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Prototype Design of Remote Monitoring Software of Street Lighting System

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ABSTRACT

Street lightings are used in public area to support people activities throughout the night. Maintenance activities are needed to keep the availability of street lights. The advanced of technologies give ideas to create such tools to support the maintenance. Monitoring and controlling tools are proposed to maintain the availability of street lightings. This paper describes a design of web-based remote monitoring software of street lighting. The street lights should be equipped with GPRS module in transmitting data to the software. This research follows three steps: literature review, analysis, and design. The design tools such as BPMN, use case, ERD, and mockup are used to describe the system. The software can be used to monitor the street lights in the widespread area without having to come to the location.

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1. Introduction

Public street lighting systems are usually built by a government for supporting the night activities of the society. There are two common energy sources used for street lights, which are electricity and solar power. For areas that are not covered by electricity, the use of solar power street lights is more appropriate.

The maintenance of street lights is needed to keep the availability of street lights. There are two activities involved: monitoring and controlling. In General, the task of monitoring is done manually, where the officer came to the location to check the condition of the lights: whether the lights are still existed or not, or whether the lights are working properly or not. The task of controlling is even further, for example, when the light is still on during the day then officers must turn it off. Sometimes this activity has a problem especially when the locations are difficult to access. Another problem is when the number of locations is not proportional to the number of officers.

The advance of technologies gives the ideas to people for creating such tools to make the monitoring and controlling activities easier to do. Many researchers proposed such tools, i.e. for just controlling, controlling and monitoring, or just monitoring. This paper focuses on a monitoring tool by designing a software to monitor solar street lights by utilizing data transmitted from street lights via the GPRS module. The transmission process is not included in this software. The data consists of some important elements, which are indicators that can determine the availability of street light. By processing these elements, the information of each street light will be displayed on the web.

2. Methodology of Research

The research consists of three steps, i.e. literature review, analysis, and design as shown in Figure 1. In the literature review, we search for researches related to this paper, and then analyze them to find the requirement of the design. The last step is to design the software using tools for design such as Business Process Modeling Notation (BPMN), Entity Relationship Diagram (ERD), and use case.

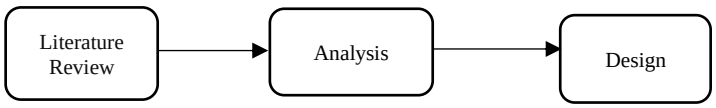

Figure 1 Research Methodology

3. Related Work

Many kinds of research have been conducted in using technology for controlling and monitoring street lighting systems. Kumar et al. [1] proposed a tool to control the solar panel based LED street lighting system remotely by using ZigBee technology. As a result, 20-25% of power consumption and maintenance cost were reduced. Palitil et al. [2] used sensors, ZigBee, solar inverter and solar tracking system to remotely control automated street lighting system. M. Saad et al. [3] utilized Microcontroller to produce Automatic Street Light Control System whereas Kumar [4] used Arduino to build a Smart Light Control System. Khandelwal et al [5] and Saleem et al. [6] controlled the light system by using the light sensor to activate the ON/OFF switch and photoelectric sensor to detect the movement of cars on the street. Karthikeyan et al. [7] integrated cloud computing

to monitor street light system. Another monitoring system uses Internet of Things (IoT) and Zigbee technology [8].

From all researches above, there is only one research that focused on monitoring systems [8], whereas others proposed controlling systems. To see the comparison between [8] and the proposed system, Table 1 shows the details.

Table 1 Comparison Analysis

Features	Monitoring System [8]	Proposed System
Transmits data	√	
Receives data	√	√
Display data	√	√
Display map		√
Display chart	√	√

4. Software Design Processes

There are three main functions of remote monitoring software which are input, process, and output. The data input comes from street lights equipped with tools that can capture current of the light and the battery, voltage of the battery, and also the location of the street light. The data is sent through GPRS module and will be stored in a temporary database. The processing of data will determine whether the light is ON or OFF. This information will be displayed on the web as street light information. Figure 2 describes the input-output of the system.

