Street Light Energy Conservation System using PIR Sensor

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Abstract

This paper proposes energy efficient automatic street lighting system based on low cost microcontroller. The main objective is to design energy efficient based controller for controlling the Light Emitting Diode (LED) based street lamp via appropriate lighting levels control. This system consists of a microcontroller, light sensor, PIR sensor and a set of the LED module. The controlling and managing of the system is based on the density of traffic and five different level of street light brightness has been used for lighting up street proportional to the density of traffic. The system was programmed to automatically turn off during the night. Several numbers of tests have been conducted to test and validate the proposed prototype in the different environment. As conclusion, around 77%-85% reduction in power consumption can be achieved through this proposed automatic street lighting system for energy efficiency system design.

Keywords- Street light, Low Power Consumption, LDR, PIR Sensor, Microcontroller

I. INTRODUCTION

Basically, street lighting is one of the important parts of a city's infrastructure where the main function is to illuminate the city's streets during dark hours of the day. In early days, the number of streets in the town and city were very less. Therefore, the street lamps are relatively simple but with the development of urbanization, the number of streets increases rapidly with high traffic density which highlighted There are several factors need to be considered in order to design a good street lighting system such as night-time safety for community members and road users, provide public lighting at cost effective, the reduction of crime and minimizing its effect on the environment.

At the beginning, street lamps were controlled by manual control where a control switch was fitted in each of the street lamps. It is called first generation of the original street light. After that, another method that has been used was optical control method. This method is using high pressure sodium lamp in their system. It can be seen that this method is widely used in the country nowadays. This method operates by using optical control circuit, change the resistance by using of light sensitive device to control street lamps light up automatically at dusk and turn off automatically after dawn in the morning. Due to the technological development nowadays, road lighting can be categorized according to the installation area, performance and their use, for example, lighting for traffic routes, lighting for subsidiary roads and lighting for urban center and public amenity areas. While, the sensor network helps in improving the network sensing for street lighting as highlighted meanwhile, street lighting technology can be classified according to the type of lamps used such as incandescent light, mercury vapour light, metal halide light, high pressure sodium light, low pressure sodium light, fluorescent light, compact fluorescent light, induction light and LED light.

LED is considered a promising solution to modern street lighting system due to its behavior and advantages as emphasized. Apart from that, the advantages of LED are likely to replace the traditional street lamps such as the incandescent lamp, fluorescent lamp and High Pressure Sodium Lamp in future but LED technology is an extremely difficult process that requires a combination of advanced production lines, top quality materials and high-precision manufacturing process. Therefore, this paper highlights the energy efficient street lighting design using LED lamps through intelligent sensor interface for controlling and managing.

II. METHODOLOGY OF AUTOMATICS STREET LIGHTING SYSTEM

Three parts have been included under this topic for completed this study. Design architecture is the main block function for the proposed design. While, the hardware specification will detail out the components involved in this design from the sensor components until the controller selection. Software development based on the proposed design will be detail out in software part where the flow of the system operation will be detailed out elaborated.

A. Design Architecture

The system development is start with the design architecture of the proposed design. Transparent block diagram has been used to outline the proposed design as shown in Figure 1.Three main components have been identified as the inputs to the system; clock, power, Vector input, while one have been declared as the output of this system; the LED module.

The light detection, ON-OFF control and presence of vehicles are the three processes managed and controller by the microcontroller based on the input from the PIR sensor, light sensor and the brightness of the LED module is controlled by the light intensity block based on the input from microcontroller. Fig.1 shows the transparent block diagram of Street Lighting system.

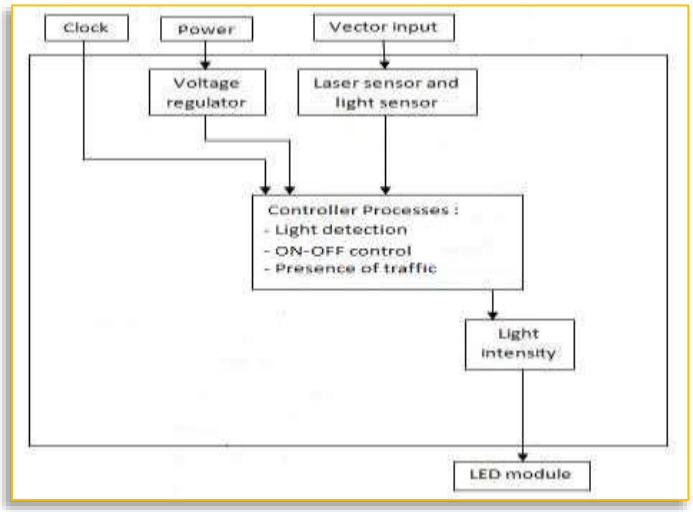

Fig. 1: Transparent block diagram of Street Lighting System

B. Hardware Specification

In hardware specification, the components for the proposed system have been classified based on the components group; input, output and controller. Three type of the input have been used in this system; clock, power supply and sensor. The clock has been used to provide clock oscillation to the microcontroller while the power supply is used to power up the overall system. The supply is controlled by the switch for power switch on and off.

