

AN ENERGY EFFICIENT STREET LIGHT SYSTEM- A SURVEY

Gudinho Diana Minine¹, Pratiksha Prabhu²,
Soumya Bhandary³, Sushmitha⁴

Department of Information Science and Engineering, Canara Engineering College

Project Guide: Mrs.Archana Priyadarshini Rao,

Assistant Professor, Dept. of ISE, Canara Engineering College

ABSTRACT: *This project focuses on one of the many ways in which piezoelectric materials can be used to produce electrical energy. A well-designed energy efficient street light system should permit traffic and pedestrian to travel with great visibility in safety and comfort while reducing cost and energy consumption. This project requires an LDR to detect day or night. In this system we put into light the piezoelectric effect in which certain materials have the ability to build up an electrical charge from having pressure and strain applied to them. This system is focused on the applications of auto street light for transportation facilities using that energy. When the roads are engineered with piezoelectric technology, the energy produced by the pressure of moving vehicles is captured by piezo sensors and converted it into electrical charge by a Piezoelectric Transducer (PZT), then the energy is stored and used as an energy generation source. This energy source can be used for auto street lighting as a source of roadside power generation unit. The power is generated as a result of pressure due to movement of vehicles on the road to control street lighting on highways and also automating their process. It provides sustainable solution in terms of environment, economy and social needs.*

Keywords- *Energy,IOT, LDR, Piezoelectric transducer (PZT),Street light*

I. INTRODUCTION

This system is focused on the applications of auto street light for transportation facilities using electrical energy. Power has been a critical part in our lives from the time it was developed of the country. Power is characterized as a set of physical wonder connected with the stream of charge. As we all know, street lights are one of the main city's assets which provide safe roads and enhanced security in homes as well as city centres. There are many alternate methods by which electricity can be generated. In the past few decades, there were few streets in a town or city, street lamps and management control is relatively simple, but as the country developed into a well-off society, and with urbanization, the number of streets in the town increased rapidly. So, the control and management of street lights became a problem. At present, street lamps are under manual control, a control switch set in each of the street lamps, it is also called as the first generation of the original street light control, which is inefficient and a waste of manpower. A huge amount of electrical energy is wasted. The highly

2 Days International Conference on CSIT-2019, ICSD-2019

Mahratta Chamber of Commerce, Industries and Agriculture Tilak Road, Pune (India)



2nd-3rd November 2019

www.conferenceworld.in

ISBN : 978-81-943584-1-1

discussed topic in the present situation in Science and Technology is “Energy conservation and reduction of workforce”. The existing prototypes should be improvised in the manner of low power consumption, which is a major priority. Especially in developing countries like India. In rural areas vehicle movement are less so need of full intensity street light is less.

One such system is to change the resistance by using the light-sensitive device to control street lamps that lights up automatically in the evening after dark and turns off automatically in the morning. In this project, in one of the cases the street light turns on when the light intensity is decreased along with the motion of the vehicles or the pedestrian using IR sensors where the street lights glow for a few seconds, so the energy wastage is reduced and the street light glows automatically. This system is mounted with IR sensors which is used to detect movement. These systems are installed on either side of the road in such a way that they are vulnerable to external factors and natural calamities. The combination of LDR and piezoelectric sensor would predict the movement on the roads as well as the density of vehicles on the roads, which may increase the efficiency of energy conservation operation. The vehicles moving on the road tends to vibration of the piezoelectric material placed below the road due to deformation, caused by the pressure of vehicle passing. The possibilities of damage are reduced considerably as they are mounted under the road. This lays down our project of the automated street light system based on IOT and piezoelectric effect.

II. LITERATURE SURVEY

There have been many studies done in the area of smart street light system to provide an easy and efficient method to control street light and automate their process. The following are a few studies that we have referred to.

Intelligent Street-Light System using Arduino UNO [1]The purpose of this work is to describe the Intelligent Street Lighting (ISL) system, an approach to accomplish the demand for flexible public lighting systems. The present system is like, the street lights will be switched on in the evening before the sun sets and they are switched off the next day morning after there is sufficient light on the roads. This project gives the best solution for electrical power wastage. Also, the manual operation of the lighting system is completely eliminated. In this project, sensors used are, Light Dependent Resistor (LDR) to indicate a day/night time and photoelectric sensors to detect the movement on the street. The Arduino Uno is used as brain to control the street light system.

In their system, the use of LASER and photoelectric sensor for detection and movement of vehicles whereas in our system we are using piezoelectric transducers for motion detection as well as density measurement.

