Pelita: Jurnal Pengabdian kepada Masyarakat
Vol. 5, No. 4, Oktober 2025, pp. 129-137
ISSN: 2775-0094 (Online)
Available Online at: https://journal.kualitama.com/index.php/pelita

Implementation of Solar Cell and Photocell-Based Street Lighting in Gaprang Village, Blitar

Reza Sarwo Widagdo[1(*)], Ardianik[2], Puji Slamet[3], Aris Heri Andriawan[4], Imam Suri Tauladan[5], Balok Hariadi[6]
[1,3,4,6]Department of Electrical Engineering, Universitas 17 Agustus 1945 Surabaya, Indonesia
[2]Department of Mathematic Education, Universitas Dr. Soetomo Surabaya, Indonesia
[5]Department of Electrical Engineering, Universitas Riau, Indonesia

Article Info

Article history:

Received : 16 Sept 2025
Revised : 10 Okt 2025
Accepted : 18 Okt 2025

Keywords:

street lights; solar panel; photo cell; renewable energy

ABSTRACT

The increasing demand for sustainable energy sources has encouraged the application of renewable technologies in rural infrastructure, particularly in public lighting systems. This study focuses on the implementation of solar cell and photocell-based street lighting in Gaprang Village, Blitar Regency, as a solution to reduce dependency on conventional electricity and to enhance energy efficiency. The system utilizes photovoltaic modules as the primary energy source to convert solar radiation into electrical power, which is stored in batteries and subsequently used to supply street lamps during nighttime. In addition, the integration of photocell sensors enables automatic control of the lighting system by detecting environmental illumination levels, ensuring that the lamps operate only when required. The design and installation process involved site surveying, load estimation, solar panel configuration, and the application of photocell-based automation. The results demonstrated that the system provided reliable illumination for rural roads, significantly lowering operational costs and minimizing environmental impact compared to traditional grid-powered lighting. Furthermore, the use of photocells improved energy management by preventing unnecessary power consumption during daylight. The activity will take place in August 2025, with a focus on installation in Gaprang Village. The results of the activity include community understanding of the benefits and maintenance of street lights, as well as the implementation of solar cell-based technology. The conclusion states that this project can provide a positive and sustainable impact, empowering communities and creating efficient infrastructure that aligns with renewable energy initiatives.

(*) Corresponding Author: rezaswidagdo@untag-sby.ac.id

How to Cite: Widagdo, R.S., Ardianik, A., Slamet, P., Andriawan, A.H., Tauladan, I.S., & Hariadi, B. (2025). Implementation of Solar Cell and Photocell-Based Street Lighting in Gaprang Village, Blitar. *Pelita: Jurnal Pengabdian kepada Masyarakat*, 5 (4): 129-137.

INTRODUCTION

The rapid growth of energy consumption worldwide has raised concerns about the availability and sustainability of conventional energy sources. Fossil fuels, which dominate the current energy supply, contribute significantly to environmental issues such as greenhouse gas emissions, air pollution, and climate change. These challenges have stimulated global efforts to promote renewable energy technologies that are clean, sustainable, and capable of meeting the growing demand for electricity. Among the many applications of renewable energy, solar energy is one of the most accessible and widely adopted, especially in countries located near the equator where sunlight is abundant throughout the year (Widagdo et al., 2025).

In rural areas, particularly in developing regions, the implementation of renewable energy technologies plays a crucial role in improving public welfare. Electricity infrastructure is often limited, and communities may face difficulties in accessing reliable lighting for streets, public spaces, and community facilities. Street lighting, in particular, is essential for ensuring safety and supporting economic activity. However, conventional street lighting systems that depend on the national grid often lead to high operational costs and may not be sustainable in remote or underserved areas. This condition has encouraged the exploration of solar-powered street lighting as a viable alternative solution (Widagdo et al., 2023).

