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Utilization of solar-powered lights as a means of lighting the mueang pattani District Mosque Area

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Abstract
Street lighting is a critical facility to support all activities in modern times, as well as at Darul Huda mosque, precisely at R73J + QCJ, Puyut, Mueang Pattani District, Pattani 94000, Thailand, Pattani. Situated alongside a public road, widespread crime and significant discomfort characterize the surrounding area, forming the backdrop for community service activities. The results of the activity are in accordance with the initial purpose of this activity; namely, participants have understood the Smart Solar LED Street Light infrastructure, benefits, and maintenance. The installation point is appropriate, with success indicators. Community users have stated that at night, they feel brighter and safer. The education of female children on behavior has been successful, as evidenced by changes in behavior and dress patterns, making it safer. It directly supports the learning process of students, mothers, and fathers who do activities at night and has created a sense of security. Night lighting is more supportive of accessibility activities around the highway and safer from the possibility of crime.

Keywords: Smart solar LED street light, safety, comfort, education, community service

1. Introduction

The population is increasing, so the overall need is also increasing. With increasing population and energy needs (Chitra *et al*., 2019) [3], then Energy needs will increase significantly (Mohamed *et al*., 2021) [11]. TRen increased the population, resulting in an increase in energy consumption in various regions. Meanwhile, there is a crisis in electricity production that needs to meet consumer needs adequately. If this problem is not resolved, it will inevitably cause people to suffer, which can affect the country's economy in all aspects (Rangpan & Act., 2013) [16].

The Community Service Team determines the area of activity in the mosque Darul Huda precisely in R73J+QCJ, Puyut, Mueang Pattani District, Pattani 94000, Thailand; Pattani is a city in the far south of Thailand, near the border with Malaysia. Pattani is the capital of Pattani Province more precisely activities are carried out in Mueang Pattani, which has a population of 297,540, an area of 756,971 km², and a density of 393.066577187237; Mueang Pattani is divided into 13 sub-districts (Tambons), which is further subdivided into 66 administrative villages (Mubans), Mueang Pattani. Pattani is located 1 056 km *south* of Bangkok, as per Figure 1.

Darul mosque, actually, is not a mosque located in a remote area, but on the side of the highway is a very strategic mosque for a stopover for worship for pedestrians who travel long distances; ironically, the night around the mosque is still in dark conditions. Based on the above, the collaborative Community Service (PKM) activity team consisting of Narotama University Surabaya, Jakarta State University, Veteran Bangun Nusantara University, Muhammadiyah Tangerang University and Fatoni University held joint activities.

Fig 1: Map of Community Service Activities (https://www.google.com/maps/place/R73J%252BQCJ, +Tambon+Puyut, +Amphoe+Mueang+Pattani,+Chang+Wat+Pattani,+Thailand, 2023)

Figure 1 shows that Darul Huda mosque is a mosque that is very poorly lit at night. Night is a condition where crime has a greater possibility of occurring than morning and afternoon. As for the distribution of cases that occur during this day, the pattern of cases is different from night. It is usually so concentrated in crowded cases and easy to do. Crime statistics from 2014–2018 research was also conducted on the same thing, with the highest density of arson cases found in Mueang Pattani District, Pattani Province, in areas with buildings and workplaces, often at 6:00 p.m. until morning at 06:00 a.m. (Nattaporn Soontorn, 2020; Pongsakorn Srinarong, 2022) [14]. Crime on the rise in Pattani leads to a heightened sense of concern, which leads to insecurity. The problem of crime affects the quality of life; it causes a lot of damage both on a personal and a social level. It also affects the feelings of fear and insecurity that occur in life. A study was conducted to describe the pattern and density of crime in the three southern provinces of Yala, Pattani, and Narathiwat, using GIS and spatial analysis, with the result that cases of arson and violence were identified in Pattani (Pongsakorn Srinarong, 2022) [14]. Pattani's Statistical Modelling of Conflict Casualty Incident Rate (AIKK) has the highest injury fatality rate of 76.51 cases per 100,000 population (Duereh & A, 2023) [5]. Based on this, it is necessary to make solutions that minimize the existence of crime at night.

