AUTOMATIC STREET LIGHT CONTROL SYSTEM USING WSN BASED ON VEHICLE MOVEMENT AND ATMOSPHERIC CONDITION

Sakthi Priya V.1, Mr.M.Vijayan2.,

1,2. V.Sakthi Priya,PG Scholar,Master of Engineering in Applied Electronics,Velalar College of Engineering and Technology,Thindal, Erode, India.

Received: 20-01-2017, **Revised:** 14-03-2017, **Accepted:** 21-04-2017, **Published online:** 11-06-2017

Abstract

Light Emitting Diode based street lighting system are becoming most common these days. But the limitation with this ordinary street light system is that it lacks of intelligent performance. It is necessary to automate the system, so that we conserve energy as well as to maximize the efficiency of the system. This paper presents a remote streetlight monitoring and controlling system based on LED and wireless sensor network. The system can be made set to run in automatic mode, which controls the streetlight. The control can make a reasonable adjustment according to the seasonal variation. This system also can run in controlled mode. This mode can take the initiative to control streetlights through PC monitor terminal.

The street lamp system includes a time cut-out , and an automatic control pattern for even more electricity conserving, namely when vehicles pass by, the LED will turn on automatically, later it will turn off. Here automation of street light is done by light-dependent resistor. The system is developed with various sensors namely IR sensor for vehicles, PIR sensor for human movement detection and LDR sensor for sunlight detection. As the sensors detect the conditions, using wireless technology microcontrollers made variations in LED. As the system is made connected to Internet of Things. It helps to make automatic street light to visualize the real time updates of street light and notifying the changes occur. Also help to check the status of street light from anywhere to operate using IoT in case of any failure. As it helps to verify the energy consumption of the street light.

Keywords— Street lamp, LED, PC monitor, IR, PIR, LDR, IoT.

I.INTRODUCTION

A street light, light pole, lamp post, street lamp, light standard, or lamp standard is a raised source of light on the edge of a road or walkway. It is used to illuminate the road side. The olden times of lighting streets and roadways is ancient, with evidence that many communities in the Ancient World encouraged citizens to keep outside lights burning through the course of the evening for navigation and safety.The earliest formal street lamps operated as a municipal service were gas lights, which were handlit by a crew of people every evening. Eventually, gas lighting was replaced with electric lighting and street lights today were fully automated.

Wireless sensor networks are currently being applied to energy conservation applications such as light control. In today's life, due to expanding social activities, people require reliable lighting during all hours of the day and night. Due to limitations and rising cost of energy production, and it is becoming increasingly important to direct greater efforts into optimizing electrical energy utilization.

An important part of the concept is also the implementation and testing of a street lighting monitoring and control system that is mainly directed at reducing the costs related to energy consumption and facilitate the maintenance process.[1]. In the area of use of new technologies for the sources of light and light-emitting diode (LED) technology is the best solution as it offers many benefits.[3]. Nowadays, the smart dimming capabilities are considered the

main way to increase the energy efficiency. This work investigates a simple and energy-efficient individual automatic dimming device.[8].

The public lighting in streets, tunnels, city centers, ports and squares etc. It can account for about 30% of the city energy consumption and the maintenance costs are very high. India is facing a enormous energy crisis which has to be addressed to at the earliest using devices that are energy capable. Based on environmental and financial factors, cities need smart energy management systems urgently for energy saving, maintenance costs decrease and CO2 emission decrease. This paper consist of spatially using autonomous devices embedded along with sensors which monitors an environmental parameters like sound ,fog ,temperature ,carbon monoxide release.

The system compromises of server, GUI to display and nodes which are micro controlled processed with embedded sensors measuring different parameters.[4] Each node in the network is linked to the main server. The analog data sensed by the sensor is converted in digital form, processed by microcontroller and then sent to the server. The master controls all the slaves and the other nodes sends the data to master and the master collects the data and further sends to concentrator and server where the data is monitored and on essential alterations process it to switch On/Off the nodes devices.[4].

II. DEVICES AND METHODS

In the device wireless sensor networks(WSN) are currently being applied to energy conservation applications such as light control. Recently, wireless sensor network have been applied to applications such as street light control. The logic of street lighting control systems may include factors such as daylight intensity, which is measured by light-sensitive sensors. When the human or vehicle movement detected, the motion sensor triggers the microcontroller to turn the LEDs to their complete brightness and it gets restored back to the dimming brightness. In addition, the system integrates a LDR to detect the sun light conditions so that the intensity of light will be changed according to the microcontroller output.