Two type of sensor have been used including vector and non-vector type sensor. The function of dark or light sensor module is to detect the surrounding light level. Light Depends Resistor (LDR) has been used to detect and measured the surrounding light level. All light response or changing is measured in volt. PIR sensors are used in this paper. Their functions to sense the objective that will pass through the street, at the same time give a signal to the microcontroller to turn on the lamp. The idea to save the energy, where the systems have been designed to light ON the lamp in the night only and only if there is any object passes through the street. Except to that the light will be OFF.

PIC16F77A has been selected as the controller in this system due to the low cost, compatibility, compact size and easy interfacing over several type of other controller including Programmable Logic Controller (PLC) and Programmable Integrated Circuit (PIC). The accessible to the Analog to Digital Converter (ADC) without required register location access has making the controller more user friendly for programming and interfacing. On top of that, the complete board running at low power consumption. Fig.2 shows the complete schematics diagram for the proposed design.

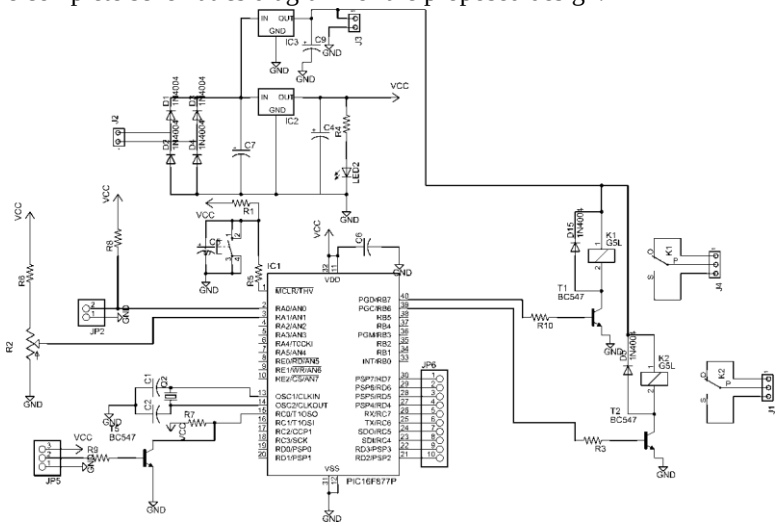

Fig. 2: Complete schematic diagram for the proposed design

C. Software Development

The microcontroller required a program to operate and execute the process associated with the proposed design. PIC programming has been used to construct the program for the proposed design.Fig.3 shows the flow chart proposed system.

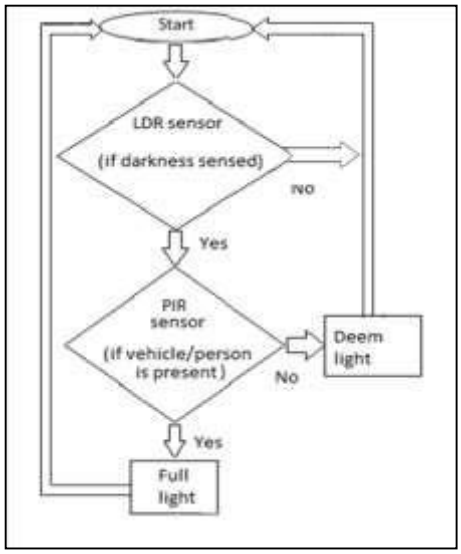

Fig. 3: Flow Chart

III. RESULT AND DISCUSSION

The project aims were to reduce the side effects of the current street lighting system, and find a solution to save power. In this project the first thing to do, is to prepare the inputs and outputs of the system to control the lights of the street. The prototype as shown in Fig.4 has been implemented and works as expected and will prove to be very useful and will fulfill all the present constraints if implemented on a large scale.

Fig.4 shows the street light system, from the figure it can be seen that, LED is Dim, because there is no any object passes through the street; this is the idea of using the microcontroller to control each lighting separately. When any object passes in front specific PIR sensor the LED which connected PIC Controller and it will be give full light intensity automatically.

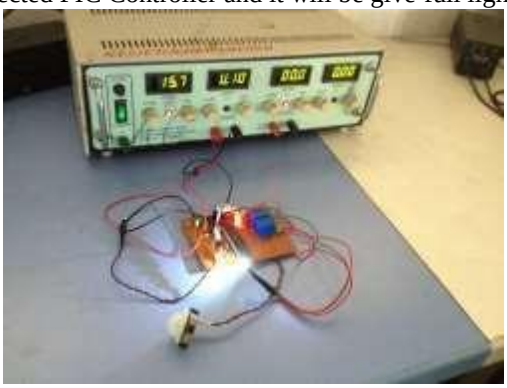

Fig. 4: Prototype of Street Light System

IV. CONCLUSION

The automatic street lighting system is developed and successfully implemented presented. As a conclusion, around 77%-85% of power consumption can be reduced by using this system, providing a solution for energy saving. Furthermore, the minimum components including the low cost controller and LED module produce the better saving in term of cost. On top of that, the life time, better illumination and low power consumption of LED are the other criteria for reducing the operational and maintenance cost after installation compared to high pressure sodium lamp. Hence, it helps in further improving the energy efficiency and quality of lighting level

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