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# Zigbee Based Smart Street Light Control System Using LabVIEW

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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. For monitoring purpose, a graphical user interface (GUI) is created.

**KEYWORDS:** Smart street light, ZigBee, LabVIEW, Motion sensors, wireless control.

## I. INTRODUCTION

### A. SMART STREET LIGHT

Smart street light refers to public street light that adapts to movement by pedestrians, cyclists and cars. Smart street light also referred to as adaptive street lighting, dims when no activity is detected, but brightens when movement is detected. This type of light is different from traditional, or dimmable street lighting that dims at pre-determined times.

In our project Street lights are made smart by placing motion sensors on them, which enables them to detect movement. Zigbee technology enables the street lights to communicate with one another. When a passer-by is detected by a motion sensor, it will communicate this to neighbouring street lights, which will brighten so that people are always surrounded by a safe circle of light. Software will be designed in LabVIEW with which the street lights can be monitored and managed wirelessly. Clients, or other companies, can access the software from a computer, or even a tablet. From this software, they can gather data, pre-set levels of brightness and dimming time; receive warning signals when a light defects.

Benefits of this type of technology can:

- Energy savings: energy use and costs decline, because the lights dim at night when there is low activity.
- Maintenance cost reduction: maintenance costs are reduced because it takes more time before the lamps have to be replaced.
- Reduction in CO<sub>2</sub> emissions: when energy consumption is reduced, there is reduction in CO<sub>2</sub> emissions.
- Reduction of light pollution: light pollution is reduced, because the street lights don't shine at full brightness anymore. Street scenes become calmer looking.
- Maintenance of safety: safety is maintained, because the lights are dimmed, not turned off completely. One might even argue safety improves because it becomes clear from far away when movement is approaching (the lights brighten).

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## **B. LABVIEW**

LabVIEW, the short form of Laboratory Virtual Instrumentation Engineering Workbench, is a programming environment in which we can create programs using a graphical notation (connecting functional nodes via wires through which data flows) in this regard. It is different from traditional programming languages like C, C++ or JAVA, in which we program with text.

However LabVIEW is much more than a programming language. Programs that take weeks or months to write using conventional programming language can be completed in hours using LabVIEW because it is specifically designed to take measurements, analyze data, and present results to the user. As LabVIEW has such a versatile graphical user interface and is easy to program with, it is also ideal for simulations, presentations of ideas, general programming, or even teaching basic programming concepts. LabVIEW provide comprehensive tools that you need to build any measurement or control application in dramatically less time.

## **C. ZIGBEE**

ZigBee is an IEEE 802.15.4-based specification for a suite of high-level communication protocols used to create personal area networks with small, low -power digital radios. The technology defined by the ZigBee specification is intended to be simpler and less expensive than other wireless personal area networks (WPANs), such as Bluetooth or Wi-Fi. Applications include wireless light switches, electrical meters with in-home-displays, traffic management systems, and other consumer and industrial equipment that requires short-range low -rate wireless data transfer. Its low power consumption limits transmission distances to 10–100 meters line-of-sight, depending on power output and environmental characteristics. ZigBee devices can transmit data over long distances by passing data through a mesh network of intermediate devices to reach more distant ones. ZigBee is typically used in low data rate applications that require long battery life and secure networking (ZigBee networks are secured by 128 bit symmetric encryption (keys.) ZigBee has a defined rate of 250 kbit/s, best suited for intermittent data transmissions from a sensor or input device.

## **II. CHALLENGES TO SYSTEM**

### **A. NEED OF SYSTEM**

‘Energy’ is the basic need of human beings. Advancements in the technology and changing life styles have increased its use and demand. But depleting energy resources and constraints on energy supply is resulting in increase in the gap of supply-demand. It is high time to focus the attention towards this unending energy demand.

From the electrical energy consumer categories, with an important weight, 10% is owned by the public lighting. The public street lighting has the part to ensure not only the direction and safe circulation of the vehicles and pedestrians in the night but also a corresponding surrounding during the lack of the daylight luminance. An important equipment of a public street lighting system is the switch on point, which ensures the correct supply of the lamps on a hour interval imposed by the beneficiary and thus also provides the energy economy.

### **B. AIM OF SYSTEM**

Street lights being one of the major sources of energy consumption and energy wastage, it is getting essential to manage the street light energy consumption properly and efficiently. The whole world is going through energy crisis and it is a big challenge for the engineers and scientist to conserve and manage electrical energy properly and to get rid of this problem.