The integration of solar cells and photocells in public lighting systems offers both environmental and economic benefits. Solar cells convert solar radiation into electricity, which can be stored in batteries for use during nighttime. Photocells, on the other hand, act as intelligent control devices that automatically switch the lights on at dusk and off at dawn, optimizing energy consumption. The combination of these two technologies ensures that the system operates efficiently, reduces unnecessary power usage, and minimizes human intervention. Moreover, the adoption of renewable-based street lighting aligns with global sustainability goals and national programs promoting energy conservation and clean energy utilization (Widagdo et al., 2024).

Gaprang Village in Blitar Regency represents a rural community in need of innovative yet affordable and environmentally friendly infrastructure solutions. One pressing challenge identified is the lack of adequate street lighting, which poses safety risks for pedestrians, drivers, and economic activities occurring after sunset. To overcome this issue, a community service initiative has been proposed involving the installation of solar cell and photocell-based street lighting. This program not only provides sustainable infrastructure to improve public safety and mobility but also empowers residents through education on the operation and maintenance of renewable energy systems for long-term community benefits.

The activity is planned to take place in August 2025, focusing on the installation of solar-powered street lamps in selected areas of Gaprang Village. Beyond the technical installation, this program emphasizes community participation and knowledge transfer. Local residents will be introduced to the working principles of solar cells and photocells, trained in basic maintenance procedures, and encouraged to actively support the sustainability of the project. By involving the community, the project ensures that the installed system can operate effectively in the long term and reduce reliance on external technical assistance.

The expected outcomes of the project include increased awareness and understanding among the villagers regarding the advantages of renewable energy technologies, particularly solar-based lighting. In addition, the project is designed to empower the community by providing practical skills in maintaining the street lighting system, thereby fostering a sense of ownership and responsibility. From an environmental perspective, the use of solar energy will reduce the carbon footprint of public lighting, while economically, it lowers electricity expenses that would otherwise be drawn from the national grid.

In conclusion, the implementation of solar cell and photocell-based street lighting in Gaprang Village, Blitar, is not only a response to the community's urgent need for reliable, affordable, and sustainable infrastructure but also a strategic step to promote broader awareness and adoption of renewable energy technologies at the grassroots level. This community service program is designed with three main objectives: (1) to provide efficient, cost-effective, and environmentally friendly street lighting that improves safety and mobility, (2) to enhance the community's knowledge, technical skills, and capacity in managing renewable energy systems for long-term sustainability, and (3) to empower local residents to take an active role in future sustainable development initiatives.

METHODS

The implementation of solar cell and photocell-based street lighting in Gaprang Village required a structured approach to ensure technical accuracy and community involvement. The method began with a preliminary survey to identify strategic installation points and assess local conditions. Load analysis and system design were then conducted to determine the required capacity of solar panels, batteries, and lighting units. The installation phase involved collaboration with local residents, followed by training sessions on operation and maintenance to guarantee long-term sustainability and community empowerment.

Pelita: Jurnal Pengabdian kepada Masyarakat
Vol. 5, No. 4, Oktober 2025, pp. 129-137
ISSN: 2775-0094 (Online)
Available Online at: https://journal.kualitama.com/index.php/pelita

Solar Panel Installation as a Source of Electrical Energy for Street Lighting

In recent years, solar photovoltaic (PV) technology has become one of the most widely adopted renewable energy solutions due to its simplicity, reliability, and environmental benefits. Rural electrification, urban infrastructure, and standalone systems increasingly rely on solar cells as clean alternatives to fossil-fuel-based energy. The diagram shown in Figure 1 represents a general block structure of a PV system, outlining the main components and their interconnections. Each block plays a critical role in converting, regulating, storing, and delivering energy to meet user demands. Understanding this flow is essential for designing efficient and sustainable solar-based systems (Mahfud et al., 2025).

