

Using Operational Dashboard for ArcGIS as A Solution for Monitoring of Public Street Lighting

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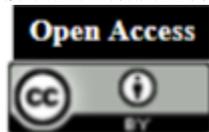
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Abstract

Public Street Lighting (PSL) is a part of road complementary buildings installed on the left, right and/or in the middle of the road to illuminate the surrounding environment. PSLs in residential areas usually do not have a small amount, so it will be difficult if the supervision is done manually. Therefore, we need a system that can monitor and maintain PSL effectively and efficiently. This study aims to prove that the Operations Dashboard for ArcGIS (ODA) can be utilized in monitoring PSL based on Geographic Information Systems (GIS). This PSL monitoring system can be used by the government and private parties to conduct PSL maintenance activities more efficiently and effectively, by providing information about PSL in realtime through widgets contained in ODA, and with the help of a mobile application, Collector for ArcGIS (CFA) as a sensor replacement that functions to carry out data collection in the field. The results of this study indicate that ODA can be used to monitor PSL by showing information about the status, location, type, and number of PSLs damaged.

Keywords: Public Street Light, Monitoring, Operational Dashboard for ArcGIS

1. Introduction

House is one of the basic human needs besides clothing and food. High population causes a higher demand for housing. This also attracts the attention of relevant parties, both government and private parties, to meet the needs of the community by offering facilities and infrastructure that are comfortable and safe, and have a beautiful environment.

In developing a residential area, of course, related parties need to prepare facilities that can help guarantee the security of housing itself, one of which is Public Street Lighting (PSL). Good street lighting can provide adequate light on the road or transportation route through which the residents occupy. The lack of street lighting can lead to accidents and crime at night (Fahas, 2019; Jalimin, 2020; Sam, 2019). Apart from the PSL that has not been installed, the lack of street lighting can also be caused by PSL being damaged but not immediately replaced by the party responsible for carrying out PSL maintenance (Sam, 2019). New street lamp replacement will be done if there are reports of damage by residents around (RIAUPOS.CO, 2020).

PSL in residential areas usually has a huge amount. So, it will be difficult if PSL maintenance is done through manual checking. For this reason, we need a system that can monitor PSL without having to come directly to its location. This system functions to provide information related to PSL efficiently so that

the responsible party can immediately know the problem or damage to PSL without having to wait for citizen reports.

Making a PSL monitoring system can be done using Operation Dashboard for ArcGIS (ODA). ODA is a web application developed by the Environmental Systems Research Institute (ESRI). ODA can assist related parties in supervising PSL by providing information on location, number, type, ID, height, status (normal, damaged or under repair), lighting brand, and PSL power. This information was obtained from the results of inputting field data using Collector for ArcGIS (CFA).

The purpose of this research is to design a web-based Geographic Information System (GIS) of PSL monitoring system. This research is expected to prove that the ODA and CFA can be used as PSL monitoring solutions. While for other researchers, it is expected to be a reference in conducting similar research. The scope of this research is the use of ODA and CFA to create a demo of PSL monitoring solutions.

2. Literature Studies

Research related to PSL has been done before, one of which aims to provide solutions to information limitations and provide convenience in getting information about PSL by designing operational dashboard monitoring for GIS-based PSL web. This dashboard is expected to be able to complete and facilitate the implementation of street lighting maintenance activities by the Public Works Department of Public Works (Bina Marga) of Malang Regency, at which time all information was still obtained manually. The development of GIS web-based operational dashboards in this study uses the high-fidelity prototype method to produce a prototype operation dashboard with regard to user needs. The results of this study indicate that PSL's operational dashboard monitoring can improve road lighting maintenance performance by 70% with a significant level of significance, which is 30% (Joddy et al., 2019).

Another research aimed to develop an application that can be used as an instrument for monitoring, evaluating and predicting the village development process. The method used is a prototyping software engineering method that involves the user and is adjusted to the dashboard development methodology. The stages of dashboard development consist of identifying key performance indicators, analysis, function design, dashboard design, and testing. This research resulted in a web-based application with the domain *desapandai.com*, which can be used to help village governments monitor, evaluate and make decisions in the village development process (Rusdi et al., 2018).