Zigbee based Street Light Control System: The Development of Zigbee based Street Light Control System [2] is proposed by S.H. Jeong. In this paper, a new method is suggested that is ZIGBEE and sensors which increases the efficiency of the street lighting system so as to maximize the efficiency of the street lighting system it uses a combination of sensors to control the system. The ZIGBEE transmitter’s information or data use point to point and it is sent to check the state of the street lamps. Moreover, it uses a control terminal and hence we can take immediate actions if required which monitor and control condition of street lights installed beside the street.

2 Days International Conference on CSIT-2019, ICSD-2019

Mahratta Chamber of Commerce, Industries and Agriculture Tilak Road, Pune (India)



2nd-3rd November 2019

www.conferenceworld.in

ISBN : 978-81-943584-1-1

Lights are switched to ON/OFF by this control system. The control system monitors the local information status through the communication channel. Status information which is monitored are on/off status information, energy-saving mode status, control group status information and information related to safety, etc. For control command transfer and status information between the streetlight control system and street light control remote terminals in which each light pole installed, it uses various communication protocols and communication media. As communication media, wireless or power lines are generally used.

In our system, Street light control system can save maintenance time and costs and which can improve the safety level.

Remote Street Light Monitoring System: Remote street light monitoring system is proposed to overcome the already proposed technologies which are complex and time-consuming. To observe the current population and the increase in traffic, this system perfectly matches all the requirements. Remote streetlight monitoring system based on wireless sensor network [3] is proposed by Gong Siliang. It controls streetlight according to light intensity and Sunrise and Sunset Algorithm. This controls reasonable adjustment and seasonal Variation. We can control street lights because this system also can run in controlled mode with the use of display monitor terminal. In addition, the system contains a digital temperature-humidity sensor for monitoring the streetlight Real-time, temperature and humidity. Because this system is equipped with the high-power relay output and can be widely applied in all places such as streets, stations, mining, schools, and electricity sectors and so on. This system is especially proposed for urban areas. A sensor node, controller centre and the remote terminal system are the gadgets used to form this system. The sensor nodes are installed in each pole of the lamp to monitor each lamp pole, remote terminal unit for performing the entire task from the remote places.

In our system, we use wired technology for better speed and connectivity. There is no specific algorithmic based methodology.

LED street lighting system [4]: Proposed by Gustavo W. Denardin. For the modern street lighting systems, the use of LED is very convenient and economic because compared to others lighting system LED has a longer lifetime, higher luminous efficiency and higher CRI. In this control network disconnection of the street lighting system can be done automatically, consumption of distributed power system, management cost is less than the others and it observes to control and monitor the information of each street lighting unit. In order to meet the system requirements, a wireless sensor network based on IEEE 802.15.4TM standard is employed. Its geographic routing strategy is used for this system handling, which makes it more scalable.

The system which is used is not externally powered when compared to our system which is powered by the pressure sensors. We use the NodeMCU which is built-in with the Wi-Fi module that helps connect to the Internet.

Intelligent Street Light System using RF Transmission [5]: The proposed prototype of intelligent street light can detect daylight and vehicles and vary the intensity of the LED based street lamps as per the traffic flow. It can also help in monitoring of street light system and fault detection through RF wireless technology. If intelligent street light is designed and installed in the cities, then a lot of power can be saved and this will also minimize the

2 Days International Conference on CSIT-2019, ICSD-2019

Mahratta Chamber of Commerce, Industries and Agriculture Tilak Road, Pune (India)



2nd -3rd November 2019

www.conferenceworld.in

ISBN : 978-81-943584-1-1

cost of maintenance over traditional wired systems. The system is versatile, and can be extended as per user needs.

Our system uses the technique of pressure generated electricity, hence the use of large number of sensors is omitted. The distinctive feature of our project is the provision of web interface to monitor the entire system.

TABLE 1: ANALYSIS AND COMPARISON OF DIFFERENT TECHNIQUES

Paper	Merits	Demerits
Intelligent Street Light System using Arduino UNO	1. Scalability is high. 2. Deployment is easy.	Semantic point of view is not defined.
Zigbee based street light control system	1. Save more energy. 2. Reduces manualwork.	Design is complex.
Remote streetlight monitoring system	1. Consume power. 2. Scalability is high.	Cannot be self-localized.
LED Street Lightingsystem	Consumes more power.	Regular maintenance.
Intelligent Street Light System using RF transmission	Uses RF wireless technology.	Large number of sensors are used.

