International Innovative Research Journal of Engineering and Technology
ISSN: 2456-1983 Vol: 1 No: 4 June 2016

Remote Monitoring and Controlling of Solar Powered Street Lights

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Abstract: The use of single power solar system in generation of electricity for streetlights nowadays is widely used. Generally, many of this kind of streetlight are using one solar panel system to power its lamp. The problem that can arise for this kind of streetlight is how to control and guarantee the optimal system. The proposed system can optimize management and efficiency of street lighting systems. It enable more efficient street lamp-system management, by automatic ON and OFF during evening and morning times respectively. The information is transferred point by point using Zig Bee transmitters and receivers and is sent to a control terminal to check the state of the street lamps. The data is updated in PC. The proposed method proceeds with smart energy infrastructure which detect a human presence and adopt the light intensity accordingly . It also provides protection over the theft of PV panels. To evaluate operations of proposed system, they have been modeled and simulated in PROTEUS**.**

Keywords: Solar PV panel, LDR sensor, PIR sensor, AT89S52 Microcontroller, Relays and Zig Bee communication system.

1. INTRODUCTION

Nowadays the usage of renewable energy is increased drastically all over the world especially in India. The usage of solar energy is the suitable way as an alternate source for the countries like India where solar energy is available in most of the months. Lighting system using solar power in public sectors is drastically increased. How to monitor and control the performance of the street lights is the main problem in the high way service. Many research shows that there was several methods to monitor this lightning system like Bluetooth, Wi-Fi, GSM and Zig Bee.

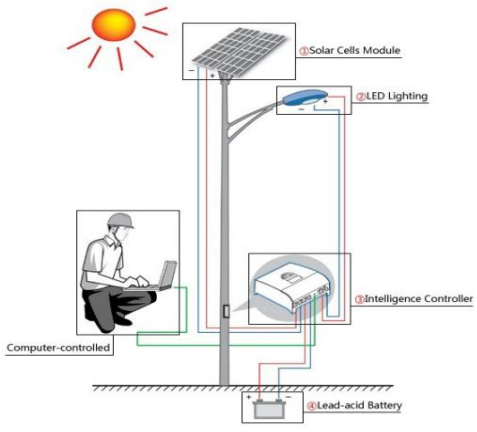

Figure 1. General setup for streetlight solar panel system

In general, as shown in figure 1, street lights using solar energy consisting of a battery, LED lights, and a controller. The sensors will be installed over the post and lamps of this system for the efficient monitoring of the street lights. LDR1 is used for the automatic ON/OFF of street lights in evening and morning respectively. LDR2 is used for the fault identification of street lights. PIR sensor is used to change the intensity of light according to the human presence. Another IR sensor is used to prevent the theft of solar panels.

The method of communication that will be used in this research is using of Zig Bee communication system to monitor the performance of the streetlight.

2. LITERATURE REVIEW

In Reference[1] a proposal of an intelligent street lighting system is described using the highly economical LED technology supplied by renewable energy.

In Reference[2] the design and implementation of a wireless smart sensor platform targeted for instrumentation systems and predictive maintenance was discussed and presented.

In Reference [3] a remote control equipment for monitoring and managing a street lightning system with master boards and slave boards is presented.

In Reference[4] the development of wireless automatic meter reading system is described is based on high performance and extremely low power consumption.

In Reference[5] a developed street light system for public area with high energy efficiency by utilize solar panel to

battery charging circuit using MPPT, and high efficiency LED drive circuit.

3. MATERIALS AND METHODS

The system constructed in this study consists of four parts, namely: Automatic ON/OFF, Fault Identification, Change in light Intensity and Protection over theft of panels.

3.1 Automatic ON/OFF

In this method, the automatic on/off control of the street lights in evening and morning is achieved with the help of LDR1. The resistance of the LDR varies with respect to the intensity of light from sun and this data is sent and processed in the microcontroller. According to the preset values in AT89S52, the relay 1 is on and off and it is clearly shown in figure 2.

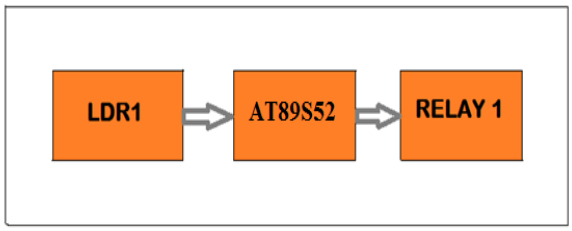

Figure 2. Automatic ON/OFF

3.2 Fault Identification

In this method, the street lights are checked whether it is working or not. It is achieved by using LDR2, which is placed in the casing under the LEDs of the lamp. If the LED is not glowing or not, which is sensed by the LDR and the data is sent to microcontroller. This data is processed in AT89S52 and the condition of lights is transferred to the control unit via Zig Bee communication system. This setup is clearly explained in the following figure 3

