

# Smart Street Lighting using a ZigBee & GSM Network for High Efficiency & Reliability

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**Abstract**— This paper focuses on development of Wireless monitoring system for Street light controlling & other Function which are present on side.

This System consists of different Sensor for collecting the data & the combination of ZigBee & GSM module for transmission of data from one place to another place. Then it finally display on PC or Terminal window. It uses ZigBee based wireless device which is more power efficient with a high node capacity. There is one Base Station which collects the all data receiving from different poles of Street Light & analysis this data & take the appropriate action against it.

**Index Term:** - Wireless Control, Automatic Lighting, ZigBee, GSM, Sensor Network.

## I. INTRODUCTION

These proposed Wireless control system is design for optimization of management & getting high efficiency of power to Street Lighting system. It consists of ZigBee wireless devices which help to increasing more efficiency of street lamp system management with the help of advanced interface & control architecture. In this system we use a sensor combination to control the desired system parameters.

The information transmission between lamp post is transferred by ZigBee devices & this information can be transmit to Base Station via GSM module to check the status of various Functions which are mount on the Street Lamp Post. On this status condition system can take appropriate action in case of failure.

In our project we developed wireless communication system which include data transfer and control node operation. We are using zigbee protocol and GSM technology for the wireless communication system. The merit of using ZigBee devices is the each node device requires very less amount of power. And in this way we have managing the available power with the help of wireless network based on zigbee operation. Each device can measure the power, which is consumed by the LED Lamp Post. System overall operation is controlled by the control device. Here we are planning to create a wireless sensor network which will differentiate and control the devices on the requirement of power consumed by then to make the efficient use of power.[1]



Fig. 1 General View of the System

## II. CHALLENGES TO SYSTEM

### A. NEED OF SYSTEM

Today the world is facing the most critical difficulty is the irregular power. Also in many countries peoples had not getting at least the primary needs such as Street Light and at Public Places Etc. In nearly every country, researchers expect existing energy production capabilities will fail to meet future demand without new sources of energy, including new power plant construction. However, these supply side solutions ignore another attractive alternative which is to slow down or decrease energy consumption through the use of technology to dramatically increase energy efficiency. To manage the easily and free power more often the power is cut for particular area, and that area goes in dark i.e. not even a single bulb can work. Instead, we can use solar power in such a way that we can light the Public Places at Free of Cost. Which are primary needs should be allowed and high power devices like Street Lamp.

### B. AIM OF SYSTEM

Lighting system in Public area or especially on Street are still designing in accordance with old standards, this type of system is much less reliable & they do not take the advantage of new incoming energy efficient technologies.

In today's world there is a high pressure related to raw material cost & with social sensitivity to the Green Environments. So we can find three possible aspects to solve this problem in the paper.

- The first one invention is the use of new technology for the source of light, for this LED lamp is one the best idea for increase energy efficiency.
- The second revolutionary idea is the uses of wireless control system from one position, which is based on intelligent lamp post which send the sense information to base station thus it, solve the problem related to maintenance & management of power.
- Third possible solution is the use of renewable energy source, which is easily available everywhere, which helps to maintain green environments.[1][3]

C. SCOPE OF THE SYSTEM

Our work aims to develop a unique system based on above mentioned three possible solutions for creating an intelligent lamp post managed by wireless control system. It uses energy efficient LED & it powered up by renewable energy i.e. the combination of Solar Panel & Battery.

The sensor control is developing through wireless devices to collect the status information related to power management and maintenance of the system. Information gathers at Base station via combination of ZigBee & GSM module. We can also find ZigBee

In this paper we make a system which easily adapts the latest technologies to make a system advance to intelligent management and control of power of street lamp post.[1]

