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ENERGY SAVING SYSTEM IN E-STREET

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ABSTRACT

The paper presents a remote streetlight monitoring and controlling system based on LED and wireless sensor network. The system can be set to run in automatic mode, which control streetlight. This control can make a reasonable adjustment according to the seasonal variation. Also this system can run in controlled mode. In this mode, we can take the initiative to control streetlights through PIC controller. This street light system also includes a time cut-out function, and an automatic control pattern for even more electricity conserving, namely when vehicles pass by, the light will turn on automatically, later turn off. This design can save a great amount of electricity compared to streetlamps that keep a light during nights. The design implements traffic flow magnitude statistics without adding any hardware, facilitating transportation condition information collecting. Furthermore, this system has auto-alarm function which will set off if any light is damaged and will show the serial number of the damaged light, thus it is easy to be found and repaired the damaged light.

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Introduction

The idea of designing a new system for the streetlight that do not consume huge amount of electricity and illuminate large areas with the highest intensity of light is concerning each engineer working in this field. Providing street lighting is one of the most important and expensive responsibilities of a city. Lighting can account for 10–38% of the total energy bill in typical cities worldwide [1]. Street lighting is a particularly critical concern for public authorities in developing- countries because of its strategic importance for economic and social stability. Inefficient lighting wastes significant financial resources every year, and poor lighting creates unsafe conditions. Energy efficient technologies and design mechanism can reduce cost of the street lighting drastically. Manual control is prone to errors and leads to energy wastages and manually dimming during mid night is impracticable. Also, dynamically tracking the light level is manually impracticable. The current trend is the introduction of automation and remote management solutions to control street lighting [2].

There are various numbers of control strategy and methods in controlling the street light system such as design and implementation of CPLD based solar power saving system for street lights and automatic traffic controller [1], design and fabrication of automatic street light control system[3], automatic street light intensity control and road safety module using embedded system [4], automatic street light control system [5], Intelligent Street Lighting System Using Gsm [6], energy consumption saving solutions based on intelligent street lighting control system [7] and A Novel Design of an Automatic Lighting Control System for a Wireless Sensor Network with Increased Sensor Lifetime and Reduced Sensor Numbers[8].

In this paper two kinds of sensors will be used which are light sensor and photoelectric sensor. The light sensor will detect darkness to activate the ON/OFF switch, so the streetlights will be ready to turn on and the photoelectric sensor will detect movement to activate the streetlights. LDR, which varies according to the amount of light falling on its surface, this gives an inductions for whether it is a day-night time, the photoelectric sensors are placed on the side of the road, which can be controlled by microcontroller PIC16f877A. The photoelectric will be activated only on the night time. If any object crosses the photoelectric beam, a particular lightwill be automatically ON. By using this as a basic principle, the intelligent system can be designed for the perfect usage of streetlights in any place.

ARCHITECTURE OF THE REMOTE STREET LIGHT CONTROL SYSTEM:

The system consists of a group of measuring stations in the street (one station located in each lamppost) and a base station located nearby. The system is designed as a modular system, easily extendable. The measuring stations are used to observe street conditions as the intensity of daylight and, depending on the conditions they activate or off the lamps. Other factors influencing the activation are: climatic conditions, seasons, geographical location, and many possible alternative factors.

For these reasons every lamp is designed independent to decide about the activation of light. The base station Conjointly checks if any lamp is correctly operating and sends the message using the wireless network to the operator who will act in case of malfunction. Fig 2 shows the function, when the vehicle passing is in the road.

The streetlights are switched ON when the vehicles are come closer to the lamp the LEDs are activated and later turn OFF. And the vehicles in certain distance the nearby LED lights are dimmed the half of the level of LED power using the PWM technique, to reduce the power. These control and LED status information are passed through the Mi-Wi wireless medium

Fig 2: Schematic of E-Street light system.

DESIGN OF HARDWARE

The block diagram of proposed street lights control system is shown in Figure 3(a) and Figure 3(b). The transmitter end consists of power supply, microcontroller PIC 16F, photosensitive detection circuit (Day & night sensor), infrared vehicle detector, feedback circuit, fault detection circuit, LCD display and WI-FI transmitter module. The receiver part consists of WI-FI receiver module, MAX232, RS232. The block diagram explains the simple working of the whole system developed.

