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Internet of Things (IoT) Innovation Solution for Making Biomass Stoves in Padasuka Village, East Sumedang

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Abstract

The community service team, comprising instructors and students from STMIK Mardira, in partnership with Universitas Kebangsaan Republik Indonesia, initiated an initiative to develop Sukajadi Village in East Sumedang. During the project, the team concentrated on resolving the challenge of biomass stoves utilizing the Internet of Things (IoT) with temperature sensors capable of real-time temperature monitoring and remote temperature control. The team ensured a consistent temperature of 90°C during the steaming process to preserve the quality and sterility of East Mushroom spawn bags.

The community service team implemented IoT-based biomass stoves and conducted training for the local population in Padasuka Village to optimize the use of these stoves for temperature monitoring. The community service project resulted in the deployment of IoT-enabled biomass burners for real-time temperature monitoring during the steaming of oyster mushroom bags for the inhabitants of Padasuka Village in East Sumedang. The IoT-enabled biomass burners allow the local community to monitor the temperature in real-time, as shown on the application screen, to maintain a consistent temperature of 90°C for optimal steaming processes.

The collaborative community project in Sukajadi Village has substantially benefited the local community by adopting IoT-based technology for real-time temperature monitoring of biomass burners. The measures implemented are anticipated to be further improved and yield enduring advantages for the inhabitants of Sukajadi Village in East Sumedang.

Keywords: Biomass Stove, Internet of Things, Sukajadi Village Community Training, Benefits of Implementing IoT Technology

Introduction

The predominant inhabitants of Padasuka Village, North Sumedang District, are oyster mushroom cultivators who encounter a multifaceted problem in sustaining a consistent steaming temperature of 90°C to ensure the purity and sterility of the mushroom spawn bags. The workforce's deficiencies in knowledge and technical abilities have impeded the appropriate temperature monitoring process (Abdillah, 2024). Implementing Internet of Things (IoT) technology in biomass stoves has emerged as an effective solution to this difficulty (Halim & Ardiani, 2024).

By implementing IoT-based information technology in biomass stoves, the inhabitants of Padasuka Village can improve operational efficiency, facilitate transparent temperature monitoring during the steaming of oyster mushroom bags, and foster community engagement within the village. Residents can monitor real-time temperatures via a mobile application connected with IoT technology and sensors on the steaming oven (Nasir et al., 2024). The introduction of IoT signifies not merely an advancement in efficiency but a digital transformation that enables the population of Padasuka Village to be more attuned to technological advancements in the contemporary day (Alwansyah & Fahrurozi, 2024).

Implementing IoT-enabled biomass stove modifications and temperature sensors within the mobile application interface is anticipated to enhance real-time temperature monitoring, maintaining an optimal level of 90°C. The created solution enables a more transparent presentation of temperature monitoring information to users, specifically the community. It is anticipated to enhance community engagement and promote increased participation in operating an IoT-based biomass stove.

Studies on the application of the Internet of Things (IoT) in temperature monitoring have consistently demonstrated that IoT implementation markedly improves transparency and efficiency in diverse community activities (Susanti et al., 2024), (Oematan et al., 2024), (Elektro et al., 2024), (Dayera et al., 2024), (MELELO, 2023). Nonetheless, substantial gaps exist in the application of IoT across many sectors, particularly in rural or remote urban areas. These discrepancies stem from multiple aspects,

including insufficient human resources and a lack of comprehension regarding the advantages of temperature monitoring or control systems.

The community service initiative aims to mitigate existing discrepancies by offering IoT-based biomass burners equipped with appropriate temperature sensors that Padasuka Village residents quickly adopt. By tackling these technology-related disparities through IoT, it is anticipated that the inhabitants of Padasuka Village can exemplify for other communities, both urban and rural, the practical, transparent, and community-engaged utilization of IoT technology for improved real-time temperature monitoring and control with IoT-based biomass stoves.

The primary aim of this community service program is to develop a biomass burner apparatus equipped with IoT-based temperature control sensors that serve as temperature monitoring devices during the oyster mushroom bag steaming process conducted by the residents of Padasuka Village in East Sumedang. With this objective, it is anticipated that the inhabitants of Padasuka Village will actively participate in the implemented technological revolution.

Method

The community service team of academics and students from STMIK Mardira Indonesia partnered with Universitas Kebangsaan Republik Indonesia to launch a community service initiative to support the Sukajadi, North Sumedang local community. The team's primary objective was to tackle the issues encountered by the Sukajadi village community in regulating the temperature during the oyster mushroom bag steaming procedure. Due to constrained resources and insufficient technological expertise, real-time temperature monitoring was unfeasible, hindering the attainment and preservation of ideal quality and sterility in the manufactured oyster mushroom bags.

