nutrients for plants. Soil pH is expected to be around 6 to 7.5. Humidity refers to water availability. Overly low humidity can introduce stress to the plants, while overly high humidity may entail more pests and pathogens. Temperature affects the activity of soil microorganisms. It can also promote root growth and nutrient uptake. Warmer temperature is preferred in most cases. All of the metrics would be shown in the IoT system's monitor. An internet SIM card can be attached to the IoT system, which periodically sends the data to our server in Indonesia for further analysis.

Further technical details of the IoT land monitoring system are out of the paper's scope (community service) and will be reported as a research publication. Upon development, the IoT system underwent two internal tests. The first one was conducted near an author's house, while the other was conducted on a farm in Garut, West Java, Indonesia. The sensor would be checked to see whether the captured metrics were appropriate and relevant to real conditions. In February 2025, authors from Maranatha Christian University and Telkom University went to the Philippines to deliver the IoT system, do a workshop, and evaluate the impact of the community service. On the first day, they met with the author from De La Salle Araneta University, Philippines, on their campus. The authors planned the workshop on Salikneta Farm.

After that, the authors went to Salikneta Farm and met the supervisor. The trip was about two hours by car. The authors then conducted a workshop for the supervisor, staff, and interns. Salikneta Farm had some interns who were undergraduate students in agriculture. About 13 people participated in the workshop, which is summarised in Table 1. The team started by introducing the community project and involving institutions. The goal was to provide the participants with an overview of the community service project. The session just took 10 minutes.

Table 1. Workshop rundown

No.	Topic	Duration
1	Introduction of the community service project	10 minutes
2	Introduction to IoT	10 minutes
3	IoT-based Land Monitoring System	30 minutes
4	Simulation and Testing	80 minutes
5	Conclusion and Summary	10 minutes
6	Group Photo	10 minutes
	Total duration	**150 minutes**

The second session was an introduction to IoT, and again, it took just 10 minutes. One of the authors described the concept of IoT and why the technology can be helpful for the agricultural sector, especially for monitoring. After that, the third session, which was the main session, was conducted. It discussed the overview of the IoT system and how to use it. Figure 2 shows the workshop condition during the session. It took about 30 minutes. The fourth session also covered how to use the IoT system. However, it was more focused on real conditions on the Salikneta Farm. The team went to five fields, simulated, and tested the IoT system on each one. After the system had reported the land metrics, the team discussed with the participants whether the reported numbers were reasonable. Figure 3 shows the activity of visiting one of the fields and testing the IoT system. It is worth noting that the session took 80 minutes since it included time to walk from one field to another. The fields chosen were quite far from one another since the team wanted to get broader coverage.

Upon visiting the fields, the team gathered back in the workshop room and thus concluded the workshop. The team also discussed future steps and post-workshop consultations. Finally, the team took group photos, one of which can be seen in Figure 4. During the workshop, the team informally asked some participants about their feedback regarding the workshop. At the end of the workshop, the team also asked the supervisor to provide their written feedback.

Fig. 1. The third session discussing the IoT-based land monitoring system with some participants observing the IoT system closely

Fig. 2. Testing the IoT system in a field of Salikneta Farm

Fig. 4. Group photo with the workshop participants

The team then spent a night on the Salikneta Farm for post-observation. The team needed to ensure that the IoT system considered most aspects of the farm. The next day, the team went to De La Salle University in Manila, Philippines, to meet with the author from that institution. They would be in charge of monitoring the IoT system and reporting any issues. Compared to the traditional method, the IoT approach is more efficient and effective. The cost might be less affordable at first, but the team believes that in the long run, it might be cheaper than paying for manual labour.

It is worth noting that the community service results in five official partnerships: 1) Telkom University with De La Salle University; 2) Telkom University with De La Salle Araneta University; 3) Maranatha Christian University with De La Salle University; 4) Maranatha Christian University with De La Salle Araneta University; and 5) Telkom University with Maranatha Christian University. All institutions support the project, but only two went through their internal grant scheme (Telkom University and Maranatha Christian University).