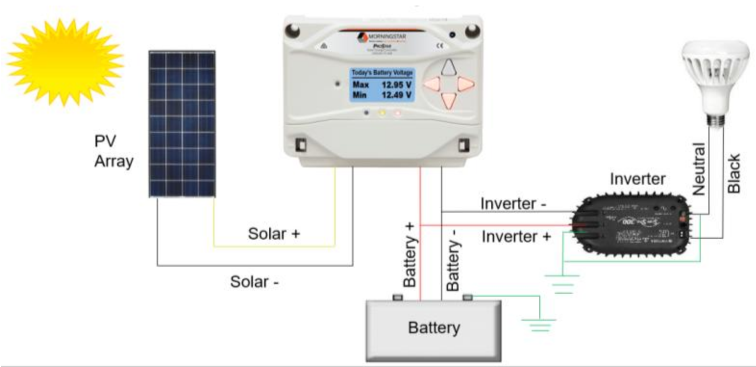

Figure 1. Solar Panel Installation Diagram Based on Solar Charge Control (SCC)

Figure 1 illustrates the basic configuration of a solar photovoltaic (PV) system integrated with both direct current (DC) and alternating current (AC) loads. At the input stage, the solar cell acts as the primary source, converting solar radiation into electrical energy. This energy is delivered to the charge controller, which functions as a regulator to ensure that the power supplied to the battery and loads is stable and within safe operating limits. The charge controller prevents overcharging and deep discharging of the battery, thereby extending its lifespan and maintaining system reliability (Ariyapijati et al., 2025).

The battery serves as an energy storage unit, allowing the system to provide electricity during periods of low solar radiation or at night. Stored energy can be supplied directly to DC loads through the charge controller. However, many household and community appliances operate on AC power, which necessitates the use of an inverter. The inverter converts the stored DC energy from the battery into AC electricity, making it compatible with conventional appliances and public infrastructure. This configuration highlights the flexibility of solar PV systems in meeting diverse energy demands. By supporting both DC and AC loads, the system can cater to efficient low-voltage applications as well as standard electrical devices. Overall, Figure 1 demonstrates a practical and sustainable energy system that maximizes solar energy utilization, ensures reliable supply through storage, and broadens applicability through conversion for different types of loads (Resky et al., 2024).

Photo Cell Installation for Street Lights Automation

In modern electrical engineering, automation plays an essential role in improving efficiency and reducing manual intervention. One of the most common applications of automation is in lighting systems, where technology is used to regulate operation according to environmental conditions. The integration of sensors and control devices ensures that electrical energy is consumed only when required, thus minimizing waste. Such systems are increasingly applied in public infrastructure, households, and rural development projects as part of sustainable energy initiatives. These innovations not only reduce operational costs but also enhance safety, reliability, and user convenience (Ulum et al., 2024).

Pelita: Jurnal Pengabdian kepada Masyarakat
Vol. 5, No. 4, Oktober 2025, pp. 129-137
ISSN: 2775-0094 (Online)
Available Online at: https://journal.kualitama.com/index.php/pelita

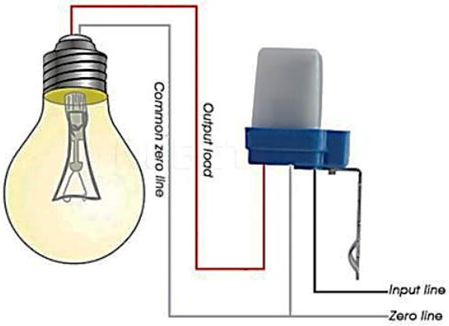

Figure 2. Photocell Installation Schematic

Figure 2 presents the basic wiring configuration of a lighting system controlled by a photocell sensor. The system integrates a lamp with an automatic switch that responds to surrounding light intensity, ensuring the lamp operates only when necessary. This arrangement highlights the practical application of photocells in modern, efficient, and energy-saving street lighting as well as household illumination. The diagram shows three main electrical connections: the input line, the zero line, and the output load line. The input line delivers power supply to the photocell, while the zero line acts as a return path, completing the electrical circuit. The photocell functions as an intelligent controller, automatically detecting ambient light conditions. When the environment is bright, the photocell keeps the circuit open, preventing current from flowing to the lamp. Conversely, when darkness falls, the photocell closes the circuit, allowing current to pass through the output load line and illuminate the lamp.