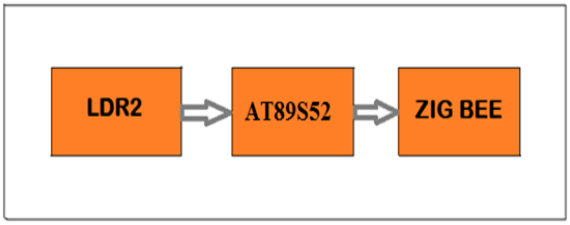

Figure 3. Fault Identification

3.2 Change in Light Intensity

In this method, the wastage of energy due to the continuous operation of the lights with full intensity, even there is no presence of humans is regulated. It is achieved by using a PIR sensor which senses the human presence and the data is sent to microcontroller. The AT89S52 process the data and operates the relay 2 at the times of human presence which offers 100 percent light intensity. Otherwise it operates relay 1 whether there is no human presence which offers 70percent light intensity. Thus we can save the energy and it is clearly explained in figure 4.

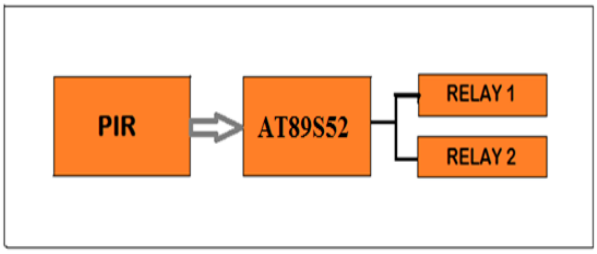

Figure 4. Change in Light Intensity

3.3 Protection over Theft of Panels

In this method, the theft of the solar panels is restricted with the help of IR sensor. The IR sensor transmitter and receiver units are fixed along the fixing bolts of the solar panel. If any disturbance occurs in the signal like human interruption, the data is sent to the microcontroller. The AT89S52 process the data and sends the intimation to the control unit via Zig Bee communication system, where it is monitored. This setup is clearly explained in the following figure 5.

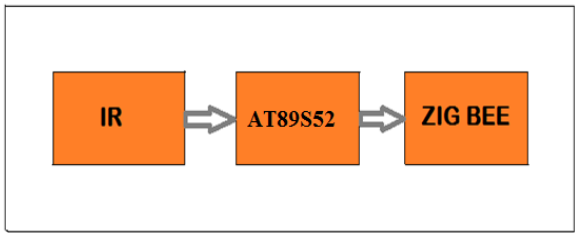

Figure 5. Protection over Theft of Panel

4. RESULTS AND DISCUSSION

Thus the proposed system is fully automatic with many sensors for monitoring and protection of the solar powered street lightning system. Four techniques are used to enable more efficient street lamp system management with smart energy infrastructure. Intervention of humans is avoided by automatic on and off of lamps and fault identification. The energy saving technique which used in this system provides high efficiency in saving of power. The theft of the solar panels which are expensive is also restricted with this system. The proposed monitoring systems block diagram is shown in the figure 6.

International Innovative Research Journal of Engineering and Technology
ISSN: 2456-1983 Vol: 1 No: 4 June 2016

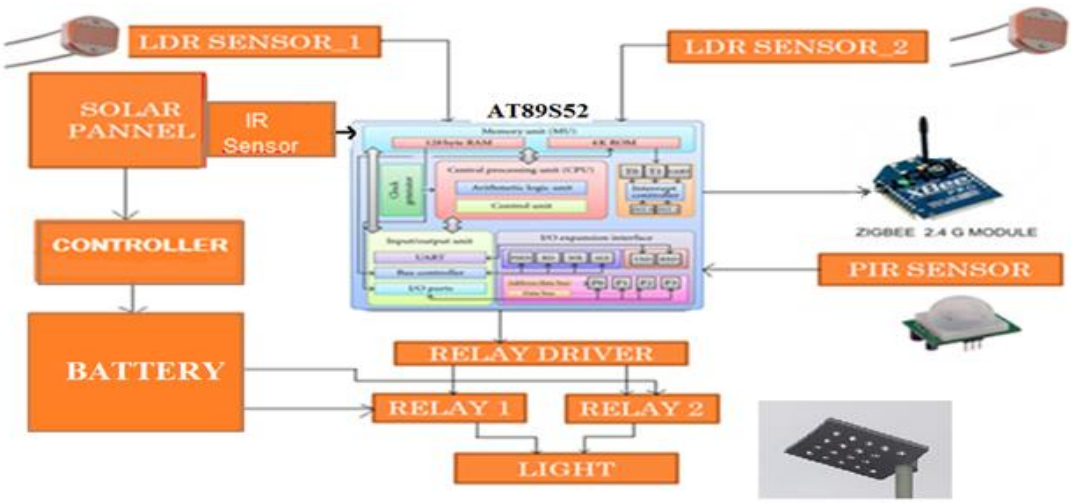

Figure 6. Block Diagram of Proposed System

5 HARDWARE KIT

The Hardware of the Proposed System consists of the following blocks. They are as follows

1. LDR1 block
2. LDR2 block
3. PIR block
4. AIR block
5. Relay block
6. Microcontroller block
7. ZigBee Transmitter block
8. ZigBee Receiver block
9. Solar Cells
10. Battery

It is clearly shown in figure 7.

