International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 05 Issue: 05 | May-2018 www.irjet.net p-ISSN: 2395-0072

AUTOMATIC STREET LIGHT CONTROL AND TRAFFIC INFORMATION USING POWER LINE COMMUNICATION

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Abstract - *Street lighting in its many forms is a major consumer of electricity and is also a vital part of public safety .Ensuring that street lights are reliably on and at the optimal illumination level for pedestrian and vehicle traffic is critical to public safety and it makes the process of energy saving easier and efficient. As a result, any improvements to energy usage, operational reliability and maintenance costs provide significant payback for the organizations responsible for that street lighting. The aim of the project is to provide automatic on/off control and fault detection of street light. Power line communication [PLC] is the natural choice for automating street lighting networks. PLC enables companies and municipalities to reduce operational costs and improve safety. The street lights in a lane of traffic are controlled automatically by sensing the intensity of atmospheric light. It also detects the faulty lamps and gives the feedback to the nearest remote station with the help of PLC network. The main feature of this project is to implement an automatic traffic warning system. Warning signals are provided at an area about a traffic jam of a particular area coming forth. Once traffic block is detected, the information is transmitted via a power line by using suitable modulation techniques. This project discusses the benefits of a Power line communication-based automation system and presents a real world example of a system for reducing energy usage, lowering maintenance costs and traffic block in streets.*

***Key Words*: Power line communication, Energy saving, Fault detection, Automating Street lights**

1. INTRODUCTION

In the past, street lamps were turned on or off by a simple Timer or switch. A street lighting system which is designed well should allow users to travel at night with good visibility in the sense of safety and comfort. The system enhance the appearance of the neighborhood reduces the accident during late night. On the other hand, poorly designed existing lighting systems can lead to poor visibility which may not be helpful for any footer and who are passing by that street. According to global grid electricity consumption for lighting was about 2650 TW in 2005, which was an equivalent of 19% of total global electricity consumption. The building dedicate about 50% of their electricity for lighting, whereas the share of electricity for lighting is around 20-30% in hospitals, 1015% in schools,10% in residential building and 15% in factories. Automatic smart lighting control system is a perfect solution especially in public lighting management. It realizes on/off and intensity control of lights, which save energy by 40%, save lights maintenance costs by 50%, and prolong lamp life by 25%.

When a street lamp did not light due to fault or electric leakage, it would not be found until it was reported by somebody or found by patrol men. In addition, sometimes the wires for street lamps were stolen, and because the street lamps were extensively distributed, they could not be completely protected by laborers. Street lamps should be protected by automatic detection devices, and with the continuous development of communication technology, such as power line communication technologies, extensive street lamp monitoring and energy conservation management becomes feasible. With the requirements of the public, management units, safety, and energy saving, the combination of street lamps and intelligent lighting techniques is an inevitable trend, as well as an inevitable requirement of developing or developed countries. The combination of LED street lamps and intelligent lighting can optimize energy saving and meet the requirements of the public, management, and safety. Despite increasing traffic congestion, Americans still depend on the automobile for mobility, and there's no trend towards change. Cars continue to dominate urban travel among every segment of the population. In 2002, more than 9,400 people were killed and 1.4 million injured in crashes at intersections (Funderburg, 2004). Drivers need help in driving safely and avoiding traffic accidents at any point on the roadway: entrances, highways, exits and intersections. Transportation has enabled the creation of the modern city, but the public's increasing need to travel and the difficulty of providing additional capacity to accommodate this travel has increased congestion and reduced mobility in many cities. Current technology for intelligent transportation systems (ITS) can provide the potential to improve the operations and efficiency of travel by providing information that can help drivers make better use of existing facilities. Population and number of households have continued to increase in most areas. There is a perceived need to accommodate this growth by rebuilding the roadway infrastructure (i.e., roadways) themselves. The shortcomings in the roadways coupled with the longer travel distances to existing work places and other services, cause major increases in automobile travel. Transportation demand has typically greatly

exceeded the population growth. Transportation improvements will benefit the roadways if the improvements facilitate the movement toward an effective transportation system.