This configuration ensures the lamp is energized only during nighttime or low-light conditions, thereby reducing unnecessary electricity consumption. The common zero line connects both the photocell and the lamp, ensuring a stable return path for current flow. By using this system, operational efficiency is increased, and manual intervention is eliminated, making it highly practical for outdoor lighting such as street lamps, garden lights, and perimeter illumination. Overall, Figure 2 demonstrates a simple yet effective automation technique. The integration of a photocell not only minimizes energy waste but also enhances convenience and safety, proving its importance in sustainable lighting systems (Wardhany et al., 2024).

RESULT AND DISCUSSION

The target location for the installation of public street lighting is the Gaprang Village office area, using the method of “Socialization on the Use of Solar Cell and Photocell-Based Street Lighting” through community outreach and the substitution of science and technology (Miswaty et al., 2025; Nurhidayah et al., 2024). This method was carried out by encouraging questions and discussions with local residents. The socialization focused on communities living near the installation points, particularly regarding procedures for maintenance, care, and troubleshooting of the solar cell–photocell street lights in Gaprang. Such efforts aim to extend the service life of the system while ensuring its long-term benefits for society.

Solar cell-based street lighting technology represents a progressive step in the utilization of renewable energy for public road illumination (Irsyam et al., 2022; Ramadhan et al., 2024). Solar cells play a critical role by converting solar energy into electricity through photovoltaic processes. With the integration of photocell sensors as automatic controllers, the lighting intensity can be adjusted according to surrounding conditions. The advantages of this technology include improved energy efficiency, reduced carbon emissions, and greater energy independence. Nevertheless, its successful implementation requires specific knowledge and regular maintenance. With deeper understanding and proper community involvement, solar cell–photocell-based street lighting is expected to become an effective and sustainable solution for both rural and urban road lighting.

Pelita: Jurnal Pengabdian kepada Masyarakat
Vol. 5, No. 4, Oktober 2025, pp. 129-137
ISSN: 2775-0094 (Online)
Available Online at: https://journal.kualitama.com/index.php/pelita

Program Implementation Results

The implementation of this program began with discussions and observations to determine the installation points of public street lighting. Meetings with village officials were conducted to align the installation needs and enhance effectiveness, as officials have a better understanding of lighting requirements in Gaprang Village. Two discussion sessions were held to review and finalize the installation points.

Figure 3. Solar Panel Output Voltage Test

Figure 3 illustrates the activity of testing the output voltage of a solar panel as part of the community service program in Gaprang Village, Blitar. The test was conducted by the team together with students to ensure that the solar panel operated properly before being installed as part of the solar cell and photocell-based street lighting system. This initial measurement was carried out under direct sunlight conditions to evaluate the panel's ability to convert solar energy into electrical power efficiently. The results of this test serve as an important reference for determining the panel's readiness and reliability to support the public street lighting units.

Involving students in this activity provided valuable practical experience, allowing them to directly observe how solar panels generate voltage depending on sunlight intensity and installation angles. This knowledge transfer is essential to strengthen community understanding of renewable energy technology, particularly regarding how to test, monitor, and maintain solar panels. By combining technical validation with community participation, the activity not only guaranteed the quality of the installed system but also empowered the local community to take an active role in maintaining and sustaining the technology.