III. PROPOSED SYSTEM

This system basically is an IOT powered smart street lighting using piezoelectric effect. It makes use of the different sensors such as LDR (Light Dependent Resistor) and IR (InfraRed) sensor. With the help of variable resistance in the LDR sensor this system can detect by whether it is day or night. The IR sensor is used to detect any motion in the surrounding, when a vehicle passes from the street light, the sensor will indicate the street light to glow.

The glowing of the street light is using the phenomenon of piezoelectric circuit. The pressure generated by the movement of vehicles over the piezo sensors, will produce AC voltage output over the piezoelectric transducers. This generated voltage is given as an input to the rectifier circuit which will convert the AC voltage

to the DC voltage. The system stores this in the capacitor circuit as shown in **Fig 1** and it will be used to glow the street light in the later part.

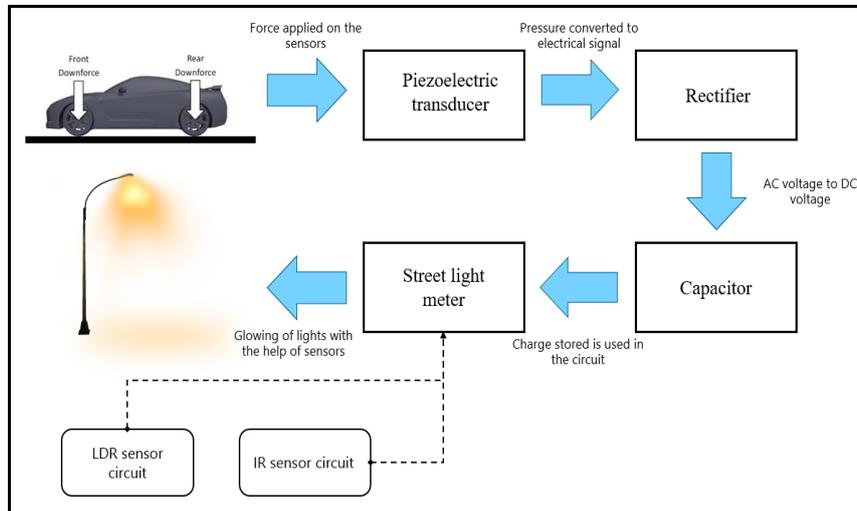


Fig 1: Block diagram of automatic streetlight using piezoelectricity generation

IV. REQUIREMENTS OF PROPOSED SYSTEM

In order to build the proposed framework for the energy efficient street light system, we have used the following hardware and software components:

a. Piezoelectric Transducer:

The Piezoelectric transducer is an electroacoustic transducer use for conversion of pressure or mechanical stress into an alternating electrical force. It is used for measuring the physical quantity like force, pressure, stress, etc. which is directly not possible to measure. The piezoelectric transducers work on the principle of piezoelectric effect. When mechanical stress or forces are applied to some materials along certain planes, they produce electric voltage.

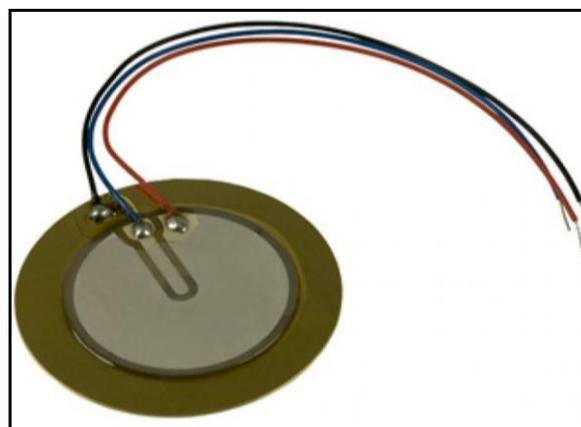


Fig No.-2

b. LDR:

An LDR is a component that has a (variable) resistance that changes with the light intensity that falls upon it. This allows them to be used in light sensing circuits.



Fig No.-3

c. Rectifiers:

A rectifier is an electrical device that converts AC to DC. AC regularly reverses direction, while DC flows in one direction only. Rectification produces a type of DC that encompasses active voltages and currents, which are then adjusted into a type of constant voltage DC, although this varies depending on the current's end use. The current is allowed to flow uninterrupted in one direction, and no current is allowed to flow in the opposite direction.

