Analysis and Development of a Self-Dimming Module for Road Traffic Signal

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ABSTRACT – The road traffic signals have been increasingly replaced with LED displays in the recent years as it contribute to saving for the municipality and taxpayers money at every intersection. The fact that LED traffic signals eliminates energy waste from heat and consumes less power makes them perfect for 24/7 operations throughout the year. The operation of a traffic light is required during day and night where with the current practices, the energy usage would be the same as there is no display dimming function embedded in the LED driver. In the context of Malaysia or most countries around the world, we can achieve 50% of the day and 50% of the night with ambient light and no ambient light. Thus, the research has proposed a dimming system for the LED traffic signals to optimize energy from 12V dc to 5V dc especially during nightfall that could help the local municipality to save up to 50%. The proposed system also ensure the road users to see the LED signal clearly by increasing 5V dc up to 12V dc especially during the heavy rain. The project will involve analysis of energy consumption of the traditional LED traffic signals compared to the proposed LED traffic signals with multiple dimming systems.

1. INTRODUCTION

The traffic light is designed to facilitate traffic movement for road intersection that is known as the best practices to control traffic flow around the world. Before the traffic light system was introduced, the road intersection was controlled by a physical policeman to prevent the congestion as well as unwanted accidence among the road users. The main purpose of the signal lights is to prevent any road traffic accident by sending three-color signals red as a sign for stops, a yellow signal light to be ready to stop and ready to run on a green traffic light. Soon all later with the technological growth, the traffic signal displays adopted LED as an energy efficient display that can save a tremendous amount of energy as compared to the traditional displays as previous authors[1][2]. In the current era, energy saving is an afford initiated by government sector due to the rising cost of electricity. Thus, the proposed system is introduced to gain saving in power usage through a dimmer system in the afford to reduce the power usage and the accruing cost as mentioned in previous authors [3][[4]. As the high consumption power not only affected the energy wastage and high power usage increases the heat produced by the display that reduces the lifetime of LED as a previous study [5][6].

2. METHODOLOGY

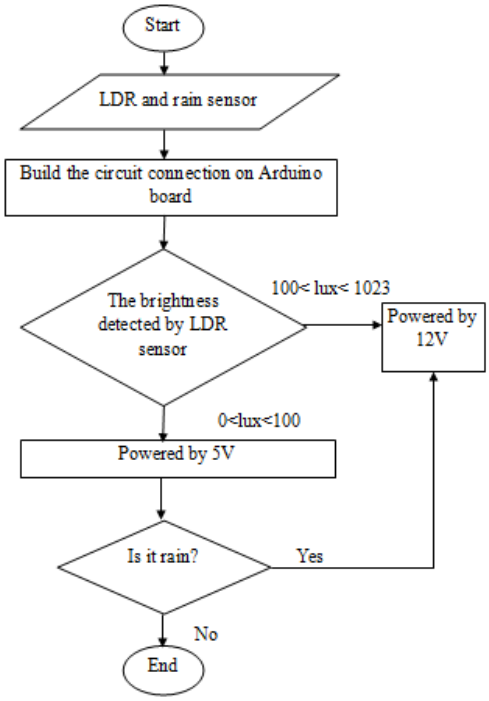

Figure 1: The flowchart for an overall operation of proposed dimming system

System Architecture for a proposed dimming system

Referring to Figure 1, the dimming concept incorporated with traffic signal provides high brightness during daytime and decreases the brightness of during low light intensity. The proposed system has two power supplies which are 5V and 12V with only one power supply operating at one time. During the daytime, the higher power supply will be used to produce high-intensity light while during the night; the relay will switch the power supply from 12V to 5V due to low light intensity sensed by the LDR. Apart from that, the proposed system increases the display brightness during rain or fog due to the limited vision of road users. The other features of the system indicate the poor brightness or partially working display during the operation of the system. The indicator ensures a standardized

maintenance process that will be transmitted automatically via the wireless internet network.

3. RESULT & DISCUSSION

Table 1 shows two different voltages that will be used in this proposed system. The concept of dimming is applied during the night time as the LDR detect the lower light intensity and switched the higher voltage to the lower voltage. As shown in table 1, the dimming concept can save approximately 50% of power usage. Basically, the existing traffic light maintained the same voltage on a 24-hour clock. Through the proposed system, during the night time, the LED traffic light will consume less power as compared to daytime. Referring to Figure 2, the comparison of a traditional traffic signal and a traffic signal with a dimming system has a significant impact on energy usage over a period of a year. This Figure is based on a running time of red display about 62% followed by the green at 25% and yellow at 13%.

Voltage type		Red	Yellow	Green
5V	Current(A)	0.5	0.5	0.6
	Power(W)	2.5	2.5	3.0
	Power(kWh)	0.0025	0.0025	0.003
12V	Current(A)	1.7	1.8	2.4
	Power(W)	20.4	20.4	28.8
	Power(kWh)	0.0204	0.0204	0.0288

Table 1: Experimental measurements for 12V and 5V.

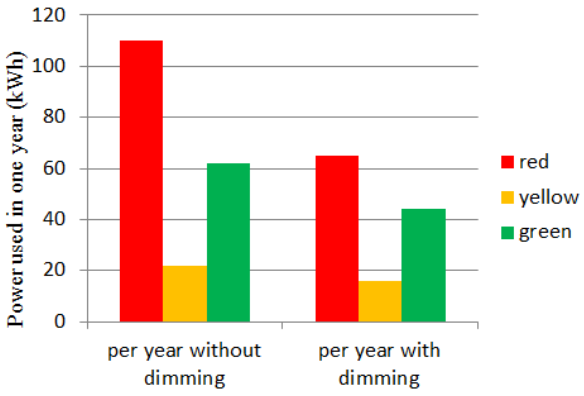

Figure 2: The comparison of power consumption of existing and the proposed traffic light display for a year

The calculation of current and power produced by the LED is calculated using the formula shown in Eq. 1 and Eq. 2 below:

$$V = IR \qquad \text{Equation (1)}$$

$$P = VI \qquad \text{Equation (2)}$$

4. CONCLUSION

This paper has highlighted a research conducted to analyze the impact of incorporating a dimmer system to a traditional LED traffic signals in the afford to reduce energy wastage. The outcome of the analysis has shown a significant level of energy wastage reducing the LED traffic signals by 50%. Incorporating the proposed dimmer system to the traditional LED traffic signals does not only reduces energy wastage but also helps to prolong the lifespan of the traffic signals. Better lifespan further reduces the maintenance costs and the frequency of replacing the traffic signals. Such an technology could contribute towards the governments afford to achieve a green city status.

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