Solar based Intelligent LED Lighting System for Energy Efficiency

Rekha Mabaka, K.Ashok Kumar

Abstract*— Now-a-days most of the street lighting system is based on solar panels only. This is preferred so to reduce the huge power consumption which is allotted especially for street lighting systems. After introducing solar panels also, much loses are being present in the system due to the lack of intelligence and automation in the system. In order to reduce the losses we have introduced some sensors and networking into the system. A LDR in co-ordination with PIR sensor is used along with the Zigbee network in this project. At night, when no humans are present the street light system is set to 20% of its brightness. Whenever human is coming to existence then lighting is automatically increased to 100% of its brightness.

***Index Terms*— Sensors, Street light system, Zigbee Network**

I. INTRODUCTION

Currently the LED lamp is popular due to its efficiency and many believe it is 'new' technology. The LED as we know it has been around for over 50 years. The recent development of white LEDs is what has brought it into the public eye as a replacement for other white light sources our work aim is creating an intelligent lamp post managed by a remote-controlled system which uses LED-based light sources and is powered by renewable energy.

The advantage of LEDs is that they have extremely long lives -- they don't have filaments that can quickly burn out -- and they don't contain toxic chemicals like mercury, unlike traditional high-pressure sodium lamps or mercury-vapor lamps. An LED light can last 100,000 hours. These lights also have reduced maintenance costs because of their long lives, and they give off less heat than other bulbs. Because they last so long, LEDs are suitable for places where replacing light bulbs is expensive, inconvenient or otherwise difficult.

In general CFL bulbs are used for street lighting system. Here we are replacing them with light emitting diodes(LEDs). The main reason to replace CFL is they will conserve more energy when compared to LEDs. By using LED's we are going to save the power of 15% when compared to CFL's. Here LED's produce 80 lumens per watt which is sufficient for street lighting.

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Earlier system uses Metal Halide (MH) lamps which consumes more energy and requires improvements to increase the energy efficiency. Earlier systems like Power line communication (PLC), light level tuning methods are of wire structured which increases the communication cost, in-turn effects the overall product cost.

While the disadvantages in Existing Systems are like In PLC design, system produces noise and attenuation which causes voltage drops in the networks operating on low voltage power lines which may last for few minutes. Due to the attenuation there may be high latency or communication failure in PLC based design

II. BLOCK DIAGRAM

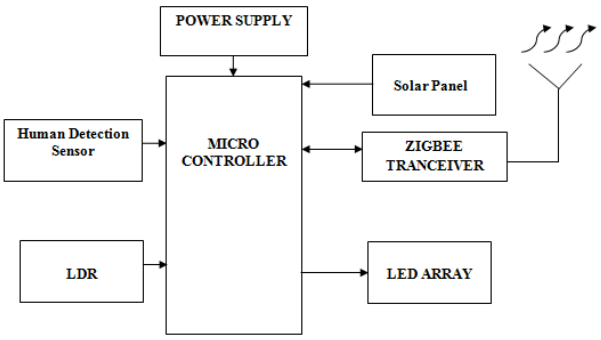

Figure 1: Transmitter section

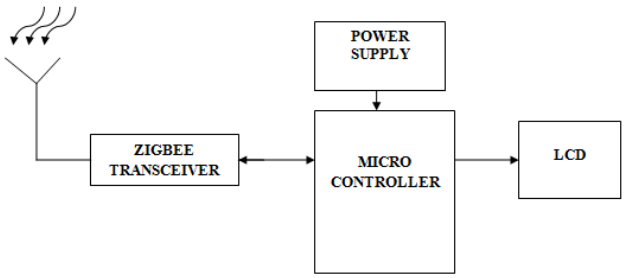

Figure 2: Receiver section

The proposed system consists of Transmitter section and Receiver section both are communicated with Zigbee. Sensors used in this project are LDR and PIR sensors.

Sensors are used to control and guarantee the desired system parameters and the sensors transfer the collected information to controller which runs the firmware to analyze the system. The purpose of microcontroller is to take the data

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from all the streetlight through parallel processing and convert them into serial communication. We find the lumens by using LDR sensor, PIR sensor is used to detect the human beings. Here we have used 12V solar panel and 12V rechargeable battery. In LED array we used twenty 1w LEDs.

