Perspectives in Communication, Embedded-Systems and Signal-Processing (PiCES) – An International Journal
ISSN: 2566-932X, Vol. 1, Issue 6, September 2017
Proceedings of National Conference on Emerging Trends in VLSI, Embedded and Networking (NC-EVEN 17), May 2017

Energy Efficient Street Lighting System

Rahul R, Anusha S, Pushpalatha C M, Yashas K J

Department of Electrical and Electronics Engineering, CITECH, K. R. Puram, Bangalore-36

V K Gupta

Faculty of Electrical and Electronics Engineering, CITECH, K. R. Puram, Bangalore-36

Abstract*—This paper presents an energy efficient street lighting system which provides some percentage of saving in energy. The main objective is to build an automation system of street lighting using a low cost microcontroller which Arduino to achieve energy is saving. Light Emitting Diode (LED) is represented as the lighting system. Whole system is controlled by two sensors which are Light Dependent Resistor (LDR) and Passive Infra-Red (PIR) sensor. This system operates in night times using LDR sensor. And automatically adjusts the illumination of LEDs according to motion (vehicle or human) using PIR sensor. The system is implemented for two way road with a junction. Street lights will be 100% illumination when only there is road user; otherwise it will be at 30% illumination. This design can save a large amount of energy consumption compared to conventional street lights that keep lights ON during night. Therefore this system has been successfully designed and implemented as a model.

Keywords: Street; Light; Efficient; LDR

I. INTRODUCTION

Basically in developing countries energy crisis is more because of increase in population which in turn increases the demand for electricity. Therefore electricity plays a major role. The consumption of electricity increases due to modern life style and also demand for transportation increases. So the road ways plays a major role and lighting is mandatory for road ways. Around 30%of total electrical power of any county is consumed in lighting road ways [1].

The present system of lighting in road ways is switching ON the lights during whole night. This causes wastage of energy when there is no usage of road. We know that for some roads, vehicle pass with very small rates in specific period of time. The energy can be saved in this period time. In recent time smart lighting system gained more popularity and it has much scope and energy saving is more. Though there are many ways of energy conserving method in lighting system here we discussing to control the wastage of energy in lighting system detecting the movement. In this paper our main aim is to conserve the energy when there is no usage of road.

II. METHODOLOGY

The system development starts with the design architecture of the lighting system. The various components used for this project have been selected based on the requirements. The figure-1 shows the block diagram of this system. Light Dependent Resistor (LDR) is used to detect the day and night. If the LDR sense night, automatically the system is switched ON. Passive Infrared sensor is used to detect the movement of any objects. Arduino is used to control the whole system, LED (Light Emitting Diode) is used as the lighting system.

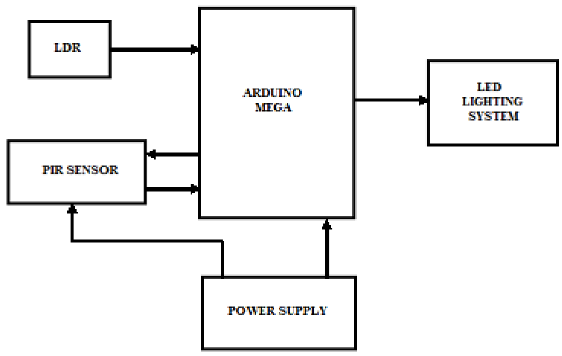

Fig 1. Block diagram of energy efficient street lighting system

III. HARDWARE SPECIFICATION

The components used are,

- Arduino MEGA
- LDR sensor
- PIR sensors
- LED

Arduino MEGA has been selected as the controller for this system due to its compact size, compatibility, easy interfacing over several other type of controller including Programmable Integrated Circuit (PIC), Programmable Logic Controller (PLC) and others. It comes with boot loader which uploads programs into microcontroller memory [2]. Figure-2 shows the diagram of Arduino MEGA.

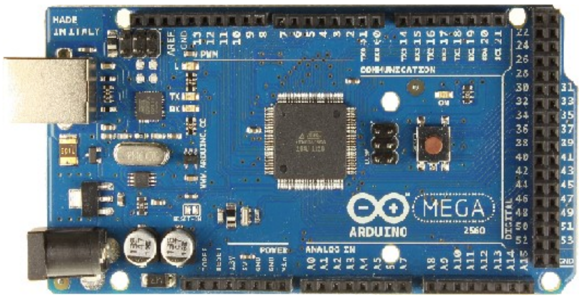

Fig 2. Arduino mega

Two types of sensor used in this system, which are Light Dependent Resistor (LDR) and Passive Infrared (PIR) sensor. LDR sensor is an electronic component that has a variable resistance, this resistance changes with the light intensity fall upon it. The resistance will decreases with increasing incident light intensity. In other words, when there is dark, it has high electrical resistance and when there is light, it has low electrical resistance [3].

Fig 3. LDR

A passive infrared sensor (PIR sensor) is an electronic sensor that measures infrared (IR) light radiating from object in its field of view. Figure-4 shows the diagram of the PIR sensor [4].

