

Street Light Commander System Using Zigbee Network of Devices

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Abstract—The objective of this paper is to form an intelligent lamp post using zigbee network of devices. The newly proposed system offer higher efficiency and considerable savings in power that can be achieved by using high efficient LED technology and also helpful to inform any accidents through wireless camera to the concerned base station. Early days, the street lighting systems are controlled manually. So there was much more power consumption not only that if we forgot to switch off the light means that will be glowing entire day. The main factor is that street lighting system is an essential factor in public sectors. So we need to design and implement solar based street lighting system. The solar street lights are raised light source which are powered by photovoltaic panels generally mounted on light structure. The photovoltaic panels charge a rechargeable battery like lead acid battery, which powers a LED lamp. The systems have monitoring station in each lamp post and one base station in nearby building. The monitoring station contains several modules that are work together and transfer information to the base station through zigbee network of devices. From base station the corresponding actions will be take place.

Index Terms- Hall Effect Sensor, MIC, PIR Sensor, Solar Street lighting system.

I. INTRODUCTION

The street lighting system is an essential factor in public sectors. So we need to design and implement solar based street lighting system with the help of Zigbee network of devices and the newly proposed street lighting system offer higher efficiency and considerable savings that can be achieved by using high efficient LED technology. Early days, the street lighting systems are controlled manually. So there was much more power consumption if we forgot to switch off the light means that will be glowing all the day. But the newly proposed system is a good power saver [1]-[4] and that will be automatically controlled by the base station. This project contains monitoring stations and one base station. The monitoring station consists of three sensors, MIC, Emergency Micro Switch, Wireless camera, Zigbee and so on.

The monitoring station located in each lamp post consists of several modules such as PIR sensor, the LDR sensor, the Hall Effect sensor, MIC and an emergency switch. These devices work together and transfer all of the information to a microcontroller which processes the data and automatically sets the appropriate action. The PIR Sensor will helpful to detect the presence of human. Whenever the presence of human will be detected the next step to measure the intensity of light. For that purpose we are using an LDR sensor. A light sensor can measure the brightness of the sunlight and provides information. In day time intensity of

light will be high because of negative temperature coefficient so no need of lighting system. When the intensity of light becomes low that time necessary of the street lighting. So the information will pass to the base station via zigbee. From the base station a message pass to the microcontroller to glow the street light according to the intensity of light. The Hall Effect Sensors are used to sense the current level and also checking any short circuit problems or other damages are occurred. The microcontroller will send that information to the base station and corresponding action will take.

II. LITERATURE REVIEW

The literature review gives brief idea about the existing system and why we are introduced new street lighting system. The main issues associated to the existing systems are increased raw material cost and social sensitivity to the environmental issues. So the manufactures develop three solutions to solve this problem. They [5]-[9] are LED technology, remote control technology and solar technology. The newly proposed system combined three technologies such as LED technology, Remote control technology and solar technology and forming a good power save system.

III. PROPOSED SYSTEM

The proposed system consists of PIR Sensor circuit, LDR Sensor circuit, PIC microcontroller and so on. The passive infrared sensor measures the infrared light emitting from objects in its field of view. The front side of the sensor will be a sensor face, through which the infrared light enters to the sensor. It is made up of pyroelectric materials which can detect the level of infrared radiation. This sensor uses the BISS0001 IC. It is a micro power PIR sensor IC. This IC takes the output of the sensor and does some minor processing on it to emit a digital output pulse from the analog sensor. Here we are using a NPN transistor for switching purpose and it is mainly used to interface PIR to microcontroller. When a high signal is reached to the transistor. The NPN will be on and a low signal will be passes to the PIC microcontroller [10]- [14] that informed the microcontroller objects is detected.

The LDR circuit consists of two resistors they are one variable resistor and a fixed resistor. Both are act as a voltage divider. A LDR Sensor is made of a semiconductor that absorbs photons and based on the quantity and frequency of the absorbed photons, the electrons will gain enough energy to jump into the conduction band. Thus the resulting free electrons conduct electricity that causes reducing resistance of the Light Dependent Resistor Sensor.

