DESIGN AND IMPLEMENTATION OF PKBM AMARI NAME BOARDS USING IOT-BASED SOLAR PANEL TECHNOLOGY

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ABSTRACT

This community engagement program aims to develop and implement an IoT-based solar-powered signage system at PKBM Amari, an educational institution in West Jakarta, Indonesia. The main objective of this program is to improve the visibility of the institution's signage, especially at night, by implementing an autonomous lighting system that also serves as an educational resource. The approach includes initial field observations, system design using solar modules integrated with IoT components, on-site prototyping, and training workshops for students and staff. The result is a fully functional nameplate that illuminates autonomously using collected solar energy and facilitates real-time condition monitoring through IoT technology. Knowledge transfer sessions were held to promote sustainability and empower the community. This project addresses functional infrastructure issues while enhancing local technology literacy and encouraging the adoption of renewable energy. It offers a replicable framework for similar institutions with limited access to grid electricity.

Keywords: Community Service, IoT, Solar Panel, School Nameplate Lighting, PKBM Amari, Meruya Selatan.

1. INTRODUCTION

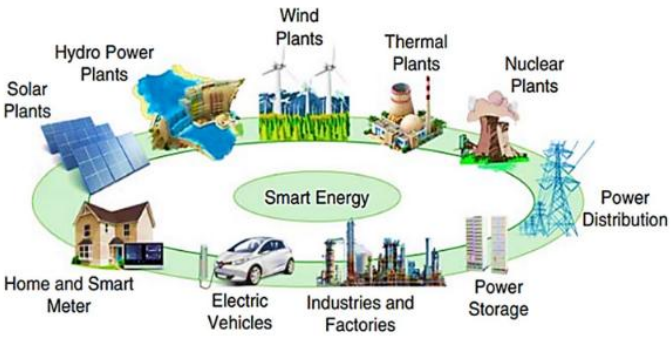

Figure 1. Smart energy application of IoT (Kalla et all., 2020)

The rapid development of the Internet of Things (IoT) and renewable energy technologies has opened up promising opportunities to improve infrastructure in resource-constrained environments. In particular, the integration of solar photovoltaic systems with IoT platforms has proven effective for applications such as smart lighting, remote monitoring, and autonomous power systems (Archibong, Ozuomba, & Ekott, 2020; Kumar et al., 2023). Educational institutions in non-formal settings, such as community learning centers, often lack access to reliable infrastructure, including signage or lighting systems that remain visible at night. PKBM Amari, an educational center in West Jakarta, Indonesia, is one such institution facing challenges related to the visibility of its signage, particularly in low-light conditions. To address this issue, a community service project was launched to design and implement a solar-powered signage system equipped with IoT capabilities. The integration of energy-efficient lighting components is at the core of this solution, offering a reliable and scalable technological intervention (Bentabet, Dennai, & Sonaskar, 2022; Garg & Raj, 2022). Previous studies have demonstrated the feasibility of similar systems in public lighting and smart road applications (Rathi & Ali, 2020; Rahmadhan, Kusnanto, & Winarno, 2021), highlighting the potential for replication in educational and community-based environments. Additionally, the utilization of solar panel optimization and remote control has proven to enhance system efficiency and user accessibility (Hamam, Martanto, Dikananda, & Rifa'i, 2025). Community participation and education play a vital role in ensuring the sustainability of these systems, as demonstrated by initiatives that include knowledge dissemination and training for local stakeholders (Inayah & Agustina, 2024). This program aims to address the dual challenges of infrastructure limitations and low technological literacy at PKBM Amari. Through the design, implementation, and knowledge transfer of an IoT-based solar signboard system, this project aims to empower the community while promoting sustainable and self-sufficient infrastructure solutions. The main objectives of this initiative are to increase visibility through the use of renewable energy, introduce IoT applications to local students, and develop a model that can be replicated by similar institutions throughout Indonesia.