Raspberry Pi microcontroller board is used to provide different intensities at the different times of night using pulse width modulation(PWM) technique. The device is used by people of all ages to learn and explore computing. Raspberry Pi can be used to study Python and scratch programming. It is able of doing the whole thing from browsing the internet, playing video and games. The Raspberry Pi has the capability to interrelate with the real time applications, and is used in different applications.

The microcontroller is the heart of the system. It takes input from the sensors and makes the corresponding changes to the LED by increasing and decreasing the intensity. Here the Raspberry Pi 3 model is used which is 2GHz Quad-Core Advanced RISC Machine (ARM) Cortex-A53 (64Bit) 802.11b/g/n Wireless LAN and Bluetooth 4.1, Bluetooth Classic and LED.

Internet of Things (IoT) is implemented on automatic street light. IoT based street light helps to visualize the real time updates of street light and notifying the changes occur. Also help to check the status of street light from anywhere to operate using IoT in case of any failure. The whole control of the implemented street light can be controlled by controller through internet from anywhere. The notification of any street lamp is received using IoT, so that maintainability can be made easy.

A.Operation Methods

- Automatic Mode
- Manual Mode

In automatic mode, the street light is made ON and OFF automatically according to the vehicles and human moments. The street lamps automatically switches ON when the sunlight goes below the observable region of our eyes. This is done by a sensor called Light Dependent Resistor (LDR) which senses the light truly like our eyes. The system automatically switches OFF lights whenever the sunlight comes, observable to our eyes.

In manual method, in case of any need the implemented street light can be controlled manually using a controller.

III. SYSTEM ARCHITECTURE

To detects real time light intensity by the ambient lights sensor and depending upon the sensed light intensity take appropriate control action on the Street Light which is an end device, to produce library of several modules to simulate the network condition parameters, to provide graphical user interface which controls and monitors the status of street lights, to give graphical simulation of light intensity to the user.[4].

The block diagram of the method is shown in Fig.1. where the blocks performs it desired operation. The raspberry pi microcontroller is the heart core of the system as all the sensors are connected to the controller. As the sensors detects it corresponding action it wirelessly intimates to the controller. As the controller is programmed to make the desired changes to the LED according to the sensor intimation. The controller connects to the internet to manage in case of failure, energy consumption details. The IoT helps to collect all the details of the implemented system at a place. It is also possible to make any other required sensors connect to the controller without any disturbance to the system.

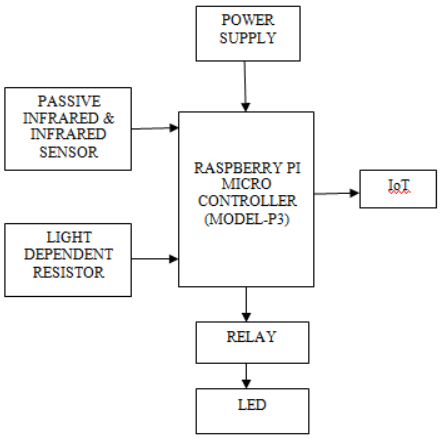

Fig. 1. Block Diagram

The system consists of microcontroller, light dependent resistor (LDR), passive infrared sensor (PIR) and light emitting diode. By using the LDR we can operate the lights, that is when the light is existing then it will be in the OFF state and when it is dark the light will be in ON state, that is LDR is inversely proportional to light. When the bright light falls on the LDR then it sends the commands to the microcontroller that it should be in the OFF state and then it switches OFF the light. The photoelectric sensor will be used to switch ON or OFF the light according to the presence or absent of the objective. All these commands are sent to the controller then according to that the machine operates. We use a relay to act as an ON/OFF switch. The PIR sensor helps to detect the human and infrared (IR) is used to detect vehicle movements. As the microcontroller is connected to the relay. The relay is an electrically operated switch which deals with many relays use an electromagnet to mechanically operate a switch. Here it is used to turn on and off the LED.

A.RASPBERRY-PI MICROCONTROLLER

The Raspberry Pi is a series of credit card-sized single-board computers developed the Raspberry Pi Foundation to promote the teaching of basic computer science. As the controller has the whole

control of the system. As the sensors detects and communicates through wireless technology to the controller, which activates and deactivates the LED light. Raspberry Pi microcontroller helps to make the system to control by IoT. The feature of a Broadcom SoC, which includes an ARM compatible Central Processing Unit (CPU) and an on chip GPU, a Video Core IV. The CPU speed of Raspberry Pi ranges from 700 MHz to 1.2 GHz for the Pi 3 and on board memory range from 256 MB to 1 GB RAM. SD cards are used to store the operating system and program memory in either the Secure Digital High Capacity (SDHC) or Micro SDHC sizes.