Lighting is one of the important things that provide a sense of security at night. Electric power is very important for human life because energy is one of the important elements in economic and social development in all branches. There is a crisis in electricity production that needs to meet consumer needs adequately. If this problem is not resolved, it will inevitably cause people to suffer, which can affect the country's economy in all aspects (Rangpan *et al*., 2013) [16].

The availability of electricity in Pattani, including wind power, reached an installed production capacity of 224.5 MW by the end of 2014 (Department of Alternative Energy Development and Efficiency, 2014) [5]. The Energy Conservation Promotion Fund Studied Thailand's Wind Energy Potential Report. Wind resource maps are evaluated using surveyed data, the Digital Elevation Model (DEM), and the low area suitable for large wind turbines, which have a total area of 7,675.3 hectares. These areas are mostly found in Phatthalung province (2,132.1 acres), Narathiwas province (1,769.0 acres), Songkhla province (1,672.5 acres), Nakhon Si Thammarat province (1,424.9 acres), and Pattani province (676.8 acres), respectively, but Mueang is an area of no potential (Bennui *et al*., 2007) [1].

A good and correct lighting system indirectly supports teaching and learning activities until night. The African University of Science and Technology (AUST) Nigeria undertook street lighting on campus, so a solar street lighting system was designed considering the potential of good solar energy in the region. The installation of solar street lights on campus based on the results of the analysis of technical, economic and social aspects provides good and feasible results, the cost-effectiveness of solar-powered LED (Light Emitting Diode) road use (Nugraha & Desnanjaya, 2023; Ilipa Baburajan, 2017) [13, 17]. About the reliability and performance of installed solar-powered street lighting systems, hot and humid environments (Fashina *et al*., 2017) [8].

Similarly, in Libya, stand-alone solar LED lighting systems have been shown to reduce CO_2 emissions, save fuel and be economically viable (Khalil *et al*., 2012) [9]. Era currently characterized by the increasing use of renewable energy sources, the use of LED street lights (Danyali *et al*., 2023) [4], renewable energy sources such as solar power and wind electricity that are clean, safe, and inexhaustible (Em-Udom & Jaisumroum, 2023) [7].

The need for street lighting and the surrounding area is inseparable from the expenditure of funds that must be paid. Based on the background, Pattani is one of Thailand's three southern border provinces that has the highest number of poorest people and an urgent need to improve their quality of life (Maroning Useng *et al*., 2022) [10]. So this is the reason for the PKM team to create a solution so that lighting is

fulfilled but is efficient in management and easy to maintain.

2. Method

Darul Huda mosque is located on the edge of Pattani's main road, so it must be considered night lighting. Different lighting conditions can result in accidents of varying severity. It is very important to socialize lighting infrastructure for the student community, especially at Darul Huda mosque, so based on the background of high crime at night and lack of lighting, the PKM team developed a solution to socialize LEDs to help save electricity payments but still guaranteed lighting at night. In order for PKM activities at Darul Huda mosque to continue, activities are carried out in accordance with Figures 2 and Figure 3.