Block diagram:

Transmitter:

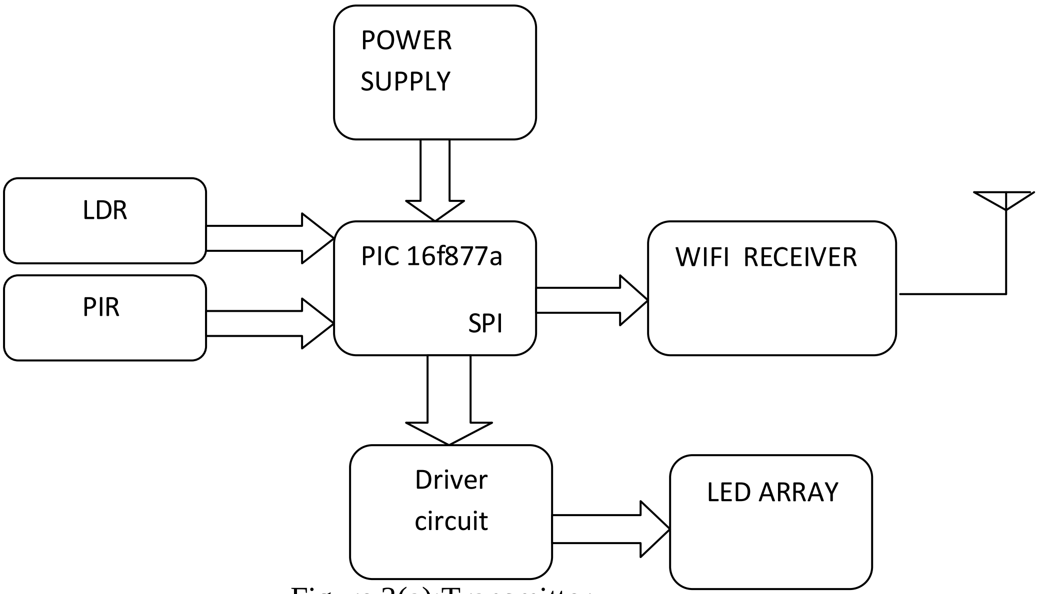

Figure 3(a):Transmitter

Receiver :

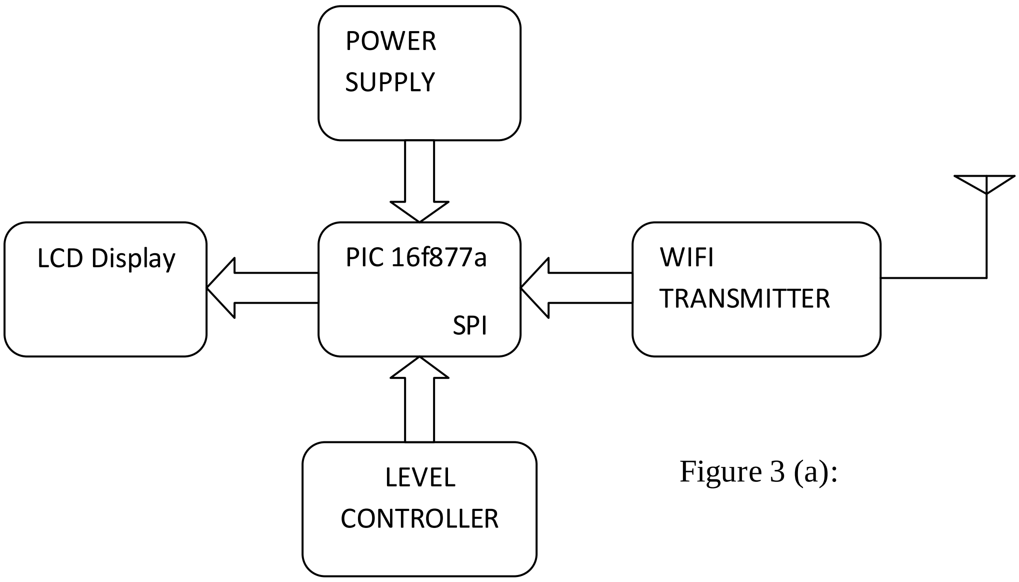

Figure 3 (a):

The power supply circuit provides the 5V regulated power supply for revitalizing the microcontroller module. The core of the system is an PIC18F45J11 microcontroller. It is preferred because of the following features:- it is a lowpower, high-performance enhanced flash 8-bit microcontroller with 8K Bytes of in-system programmable Flash memory, 256 bytes of RAM, 32 I/O lines, three 16-bit timer/counters, a full duplex serial port, on-chip oscillator, and supports two software selectable power saving modes: low power Idle and Power- down mode.

The photosensitive detection circuit consists of Day & night sensor to determine the external light intensity. The threshold (reference) illumination level is set initially. The photoelectric sensor with set threshold intensity is used to observe street conditions as the intensity of daylight and, depending on the conditions they activate or off the lamps. The street lamps still consume a lot of electricity when merely a few vehicles are driving around the road. Thus, there is a great necessity to develop a control system based on the traffic flow density.