Figure 4. Solar Charge Control (SCC), Battery, and Inverter Installation

Figure 4 shows the installation process of the Solar Charge Controller (SCC), battery, and inverter as essential components of the solar-powered street lighting system. The SCC regulates the charging and discharging process of the battery to ensure stability and prevent overcharging,

Pelita: Jurnal Pengabdian kepada Masyarakat
Vol. 5, No. 4, Oktober 2025, pp. 129-137
ISSN: 2775-0094 (Online)
Available Online at: https://journal.kualitama.com/index.php/pelita

while the inverter converts the stored DC energy into AC power to supply conventional loads. Together, these components form the core of an efficient and reliable renewable energy system.
This activity was carried out as part of the community service program in Gaprang Village, Blitar, where technical teams and students collaborated in assembling the system. By involving the community, the program aimed not only to install infrastructure but also to transfer knowledge about the operation and maintenance of solar energy systems. Residents were introduced to the functions of each component and trained to perform basic troubleshooting, ensuring the sustainability of the street lighting units after installation.

The installation of the SCC, battery, and inverter demonstrates the practical application of renewable energy technology in rural areas. Beyond providing illumination, it empowers the local community by enhancing their technical understanding and encouraging independence in managing infrastructure. This aligns with the broader goal of the program, which is to create a sustainable, community-driven solution to public lighting needs while promoting clean energy utilization (Mauriraya et al., 2020).

Figure 5. Implementation of Street Lights and Panels for Lighting Around Gaprang Village Hall

Figure 5 illustrates the implementation of street lights and control panels for public lighting around Gaprang Village Hall. The system integrates a solar charge controller, battery, and inverter within a protective enclosure, ensuring reliable operation and safety of the solar-powered street lighting units. On the right side of the figure, the installation process is shown, where the technical team and local residents collaborated to mount the system and connect it to the lighting fixtures. This activity was part of the community service initiative in Gaprang Village, aimed at providing sustainable street lighting infrastructure while fostering community involvement. By engaging local residents in the installation, the program not only delivered renewable energy-based facilities but also enhanced the community's technical capacity in system operation, maintenance, and troubleshooting.

The placement of street lights around the village hall serves as a strategic effort to improve safety, accessibility, and community activities during evening hours. Furthermore, this implementation reflects the practical application of solar energy technology in rural environments, promoting clean energy adoption and reducing dependency on conventional electricity. Ultimately, the project demonstrates a model of energy self-sufficiency that can be replicated in other rural areas to support sustainable development goals.

Table 1. Community Satisfaction Survey Results

Satisfaction Score	Category	Frequency (f)	Percentage (%)
1	Very Dissatisfied	0	0.0
2	Dissatisfied	1	3.3
3	Fairly Satisfied	4	13.3
4	Satisfied	15	50.0
5	Very Satisfied	10	33.3
Total	-	30	100

Pelita: Jurnal Pengabdian kepada Masyarakat
Vol. 5, No. 4, Oktober 2025, pp. 129-137
ISSN: 2775-0094 (Online)
Available Online at: https://journal.kualitama.com/index.php/pelita

$$\bar{x} = \frac{\sum(x_i \cdot f_1)}{N} = \frac{(2 \times 1) + (3 \times 4) + (4 \times 15) + (5 \times 10)}{30} = 4.13$$

The results of the community satisfaction survey indicate that most respondents expressed positive perceptions of the service program implemented in Gaprang Village. Specifically, 50% of participants stated that they were satisfied, while 33.3% reported being very satisfied with the overall performance of the community service team.

This finding demonstrates that the majority of villagers acknowledged the program as beneficial and effective in addressing local needs. The calculated mean score of 4.13 further reinforces the conclusion that the initiative met community expectations and was considered successful in practice. Nevertheless, the responses also reveal that 13.3% of participants were only fairly satisfied. This suggests that although the program has been generally well-received, there remain areas that require improvement. In particular, long-term technical support, system maintenance, and follow-up activities could be strengthened to ensure the sustainability of the installed facilities and to enhance the community's overall satisfaction in the future.

Table 2. Descriptive Analysis

Variable	Pre-Test (Mean ± SD)	Post-Test (Mean ± SD)	Improvement (%)
Konowledge	55.3 ± 9.8	82.1 ± 8.2	48.4%
Practical Skills	60.5 ± 11.7	85.4 ± 9.1	41.1%
Community Satisfaction	-	92% (27 out of 30)	-

Based on Table 2 among 30 respondents, the average knowledge score increased from 55.3 to 82.1 (48.4% improvement). Practical skills improved from 60.5 to 85.4 (41.1% improvement). In addition, 92% of respondents expressed satisfaction with the program.