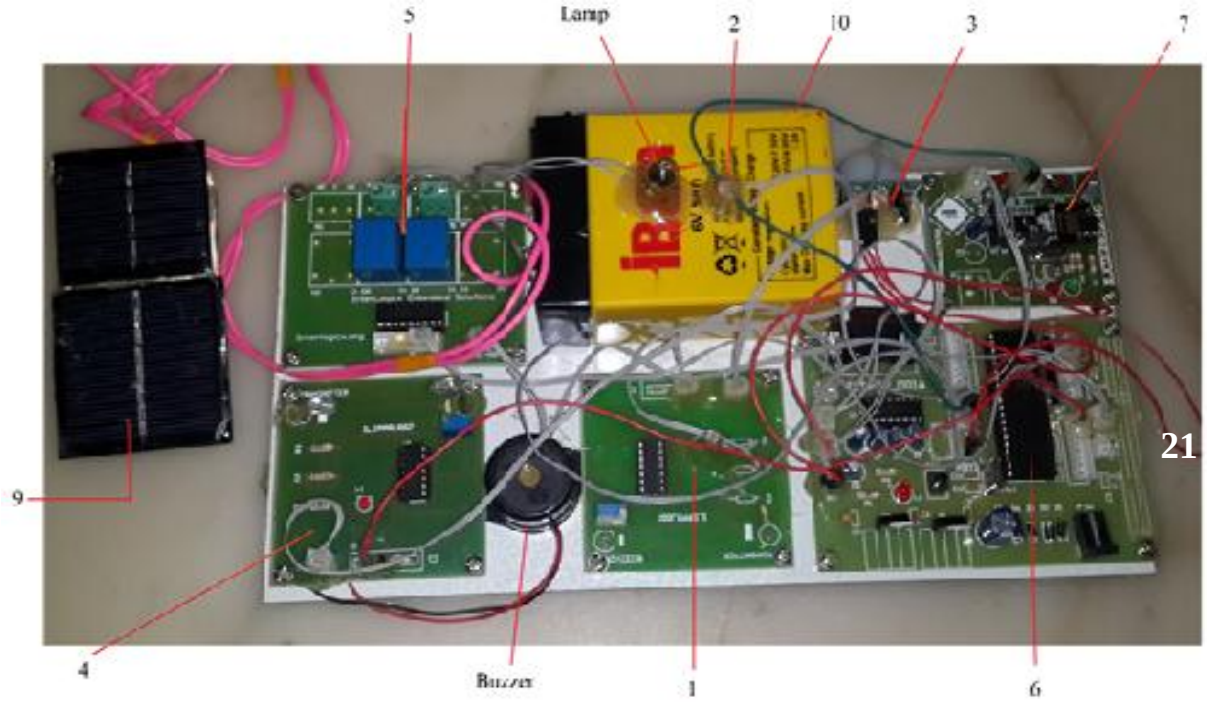

Figure7. Hardware Kit

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The ZigBee module Kit is shown in the following figure 8.

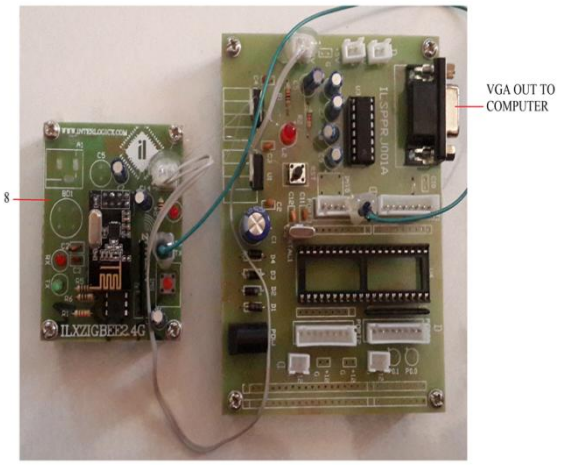

Figure 8. ZigBee Receiver

6. HARDWARE RESULTS

The monitored results are shown in four stages.