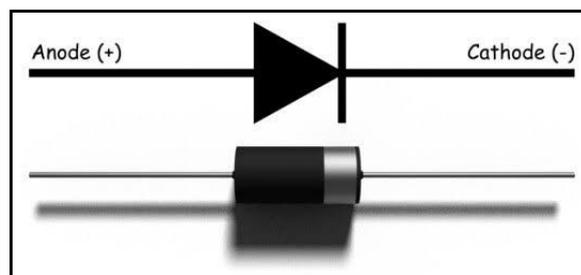


Fig No.-4

d. NodeMCU:

NodeMCU is an open-source firmware and development kit that helps you to prototype or build IoT product. It allows you to program the ESP8266 Wi-Fi module with the simple and powerful LUA programming language or Arduino IDE.

2 Days International Conference on CSIT-2019, ICSD-2019

Mahratta Chamber of Commerce, Industries and Agriculture Tilak Road, Pune (India)



2nd -3rd November 2019

www.conferenceworld.in

ISBN : 978-81-943584-1-1

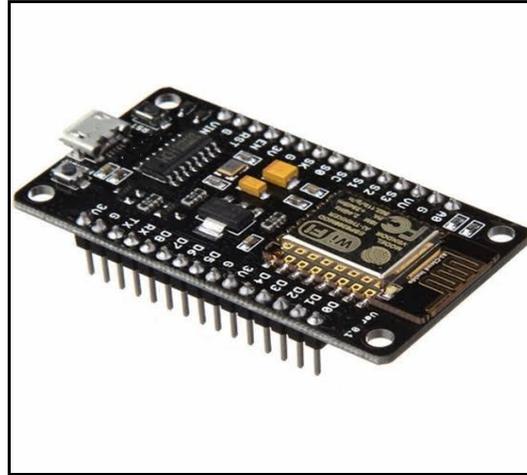


Fig No.-5

e. Capacitors:

Capacitor, device for storing electrical energy, consisting of two conductors in close proximity and insulated from each other. They are used, for example, in digital circuits so that information stored in large computer memories is not lost during a momentary electric power failure; the electric energy stored in such capacitors maintains the information during the temporary loss of power. The ability of the capacitor has to be coordinated to the ability of the battery in order to provide consistent electrical results. A simple example of such a storage device is a parallel-plate capacitor.



Fig No.-6

VII. CONCLUSION

On comparing and studying all of the above technologies, it is concluded that our project is fulfilling all the requirements it's not only cost efficient but also it contains less complexity. As a conclusion 60% of power consumption can be reduced by using this system for providing a solution for energy saving. LEDs are going to be vital lightning option due to its low power consumption and cost-effectiveness. Our system will help in

2 Days International Conference on CSIT-2019, ICSD-2019

Mahratta Chamber of Commerce, Industries and Agriculture Tilak Road, Pune (India)



2nd -3rd November 2019

www.conferenceworld.in

ISBN : 978-81-943584-1-1

eliminating the current sodium vapour street lamps with better LED comprised lamps operated smartly using LDR and piezoelectric sensors. The main drawback is that maintenance of these roads is bit difficult and constant inspections are to be made.

It is a great hope that energy harvesting will rule the next decade in the technical field. Thus, this method can be used efficiently in street light management to save energy.

REFERENCES

- [1] "Intelligent Street-Light System using Arduino UNO" *International Journal of Recent Trends in Engineering & Research (IJRTER) Special Issue; March - 2017 [ISSN: 2455-1457]*.
- [2] "Development of Zigbee based Street Light Control System" *IEEE PSCE 2006*.
- [3] "Survey of Wireless Sensor Network and Street light Monitoring" *International Journal of Engineering Research and Technology (IJERT), ISSN: 2278-0181 Vol 5 Issue 10 October 2016*.
- [4] "Automatic Street Light Intensity Control and Road Safety Module Using Embedded System" *International Conference on Computing and Control Engineering (ICCCE 2012), 12 & 13 April, 2012*.
- [5] "A New Streetlight Monitoring System Based on Wireless Sensor Networks" *IEEE 2010*.
- [6] "Wireless internet lighting control system", Budike, E.S. Lothar (*Power web Technologies*), US patent 7,167,777, Jan 23, 2007.
- [7] "Generation and Storage of Electric Energy from Piezoelectric Materials" *IEEE 2017*.
- [8] "Intelligent Street Lighting System Using Gsm" *International Journal of Engineering Science Invention ISSN (Online): 2319 – 6734, ISSN (Print): 2319 – 6726 Volume 2 Issue 3 March 2013*.