Solar-Cell Implementation for Supporting Tourist Facilities and Tourism Promotion Media

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Abstract. Solar-Cell panels function is to capture the energy of sunlight and then convert it into electrical energy. In this tool, Solar-Cell panels can move according to the tilt of the sun's direction of motion so that the captured sunlight can be maximized. The electrical energy is used for free tourist facilities such as lighting, internet wi-fi, charging electronic devices, CCTV, and LCD. This tool will be placed in one of the tourist attractions in the city of Padang. So far, based on observations, tourists do not like to linger in tourist attractions because of the lack of free facilities for tourists. They cannot charge their gadgets, cannot access free internet, feel unsafe because there are no CCTV cameras and no audio-visual media. The purpose of this tool is made to increase the number of tourist visits to tourist attractions in Padang so that it can increase the PAD of Padang.

1. Introduction
The implementation of information technology in human life is increasingly widespread and developing significantly, thus creating a lot of convenience, comfort, and speed to humans in carrying out daily activities [1], [2]. This can be seen in the form of the application of various sciences, one of which is technology, information, and computers in running all aspects of life such as education, economics, and tourism [3], [4]. The computer is an electronic device used to process data following an algorithm (program) that has been made previously. Whose people work performed arithmetic calculations were originally used to describe computers, with or without assistive devices, but the meaning of this word was then transferred to the machine itself [5], [6]. In the beginning, data processing and information were exclusively related to arithmetic problems, but nowadays modern computers are used for many tasks that are not only related to mathematics [7], [8].

Solar cells, or photovoltaic cells, are a semiconductor-type electronic component consisting of a large region of p-n junction diodes, where, in the presence of sunlight striking its surface, it can be converted into electrical energy. This change is called the photovoltaic effect [9], [10]. A solar cell is a device consisting of cells and solar which then converts light into electrical energy [11], [12]. The process of changing the energy of sunlight into electrical energy occurs because the materials that make up the solar cell are semiconductors, namely two types of semiconductors, namely type n and type p. The type n semiconductor is a semiconductor that has an excess of electrons, so the excess charge is negative, (n = negative) [13]–[15]. Excess electrons or holes can increase the electrical conductivity and heat of a semiconductor [16], [17]. These two types of n and p semiconductors, when
combined, will form p-n or p-n diode connections. Another term calls it the metallurgical junction [18], [19].

Tourism in Indonesia is an important economic sector. In 2009, tourism ranked third in terms of foreign exchange earnings after oil and gas commodities and palm oil. Based on 2016 data, the number of foreign tourists coming to Indonesia was 11,525,963 million or growing by 10.79% compared to the previous year. The city of Padang makes tourist visits to the area as one of the sources of Local Revenue (PAD) which is quite large. With this aim, the Padang City government undertook a massive and comprehensive development and revitalization in Padang City. Various tourist attractions were built and revitalized such as Padang Beach, Air Manis Beach, Padang Mountain, etc. The place becomes more beautiful and interesting to visit. The following data is the visit of tourists in the city of Padang, sourced from BPS Padang City:

| Tourist Type | Number of Foreign and Domestic Tourists 2013 | 2014 | 2015 | 2016 |
|--------------|---------------------------------------------|------|------|------|
| Overseas     | 53,057                                      | 54,967 | 57,318 | 45,194 |
| Domestic     | 3,001,306                                   | 3,199,392 | 3,298,454 | 3,628,299 |
| Amount       | 3,054,363                                   | 3,254,359 | 3,355,772 | 3,673,493 |

Based on table 1 above it can be seen that tourist arrivals in the city of Padang from year to year always increase. But the increase is still small or can be said to be insignificant. Many factors attract tourists one of them is whether or not there are free facilities for tourists in tourist attractions [20], [21]. The free facilities consist of various types such as toilets, shelters, lighting, gadget charging, places of worship, etc. With the availability of many free facilities that support the comfort of tourists, more tourists will visit and have the desire to come back to these tourist attractions.

Based on observations in the field, tourists do not like to linger in tourist attractions. This is caused by the lack of free facilities for tourists. Among them are charging gadgets, wi-fi internet signals, CCTV cameras, and audio-visual media. The main energy source in this tool is sunlight. This is where the sun's rays are captured using solar cell panels and then converted into electrical energy so that it can be used by other devices. The use of solar cell panels is aimed at saving electricity bill costs. If you use a PLN electricity source, there will be a monthly electricity bill that imposes a tour manager. By utilizing electrical energy derived from solar energy by using solar cell panels, the electricity bill for this tool becomes non-existent or free or IDR 0.00.

