International Journal of Research in Engineering, Science and Management
Volume-1, Issue-7, July 2018
www.ijresm.com
ISSN (Online): 2581-5782

Smart Street Light System Using Reconfigurable FPGA Tool

Asha Rani A. R[1], Anjali P[2]

[1]Assistant Professor, Department of ECE, Dayananda Sagar Academy of Technology and Management, Bengaluru, India
[2]Assistant Professor, Department of ECE, Dayananda Sagar Academy of Technology and Management, Bengaluru, India

***Abstract*—The present street light systems consume huge amount energy. The cost per unit is very expensive and we have limited amount of renewable resources to depend on. Therefore, the goal of the present study is to save energy. In the existing system, power consumption takes place due to continuous glowing of street lights throughout the night. Smart street light system using FPGA is an easy and potential technique. The concept is to implement such system which automatically turns ON and OFF depending on sunlight and identification of movement of any object like vehicles and human beings using IR sensors. The proposed idea is implemented using FPGA, IR sensors and light dependent resistors.**

Key Words—Power consumption, FPGA board, IR sensors, LED

I. Introduction

One of the substantial parts of a country's infrastructure is the street lighting system. The prominent task is to illuminate the nations streets during the night hours. In the present situation, due to high traffic density the number of street lights are increasing at a rapid rate. In order to have an efficient street lighting system some factors have to be looked after such as power consumption, cost, traffic and mainly accuracy related to time or condition.

This paper deals with the intelligent control of illumination of the streets during the off-peak hours in the night based on detection of movement on the road by vehicles(mostly) and pedestrians (if any). The main motto behind this project is obtained from the shortage of power inn the ever-increasing power demand scenario in India. And also, this system makes the night life more convenient, safe and environment friendly.

Automation of street lights limit the involvement of humans. They are self-sufficient to operate on their own which in turn leads to time saving and reducing the cost as it results in more efficient system than the manual one. As the sunlight decreases slowly from evening to night, the intensity of the LED based LDR which is interfaced with the FPGA board is controlled. This process repeats every day.

The paper is organized as follows. Section II presents a literature survey. Section III explains about the components being utilized and their work in general as well as related to this project. Section IV describes the working and implementation of the proposed system. Section V gives an idea about further improvisation and techniques that could be added in the later part. Section VI outlines the results of the project and concludes the paper.

II. Literature Survey

A number of studies presented various aspects of smart street lightning system in the literature. Developing new technologies for controlling and managing street lighting was the subject on which maximum effort was made on. In this section, we summarize the studies which were more to our work.

In [1], the author suggested that making use of LED DC street will increase the efficiency up to 64% and lifetime of the street lights which reduces the maintaining cost and also the harm it causes due to the usage of traditional AC street lights as they emit greenhouse gases.

In [2], an idea was proposed to track the pedestrians walking as the detection of the pedestrians is important in this system.

In [3], the author suggested a method which works with optical control circuit which controls the street lights by using light sensitive devices which turns off automatically after dawn.

In [4-6], the Wireless Sensor Network (WSN) was developed. It consists of sensor node, remote terminal unit (RTU) and control center. The sensor senses the status of the lamp and the intensity of the light. Using the Power Line Communication (PLC) the control and status signals can be sent from the RTU and the control center or vice versa.

III. Hardware Requirements

The hardware design has been done for the following:

A. Field Programmable Gate Array

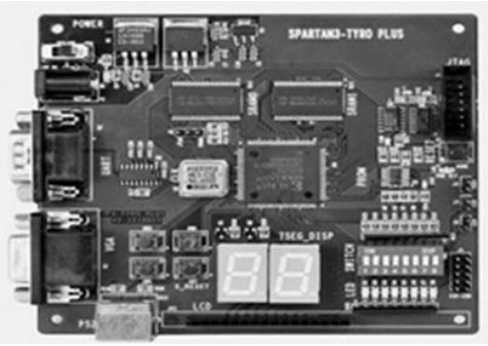

Fig. 1. Hardware design

Field programmable gate arrays (FPGAs) are reconfigurable silicon chips that can be used to implement custom hardware functions. They are extensively used in rapid prototyping and verification of a conceptual design and also used in electronic

International Journal of Research in Engineering, Science and Management
Volume-1, Issue-7, July 2018
www.ijresm.com
ISSN (Online): 2581-5782

systems when the mask production of a custom IC becomes prohibitively expensive due to small quantity.

They give us time speed of hardware, flexibility, less cost and hardware parallelism. In this case, we have used a Xilinx spartan 3 board.

B. Light Dependent Resistors (LDR) Sensors

As the name suggests light dependent resistors suggests the resistance depending upon the amount of light incident on it. The resistance of the light dependent sensors varies in accordance with the intensity of light. In this case, it depends upon the intensity of sunlight. When the intensity of sunlight is high the resistance offered by the LDR is less and when the intensity of sunlight goes low the resistance offered is more. In total an LDR acts as a variable resistor. These properties of an LDR helps in regulating the lighting of our smart street light system accordingly.

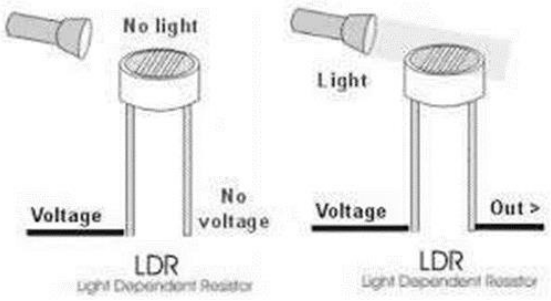

Fig. 2. Light dependent resistor sensors

C. Light Emitting Diodes (LDR)

A light emitting diode is a PN junction diode, which emits light when activated. When a voltage is applied to the positive and negative lead of an LED, the electrons and holes within the LED recombine, emitting energy in the form of photons which gives the light. Therefore, it is a two-lead semiconductor light source.