Fig. 2. Raspberry Pi

B.PASSIVE INFRARED SENSOR

A passive infrared sensor (PIR sensor) is an electronic sensor that deals with the infrared (IR) light radiating from objects. They are most often used in PIR-based motion detectors. All the substance with a temperature above absolute zero emit heat energy in the form of radiation. This radiation cannot be visible to the human eyes because it radiates at infrared wavelengths, but it can be detected by electronic devices designed for such a purpose.

Fig. 3. PIR Sensor

C.IR Sensor

An infrared sensor is an electronic instrument that can used to detects certain characteristics of its environment by either emitting or detecting infrared radiation. It is capable of measuring temperature of an object and detecting motion. Infrared waves are not visible to the human eye. In an electromagnetic spectrum, infrared radiation is the region having the wavelengths longer than observable light wavelengths, but shorter than microwaves. The infrared region is approximately demarcate from 0.75 to 1000μm. IR (infrared) sensors detect infrared light. IR light is transformed into an electric current, and this is detected by a voltage or amperage detector.

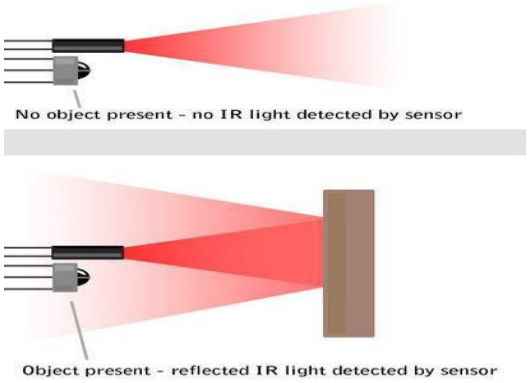

Fig. 4. IR Sensor

D.LDR

An LDR is a variable resistor whose value decreases with increasing light intensity. It is made of a high-resistance semiconductor. If the light falling on the devices is of high sufficient frequency, photons absorbed by the semiconductor gives bound electrons enough energy to fly into the conduction band. The resulting free

electron conduct electricity, thereby lowering resistance.

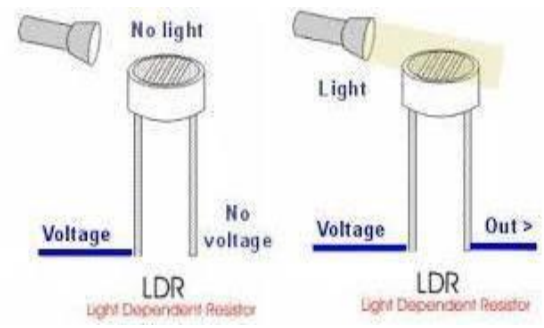

Fig. 5. LDR Sensor

IV.SOFTWARE DESCRIPTION

PYTHON LANGUAGE

Python is an interpreted language which emphasizes code readability using a whitespace indentation to delimit code blocks rather than curly braces or key words and have a syntax which allows programmers to convey the concepts in fewer lines of code than possible in languages such as C++ or java. It ia an multi-paradigm, functional, procedural, reflective. The typing discipline duck, dynamic, strong. The OS is cross-platform.It is a high-level programming language and features a dynamic type system and automatic memory management and supports multiple program paradigms, including object-oriented, imperative, functional programming and procedural styles. It has large and comprehensive standard library.

V.RESULTS AND DISCUSSION

The system aims to decrease the side effects of the present street lighting system, and find a solution to save power. It is necessary to prepare the inputs and outputs of the system to control the lights of the street. The prototype as shown in fig. 7. has been implemented and works as expected and it will prove to be very useful and will fulfil all the present constraints if implemented on a large scale**.** Using IoT the webpage displays the real time information of the status of the light on the webpage.

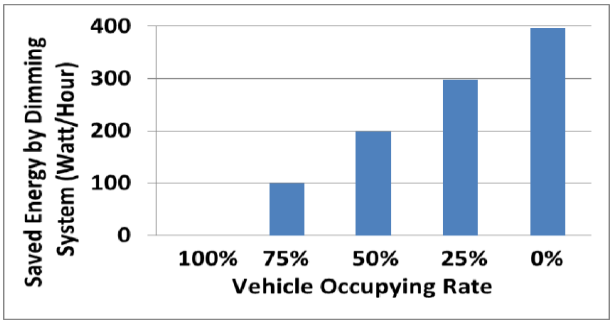

Fig. 6. Vehicle Rate Vs Energy Graph

For the proposed LED street lighting system, in addition to the energy savings due to the replacement of conventional high power pole lamp by lower power LED pole lamp, additional energy saving is achieved through employing proposed dimming circuit. Moreover, the proposed LED street lighting system results in improving system response time through decentralization by avoiding the wireless monitoring and remote control system.