1.Automatic ON/OFF.
2.Fault Identification.
3.Change in Light Intensity.
4.Protection over Theft of Panel.

6.1 Automatic ON/OFF

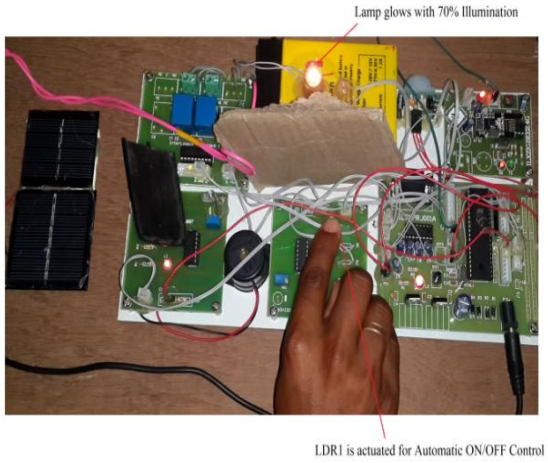

Figure 9. Automatic ON/OFF

LDR1 sensor is used for the Automatic ON/OFF control of the system. When the sensor is prevented from external light, the lamp starts to glow with 70% illumination. At the same time, when the external light is exploded over the sensor, the lamp gets OFF. Thus its working is similar to the Automatic ON and OFF of the street lights at evening and morning times respectively. It is clearly shown in figure 9.

6.2 Fault Identification

Figure 10. Fault Identification

LDR2 sensor is used for the Fault Identification of Street lights like Fused or not working etc. Once the LDR1 is actuated the lamp starts to glow and if it not works due to fault like fused bulbs, the LDR2 sense this condition and gives data to the Microcontroller. The Microcontroller sends this information to the monitoring station via ZigBee as shown in figure 11.

Figure 11. Street Light Failed

6.3 Change in Light Intensity

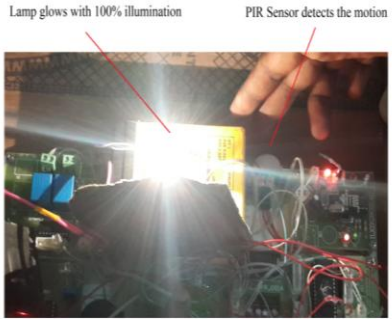

Figure 12. Change in Light Intensity

The PIR sensor is used to change the intensity of light according to the presence of humans or any vehicles. If any motion is detected by this motion sensor, it change overs the light intensity from 70% to 100% illumination. After the time delay which is preset in the Microcontroller, it comes

back to its previous illumination level. It is clearly shown in figure 12.

6.4 Protection over Theft of Panel

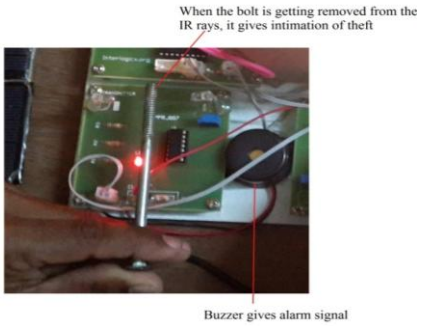

Figure 13. Protection over Theft of Panel

The AIR sensor is used for the Protection over the Theft of Panels. When the intruder starts to remove the bolts, the IR rays starts to conduct which gives the alarm signal with the help of Buzzer. At the same time the Microcontroller gives the Solar panel Theft indication via ZigBee to the monitoring station as shown in figure 14.

Figure 14. Protection over Theft of Panel

6.5 Normal Operation of the Proposed System

If the Proposed System works properly and there is no malfunctions like Fault in the lamps or solar panel theft, then the status of monitoring station is shown in the figure 15.

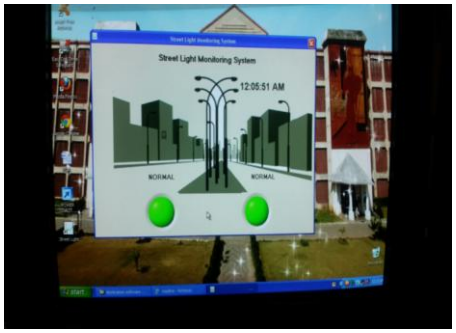

Figure 15. Normal Operation of the System

Thus the proposed system is more efficient, with developed monitoring infrastructure and protection over the system is also good.

7. CONCLUSION

From the results in this research, it can be concluded that the monitoring system of the solar powered street lightning is more efficient in accordance with the design.

There are several suggestions that can be built in the development of this system, such as: build the system using few other sensors and Maximum power point tracking (MPPT) technique.

8. NOTATIONS

LDR	Light Dependent Resistor
PIR	Passive Infrared Sensor
IR	Infrared Sensor

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