So the possible aspects to solve this problem in the paper are:

- Design a Program for smart street lighting system using LabVIEW.
- Design Hardware of Smart Street lighting system using  $\mu$ C.
- Interface ZigBee Modules with microcontroller and design dimming circuit for LED lamps.
- Control LED Lamps according to control commands and motion sensors data.

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## C. SCOPE OF THE SYSTEM

Our work aim is to develop a unique system based on above mentioned possible solutions for creating an smart street light managed by wireless control system.

- LabVIEW, one of the most powerful engineering software's of the world, can be very efficiently used to develop the software which will make general people aware of the energy they can save by properly managing it.
- By implementing ZigBee, it can be made more powerful and efficient.
- Automatic street light control will give a new horizon to the online monitoring and controlling of street light and it will lead to saving of tremendous amount of electrical energy.
- Online monitoring and control of any street light will not only lead to smart method of saving of electrical energy but also lead to more comfort, safety and intelligent way to manage the electrical energy properly.

## III. BLOCK DIAGRAM

### A. BLOCK DIAGRAM FOR HARDWARE INTERFACING

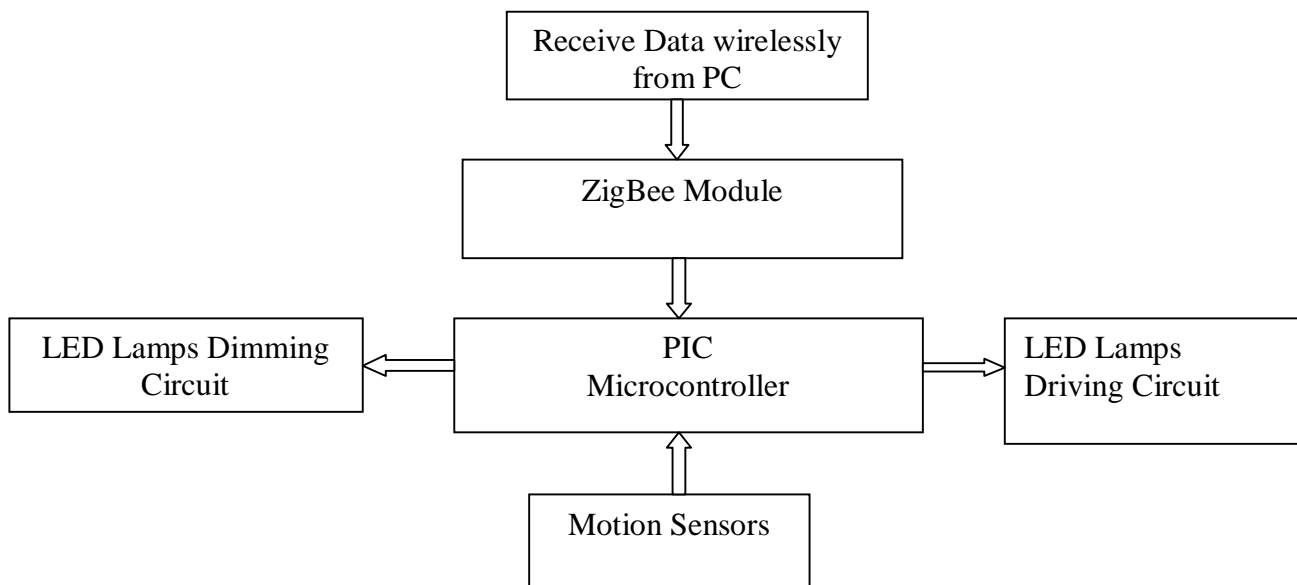


Fig.1 Hardware Interface Block Diagram

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## B. BLOCK DIAGRAM OF LABVIEW INTERFACING