Hall Effect Sensor senses the current that will be in mA. With the help of the amplifier circuit mA signal convert to the appropriate level.

emergency switch are work together and transform information to the [15]-[18] microcontroller.

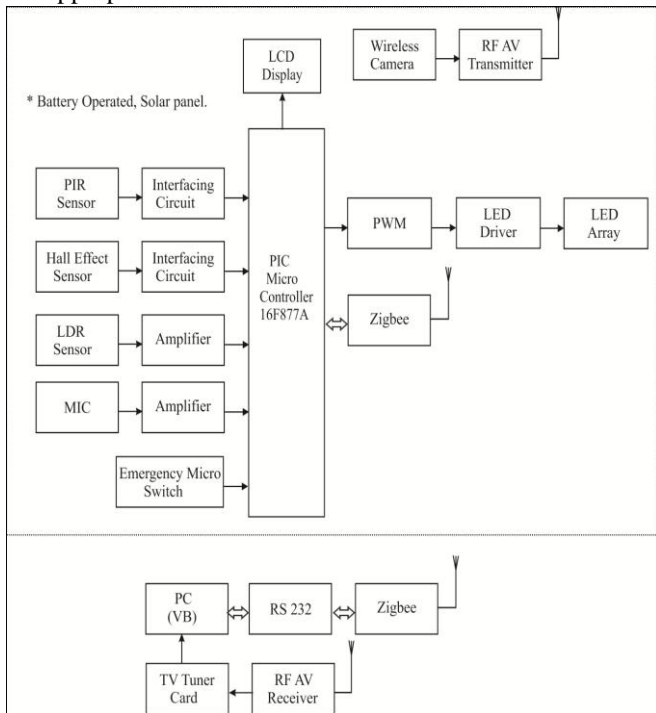


Fig. 1. Block diagram of proposed system

Here we are using a carbon MIC when any sound is detected that will be moved between the fixed and variable plate of the MIC and variation of the air between the plates produces an electric signal in mV. The amplifier circuit converts the mV to appropriate level and this output is taken as a comparator input to compare with a reference voltage. If it is high means that will be passes to the transistor and it produces a low signal that will be passes to the PIC microcontroller. Here also using Hall Effect Sensor for the purpose of detecting current used by the system. Wireless camera capture the image within the range of the monitoring station and send to the base station with the help of TV Tuner card. From base station information will be passes to the authorized person and the immediate action will be taking place. The newly proposed system will protect our life in many cases. For example if it any robbery occurs means in field of its range the wireless camera send information to the base station. From base station corresponding actions will be taking place. So the system really a useful device.

IV. DEVICES AND METHODS

The proposed system consists of a group of monitoring stations on the street and a base station typically placed in a building located nearby and it is a modular system easily extendable

A. Monitoring Stations

The monitoring station consists of several modules such as PIR sensor, Hall Effect sensor, LDR sensor, MIC and

PIR Sensor: PIR sensors are an electronic sensor that measures the infrared light radiating from any object in the field of view. Here we are using Hc-Sr501 as PIR sensor and cost is approximately 165. This sensor is used in PIR-based motion detectors and this is used to sense the movement of crowd, animals or other things.

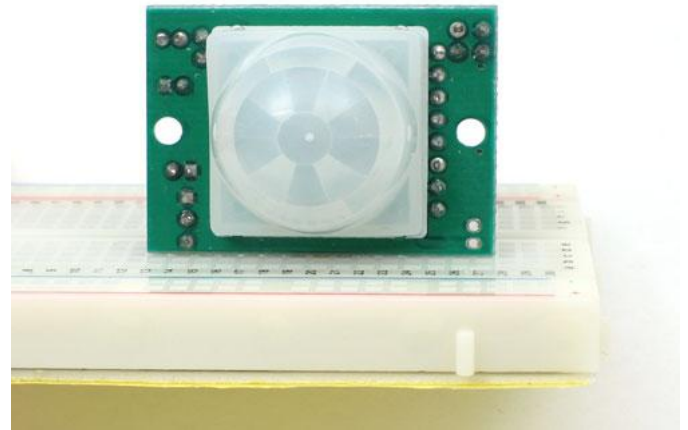


Fig. 2. PIR Sensor

The construction of the PIR sensor defines the infrared lights enters through the front of the sensor, is called “sensor face”. At the core of a PIR sensor is a solid state sensor is made up of a pyroelectric material which generates energy when exposed to heat. Materials commonly used in PIR sensors include gallium nitride.