III. BLOCK DIAGRAM

A. Block Diagram of Street Lamp Unit

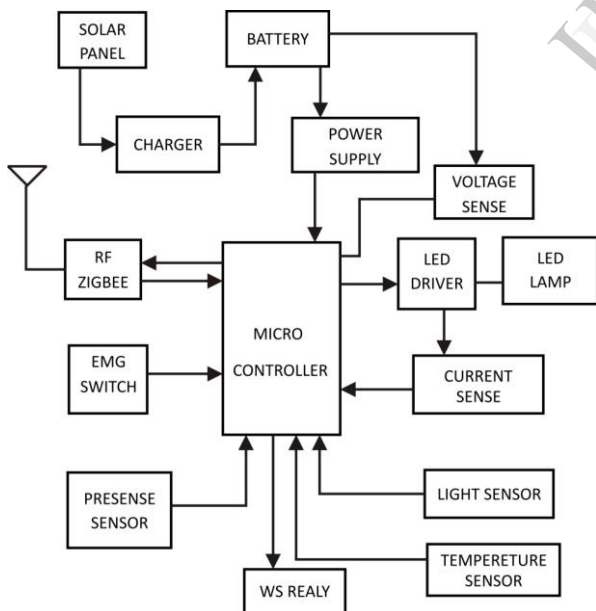


Fig. 2 General Block Diagram without GSM Module

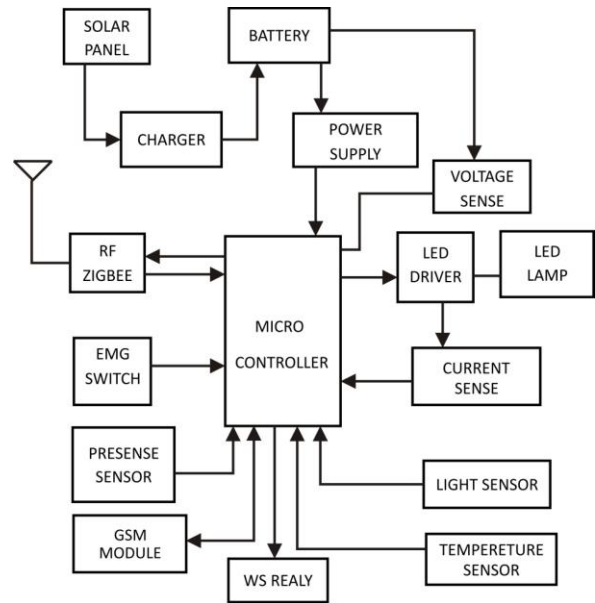


Fig. 3 General Block Diagram with GSM Module

Above two blocks diagram shows wireless system present on each Lamp Post. But there is only change in between this two schematic is second schematic shows additional GSM Module which is place at only single or last pole which present in sequence of pole to communicate between the Base Station and Street Lamp Pole reaming system is same on each pole.

B. Principal Of Working

Fig. 2 and 3 shows the schematic of desire system. It is developed by making a group of number of observation station on street i.e. station which present on each lamp post and a base station is located at any particular place or area. This system has scope for easily extend to include various functions Each station which is present on Lamp post called the observing station can monitor the various environmental condition on street such as Sun light and they decide to turn the lamp ON or OFF. This environment condition is depends on patterns of the street, solar irradiation, whether condition seasons, geographical location and many other factors. Due to present environmental condition at each lamp post is different, we decide to make each lamp post completely independent for management of its own lighting. The observing station of each lamp post also checks the lamp is properly working or not and send the information through wireless network to Base station for analyzing the data. If at base station detects any problem of failure then service engineer can perform corrective action.[1]

The centre of this project is microcontroller PIC16f690. On street light one unit is placed which detects the presence of vehicle by using PIR sensor. Different parameters are sensed such as current and voltage by using current and potential transformer. By using solar panel we can power this unit.[5]

There is RF (ZigBee) communication between street lamps. As vehicle comes closer to Lamp Post PIR sensor detects it and lamp glows, and when vehicle leaving the Lamp Post lamp gets off and next lamp glows.

If there is problem on any Lamp post, such as low voltage or low current or insufficient light, sensor detects it and informs to Base unit.

For communication between Lamp post and Base Station GSM module is used. At Base station GSM module is interfaces with controller. There is PC at control unit on which visually we can see the problems occurring at street lights. Visual Basic language is used for visual programming. Window on PC is shown above.

Facility of water supply relay is provided on this pole. We can make this relay ON or OFF as per our requirement. This function is useful for providing the automatic Water Supply for Trees which are present around the Street or on the divider. It reduces the Human effort to give the Water Supply for Tree.[4] [9]

C. Block Diagram of Base Station

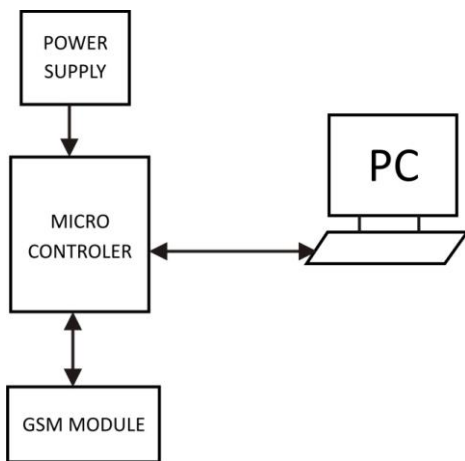


Fig. 4 Base Station Unit

The sensor collected information is received at Base station controller to process a data. At base station controller we have set threshold value for various parameters such as light intensity, current, voltage. We can change this lamp ON or OFF condition from base station by changing this value.

The system can also read the status of energy button and switch on the Lamp if this is activated. The same thing is happen with vehicle or a pedestrian. In case of detection of ON state Lamp post fault, notification or alarm is sent to the Base station. The lamp ON status or ready operation for water supply operation is regulated by timer which gives the command to system to work for the predetermined time. The stop input signal can turn off the lamp & cycle is restarted.[1][4]

D. Base Station Window

| LAMP NO. | LAMP STATUS | FAULT   |         |
|----------|-------------|---------|---------|
|          |             | CURRENT | VOLTAGE |
| 1        | ON          |         |         |
| 2        | OFF         | ●       | ●       |
| 3        | ON          |         |         |

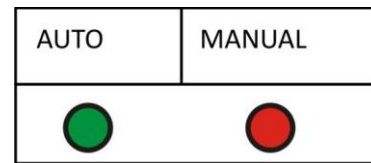


Fig 5 Visual Window of Base Station Unit

Base Station is the heart of the system since it shows the visualization of entire status of the system.