Conceptually, the research above has similarities with this research, which is monitoring an object. However, the object monitored in this study is PSL. Previous studies also used operational dashboards to monitor. However, the operational dashboard used in the study was designed by the prototyping method. Meanwhile, this research will utilize Operation Dashboard for ArcGIS and also Collector for ArcGIS in monitoring PSL.

Public Street Lighting (PSL)

PSL is part of road complementary buildings that can be placed or installed on the left/right side of the road and/or in the middle (in the median part of the road) that is used to illuminate the road or the environment around the required road including crossing roads, overpasses, bridges and roads in underground; a complete unit consisting of a light source, optical elements, electrical elements and supporting structures and lamp post foundations (Badan-Standardisasi-Nasional, 2008).

Geographic Information System (GIS)

GIS is an information system that aims to capture, store, manipulate, analyze, organize and display all types of geographic data (Eddy, 2001). According to Edy Irwansyah, there are two types of GIS namely Desktop GIS and Internet GIS. The GIS desktop uses a monolith structure where each element of its function is still on the same interface. Meanwhile, Internet GIS has a separate function element or

usually called a client-server. One part of the Internet GIS is Distributed GIS, which is a geographic information system where the system components are not in the same location. Examples are Mobile GIS, Corporate GIS, GRID Computing and Web-Based GIS (Edy, 2013).

Web-Based GIS

Web-Based GIS or web GIS is a distributed GIS system based on the web so that users can use the GIS system via the web, for example like Google Map (Edy, 2013). Web GIS is a combination of graphic design mapping, digital maps with geographical analysis, computer programming, and a database that are interconnected into one part of web design and web mapping (Qolis, 2009). A potential web GIS does not require GIS software and does not depend on the operating system (Mailany et al., 2013).

ArcGIS

ArcGIS is one of the GIS data processing applications developed by the Environmental Systems Research Institute (Esri) which has several applications with their respective functions, including ArcMap, ArcCatalog, ArcScene and ArcGlobe. In addition, ArcGIS also has premium software, namely ArcGIS Pro which has a more complete GIS data processing feature compared to regular ArcGIS or other GIS data processing software.



Fig 1. How ArcGIS Platform works (ESRI, 2015)

ArcGIS also has a platform called ArcGIS platform that connects maps, applications, data and users to help organizations make more information and decisions faster. The ArcGIS platform was created to make it easier for everyone in an organization to find, use, create and share maps from any device, anywhere and anytime. In addition, the ArcGIS platform is designed to be flexible, offering capabilities through a variety of patterns and implementation approaches (ESRI, 2019). This platform can be used as a cloud (with ArcGIS Enterprise or used through ArcGIS Online which is hosted and managed by Esri). In addition, Esri also builds basic applications across

industries. Some of them are Operations Dashboard for ArcGIS (ODA) and Collector for ArcGIS (CFA).

Operation Dashboard for ArcGIS is a part of ESRI's Cloud Geospatial (ESRI, 2015). ODA is a configurable web application that provides location-aware data visualization and analysis for real-time operational displays of people, services, assets, and events (ESRI, n.d.). CFA is also a part of ESRI's Cloud Geospatial which functions to collect and edit field data using web maps via mobile or mobile devices (ESRI, n.d.).

3. Method

This research used quantitative methods with secondary data. The tools used in this study are ArcGIS Pro, Operation Dashboard for ArcGIS and Collector for ArcGIS. This research started from November 2019 to February 2020. Research stages can be seen in **Figure 2**.