Table 3. Inferential Statistics

Variable	Statistical Test	p-value	Conclusion
Knowledge	Paired t-test (n=30)	0.0001	Significant difference
Practical Skills	Wilcoxon Signed Rank Test	0.0003	Significant difference

Since the calculated significance level was $p < 0.05$, the improvement in both knowledge and practical skills can be considered statistically significant. Analysis of the data from 30 respondents revealed that the community service program produced meaningful learning outcomes. The average increase in knowledge reached 48.4%, while practical skills improved by 41.1%. These findings indicate that participants not only acquired new theoretical insights but were also able to apply them effectively in practice. The statistical tests confirmed that these changes were not coincidental but rather the direct impact of the intervention provided through the program. Furthermore, the effectiveness of the program, measured by the N-Gain score, was categorized as moderate. Despite being moderate, the results show that the intervention was successful in enhancing competencies in a measurable way. In addition, 92% of respondents expressed satisfaction with the program, which further supports the conclusion that the activities were both beneficial and well-received by the target community. Figure 5 presents the comparison between pre-test and post-test scores in the two evaluated aspects. Knowledge increased from 55.3 to 82.1, while practical skills rose from 60.5 to 85.4. This consistent upward trend highlights the program's effectiveness in improving participants' understanding and abilities.

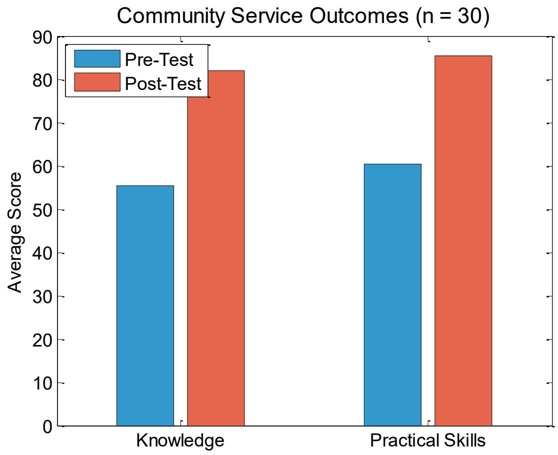

Figure 6. Comparison of Pre-Test and Post-Test Scores of Respondents on Knowledge and Practical Skills in the Community Service Program

Figure 7. Community Service Team after Installation and Handover to the Village

CONCLUSION

The community service program in Gaprang Village successfully applied renewable energy technology to improve rural infrastructure. Initial stages involved discussions and observations with village officials to determine the most strategic locations for solar-powered street lights, ensuring that community needs were addressed effectively. The installation process, which included solar charge controllers, batteries, inverters, and lighting poles, was conducted with active participation from local residents. This collaboration not only provided technical solutions but also encouraged community engagement and knowledge sharing.

The satisfaction survey of 30 respondents confirmed the program's positive impact. Half of the respondents reported being satisfied, while 33.3% expressed being very satisfied with the service team's performance. The mean score of 4.13 further indicated that the program aligned with expectations. However, 13.3% were only fairly satisfied, suggesting the need for improved long-term support. Overall, the program demonstrated sustainability, empowerment, and replicability for other rural communities.

REFERENCE

Ariyapijati, R. H., Susetyo, B., & Wibawa, S. (2025). Pemanfaatan Pembangkit Listrik Tenaga Surya untuk Penerangan Jalan Umum (PJU) di Desa Drawati. *Jurnal Arba-Multidisiplin Pengabdian Masyarakat, 2*(2), 42-47.

Irsyam, M., & Wibowo, A. (2022). Perancangan Lampu Pju (Perancangan Jalan Umum) Dan Penyedia Daya Menggunakan Solar Cell Secara Otomatis. *Sigma Teknika, 5*(2), 314-322.