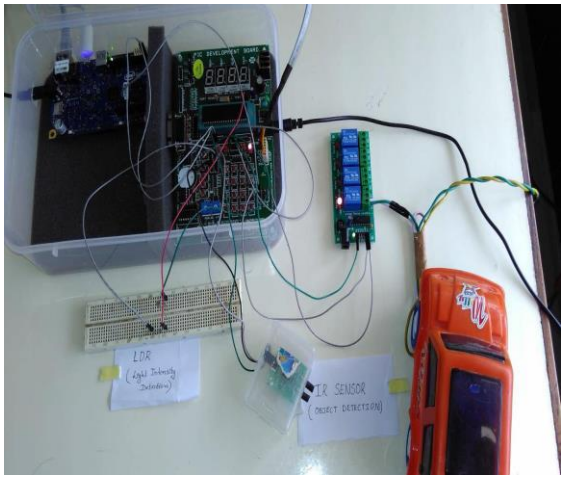

Fig. 7. Prototype of Automatic Street Lighting System

The prototype of the system in fig. 7. shows obstacle detection on the street through IR sensor when the IR Sensor detects the obstacle and intimates the microcontroller to switch ON the Lights.

VI.CONCLUSION

In this proposed paper an automatic street light is designed using Wireless Sensor

Network to detect the vehicle, human movements and atmospheric condition. This system also helps to increase and decrease the intensity of LED. Internet of Things (IoT) is implemented on this project automatic street light. IoT based automatic street light helps to visualize the real time updates of street light and notifying the changes occur. Also help to check the status of street light from anywhere to operate using IoT in case of any failure.

REFERENCES

[1] Alexandru Lavric, Valentin Popa, and Stefan Stichi, "Street lighting control system based on large-scale WSN: A step towards a smart city," International Conference and Exposition on Electrical and Power Engineering (EPE), 16-18 October, Iasi, Romania IEEE, pp. 673-676, 2014.

[2] Archana. M, and Mahalahshmi. R, "E – Street: LED powered intelligent street lighting system with automatic brightness adjustment based on climatic conditions and vehicle movements," International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, Vol. 3, Special Issue 2, pp. 60-67, April 2014.

[3] Bidhan Chandra Mishra, Avipsa S. Panda, N.K. Rout, and Sumant Kumar Mohapatra, "A novel efficient design of Intelligent Street Lighting monitoring system using zigbee network of devices and sensors on Embedded Internet Technology," International Conference on Information Technology IEEE, pp, 200-205, 2015.

[4] Chaitanya Amin, AshutoshNerkar, Paridhi Holani, and Rahul Kaul, "GSM based autonomous street illumination system for efficient power management," International Journal of Engineering Trends and Technology- Volume4Issue1, pp. 54-60, 2013.

[5] Fabio Leccese, "Remote-control system of high efficiency and intelligent street lighting using a zigbee network of devices and sensors," IEEE transactions on power delivery, vol. 28, no. 1, pp, 21-28, Jan 2013.

[6] Gul Shahzad, Heekwon Yang, Arbab Waheed Ahmad and Chankil Lee, "Energy-efficient intelligent street lighting system using traffic-adaptive control," IEEE Sensors Journal, pp. 1-9, 2016.

[7] Hussain A. Attia, Amjad Omar, and Maen Takruri, "Design of decentralized street led light dimming system," IEEE 2016

[8] Lovasoa F.F.Rakotomalala, R. Zely, Fadel C.M. Kebe, Elena Danila, and Dorin D.Lucache, "High energy saving for africa street lighting using individual automatic dimming of HID ballasts," International Conference and Exposition on Electrical and Power Engineering (EPE) , pp. 683-688, 2014.

[9] V. Shiva Prasad Nayak, A Vinay Krishna, Asmita Rangari, B.Sammunayak, and K. Madhukar, "Development of street lighting system with vehicular sensing at low light intensity based on zigbee intelligence," IEEE Fifth International Conference On Recent Trends In Information Technology, 2016.

[10] Swati Rajesh Parekar and Manoj M. Dongre, "An intelligent system for monitoring and controlling of street light using GSM technology," IEEE 2015 International Conference on Information Processing (ICIP) Dec 16-19, 2015.