2. METHOD

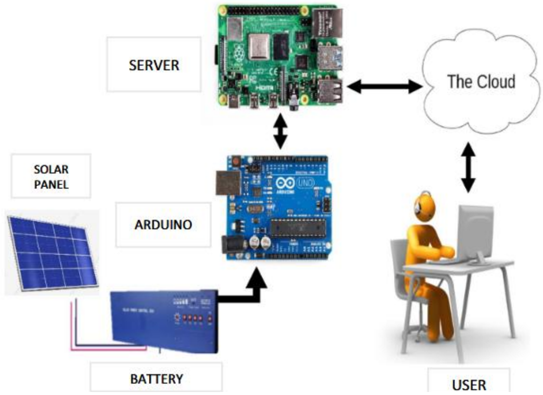

Figure 2 IoT send data to the user through cloud (SKR Engineering College, Institute of Electrical and Electronics Engineers. Madras Section, and Institute of Electrical and Electronics Engineers, 2017)

Figure 2 The Internet of Things (IoT) comprises numerous intelligent sensors, such as voltage, current, and temperature sensors, to assess the status of solar panels. This enables the retrieval and transmission of essential data, including voltage consumption, current, power output, and temperature, to the user's smartphone, allowing for remote analysis of the solar panel condition. (Firouzi & Farahani, 2020;Zafar et al., 2018).

The community service commenced with a direct evaluation of the conditions surrounding the nameplate site at PKBM Amari, Meruya Selatan. The team noted that the school's nameplate was unilluminated, hindering tourists and the public from identifying the institution after dark. A solar-powered system was consequently proposed. The design phase involved calculating the appropriate wattage and lumens required to illuminate the sign effectively. The system configuration included:

- 500 watts with dimensions 420x200. (Hamam et al., 2025)
- A 12V battery storage unit.
- LED lighting fixtures are placed to illuminate the school nameplate.
- A basic dashboard for monitoring battery level and operational time.(Bentabet et al., 2022)

The installation was executed in conjunction with school personnel and community representatives. Following the installation, a training session was held for selected school personnel to confirm their proficiency in operating and understanding the system. A workshop was conducted to elucidate the significance of renewable energy and the Internet of Things in contemporary infrastructure.

3. RESULTS AND DISCUSSION

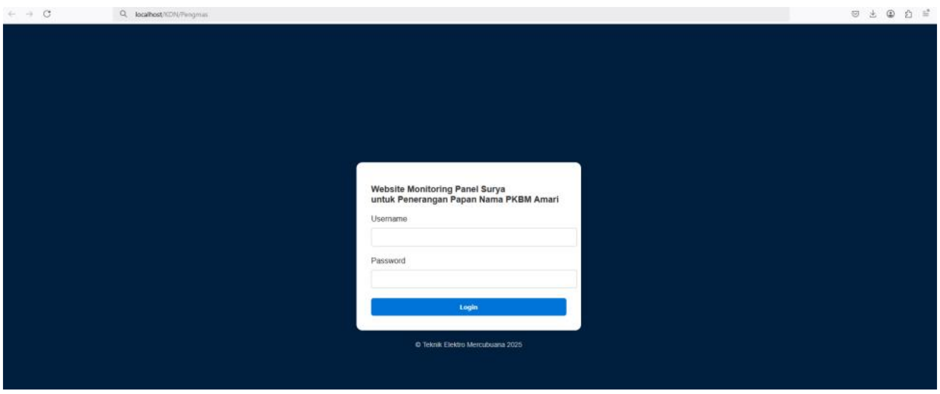

Figure 3. Login Page Display

This login page serves as the initial gateway before accessing the main dashboard. On the initial interface (as shown in Figure 3), users are asked to enter their username and password via the form provided. The data entered is sent to the server using the POST method, then verified with the registered user database. If the credentials entered are valid, the system will direct the user to the main dashboard page. However, if there is an error in the input, an error message will be displayed as feedback. The design of this login page is simple yet professional, featuring a dark blue background, a clean login form box centered on the page, and additional copyright information at the bottom stating © Electrical Engineering Mercubuana 2025, giving it an official and structured appearance.

