International Research Journal of Advanced Engineering and Science
ISSN: 2455-9024

# Pedestrian Aware Automatic Street Light Using Motion Sensor, LabVIEW and ZigBee

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*Abstract— Street light, a raised source of light that is commonly used along walkways and streets when the surrounding turns dark. Conventional street lighting systems in areas with a low frequency of passersby are ON most of the night without purpose. The consequence is that a large amount of power is wasted meaninglessly. ZigBee based Automatic Street light system is smart and provides a safe night time environment for all road users including pedestrians. The smart Street light can reduce energy consumption and maintenance costs and also helps to reduce crime activities up to certain limit. This system would provide a remote access for streetlight maintenance and control. It also discusses an intelligent system that controls ON/OFF/DIMMING considering movement of vehicle or pedestrian at night. An automatic streetlight system is designed with the help of ZigBee modules which can help in detection of faulty lights and control it. For monitoring purpose, a graphical user interface (GUI) is created.*

***Keywords***— *LabVIEW, LDR, motion sensor, PIC microcontroller, ZigBee.*

## I. INTRODUCTION

Street lights are one of the main sources of consumption and also wastage of electrical energy. By utilizing proper hardware and software techniques, huge amount of electrical energy can be saved out of street lighting process.

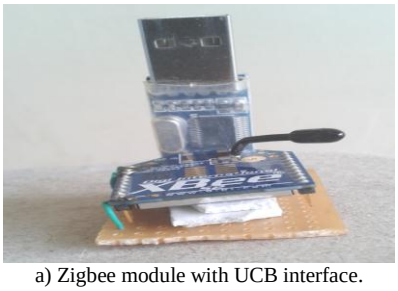
The authors in the present work have used LabVIEW for developing very efficient software and Zigbee, PIC microcontroller and motion sensor for developing hardware for street lighting, which can save more than 33% of electrical energy.

Sensor is used to control and guarantee the desired system parameters and the sensors transfer the collected information to a microcontroller which runs the software to analyze the system. The purpose of microcontroller is to take the data from all the streetlight through parallel processing and convert them into serial communication. The information is transferred point by point using ZigBee transmitter and receiver modules and is sent to a control terminal used to check the state of the street lamps. Through GUI technician can identify the faults and can easily maintain the system. The transmission system consists of a ZigBee device that receives information on the state of the lamps and sends it to a terminal. At receiver side, base station system allows the visualization of the entire lighting system. VISA driver is used for USB (parallel) to serial communication to which Zigbee module is attached. This unit receives information about the state of the lamps provided by a ZigBee device. The terminal is required for a graphical display of the results. The graphical interface enables monitoring the state of the system with the state of the lights. ZigBee device communicates point-to-point to detect the faulty lights in the system. Through GUI technician can identify the faults and can easily maintain the system.

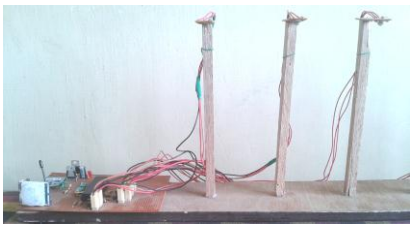
## II. DEVELOPMENT OF NEW STREET LIGHT CONTROL SYSTEM

A prototype of ZigBee based smart street light system is developed. Developed streetlight system is composed of different units, streetlight terminal and control system. Among them, street light terminal are hardware based system and control system works based on software.

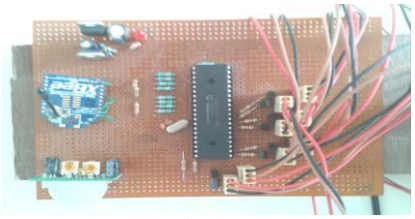
Hardware Developed is shown in figure 1.



a) Zigbee module with UCB interface.



b) Street light zone with Zigbee and motion sensor.



c) Top view of circuit developed.

Fig. 1. Hardware developed.