Whenever there is no traffic i.e. density of traffic is zero, there is no need of street light to be glow on highways which saves power consumption to a greater extent. The lights of a particular area should glow only when a vehicle enters that area on highways. For this purpose, the infrared detection circuit has been used. It consists of IR sensor (presence sensor) which has the task of identifying the passage of a vehicle or pedestrian causing the switching ON/OFF of street lamps. This feature permits to activate lamps solely when necessary, avoiding wastage of energy. The load which is street-light lamps is connected to microcontroller.

Using power transistors and solid state dual relays, the street-lamps are switched ON/OFF. The solid state relays accept the triggering voltage from power transistors which in turn are triggered by microcontroller on reception of activation signals from the sensors. Pulse width Modulation or PWM is one of the powerful techniques used in control systems today. They are not only employed in wide range of control application which includes: speed control, power control, measurement and communication. This PWM technique switches the power supply 5v to 3.3v for dimming purpose. These dimming purposes save the great amount of power consumption. The fault detection circuit indicates the LED lamp failure as well as wire fault along with lamp and wire number when the lamps are firstly turned on, on sensing the night. Through feedback circuit the malfunctioning message is transmitted to the controller which displays it on the LCD and also transmitted wirelessly through WIFI module to the control terminal.

The LCD display is used to show different conditional messages like day, night, light testing, wire fault, LED failure, etc. The sensors transfer the collected information to a controller that runs the software to manage the system. The Compact and complete, easy to use PIR Sensor Module for human body detection. Incorporating a Fresnel lens and motion detection IC, suitable for a wide range of supply voltages and with low current drain. Adjustable delay time with high sensitivity and low noise.

Output is a standard TTL output signal. The features of PIR sensors are Complete with PIR, Motion Detection IC and Fresnel Lens, Dual Element Sensor with Low Noise and High Sensitivity, Supply Voltage: 5-20Vdc, Delay Time Adjustable: 5 seconds to 18 Minutes, Standard TTL Output, Module Dimensions: 28mm Length, 38mm Width, 40mm Height.

STREET LIGHT AUTOMATIC CONTROL METHODOLOGY

the main control, initially in night time all the street lights are activated because of poor ambient light condition. The street lights are operated in two modes. First one if the street lights in automatic mode, if any human or vehicle movement detected, the motion sensor triggers the microcontroller to turn the LEDs to their full brightness and it gets restored back to the dimming brightness. Another one is control mode, in the control mode it counts the road users both human beings and vehicles, and transfers the counted value to control room. Turn on / Turn off can be controlled also manually from EB station through the same wireless medium. As per the user need only the street lights are operated in automatic mode or either the control mode. The application is developed using PIC18F45J11 Microcontroller. PIC 18Fcontrollers used for high level integration and low power consuming. This controller has the ability to work at 31KHz to 48 MHz frequency, has 8 kb of flash memory and can connect up to 32 general purpose devices within it. The program is coded in such a way if the ambient light condition is low the controller will switch ON the street unit automatically. The minimal circuit diagram is shown in the Fig 7.This circuit shows how the PIC 18F is interfaced along with the LDR, LED and temperature sensor to get the values and it is displayed in the LCD display.

ESTIMATION OF PRICES AND SAVINGS

This proposed system may be criticized as being expensive however we must consider its advantages: slightly higher prices of the lampposts are compensated by lack of costly wiring and the availability of power network and considerably lower prices of maintenance (due to central management and reliability of LEDs). Energy savings are of utmost importance today. The goal is, therefore, the reduction of operating prices of street lighting with the creation of a system characterized by straightforward installation and low power consumption, powered by a renewable supply of energy through solar panels with no harmful atmosphere emissions and minimizing light pollution. Making a short comparison with the normal street lighting systems: Supposing that one lamp is switched on for 4,000 hours per year. One streetlight has a median consumption of 200 W yearly. With the system presented in this paper, every lamp uses about 20-25 W (95% of energy consumed by the LEDs). Based on the field tests another possibility of energy savings becomes evident. Classical system consumes energy independently if it is needed or not. It is active for about 10 hours daily and the total number of working hours is about 300 per month, versus 87-108 hours proposed system, savings of about 66% to 71% are expected. The savings may be improved by using more efficient LEDs, since the consumed energy almost entirely depends on LEDs consumption.

CONCLUSION

In summary by using E-Street we can save surplus amount of energy. This is done by replacing sodium vapor lamps by LED and adding dimming technology to it. E-Street provides an effective measure to save energy by preventing unnecessary wastage of electricity, caused due to manual switching of street-lights when it is not required. The system is versatile, extendable and totally adjustable to user needs.

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