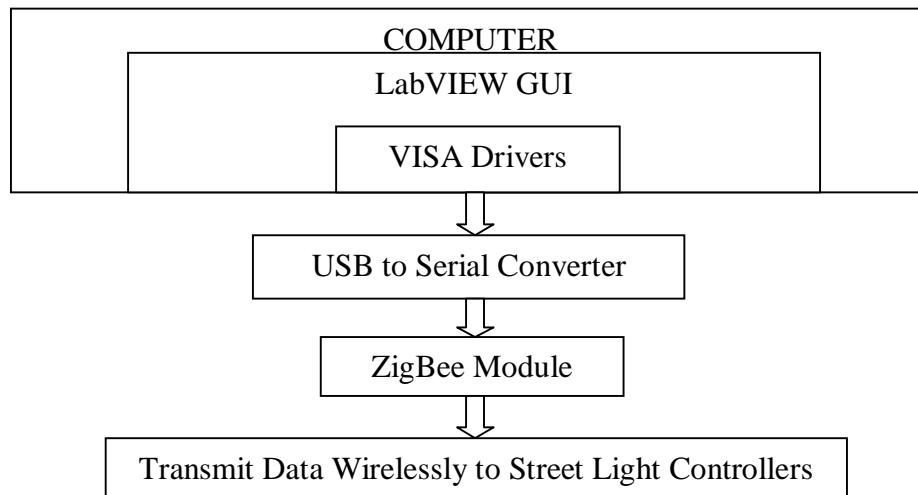


Fig.2 Labview Interface Block Diagram

## C. OBJECTIVE

To main objective of the present work is to design a smart street lighting system by keeping following points in concern:

- To design a user friendly GUI (using LabVIEW) for Smart Street lighting system that wirelessly controls the street lights.
- The GUI at control station can pre-set levels of brightness and dimming time of street light.
- The On/Off timing can also be set in the software.
- Motion sensor will be used for detecting the activity on the road.

Street lights will be automatically dim when no activity will be detected and brightens when movement will be detected.

## IV. WHY USE ZIGBEE

ZigBee is a IEEE 802.15.4-based specification for a suite of high-level communication protocols used to create personal area networks with small, low-power digital radios. The technology defined by the ZigBee specification is intended to be simpler and less expensive than other wireless personal area networks (WPANs), such as Bluetooth or Wi-Fi. Applications include wireless light switches, electrical meters with in-home -displays, traffic management systems, and other consumer and industrial equipment that requires short-range low-rate wireless data transfer .Its low power consumption limits transmission distances to 10–100 meters line-of-sight, depending on power output and environmental characteristics. ZigBee devices can transmit data over long distances by passing data through a mesh network of intermediate devices to reach more distant ones. ZigBee is typically used in low data rate applications that require long battery life and secure networking (ZigBee networks are secured by 128 bit symmetric encryption keys). ZigBee has a defined rate of 250 kbit/s, best suited for intermittent data transmissions from a sensor or input device.

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Market Name	ZigBee™	---	Wi-Fi™	Bluetooth™
Standard	802.15.4	GSM/ GPRS/ CDMA	802.11b	802.15.1
Application Focus	Monitoring & Control	Wide Area Voice & Data	Web, E-mail, Video	Cable Replacement
System Resources	4KB- 32KB	16MB+	1MB+	250KB+
Battery Life (days)	100- 1,000+	1 – 7	5 - 6	1 - 7
Network Size	Unlimited (26+)	1	32	7
Bandwidth (KB/s)	20 - 250	64- 128+	11,000+	720
Transmission Range (meters)	1 - 100+	1,000+	1- 100	1 - 10+
Success Metrics	Reliability, Power, Cost	Reach, Quality	Speed, Flexibility	Cost, Convenience

Table.No.1 Comparison of ZigBee with Other wireless technologies

### V. METHODOLOGY & FLOWCHART

#### A. METHODOLOGY

- Design of smart street light system will be executed in following steps-
- Identification of input and output parameters.
- The front panel will be designed according to the input and output required.
- Appropriate block will be developed according to the output required.
- It will be executed and debugged for further testing to get the required result.
- After completion of designing, it will be tested for accuracy.
- When the VI will start working offline, then it will be tested to control the front panel online (using LabVIEW web server).
- The required hardware for smart street light will be designed using microcontroller.
- ZigBee Modules will be interfaced with microcontroller and dimming circuit for LED lamps.
- After testing and successful result, hardware will be interfaced with the software/simulation developed.
- The smart street light LabVIEW based software will be tested and debugged until required result will be obtained.