Smart light system is represented by the LED. The amount of light emitted by the LED is directly related to amount of light in the environment, when outside light is less than the light given by LED is more.

D. Infrared Radiation Sensor (IR Sensor)

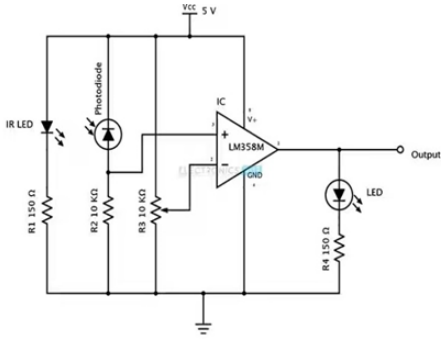

Fig. 3. Infrared radiation sensor

IR sensors work by using a specific light sensor to detect a street light wavelength in the infrared spectrum. The basic concept of an infrared sensor which is used as an obstacle detector is to transmit an infrared signal, this infrared signal bounces from the surface of an object and the signal is received at the infrared receiver.

The proposed system uses an IR sensor working as obstacle sensor.

IV. Implementation and Working

The block diagram of the proposed Smart Street Light System is shown in Fig.1. The Light Dependent Resistor (LDR) will detect the presence of sunlight. Based on the intensity of the light, the resistance of the sensing element varies, which varies the output voltage.

The output voltage is converted into digital form using an analog to digital converter according to the intensity of sunlight present in the atmosphere. This work is done by the Op-amp/Schmitt trigger. The signal which is digitized is now connected to a FPGA (Field Programmable Gate Array). Along with LDR an IR sensor is interfaced with the FPGA for detection of vehicle and pedestrian movement. A light emitting diode is a PN junction diode, which emits light when activated. When a voltage is applied to the positive and negative lead of an LED, the electrons and holes within the LED recombine, emitting energy in the form of photons which gives the light. Therefore, it is a two-lead semiconductor light source.

Smart light system is represented by the LED. The amount of light emitted by the LED is directly related to amount of light in the environment, when outside light is less than the light given by LED is more.

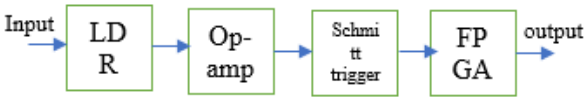

Fig. 4. Block diagram

The system is designed considering all the factors like power consumption, cost and traffic.

Here based on the output given by the LDR, switching of the street lights takes place. If the LDR detects the sunlight then the street lights are in OFF position. Otherwise, the street lights are switched ON. During the night, the IR sensor senses if there is movement of human beings or vehicles and works accordingly.

V. Challenges and Mitigation Techniques

The major challenges which are being faced automation of street lights due to objective motion are different sensors for different objective motion, working of sensor in rainy condition, material and sensor failure due to abnormal conditions.

To mitigate with this challenge, we can combine the sensor for different objective motions. It can detect every minute objective motion by combining of sensors. Also, we need to use more renewable energy resources and consume as much power as we can.

VI. Conclusion

The huge problem every country is facing in today's scenario is the energy crisis. Due to vehicle and pedestrian aware smart street light system we can reduce the consumption of huge amount of power which can diverted towards electrification of rural areas. In other words, it is an energy efficient automatic street light system based on objective motion implemented on a FPGA board. It only requires the initial cost for designing and installation and not for utilization. Therefore, such systems once implemented in a large scale can bring significant reduction in power consumption caused by street lights.

References

[1] Fares S.El-Faouri, Munthur Sharaiha, Daoud Bargouth and Ayman Faza, Electrical engineering department, Princess Sumaya University of Technology,Amman,Jordan.

[2] Yoshiura, N.; Fujii, Y.; Ohta, N., "Smart street light system looking like usual street lights based on sensor networks," Communications and Information Technologies (ISCIT), 2013 13th International Symposium on, vol., no., pp.633,637, 4-6 Sept. 2013.

[3] Costa, M. A D; Costa, G.H.; dos Santos, AS.; Schuch, L.; Pinheiro, J.R., "A high efficiency autonomous street lighting system based on solar energy and LEDs," Power Electronics Conference, 2009. COBEP '09. Brazilian, vol., no., pp.265,273, Sept. 27 2009-Oct. 1 2009.

[4] Ali, M.; Orabi, M.; Abdelkarim, E.; Qahouq, J.AA; Aroudi, AE., "Design and development of energy-free solar street LED light system," Innovative Smart Grid Technologies - Middle East (ISGT Middle East), 2011 IEEE PES Conference on , vol., no., pp. 1,7, 17-20 Dec. 2011.

[5] De Melo, M.F.; Vizzotto, W.D.; Kirsten, AL.; Dalla Costa, M.A; Garcia, J., "Photovoltaic grid-connected flyback micro-inverter and boost MPPT integrated to street lighting system based on LEDs," New Concepts in Smart Cities: Fostering Public and Private Alliances (Smart MILE), 2013 International Conference on, vol., no., pp. 1,7, 11-13 Dec. 2013.

[6] Jaureguizar, M.; Garcia-Llera, D.; Rico-Secades, M.; Calleja, AJ.; Corominas, E.L., "Energy light project: Walking from electronic lighting systems to Lighting Smart Grid," New Concepts in Smart Cities: Fostering Public and Private Alliances (Smart MILE), 2013 International Conference on, vol., no., pp. 1,6, 11-13 Dec. 2013

[7] IEEE Std C37.238™-2011 IEEE Standard Profile for Use of IEEE 1588™ Precision Time Protocol in Power System Applications: Definitions More Info.