Results and Discussions

The community service was evaluated based on four aspects: 1) the successful development and implementation of the IoT system; 2) participants' engagement and feedback during the workshop; 3) the supervisor's feedback about the workshop and the IoT system; 4) post-workshop usage monitoring and consultation of the IoT system. For the first evaluation, the team conducted two internal tests and one integration test. The internal tests were conducted in Indonesia, near an author's house, and on a farm in Garut. The team made a functionality check form and then tested the IoT system based on that. Both tests showed that the IoT system worked as expected. This was supported by the integration test held at the Salikneta Farm. For the second evaluation, the team observed participants' engagement and feedback during the workshop. The workshop was considered engaging. Many participants were curious about the IoT system and asked many questions. Some of the questions were 1) how accurate the IoT system was; 2) how to read the metrics shown on the IoT system; 3) how to fix technical issues; and 4) how to attach the sensor to the soil. Participants generally believed that the IoT system could help them maintain the farm. A participant even asked about the possibility of using the IoT system to check the environmental conditions of fish ponds and chicken cages.

The team's current workshop was more focused on land crops. Regarding the workshop itself, participants believed it was insightful and helpful. Some of them stated that they could not wait to use it in a real case. Two participants were not aware that such a technology existed. They were used to check the farm manually. A participant thought about the possibility of making the IoT system more scalable. Instead of moving the IoT system from field to field, it is preferred to have multiple sensors installed on the fields and linked with the IoT system for data processing. Another participant stated that the captured data might be insightful in understanding the farm's conditions and implementing preventive measures where appropriate. There were some conditions under which it might get worse, but the farmers could not see it physically. The IoT system might alert them earlier. A participant described the importance of this workshop.

A number of farms in the Philippines rely on manual labour, and this might be part of the solution. If possible, the IoT system could be expanded further and thus connected with the government. There was a concern about the development cost if farmers wanted to develop more IoT systems by themselves. The cost was not cheap, and the development required technical assistance. They recommended replicating the workshop and the community service on other farms. It was also possible to apply for national or regional grants to supplement the funds. Two participants discussed the possibility of utilising the IoT system as part of their bachelor's final project. They believed the IoT system could help them collect data for analysis. Their topics were related to crop growth monitoring. For the third evaluation, the team interviewed the supervisor of the Salikneta Farm about the workshop, the IoT system, and the overall community service. They believed the workshop fulfilled participants' needs. IoT was relatively new for some participants, which might bring new perspectives on farm monitoring. They also thought the workshop duration (2.5 hours) was appropriate, mainly since it featured many demonstrations.

The workshop material was quite easy to understand. This was perhaps because the team's facilitator (who was one of the authors) had some experience in similar research and community service in Indonesia. The community service was well-conducted. The supervisor hoped that such community service could be conducted again in the near future. They did not expect to get the IoT system and use it on their farm. After the workshop, the team occasionally monitors the use of the IoT system via email communications and data collected on the team's server. This was part of the team's fourth evaluation of the community service. The supervisor used the IoT system and moved it to several fields to observe the land conditions. Based on the reported data on the server, the observation looked good. The team also provided post-workshop consultations. There was one occasion where a cable was loose, and the team provided detailed guidance on how to fix it. In the first week of installation, the supervisor confirmed whether their analysis based on metrics shown on the IoT system was appropriate.

According to the team's four evaluations, the community service was well conducted. The IoT system worked as expected based on three tests (first evaluation). All the functionalities were acceptable. Participants of the workshop believed that the workshop was good and the IoT system might be beneficial for farm monitoring (second evaluation). This was supported by the interview with the supervisor of the Salikneta Farm (third evaluation). The IoT system was actually used after the workshop, and the supervisor actively discussed any potential issues with the authors (fourth evaluation).

Conclusion

In this community service, the team developed an IoT system for land monitoring. The system can detect six metrics of land fertility (Nitrogen (N), Phosphorus (P), Potassium (K), pH, humidity, and temperature). The system functionalities were acceptable. The IoT system was implemented in Salikneta Farm, Philippines. The team conducted a workshop about the IoT system. Participants, including the supervisor of Salikneta Farm, believed the workshop was insightful and that the IoT system could be helpful. The IoT system was actually used, and the team provided some consultations about it.

For future work, the team plans to develop a web-based dashboard for farmers. They can see the periodic changes in their land conditions on the dashboard and get notified if anomalies are detected. The team is also interested in lowering the development cost by redesigning the IoT system with more affordable components via local providers. Last but not least, the team is interested in reporting and evaluating the technical effectiveness of the IoT system.

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