Fig 4. PIR sensor

A light emitting diode (LED) is a semiconductor device that emits visible light when an electric current passes through it. Figure-5 shows an image of LED.

Fig 5. LED

The design of the system is shown in Figure-6. S1 to S8 indicates position of PIR sensors and L1 to L20 indicates position of LED lights. The focus is for two-way roads with a junction. Here Eight PIR sensors and twenty LEDs are used. PIR sensors can sense the movement of human or vehicle within 7 meters, two LEDs are connected to each PIR sensor. It can be modified according to the requirement.

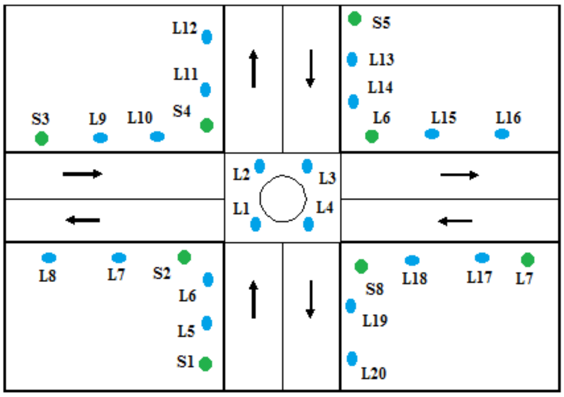

Fig 6. Design of the system

IV. SOFTWARE DEVELOPMENT

In software development Arduino plays an important role. Programming in Arduino makes easy for writing and compiling code.

The flow chart shown in the Figure-7 describes the complete operation the system operates in night times. LDR sense the light intensity which detects the night. The focus is for Two-way roads with junction. PIR sensors sense the movement of vehicles or human.

When LDR sense the night, lights L1, L2, L3&L4 switches to 100% illumination and lights from L5 to L20 switches to 30% illumination. When PIR1 sense the movement L5&L6 switches to 100% illumination. After 10 seconds if there is movement lights turns back to 30% illumination. This time delay can be changed according to the requirement. Similar to this whole system operates. Figure-8 shows the circuit diagram.

Perspectives in Communication, Embedded-Systems and Signal-Processing (PiCES) – An International Journal
ISSN: 2566-932X, Vol. 1, Issue 6, September 2017
Proceedings of National Conference on Emerging Trends in VLSI, Embedded and Networking (NC-EVEN 17), May 2017

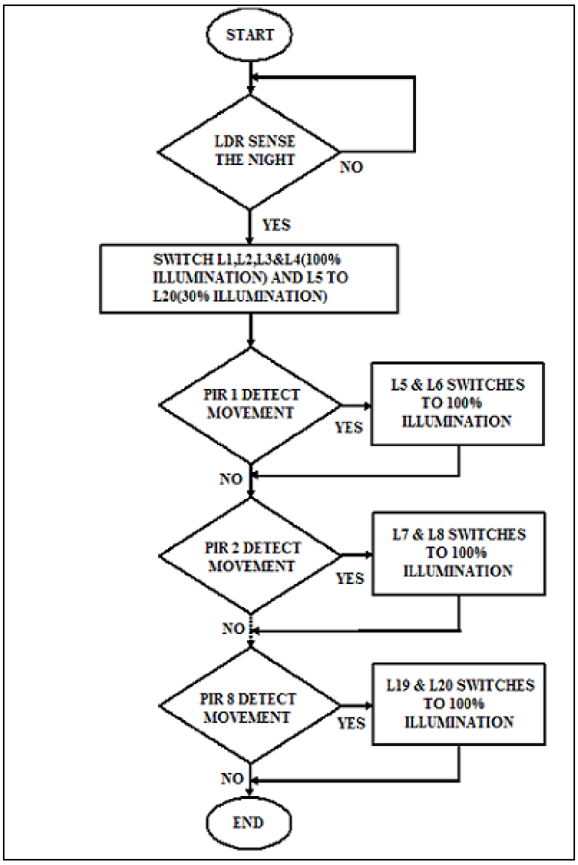

Fig 7. Flow chart

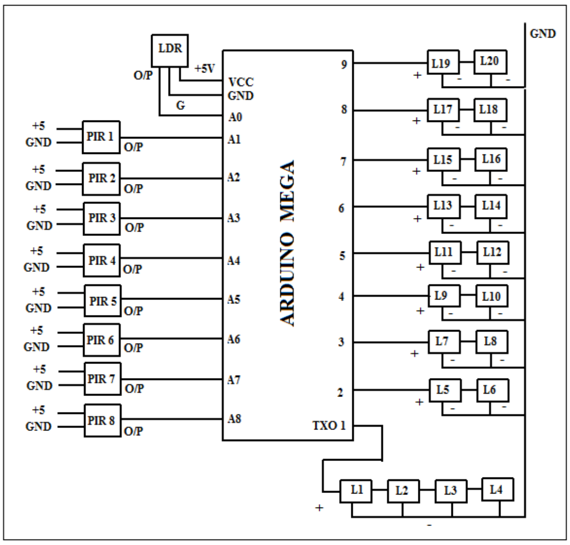

Fig 8. Circuit diagram

V. Result And Discusion

Figure-9 shows the model of the proposed system.