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## B. FLOWCHART

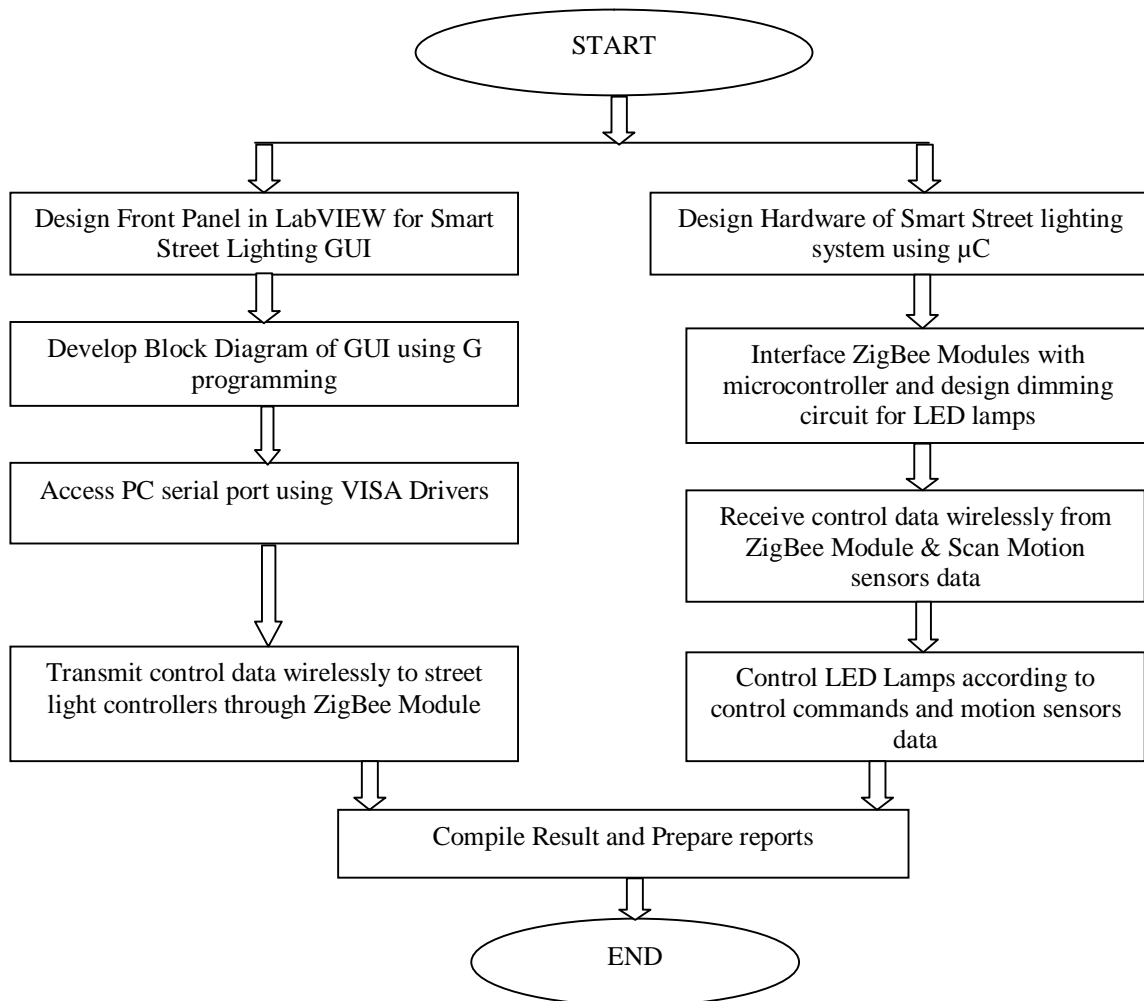


Fig.3 Flow Chart Showing the Methodology to Carry Out the Proposed Work

## VI. WORKING PROCEDURE

- Motion Sensors senses the data, collect the information and sends to microcontroller.
- Microcontroller controls the signal and runs the software to analyze the system.
- Motion sensor activates the micro-controller only when vehicle or pedestrian enters into the detection region and activates lamps driving circuit.
- Now, ZigBee device (at transmission side) is ready to receive information from streetlight and communicate with ZigBee device (at receiver side).
- Through GUI technician can identify the faults and can easily maintain the system.

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## VII. APPLICATIONS

- Public places
- Industries
- Express highways
- Universities
- Homes

## VIII. CONCLUSION

This system provides an efficient and smart automatic street light control system with the Zigbee technology. This type of smart street light system is applicable for both Urban & Rural areas, where the traffic is low. The system is flexible and extendable to user needs. 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, reduce maintenance time and increase in life span of system.

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