III. IMPLEMENTATION

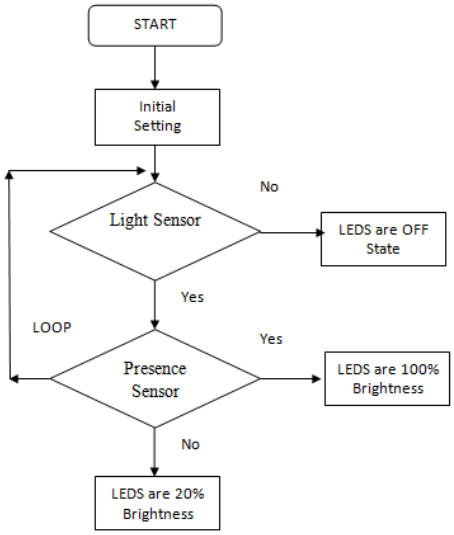

Figure 3: Flow chart

After setting up whole system the procedure will be in following manner. If light is detected with the help of light sensor then whole system is set to switch off mode .if the light is not detected or present then the default lighting will be turned on with 20% of its total brightness. If these a human detected with help of presence sensor then the brightness of the total lighting system will be increased 100%.the information is transformed from sensors to controller and vice versa using Zigbee network by controlling the brightness of LEDs the power consumption will be reduced and thus power saved.

A. AVR Development board

This is preferred because it is having atmega8 controller that is having 8K bytes flash memory which is very efficient to this project. We can dump the code into the controller by using USB ISP programmer using USB cable. Atmega8 controller having 3 ports, in which PIR sensor is connected to PC0 and LDR sensor is connected to PC1.In controller ADC channels are internally present, which are used to convert analog values to digital values.

Figure 4: AVR (Atmega8) Development Board

B. Pyro infrared sensor (PIR)

This is the sensor which detects the humans by the IR radiation which are reflected from the human body. This is one of the digital sensors, by default the value will be LOW whenever a human is detected then the value will be HIGH. The PIR sensor shown in figure 5.

Figure 5: PIR Sensor

C. Light Sensor (LDR)

By the name it tells that it is resistor which varies resistance whenever it detects the light. It is one of analog sensor which varies the value from 0-1023 along with the change in the resistance. In this project if the luminance is low the value of ldr also will be low that means it's darker. If luminance is high then the value of ldr also high. We can also use photodiode as light sensor.

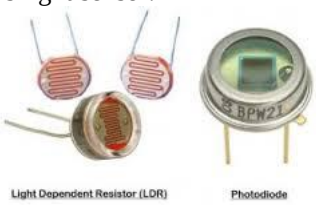

Figure 6: LDR/Photo diode

D. Solar panel

In this project we have used 12-17v solar panel is used. The solar panel converts solar energy into electrical energy. The converted electrical energy is stored in the 12v battery with the help of rechargeable circuit. In order to decrease the power consumption we have opted the natural power sources to generate the street lighting with the help of solar panels.

Figure 7: Solar panel

E. Zigbee

This one of the most commonly used wireless communication network in these modern days. The frequency range in which it operates in 2.4Ghz.There is two sections presents in this network structure. One is receiver section and the other is transmission section. The components of each section are shown in fig.8.

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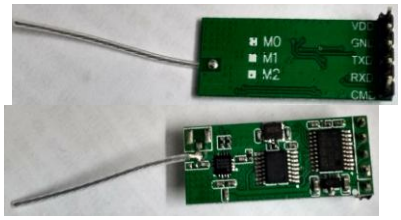

Figure 8: Zigbee

IV. RESULTS

Fig.9 shows that luminous value of light sensor in the LCD on 1st row and the voltage of rechargeable battery is shown on right corner of 1st row. In 2nd row the status of human detection is showed.

Figure 9.Resulst show in Receiver side

Fig 10 shows the actual prototype of project which shows all the physical arrangement which are involved into prototype like LDR sensor, PIR sensor, solar panel, rechargeable battery with circuit and AVR development board.

Figure 10: Prototype of Street light system

V. CONCLUSION

This project 'Solar based Intelligent LED Lighting System for energy efficiency' is a cost effective, practical, eco-friendly and the safest way to save energy. It clearly tackles the two problems that world is facing today, saving of energy and also disposal of incandescent lamps, very efficiently. According to statistical data we can save more that 40 % of electrical energy that is now consumed by the highways. Initial cost and maintenance can be the draw backs of this project. With the advances in technology and good resource planning the cost of the project can be cut down and also with the use of good equipment the maintenance can also be reduced in terms of periodic checks.

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