Mahfud, A. U., Saefudin, S., Nugroho, H. A., Pujianto, M. E., Subri, M., Muntasiroh, L., & Afif, I. Y. (2025). Implementasi Pembangkit Listrik Tenaga Surya (PLTS) Untuk

Meningkatkan Kemandirian Energi Masyarakat. *Jurnal Pengabdian Masyarakat Teknik, 7*(2), 137-142.

Mauriraya, K. T., Afrianda, R., Fernandes, A., Makkulau, A., Sari, D. P., & Kurniasih, N. (2020). Edukasi Pemanfaatan PLTS untuk Penerangan Jalan Umum Di Desa Cilatak Kecamatan Ciomas Kabupaten Serang Banten. *TERANG, 3*(1), 92-99.

Miswaty, M., Samawi, O. R., Fadillah, R., Rahmadani, N. S., Keisya, N., Daud, A., ... & Afina, Z. (2025). Pengembangan Infrastruktur PJU Berbasis Energi Terbarukan dengan Teknologi Photocell untuk Mendukung Aktivitas UMKM. *Jurnal Pengabdian kepada Masyarakat Nusantara, 6*(2), 2902-2906.

Nurhidayah, S., Basri, H., Putrianika, P., & Widyowati, D. D. (2024). Sinergitas Dan Kolaborasi Terhadap Pembangunan Desa Melalui Program Kuliah Kerja Nyata Di Kabupaten Bekasi. *Devosi, 5*(1), 36-46.

Ramadhan, D., Shabah, M. A. A., & Rahmawati, R. (2024). Instalasi Penerangan Jalan Umum Berbasis Solar Cell dan Photocell Di Desa Cilangkara Kabupaten Bekasi. *An-Nizam, 3*(1), 257-263.

Resky, A., Pagiling, L., Koedoes, Y. A., Alam, W. S. N., Zulkaida, W. O., Jie, S., & Aliansyah, A. N. (2024, October). Perencanaan Sistem Penerangan Jalan Umum Berbasis Solar Cell Terpusat Pada Universitas Halu Oleo. In *Seminar Nasional Teknik Elektro (SEMNASTEK 2024)* (Vol. 1, pp. 101-116).

Ulum, M., Saputra, K. O., Saputro, A. K., Purnamasari, D. N., & Ibadillah, A. F. (2024). Perancangan Lampu Jalan Dengan Panel Surya Terintegrasi Dan Pengaturan Otomatis Intensitas Cahaya. *Jurnal FORTECH, 5*(1), 19-25.

Wardhany, A. K., Dwiyaniti, M., Nadhiroh, N., Setiana, H., & Widjayanto, D. (2024). Penerapan Penerangan Jalan Umum Tenaga Surya Dengan Kendali Otomatis Pada Kampung Setaman Untuk Mewujudkan Ketahanan Energi. *Mitra Akademia: Jurnal Pengabdian Masyarakat, 7*(1), 15-21.

Widagdo, R. S., Ardianik, A., Tauladan, I. S., Slamet, P., Andriawan, A. H., & Hariadi, B. (2025). Technical Support for Maintaining Solar Power Plants in Plantation Areas, Sajen Village, Mojokerto. *BERNAS: Jurnal Pengabdian Kepada Masyarakat, 6*(3), 1750-1758.

Widagdo, R. S., Slamet, P., Andriawan, A. H., & Wardah, I. A. (2023). Installation of solar power plant as power supply for street lighting in livestock area. *Abdimas: Jurnal Pengabdian Masyarakat Universitas Merdeka Malang, 8*(2), 231-242.

Widagdo, R. S., Slamet, P., Hariadi, B., Hartayu, R., & Wardah, I. A. (2024). Solar Panel Education as a Renewable Energy System for Students of SMAN 20 Surabaya. *Pelita: Jurnal Pengabdian kepada Masyarakat, 4*(1), 15-23.