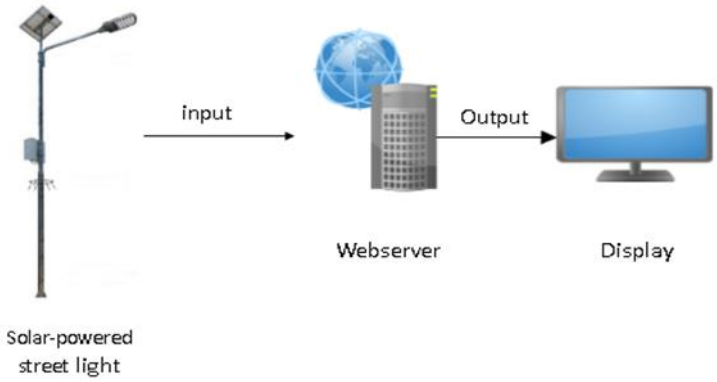

Figure 2 The Input – Output of The System

4.1. Flow of Data

The flow of data is captured using BPMN, as shown in Figure 3. The data from street light will be stored into the temporary database to be validated whether the data is in standard format or not. When the conditions are met, the data is stored into master database and will be displayed on the web.

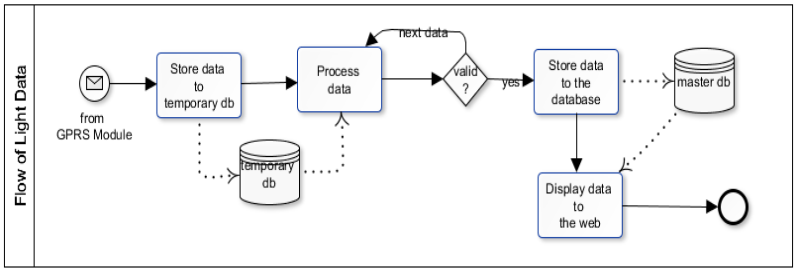

Figure 3 Street Light Data Flow

4.2. Use Case Diagram

The functions involved in the system are described in use case diagram as shown in Figure 4. There are three main functions: manage light data, process light data, and display light info. The function of manage light data includes the processes: store data to temporary and master database and input the location of the light. The location data of light must exist before the light data is stored into master database.

Transformation of data from temporary to master database will determine the status of each light. By multiplying the current of light with the voltage of the battery, the electrical power will be obtained. The minimum value of electrical power to be set ON, can be determined. In this case, we assume that the light will be ON if the power more than 50 Watt. If the light is set ON then the color of light will be bright.

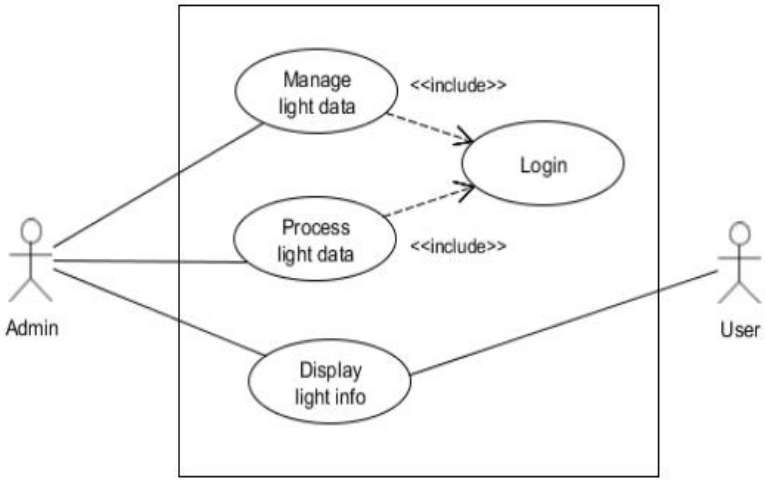

Figure 4 Use Case Diagram of The System

There are two actors involved, i.e. admin and user. Admin must be logged in before entering the system because the authority of admin is unlimited, whereas the user can only display the information in the web without logging in.

4.3. Entity Relationship Diagram (ERD)

Database design is presented using ERD as shown in Figure 5. There are two entities involved, which are location and street light data. The location has attributes that will be used on the map, whereas the attributes of light_data will be used to show up the light status. The entity of user is not drawn in ERD and is used to store username and password of admin. The temporary database also is not included in ERD and is used as a container for the data coming from the street light.