At present, faults in road lighting are manually inspected, and while street lamp controllers are thorough, there are still faults reported and fixed late. Management units require a system that automatically and instantly detects and reports the current conditions of global lighting, and even automatically analyzes lamp equipment that should be overhauled and changed, in order that lamp equipment can be rapidly maintained and periodically changed. street lamp faults result in poor lighting, which influences public safety.

2. DEVICE WORKING PRINCIPLE

Our project comprises of two parts, Automatic street light controlling system and traffic warning system. In the automatic street light controlling system, streetlights are controlled by sensing the intensity of atmospheric light. Fault detection of streetlights is also possible as a part of this sytem. In the traffic warning system, traffic block is detected and the information is transmitted via a power line by using suitable modulation techniques.

The automatic streetlight controlling system circuit consists of Arduino mega, Four streetlamps, Switching relay and two LDR's. Two LDR's are connected with each of the four lamps. One of the lamp is placed over the lamp for identifying intensity of atmosphere and the other is used to monitor the lamp health status which is placed inside the streetlamp. The LDR resistance changes with intensity of light. With increase in intensity, the resistance offered by the sensor decreases and with decrease in light intensity the resistance offered by the sensor increases. This helps in finding the amount of light intensity at that instant of time and regulating the lighting of our lighting system accordingly. LDR senses the light and sends data to Microcontroller, Arduino mega. According to the program code in arduino, when the atmospheric intensity becomes less than the threshold value, street light is made ON automatically using switching relay. The LDR placed inside the lamp is for the fault detection part. The status of the lamp is sensed by the LDR and send it to arduino where it process the information and send the data to the control station through the power line. The control station will monitor every streetlamp status. A pair of modems is used to establish a successful communication link. The data from the arduino mega is send to the first modem which is the modulator and modulates the signal at 3000Hz.The modulated signal is send to the demodulator which demodulates the signal at 3000Hz itself. At the receiver side, microcontroller used is Arduino UNO. Arduino is connected with demodulator and the received digital signal is converted to analog signal by the UNO. This analog signal is send to the LCD display and it displays the required information. Traffic monitoring system circuit consists of IR sensors.IR sensor is used for object detection using which the system gets an input of traffic density. Based upon the intensity of reflected light from the IR sensor, arduino mega checks whether there is traffic block or not. When there is a traffic block, a high signal will be send to the control station through power line after undergoing modulation techniques and the result is displayed on the LCD display.

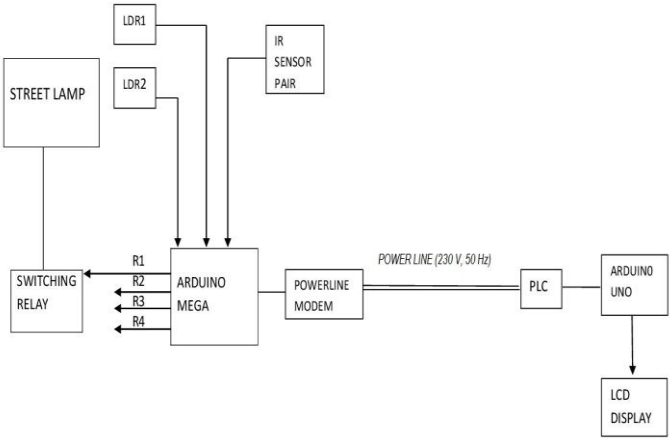

Fig -1: Block diagram of Automatic streetlight control and traffic warning system

3. DEVICE DESIGN

The idea of designing a new system for the street-light 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 . The system is designed in such a way that in the street lights circuit we place light sensors and which are responsible to automatically on/off switching. During day time street lights are automatically made OFF and during night time they are made ON. Whenever the fault occur in the system it is detected by sensors and this is send to the microcontroller and with the help of power line attached with the circuit for sending message to the control station. With this information available in the control station, the technician can easily locate the particular light which reduces the time to identify it and repair it. The main objective of the proposed system is to accomplish individual faults repaired within less working hours instead of taking more time. The status of the lamp which is sense by the LDRs is send to microcontroller, where the microcontroller will process the information and send the data to the control station. The control station will monitor every street lamp status, also controlling the operation of the street lamps.