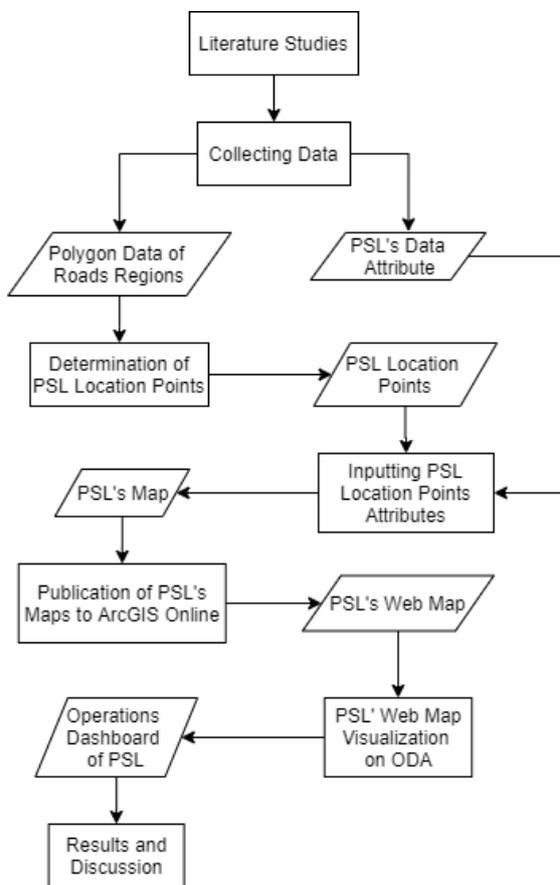


Fig 2. Research Stages

The first stage in this research is problem identification and literature study. The researcher identified the problems faced by the developer company and searched for and studied various references regarding PSL monitoring. The second stage is data collection. The data used in this study are secondary data in the form of dummy data from ESRI. Secondary data in this study consists of polygon data on the area and road from the case study site, as well as the PSL attribute data.

Then, the next step is determining the location point of the PSL using ArcGIS Pro. The author chose

to use ArcGIS Pro because this software has more complete tools compared to ordinary ArcGIS, as well as other GIS data processing software. The tool used is the create feature point from Data Management Tools. The output of this stage is the location point of the PSL. Then, in the fourth step, the authors enter the PSL attribute data in the form of location, number, type, ID, height, status, brand, and lamp power. After that, to visualize the attribute data, the data is published first in ArcGIS Online and made in the form of a web map. This web map is then displayed on Operation Dashboard for ArcGIS and Collector for ArcGIS. The next stage is a discussion of the results of research that has been done.

4. Result and Discussion

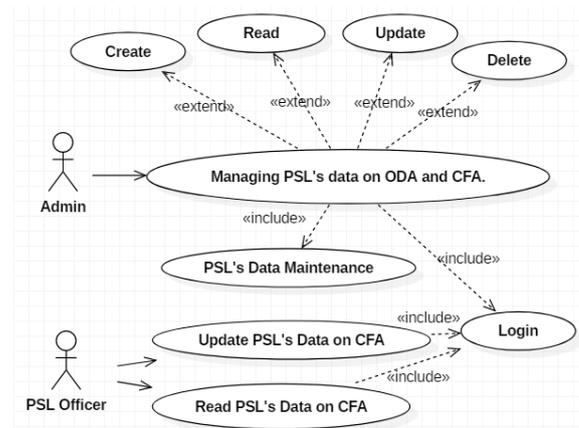


Fig 3. Use case Diagram of PSL's Monitoring System

As seen in **Figure 3**, The actors who play a role in the PSL Monitoring system are the admin (supervisor of the developer or related service) and PSL officers (technicians from the developer or related service). Admin has the duty to manage PSL data on ODA and CFA with access rights to create, read, update and delete data, and also perform PSL data maintenance. Meanwhile, PSL Officers can only update and read PSL data on the CFA.

The area which is the case study in this research is a housing estate located in Purwakarta City. The polygon data of the road and residential area is then used to determine the location of PSL. The tool used is the create features point tool on ArcGIS Pro.