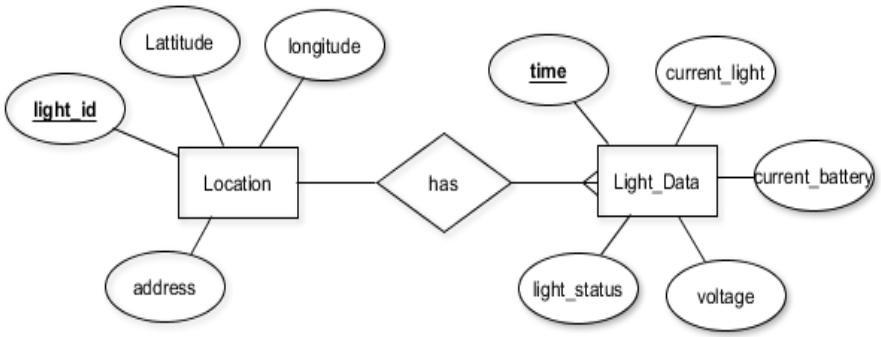

Figure 5 Database design of system

4.4. Design of Mockups

The design of home page is created in the form of a dashboard, where on one page all information is displayed. The location of street lights can be seen through the map with the icon indicated ON or OFF, as shown in Figure 6.

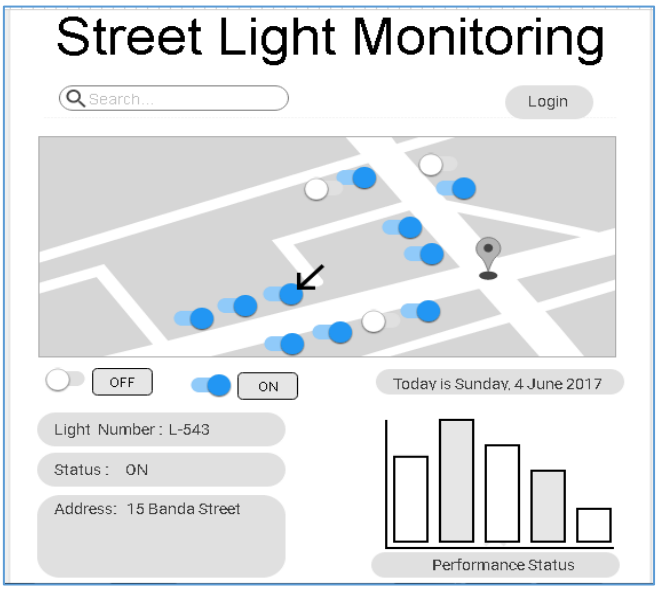

Figure 6 The Home Page of The System

The chart will be shown up together with the status and the location of the street light if one of the light is pointed. The chart explains how many times in a certain period the light is working properly.

Figure 7 The Login Page for Admin

The Login button is used only by Admin for data security purposes, whereas users can only see the home page. Admin can be more than one person, so username must be an email address to ensure the uniqueness. The login page is shown in Figure 7.

Figure 8 presents a page for input the location of data. There are four fields, where light number must be unique. To ensure the uniqueness, this number ca be generated by the system but the data is only the sequence number. If the data contains characters, so this field can be filled in directly.

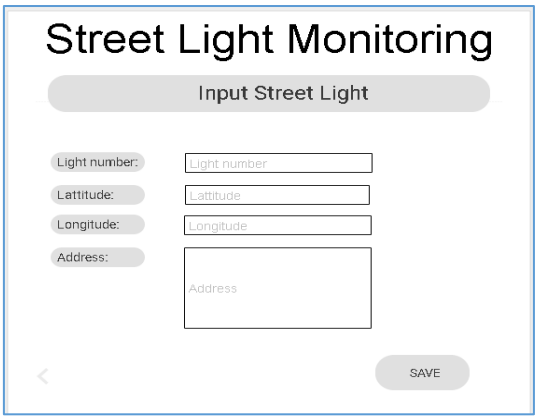

Figure 8 The Page to Input he Location of The Street Light

5. Conclusion

The design of the software allows remote monitoring of street lighting without having to come to the location. Thus the coverage area that can be monitored becomes more widespread. Monitoring of any street lights can be done by looking at the map and the performance charts. The design can be further refined to be able to detect lights that have already shown a decrease in power so that light replacement can be more anticipated.

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