Comprehending the requirements of the local community constituted the essential initial step. The community service team comprising lecturers and students from STMIK Mardira Indonesia, in collaboration with Universitas Kebangsaan Republik Indonesia, conducted thorough and

continuous communication with the village community, examined the current temperature monitoring process, and considered the aspirations and objectives of the villagers. A comprehensive strategy was established, detailing the essential procedures, allocating suitable resources, and creating an efficient project implementation timeline. Developing an Internet of Things (IoT)-enabled biomass stove has begun.

The team diligently planned and manufactured the requisite equipment to meet the village community's expectations and needs. The IoT-based biomass stove was prepared for utilization upon completing the phases of design, development, testing, and deployment. Nevertheless, the team's task still needed to be completed as they were required to instruct the local community/users on operating the developed equipment.

The community service team comprising lecturers and students from STMIK Mardira Indonesia collaborated with Universitas Kebangsaan Republik Indonesia to train the village community, equipping them with the necessary knowledge to effectively utilize the IoT-based biomass stove. The training emphasized stove operation, sensor equipment maintenance, and mobile application management. Upon deploying the biomass stove, the team was required to monitor and assess its performance. It was imperative to ascertain that the IoT-based biomass stove operated effectively, fulfilled the requirements of the village community, and provided the anticipated advantages. The engagement of the local community was underscored, with the expectation that they will actively utilize this biomass stove apparatus. The community service team of academics and students from STMIK Mardira Indonesia, in conjunction with Universitas Kebangsaan Republik Indonesia, is optimistic that this project would provide durable and advantageous solutions for the Sukajadi village community. Through robust teamwork and steadfast commitment, they aspire to effectuate a substantial positive influence on the entire Sukajadi village community.

Results and Discussion

On February 19, 2024, faculty and students from STMIK Mardira Indonesia, in collaboration with Universitas Kebangsaan Republik Indonesia, executed a community service initiative as part of the Tri Dharma of Higher Education. This effort sought to help the broader community, particularly the inhabitants of Sukajadi Village, North Sumedang. The project entailed the development of an innovative device named "IoT-Based Biomass Stove." This project primarily concentrated on the Sukajadi Village community, situated in Jl. Raya Padasuka No.131, North Sumedang Subdistrict, Sumedang City. The intended participants of this project were the inhabitants of Padasuka Village, who were instrumental in overseeing the temperature of the IoT-based biomass stove.

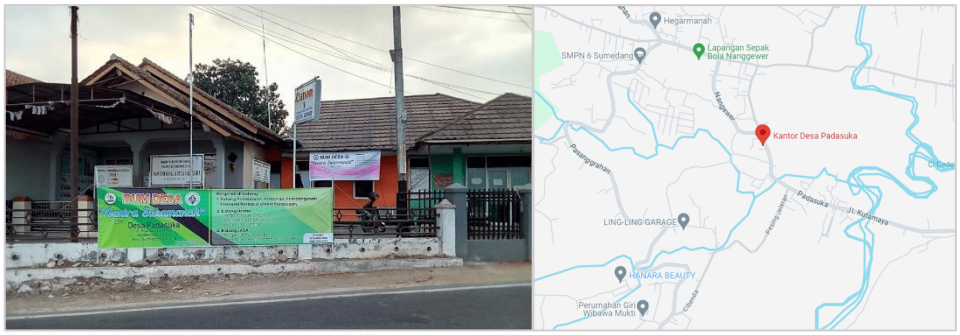

Figure 1. Location of Community Service activities

The community service team seeks to improve efficiency and transparency in managing activities and money at the mosque through this technology-based solution. The team aims to significantly enhance the management of Al-Muhajirin Mosque by aiding its administrators in leveraging technology for reciprocal advantage through their product development.

The team leader and members have resolved to implement Intellectual Property Rights (IPR) to safeguard the intellectual property created while building the Al-Muhajirin Mosque's website as part of their community service project. This decision was made to protect the creative output

generated while developing the Website Application for Managing Mosque Activities and Finances.