In this research, tools made as free facilities for tourists are lighting lamps, charging gadgets, Wi-Fi internet signals, audio-visual media, and CCTV cameras. The tool will be placed in one of the tourist attractions in the city of Padang.

2. Methodology

2.1. Research Framework

The research methodology used in this study is Research & Development (R&D). Research and development are carried out aimed at creating new technology or information that can increase product effectiveness or make product production more efficient [22]–[24]. Research and development are research methods used to produce certain products and test the effectiveness of these products.

The framework of the research methodology to be carried out in this study can be seen in Figure 1 below:

2.2. Description of Research Framework

a. The research study consists of several stages, namely design, performance, analysis, and reporting. The first important step to ensure
the validity of the results obtained is the research design. In this study, a research study was conducted by observing tourist activity in tourist attractions in the city of Padang.

b. Develop findings. The main results of a study are the findings, what are suggested, expressed, or demonstrated by the study. The totality of research results leads to findings rather than research conclusions or recommendations.

c. Making tools. Tools must be made so that the findings can be solved and implemented in the real world.

d. Field trials. Tools that have been made must be tested in the field. In this study, the device was tested in an open space exposed to direct sunlight and then placed in a tourist spot in the city of Padang.

e. Evaluation. When conducting field testing, we must also evaluate the results of the tool's performance. Is the device going according to plan or not? If yes, then the tool is correct but if not we have to fix what is missing from the tool.

f. Implementation. Implementation is using tools in the field for a long time. In this case, we apply the tool in an open space exposed to direct sunlight in one of the tourist attractions in the city of Padang.

3. Result and Discussion

3.1. Result

3.1.1. Context Diagram (CD)

The light sensor is used to detect the brightness of the sun that is used to control the servo motor so that it can move to tilt the solar-cell panel to the direction of the sun's tilt. Then the 4G SIM Card is used to capture Internet signals coming from the ISP. The collected electrical energy is used to turn on LED lights, supply electricity to power outlets, spread internet wi-fi signals, turn on LCD and CCTV screens. As seen in Figure 2.
3.1.2. Block Diagram (BD)
In the block diagram (BD) above it can be seen that the input block consists of 7 blocks namely solar-cell panels, Solar Cell Controllers (SCC), batteries, adapters, inverters, light sensors, and 4G SIM Cards. Whereas the processing block consists of 2 blocks, Arduino Mega and the program module. The output block consists of 6 blocks namely servo motors, LED lights, CCTV cameras, wi-fi modems, LCD layers, and sockets. As seen in Figure 3.

3.1.3. Data Flow Diagram (DFD)
Data flow diagrams (DFD) are detailed descriptions of the tools designed. DFD is a programming workflow on a system of tools created. Data flow diagram of this tool can be seen in Figure 3. The data flow diagram (DFD) can be a known sequence of steps in the flow of data on this tool. Starting from step 0.0 to step 16.0. As seen in Figure 4.

3.2. Discussion

3.2.1. Wiring Diagram (WD)

The wiring diagram is a diagram that illustrates the relationship between each block through cable media. These relationships are shown in each block both the input block to the process block and the process block to the output block. In this wiring diagram, you can see the real physical form on each block that is designed such as solar cell panels, solar charge controller (SCC), batteries, inverters, 4G SIM cards, light sensors, Arduino mega, DC servo motors, LED lights, CCTV cameras as seen in Figure 5.

3.2.2. Photo of Tools
In figure 6 there is an arrangement of the components used which are stored in an electric box. In the box lies the entire set that is used and some components that should not be exposed to water and direct sunlight. The storage is carried out with the aim that the security of components is maintained properly and the components are not easily.

![Figure 5. Wiring Diagram (WD)](image1)

![Figure 6. Photo of Tools](image2)

4. Conclusion
In this study, it can be concluded several things including:
1. Sunlight that hits the solar-cell panel fully and directly when the weather is sunny for ± 10 hours can produce electrical energy that is quite large, which is ± 1,000 Watts.
2. Large electrical energy can be converted from AC electricity into DC and stored in batteries up to 100 AH.
3. The electrical energy produced by solar-cell panels is stable enough to be good for use in electronic devices.
4. By utilizing technology to become a free facility for tourists in the city of Padang, it can increase the number of tourist visits to tourist attractions in the city of Padang by 50%.
5. With the increasing number of tourist arrivals in the city of Padang, the city of Padang's PAD can increase.

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