## III. SOFTWARE FOR STREET LIGHTING

The software developed by the investigator is a very powerful software application and can save 33% or more of



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energy consumed in street lights. Main features of this system are:-

1. It can be controlled both online and offline.
2. It can save huge amount of energy.
3. Simple operator can handle this software
4. It can incorporate automatic on/off facility.
5. It resumes the control properly in case of power cut.
6. Any faulty street light can be detected in the control room.

The street lighting software application is shown in figure 2. The concept behind this street light is that the street lights communicate with each other and the control room. Generally all street lights are on ON during the whole night. The investigator in the present work has used LabVIEW software to switch OFF/Dim Street Lights after10 PM. As the traffic gets reduced to quite an extent in the night hours, therefore the requirement to keep the street light ON is not so essential for whole night. The front panel is shown figure 2.

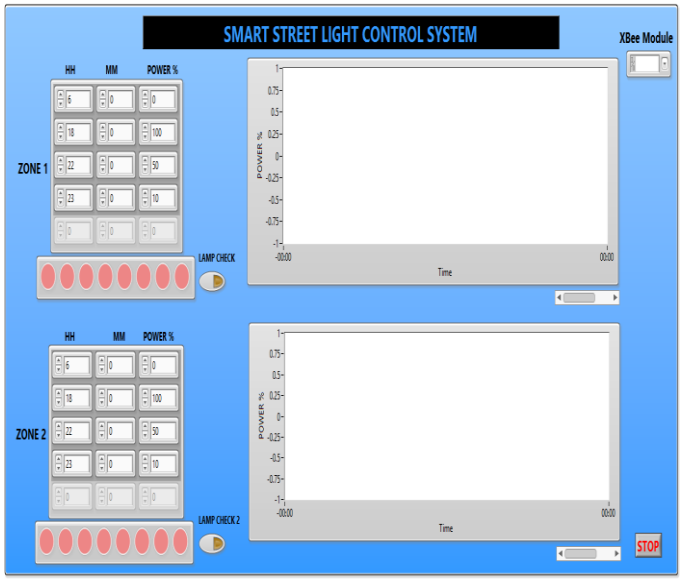


Fig. 2. Front panel of smart street light.

All the street lights are put off during day time as shown in figure 3.

Fig. 3. All lights are OFF during day time.

Figure 4 shows the evening time when all the street lights get ON simultaneously.

It continues upto 10 pm. After 10 pm, all the street lights are in dim state simultaneously.

Fig. 4. All lights are ON during 6 pm to 10 pm.

The programming is done in such a way that between 6pm to 10pm the street lights glows at 100% intensity. Whenever the intensity is 100%, the motion sensor signal is bypassed so that the street lights continuous to glow in full intensity without any interruption.

Between 10pm to 6am the street lights are programmed to glow between 0 to 50% intensity depending upon location and the signal from motion sensor is considered. When any motion is detected by the motion sensor, the Zigbee module communicates with the LabVIEW and PIC microcontroller and as per programming done the street lights in that Zone goes ON one after the other with a set delay and then goes back to previous state one after the other starting from the first.

This special software developed in LabVIEW, can automatically control the street lights and can save energy amounting to 33% or more depending upon area where installed. In addition this software is also capable of detecting the faulty street light online. A LDR is installed with each street light. Whenever the LAMP CHECK button is pressed on the front panel screen the current status of all the street lights in that zone is available online. If any light is not working the resistance of the LDR connected to that LDR changes and gives a signal to the PIC microcontroller that the light is faulty which is available online to alert the host regarding the matter. The host is notified and further actions are taken to carry out repair works. Figure 5 shows one street light is ON and faulty one is OFF. This adds to the extreme utility of the software.

Fig. 5. Fault detection one is ON other is OFF.

Compared to the conventional street lighting system, Zigbee based street lighting system offers high reliability and low maintenance with the deployment of feedback system. The feedback system allows the street light to communicate or 'respond' with the control room reporting its daily status and condition.