In the traffic monitoring system traffic is detected with the help of IR sensors. Infrared Obstacle Sensor Module has built in IR transmitter and IR receiver that sends out IR energy and looks for reflected IR energy to detect

presence of any obstacle in front of the sensor module. The module has on board potentiometer that lets user adjust detection range. If traffic is detected, the information is given as a warning to the road users via a power line. Thus the users are capable of taking another way of travel rather than wasting time in the traffic.

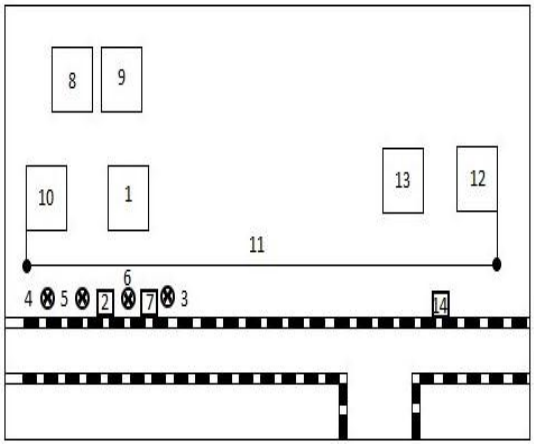

Fig 2. Plan

1 - Arduino Mega

13 - Arduino UNO

10 - Power Line Modulator

12 - Power Line Demodulator

4,5,6,3 – Streetlamps

2,7 - Infrared Sensors

8,9 - Switching Relays

14 – LCD Relays

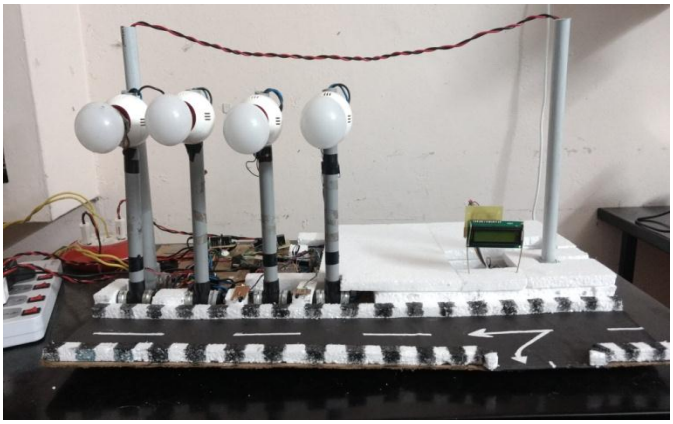

Fig-3: Experimental setup

4. CONCLUSION

This Arduino based project will provide a competent method for lighting systems and make the whole process of energy saving easier and efficient. With a capability to change the amount of light emitted depending upon the outside condition is no doubt an innovation with many future applications apart from the fact that it can also be used in many present day technologies such as head lights, street light, park lights, industrial lights and many more. The usage of the smart lighting system will undoubtedly change the world that we see today. This project is an application of power line communication. It is a promising technology for economical data transmission especially in remote areas.

5. FUTURE WORKS

Power line carrier communication technique has started to be used in smart domestic grids. It can also be used for monitoring and controlling power usage, for automation of hospitals, factories and other commercial buildings. New power line communication standards like PRIME and G3PLC has succeeded in faithful transmission with narrow band. The improvement in these standards opens wider future possibilities.

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