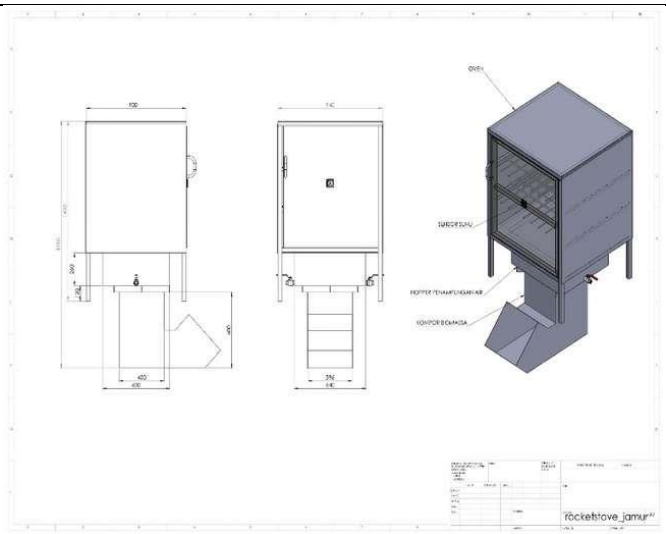

Figure 2. IoT Biomass Stove Design Wireframe

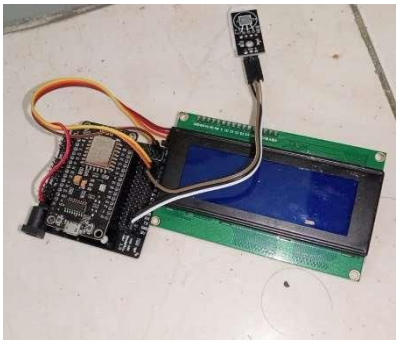

Figure 3. Control System and Non-Active Sensors

Figure 4. Active Control and Sensor System

Figure 5. Physical closed biomass stove

Figure 6. Physical Open Biomass Stove

This project involved developing an IoT-enabled biomass burner equipped with temperature sensors to monitor real-time temperature and display indicators, allowing users to maintain a consistent temperature remotely. Figure 2 depicts the wireframe design of the IoT biomass stove, Figure 3 represents the inactive control system and sensors, Figure 4 exhibits the active control system and sensors, Figure 5 reveals the closed physical biomass stove, and Figure 6 demonstrates the open physical biomass stove.

Table 1 of the specs paper outlines the technological specifications necessary for the creation of the IoT-based biomass stove.

Table 1. Technical Specifications

No	Name	Information
1	Fuel	Oyster mushroom baglog waste
2	Capacity	5-10 kg biomassa
3	Heat output	5-15 kW
4	Control system	Microcontroller-based IoT
5	Censorship	Temperature sensor, gas sensor, humidity sensor

No	Name	Information
6	Appearance	Temperature indicator via mobile application
7	Electrical power	220V AC for blower and control system

Figure 7 illustrates the evaluation of the effective deployment of the IoT-based biomass burner developed by faculty and students from STMIK Mardira alongside the apparatus from Padasuka village.

Figure 7 IoT Based Biomass Stove Testing

The IoT-based biomass stove is designed to provide convenience for the community to monitor temperature in real-time from a distance. With the system control and sensor features integrated into this biomass stove, it is expected that the real-time temperature monitoring process can be more efficient and accurate in providing information on a stable temperature of 90°C, delivering tangible benefits to the residents of Padasuka Village, North Sumedang, who are involved in the project. Intellectual Property Rights (IPR), emerging from human creativity and thinking in creating a

product or process beneficial to humanity, encompass various aspects such as copyrights, patents, trademarks, and other intellectual property rights related to the development of the IoT-based biomass gas stove for the community of Padasuka Village in North Sumedang. Protecting IPR is crucial to ensure that the hard work and innovation of the community service team remain safeguarded and not misused. By having IPR, the team can ensure that their contributions and intellectual work are recognized and protected, allowing them to regulate their work's use and utilization according to applicable regulations. The decision to establish IPR also reflects the commitment of the community service team to valuing creativity, innovation, and hard work in their project. With IPR in place, it is hoped that the work produced in this project will continue to provide sustainable benefits to North Sumedang's Sukajadi Village and inspire future community service projects.

Conclusion

A collaborative effort was undertaken by the community service team consisting of lecturers and students from STMIK Mardira Indonesia and Universitas Kebangsaan Republik Indonesia to assist the residents of Sukajadi Village in North Sumedang. From identifying needs to creating the IoT-based biomass stove and providing training to the community and village officials of Sukajadi, every step was taken with utmost dedication. After completing the project, the team's leader and members gathered to reflect on their journey. The decision to protect Intellectual Property Rights (IPR) over the intellectual work produced marked a crucial milestone in closing this project. They realized the importance of preserving and valuing the creativity and innovation embedded in this IoT-based biomass stove. In a reflective atmosphere, the community service team of lecturers and students from STMIK Mardira Indonesia and Universitas Kebangsaan Republik Indonesia concluded that this project had provided a beneficial solution for the local community in Padasuka Village, North Sumedang. However, to maintain the project's sustainability, empowering community management and village governance, expanding collaborations, and

continuously evaluating to enhance the services provided are essential. Commitment is needed to continue supporting Padasuka Village in maximizing the utilization of this IoT-based biomass stove. The community service team believes that by following these recommendations, the project will not only bring current benefits but also lay the foundation for broader development and empowerment in the future. May each small step they take bring tangible positive changes to the community, especially in Padasuka Village, North Sumedang.

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