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International Research Journal of Advanced Engineering and Science
ISSN: 2455-9024

## IV. Energy Saving Calculation of Street Lights

The front panel of the project is shown in figure 2. The scheduling operation of the street lights has been tabulated in table I.

TABLE I. Operation timings of street lights.

| S. no. | Time | Mode of Operation | Total no. of lights On | | Power consumed | |
|---|---|---|---|---|---|---|
| | | | Traditional method | Proposed method | Traditional method | Proposed method |
| 1 | 6 am - 6 pm | All lights off | 0 | 0 | 0 | 0 |
| 2 | 6 pm – 10 pm | All lights on | 8 | 8 | 8 units | 8 units |
| 3 | 10 pm – 6 am | Through software | 8 | Depends on signal from motion sensor | 16 units | 6-8 units depending upon area |

Generally it is found that after 10 pm onwards the traffic on streets reduces. Therefore after that time till morning the street lights are in dim state and as per motion sensor signal the street lights are made on in that zone. So in this way, huge amount of energy can be saved. In this application the user has given the facility of controlling the street light on line.

Total energy consumption (Rs) per day by incorporating the modified technology

= no. of units consumed * Electricity Rate (Rs)

= (14 to 16 units) * Electricity Rate (Rs) (1)

Total energy Consumption (Rs.) per day using present technology

= no. of units consumed * Electricity Rate (Rs)

= 24 units * Electricity Rate (Rs) (2)

Saving = 100*(24 - 16)/24 to 100*(24 – 14)/24

Saving = 33.33 % to 41.66 % (approximate depending upon area of installation)

## V. Results and Discussions

Today 'Energy' has become the most essential the basic need of human being. With the innovation of technology, the utilization of electrical energy is also increasing day by day. The wastage of energy in street lights, public places etc. is also increasing day by day. The increase in utilization of energy is becoming a big threat for all the countries as it leads to severe energy crisis. The demand of electrical energy is far greater than the supply in almost all the countries. This has become a threat for the whole world. This can be controlled by either increasing the resources or by saving the energy. Huge amount of energy is being wasted because of lack of proper software and hardware. It has become an urgent need to make people aware and trained for energy saving.

### *A. Challenges and Solution*

The main challenges before the world are:-

1. Save energy wastage in street lights.
2. Save electrical energy at residences, offices etc. by optimizing the whole system.
3. Make general people aware and capable of doing energy saving themselves.
4. Monitoring and control of electrical energy.
5. Development of a system capable of becoming a set of streetlights smart enough to work autonomously, as well as to be able to be remotely managed.

The application developed and used by the investigator makes a good attempt in solving the above energy problems. Such and exercise will also:-

- Immediately provide proper direction so that electricity bill will reduce.
- Improve power provisioning and green engineering.
- It can automatically monitor the street light lamps and warn the maintenance traffic authority upon failure detection in any place of the streets.
- Enhance efficiency of the energy management process.
- Plan to save huge amount of electrical energy of the country. This type of smart street light system is applicable for both Urban & Rural areas, where the traffic is low. The system is flexible, extendable and adaptive new technologies to user needs. This software will work on windows platform and can be used by normal people as well as by the professionals/energy mangers.
- Huge energy can be saved without affecting the visibility and the safety of the drivers. It extend the lifetime of the lamps.
- Save the whole data for future use.

## VI. Conclusions

This system provides an efficient and smart automatic streetlight control system with the zigbee technology. The system can reduce energy consumption and maintenance costs and also helps to reduce crime activities up to certain limit. This streetlight control system helps in energy savings, detection of faulty lights and maintenance time and increase in life span of system. This system may be boon for engineers, energy managers, scientists, industries etc. as well as for normal people.

## VII. Future Scope

- Android based applications can be developed for Smart Tabs/Mobile Phones making mobility of control possible.
- By using artificial intelligence and sensors, the saving in street lights can be increased upto 50-60%.
- Energy management system can be developed for specific industrial applications.

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