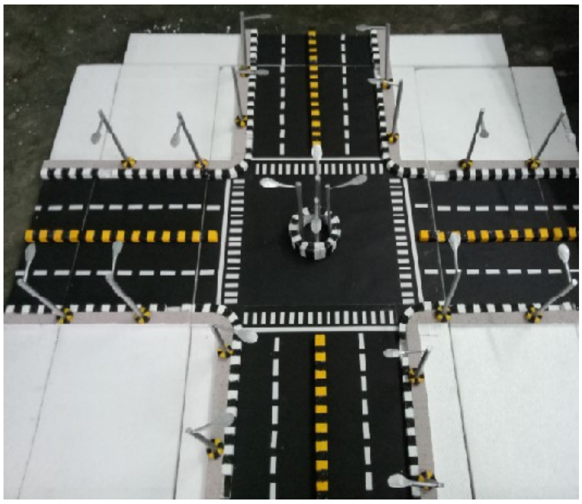

Fig 9. Model of proposed system.

The energy utilization is calculated as follows,

Taking each light rating 1.2w, 20*1.2*12 = 288wh

For 30 days 288*30=8640wh

Using proposed system, 4 LED lights at junction with 100% illumination for 12 hours,

i.e. 4*1.2*12 = 57.6wh

remaining 16 LEDs with 100% illumination when there is movement,

16*1.2*7 = 134.4wh (assuming from 6p.m to 12a.m usual vehicle movement and from 12a.m to 6a.m having one hour movement)

The same 16 LEDs with no vehicle or human movement

16*0.36*5 = 28.8wh (from 12a.m to 6a.m assuming 5 hours)

Total energy consumption in a day = 57.6+134.4+28.8 = 220.8wh

For 30 days = 220.8*30 = 6624wh

Therefore 2016wh, i.e. about 23.33% energy can be saved when compared to LED used for street lighting system.

The same can be calculated for real time street lighting system,

The typical lighting system operates whole night (i.e. from 6p.m to 6a.m) with all lights, and these lights may be High Pressure Sodium lamps or LED lights. Comparing LED and HPS (High Pressure Sodium) lamp, LEDs preferred for street lighting system. [5]

Using HPS lamps for street lights,

20 lights for 12 hours (6p.m to 6a.m) of 400 watt = 20*12*400 = 96Kwh

For 30 days or one month = 96Kwh*30=2.88Mwh

But using LEDs for street lights,

20 LEDs for 12 hour of 200 watt = 20*12*200 = 48Kwh

For 30 days or one month = 48Kwh*30 = 1.44Mwh

And LEDs with proposed system,

4 LED lights at junction with 100% illumination for 12 hours

i.e. 4*200*12 = 9600wh

Remaining 16 LEDs with 100% illumination when there is movement,

16*200*7 = 22.4Kwh (assuming from 6p.m to 12a.m usual vehicle movement and from 12a.m to 6a.m having one hour movement)

The same 16 LEDs with no vehicle or human movement

16*60*5 = 4800wh (from 12a.m to 6a.m assuming 5 hours)

Total energy consumption in a day =9600+22400+4800 =36.8Kwh

For 30 days = 36.8K*30 = 1.104Mwh

Therefore 336Kwh, i.e. 23.33% energy can be saved when compared to LED used for street lighting system.

And about 1.776Mwh, i.e. 61.667% energy can be saved when compared to HPS for street lighting system.

VI. CONCLUSION

By referring all the results, it can be concluded that both hardware and software design of this project meet the object. An energy efficient street lighting system was built using Arduino mega, PIR sensor and LED. Use of PIR sensor makes the energy saving. Since LED turns to 100% illumination when only vehicle or human movement. Using the proposed system about 23.33% energy can be saved when compared LEDs for public street lighting. And about 61.667% energy can be saved when compared to HPS lamp for street lighting system.

REFERENCES

[1] .International Journal of Engineering Trends and Technology-Volume4Issue1- 2013 ISSN: 2231-5381 http://www.internationaljournalssrg.org Page 54 GSM Based Autonomous Street Illumination System for Efficient Power Management.

[2] Implementation of passive infrared sensor in street lighting automation system. ARPN journal of engineering and applied sciences. VOL 10. NO. 22, PP. 17120-17126.

[3] K. Praveen, R. M. Nanda, A. B. Venkata, and H. Kadakol. 2014. Modular Weather and Environment Monitoring Systems using Raspberry Pi. International Journal of Engineering Research & Technology. Vol. 3, No. 9, pp.686–689.

[4] P. Chodon, D. M. Adhikari, R. Biswa, and S. Gyeltshen. 2013. Passive Infrared (PIR) Sensor Based Security System. International Journal of Electrical, Electronics and Computer Systems. Vol. 14, No. 2, pp. 2–6.

[5] Comparison between LED and HPS for street lighting. http://www.luxtg.com/led-vs-hps-street-lighting/