Source: Team Document, 2023

Fig 2: Troubleshooting solution framework

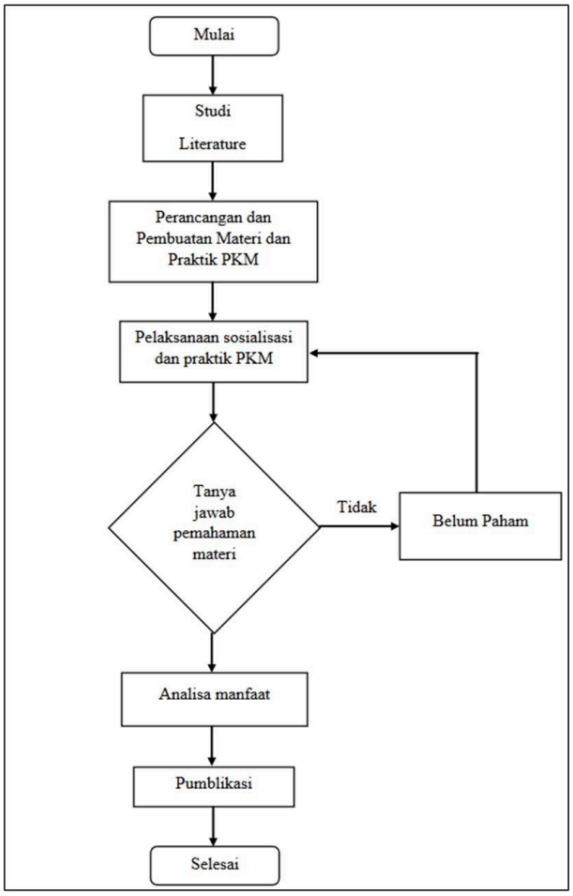


Fig 3: Troubleshooting solution framework

Stages of Implementation

1. The activity began with a site survey.
2. Literature study.
3. The design here makes a solution in choosing the most appropriate infrastructure to help the mosque community.
4. Implementation of activities and practices.
5. Socialization of installation, utilization, and maintenance
6. Analyze the benefits of discussions.
7. Preparation of publication manuscripts.
8. The activity ended with better discussion results, community response.

Methods of activity

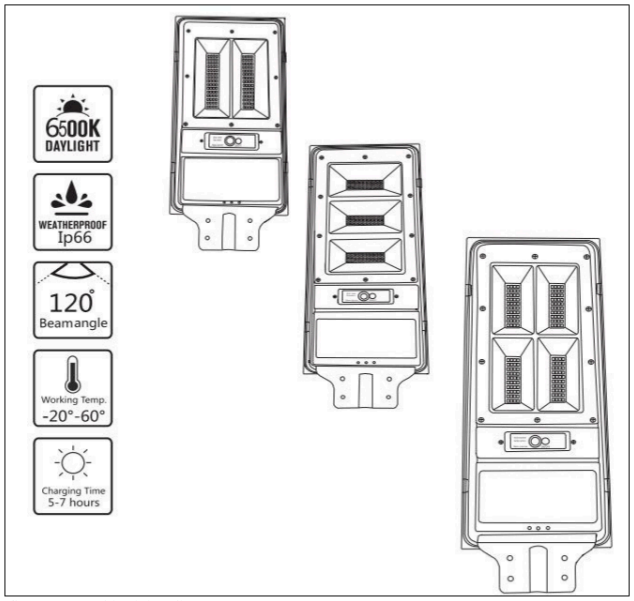
The implementation of activities is carried out using five methods of community service activities, namely:

1) Activity method with two approaches to qualitative descriptive analysis

The impact of several nighttime crimes that occur in Pattani based on survey data and interviews with mosque managers and mosque user communities shows that there are often crimes at night, worrying about activities at night. This analysis is carried out to obtain mosque profile data at night so that it can be used to validate data obtained from literature reviews.

2) Product implementation and socialization

The practice or implementation of participants makes it easier to be directly invited to discuss related products to be used. The modules used are those sourced from the Manual book (Bling88, 2010) [2], among others, as shown in Figure 4.



***Source*:** Manual book by Bling88, 2010

Fig 4: Troubleshooting solution framework

3) Evaluation analysis

Evaluations are carried out periodically through online communication with mosque managers and the user community. Question and answer as implementation: This discussion method is used to get feedback with very positive results, where the sense of security they convey has made activities at night more comfortable and greatly supports learning and worship activities better.