The installed system has significantly improved the visibility of the PKBM Amari nameplate during nighttime, making it easier for students, staff, and visitors to identify the school building. Community members reported increased satisfaction with the infrastructure and expressed appreciation for the application of renewable energy in their environment.Monitoring data over the initial four weeks showed that the battery maintained optimal charge levels, and the lighting activated automatically at dusk, thanks to the light sensor integration. No major operational issues were encountered, indicating the system's reliability. Additionally, teachers and staff who participated in the training felt more confident in explaining the basics of solar and IoT systems to others.This project also served as an educational platform for raising awareness about sustainable technologies among community members. It inspired discussions about future expansions, including similar applications for interior lighting and security systems in the school area.

Figure 3.1 Symbolic inauguration and signboard of PKBM Amari.

The visual documentation in Figure 3.1 presents two critical moments in the implementation of the IoT-based solar-powered nameplate system at PKBM Amari. The image, captured during daylight, showcases the symbolic inauguration attended by academic delegates, local community leaders, and stakeholders. This event marked the official handover of the technological innovation and reflected the participatory model adopted in this community service program. Taken at night, this emphasizes the successful deployment of the solar-powered lighting system. The nameplate remains visibly illuminated without any external power source, relying entirely on the energy harvested and managed via a solar photovoltaic (PV) module integrated with a charge controller and battery storage system. This outcome validates the core design goal of an autonomous and sustainable identification system leveraging renewable energy and embedded IoT technology for potential remote monitoring. The implementation highlights the relevance of applied electrical engineering in addressing real-world community needs. It also demonstrates a successful knowledge transfer process, where the local institution gains both a functional output and the technical understanding to maintain or scale the system independently.

Figure 3.2 Teaching by Lecturers

Figure 3.2 depicts a crucial element of the community service program: a systematic knowledge transfer session facilitated by faculty from the Department of Electrical Engineering. This initiative aimed to improve the technological literacy of students at PKBM Amari by imparting practical knowledge in Internet of Things (IoT) and solar energy systems.

The session employed a hybrid instructional method, integrating theoretical exposition with visual demonstrations and interactive conversations. Essential subjects encompassed the concepts of energy harvesting via solar modules, IoT architecture for remote surveillance, and practical implementations of embedded devices in everyday life. The materials were tailored to align with the learners' backgrounds, ensuring both accessibility and relevancy. This involvement fulfilled two objectives: introducing sustainable technology and cultivating a culture of innovation among the students. The active participation of beneficiaries in the learning process is crucial for both the adoption and the sustainability of the adopted system. It illustrates the program's alignment with capacity-building objectives and sustainable development outcomes, as highlighted by the conference theme.

4. CONCLUSION

The implementation of an integrated solar-powered nameplate system with IoT at PKBM Amari has proven its technical feasibility and contextual significance. In addition to addressing the primary issue of inadequate nameplate visibility, particularly at night, the system demonstrates successful integration between embedded electronics and renewable energy in a practical community context. To support system accessibility and monitoring, a dedicated login page was developed as the entry point to the system's dashboard. This page (as shown in Figure 3) requires the operator to enter valid credentials, which are authenticated through a secure server-side POST request. Upon successful verification, the user is redirected to the main dashboard interface for real-time monitoring. The clean user interface, supported by a dark blue background and clearly labeled login form, ensures clarity and usability. Furthermore, a copyright notice © Teknik Elektro Mercubuana 2025 underscores the academic and institutional ownership of the system. The autonomous functionality, fully powered by photovoltaic energy and monitored by IoT infrastructure, exemplifies the appropriate application of technology in addressing infrastructure limitations. Moreover, the symbolic launch of the system, accompanied by organized training sessions, ensures that this intervention goes beyond mere installation. Educators actively participated in delivering modules on IoT architecture and solar technology, thereby enhancing local understanding, promoting system ownership, and building technical literacy within the community. This initiative demonstrates that technology deployment is most effective when it includes comprehensive planning, from technical design and interface development to community training and sustainability planning. As such, it offers a replicable and scalable framework for non-formal educational institutions in resource-constrained settings. By aligning technical innovation with contextual relevance and educational outreach, the program makes a meaningful contribution to the broader vision of achieving the Sustainable Development Goals (SDGs) through localized, impactful solutions.

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