To determine the location points of the PSLs, the two polygons are used as input in the create features point tools. This tool produces points or points which are the intersection points of the two polygons. This intersection point becomes the location of PSL. However, in this study, there are also locations that are deemed necessary to serve as PSL locations but there are no points (they are not cut points). Thus, the authors use a grid with a spacing setting of 10 meters to add the location point. The results of this stage are PSL location points with a total of 500 points which can be seen in **Figure 4**.

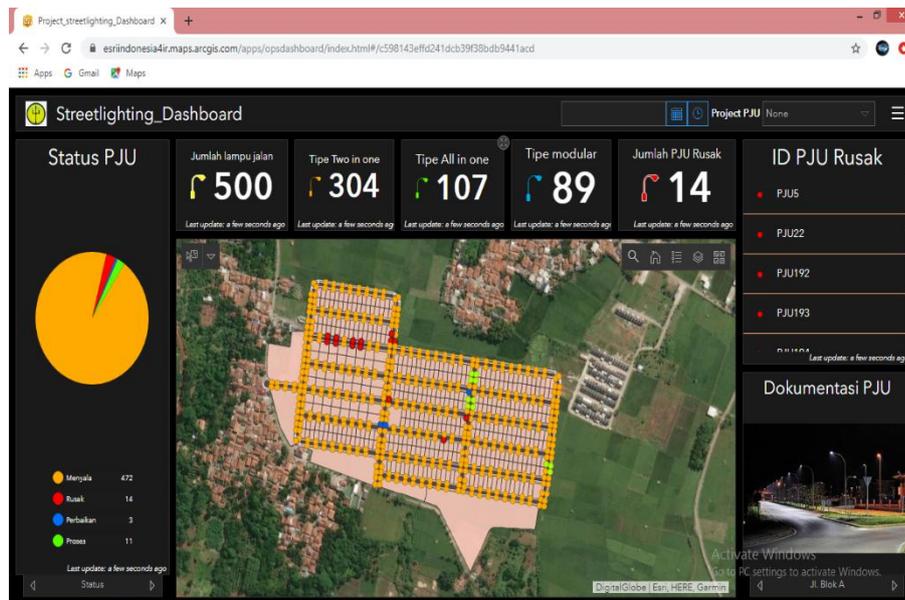


Fig. 7. Result of data attribute visualization of PSL location points

. Attributing data can also be fused using CFA. This application serves to input data in the field. CFA is a mobile application that can be used on smartphones, the way of inputting data can be done by clicking on the plus sign and then inputting new attribute data. This method makes inputting field data easier and more practical. An example of the results of inputting a PSL location point can be seen in **Figure 8**.



Fig 8. The results of field data input using CFA

In addition, PSL data editing can also be done using CFA. However, the data that could be edited only the attribute data that is allowed to be changed. In this study, the attribute that is allowed to be edited is the status in PSL. Display data that can be edited can be seen in **Figure 9**.



Fig 9. Example of display attributes that can be edited using CFA

In several studies in part two (Literature Review), the dashboard operation was designed by itself using PHP and MySQL. While in this study an operation dashboard for PSL monitoring was made using ODA. ODA has a variety of widgets that can be tailored to the needs of its users. To make it easier for officers, PSL data input can be done via a smartphone using the CFA mobile application. CFA has been integrated with ODA, so PSL information can be updated immediately without the need to ask the admin to input it via ODA. This feature was not found in several studies in part two.

6. Conclusion

Geographic Information Systems are very useful in carrying out asset management. One example of a GIS asset management function is monitoring PSL. Operations Dashboard for ArcGIS (ODA) is proven to be able to help monitor PSL by providing information effectively and efficiently through the widgets contained therein. Information provided about the status of the PSL (on, broken, under repair, currently in the process of installation), the number of PSLs damaged, the type of PSL, to the point where the PSL is. This information can assist relevant parties in conducting supervision and maintenance of PSL. In addition, by using Collector for ArcGIS (CFA) related parties whose task is to manage PSL can more easily input PSL data directly from its location point.

Suggestions for related parties or further researchers to be able to combine ODA with sensors that can transmit data in real-time so that this monitoring system can run more optimally.

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