4) Evaluation design

In the implementation of this service program, three criteria will be the basic benchmark for the achievement of training activities, namely: (a). The benchmark for success from the implementation of the activity is the delivery of educational materials, introduction in the form of socialization and delivery of Smart Solar LED Street Light, according to the right time and installation point. (b) The benchmark for success on the part of the participants is that participants are able to understand the benefits and ways of maintenance. (c) the benchmark of success on the part of the participants is the creation of the feasibility of lighting at night, cost-effectiveness, and security.

3. Results and Discussion

1. Discussion with Participants and Socialization

***Source*:** Team document, 2023

Fig 5: Preparatory activities

Figure 5 shows the condition after participants understand, where the implementation of participants is easier to discuss related to the product to be used directly; the modules used are those sourced from the manual book (Bling88, 2010) [2]. Based on the socialization carried out, there was a positive interaction between the PKM activity team mosque managers and the mosque user community, especially in determining the installation point carried out with mosque managers and the community.

According to the reference used, the system is programmed to turn off automatically during the day and only operate at night and in heavy rain or bad weather. Often, we see street lights kept on even during the day; this is a waste of electricity when India is facing a shortage of electricity (Chitra *et al*., 2019) [3]. Lighting is projected to reduce associated energy consumption by 15% by 2020 to 40% by 2030. In this contest, solar-powered LED lighting facilities offer a significant contribution to obtaining energy savings, as well as great environmental and health benefits (Primiceri & Visconti, 2017) [15]. It is necessary to procure LED lights as a form of implementation of the objectives of community service activities.

The benchmark for success from the implementation of the activity is the delivery of educational materials to mosque managers and users, about introduction in the form of socialization and delivery of Smart Solar LED Street Light, according to the right time and installation point. The next benchmark of success on the part of participants is that participants are able to understand the benefits and ways of maintenance.

2. LED Mount Point Selection

The selection of Smart Solar LED Street Light installation points based on the lighting area must be in accordance with needs, namely dark spots at night, according to Figure 6.

Source: Team document, 2023

Fig 6: Lay out four mounting points

Figure 6 shows that the determination of the installation point has been carried out in accordance with the agreement between the mosque manager and the community. It is so that participants can know that the location of the solar-powered Smart Solar LED Street Light must be maintained by covering tree leaves and others that can reduce the absorption of solar power during the day.

3. Delivery of Education to Students in Terms of Security

Education to the students is very important so that they understand the material, starting from how it works, the benefits of solar-powered Smart Solar LED Street Light, to the function of safety, especially at night, as shown in Figure 6.

***Source*:** Team document, 2023

Fig 7: Educational activities for santriwati

The benchmark for success on the part of the student participants is to understand how to work, the benefits of solar-powered Smart Solar LED Street Light, and how to maintain them. In addition, material related to education on how to dress, behaviour to take care of yourself during activities, and how to dress that does not invite the opposite sex to think and behave negatively, especially at night.

4. Conclusions and Suggestion

Conclusion

Community service activities on the application of Smart Solar LED Street Light at Darul Huda mosque precisely at R73J+QCJ, Puyut, Mueang Pattani District, Pattani 94000, Thailand; it can be concluded that

1. Participants have understood the Smart Solar LED Street Light infrastructure, benefits, and maintenance together, both by the management of Darul Huda mosque and the community who are active at the location.
2. The installation point has been appropriate, with the success indicator. The user community has started at night to feel brighter and safer.
3. Education of female students on behaviour as a woman who takes care of herself as much as possible during activities and daily activities has been successful with indicators, there has been a change in behaviour and dress patterns so that it is safer.
4. Night lighting directly supports the learning process of students, mothers, and fathers who do activities at night and has created a sense of security.
5. Night lighting is more supportive of accessibility activities around the highway and safer from the possibility of crime.

Suggestion

The necessary to hold similar activities in the surrounding environment, especially on roads where the enforcement is still very minimal. Besides that, there must be education for students and non-Muslim children so that there is a sense of security based on their behavior and dress. It is necessary to cooperate with related parties related to traffic lights for road crossings to be integrated with lighting, especially at night, so that a sense of security and comfort is more realized.

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