Processing unit has a terminal with a serial universal asynchronous receiver-transmitter (UART) interface which receive status information of lamp post provided by wireless network. For showing the graphical representation of status we use VB window. Data on lamps operation are associated with the lamp address, all fault are easily detected. Graphical represent is more suitable and easy to maintain the status of the system with the state of the lamp post & power consumed by each lamp pole.[1]

It uses the GSM protocol to communicate with the Base Station. It consists of transceiver, microcontroller and another GSM Module. This very small battery operated which provides full duplex communication with mesh networking.

IV. SOLAR BATTERY CHARGER WITH HIGH EFFICIENCY & FAST BATTERY CHARGING

This type of charger is used for Battery charging with High Efficiency and Fast Battery charging. This is new innovative idea for changing the battery and it is advantageous over the normal MPPT (Maximum Power Point Tracking) charger.

This modulation technique can confirm the width of the pulse, and pulse duration, from modulator signal information. Also this type of modulation technique is apply for encode information of transmission. Its main purpose is to distribute the control of the power supplied to different electrical devices, for an example are inertial loads to motors. Solar battery charger used two principal first one is PWM and second is MPPT.[11][8]

V. WHY WE USE ZIGBEE

| Parameter           | 802.11 (Wi-Fi) | Bluetooth                 | ZigBee                                  |
|---------------------|----------------|---------------------------|---|
| Data Rate           | 11 & 54 Mbps   | 1 Mbps                    | 20, 40, 250 Kbps                        |
| Range               | 100 meters     | 10 meters                 | 100 meters                              |
| Networking Topology | Point to hub   | very small networks       | peer to peer, star, & mesh              |
| Operating Frequency | 2.4, 5 GHz     | 2.4 GHz                   | 2.4 GHz                                 |
| Complexity          | High           | High                      | Low                                     |
| Power Consumption   | High           | Medium                    | Very low                                |
| Security            | High           | 64 and 128 bit encryption | 128 AES plus application layer security |

Table.No.1 Comparison of ZigBee with Other

## VI. ALGORITHM & FLOWCHART

### ALGORITHM

1. Start
2. Check the Initial setting or threshold value.
3. Check the Fault report
4. Measure or calibrate the current and voltage of the Battery and Lamp.
5. Measure the Light visibility through Light Sensor.
6. Check the status of Emergency switch.
7. Take the appropriate action LED Lamp by using Motion Sensor. [1]

### FLOWCHART

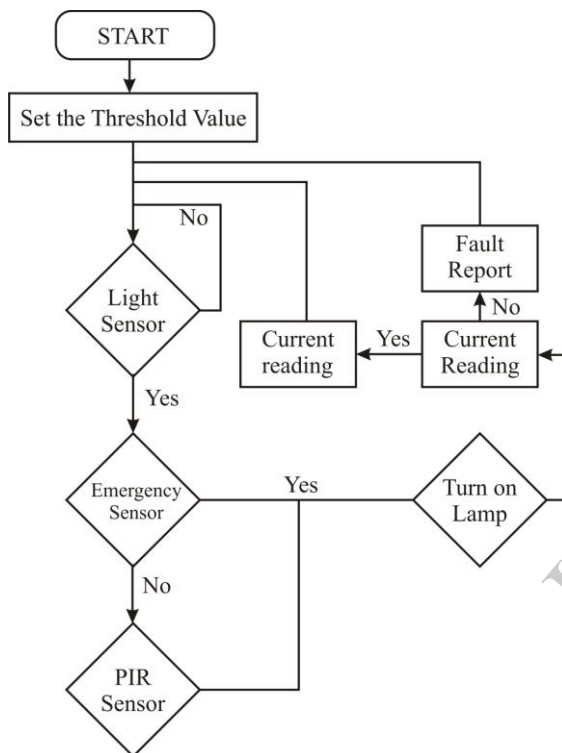


Fig 6 Flowchart of System

## VII. APPLICATION

- This project is useful in every city where street light is requires.
- Express High-Way
- Industries
- Public Places

## VIII. CONCLUSION

This system can develop new inventive idea for intelligent street lighting with multitasking system. It consists of advance technologies which offer high efficiency & reliability. Energy efficiency is obtained by LED lamp post which high energy efficient & use of renewable energy source hence it is cost effective system.

Another merits obtained from this system is Smart management of lamp post by transferring data to base station via GSM module. From base station system maintenance can be easily and effectively done.

This type of Intelligent street lighting 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 system can be built-up by simple ZigBee network, reliable component the feature of sensor network processing speed, low cost. This is system is ease to installation which gives us a Smart and Intelligent Engineering & Commercial solution with the comparison of different technologies.

- The technology which we are implementing can be used to find outing new technology for using natural power.
- Use or consume more and more power getting from sun.
- This system can be use for multifunction.
- Save the electricity
- Reduce the consumption manmade electric energy.

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