IMPLEMENTATION OF PASSIVE INFRARED SENSOR IN STREET LIGHTING AUTOMATION SYSTEM

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ABSTRACT

This paper presents a smart street lighting system which provides a safe night time environment for all road users and pedestrian. The main objectives are to build an automation system of street lighting using a low-cost microcontroller which is Arduino and to achieve energy-saving. Light Emitting Diode (LED) is represented as the light module. This system is controlled according to the specific mode. These modes are controlled by two sensors which are Light Dependent Resistor (LDR) and Passive Infrared (PIR) sensor. This system can automatically turn on and off the lights according to traffic flow. This system operates during the night and the focus is only for the one-way road at a junction. Street light will be on when only there is road user otherwise, it will turn off. This design can save a great amount of electricity or energy consumption compared to conventional street lights that keep alight during nights. Moreover, the maintenance cost can be reduced and lifespan of the system will increase. As the result, the system has been successfully designed and implemented as a model system.

Keywords: Arduino, PIR sensor, LDR sensor, Light Emitting Diode (LED), Energy-saving

INTRODUCTION

Nowadays, street lighting is essential for all areas whether urban or rural since people know that street light is an alternative during the day night in order to keep the safety of the road users. Street lights management control is quite simple, yet as the urbanization, the number of streets increased rapidly [1]. The traditional lighting street lamp on-off control is based on chronological time, which may inefficient and inflexible.

The existing street lighting control system used timer and photocell. The timer is set up to turn on the street light within 7.00 p.m. until 7.00 a.m. Meanwhile, photocell reacts based on the presence of light or electromagnetic energy. In a rainy day or when the light intensity is low, the photocell will energise the contact and automatically turn on the street lights. This system is quite inefficient since the condition of day and night is uncertain. Sometimes at 7.00 p.m. the day is still bright but the street light is already switched on. In contrast, at 7.00 a.m. the street light is already switched off although the day is still dark. Thus, this system is quite inflexible.
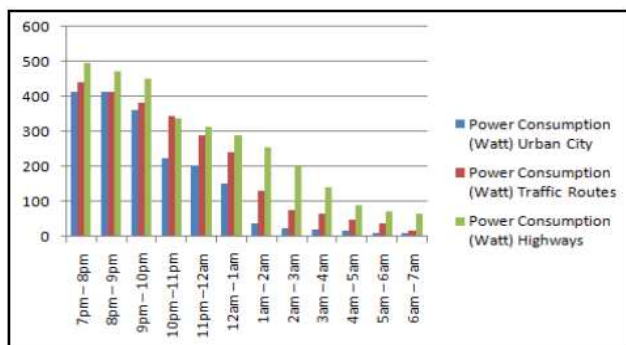
Figure-1. Power consumption for each hour at the urban city, traffic routes and highways [9]

The public lighting is designed to meet the needs of local communities, such as the rising number of road and sidewalk traffic safety [2]. In order to surge the efficiency, a modern street lighting control system must be able to adapt the light level intensity to determine the optimum energy consumption level. However, power wastage will happen if there is no user or vehicles use that road especially in rural areas at midnight. Figure-1 shows the power consumption in the urban city, traffic routes and highways from 7.00 p.m. till 7.00 a.m. The graph showing the use of road reduced beginning at 1.00 am until 7.00 am.

This Street Lighting Automation System is an intelligent system which provides the flexible and efficient system in order to control the street lighting autonomously. This system is controlled by two sensors which are PIR sensor and LDR sensor. LDR sensor is used in order to detect darkness to activate ON/OFF switch. In the previous study [3][4], the researchers have suggested the new technique to automate their system using both sensors. With the presence of these sensors that detect the intensity of light and used to detect the presence of humans or cars then, it turned on the system automatically. The main controller for this project is using an Arduino Uno.

The main reason LED was chosen is to reduce the energy consumption as it were very effective in lighting and low light decay in the lifetime. The LEDs have about 110° light emission angle. Meanwhile, the conventional lamps usually have 360° and need a reflector to direct the light beam to the target [5]. Table-1 shows the comparison between LED and another type of lamps used in existing street lighting.