The operating principle of the PIR sensor gives an idea that all the objects with temperature above absolute zero emit heat energy in the form of radiation. This radiation is invisible to human eye because it radiates at infrared wavelength, but it can be detected by electronic devices designed for such a purpose. The term passive refers to the fact that PIR sensors do not generate or radiate any energy for detection purposes and they are working based on the energy emitted from other objects.

1) **LDR Sensor:** Here we are using a light sensor that is the photoconductive light sensor which does not produce electricity but simply changes its physical properties when subjected to light energy. LDR Sensor changes its electrical resistance in response to change in the light sensor.



Fig.3. Pin diagram of LDR Sensor

The light dependent resistor is made up of a semiconductor material like cadmium sulphide that changes its electrical resistance from several thousand ohms in the dark to only a few hundred ohms when light falls upon it. Basically light sensor is a resistor which has a resistance that varies depending of the light intensity.

2) Hall Effect Sensor: Hall Effect sensor is like a transducer that converts magnetic field level into an electric signal. Here we are using wcs2720 current sensor because it has a low operating current [19]. Hall Effect sensor is a device that detects the presence of magnetic field based on the Hall Effect phenomenon.

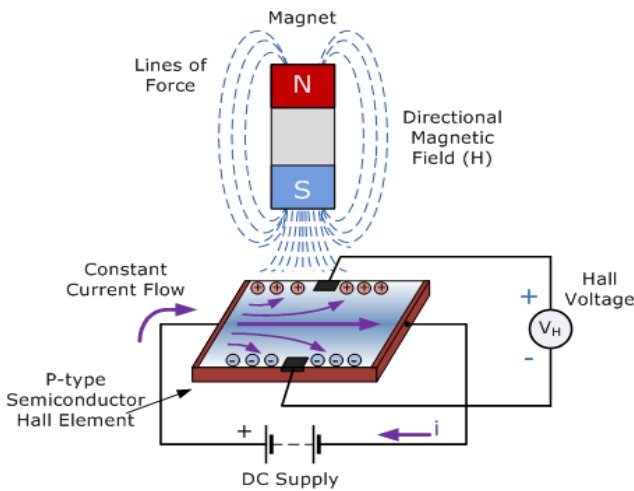


Fig. 4. Hall Effect Sensor Diagram

The above figure shows when current is passed through the conductor and the same conductor is placed in magnetic field perpendicular to the current flow a voltage is generated that is called hall voltage. It is perpendicular to both the current and magnetic field that is known as Hall Effect. The current sensor was [20] supplied with 9 volts DC. When there is no current flow means the sensor simply divides its supply voltage in half (4.5v). This device is used to measure the current using the formula

$$(V_{\text{sensor}} - 4.5) / 0.064$$

3) MIC: The carbon microphone also known as carbon transmitter that converts sound to an electrical audio signal. The main advantage of carbon microphone over other microphone designs is that they can produce high-level audio signals from very low DC voltages. Here also it using for detecting sound.

5) Wireless Camera: Wireless cameras are the device used to transmit video and audio signal to a wireless receiver. Wireless camera can transmit signal up to 300 meter and it can work in both PAL and NTSC system. These cameras operate in the frequency of 2.4GHz.



Fig. 5. Wireless A/V camera

From the monitoring station the information will be passes to the base station through zigbee network of devices.

B. Base Station

The base station is the hub of the system that control the entire proposed system. The station [21] consists of RF modules, TV Tuner card and so on.

1) ZigBee: ZigBee is a wireless communication protocol based on the IEEE802.15.4 standard. It's a specification suit for high-level communication protocols used to create personal area networks built from small, low-power digital radios. Here we are using cc2500 RF modem. It is a transceiver module which provides easy to use RF communication at 2.4GHz. Here it is a communication device between monitoring station and base station.

2) RF Modules: An RF module is an electronic device that transmits or receives radio signals between two devices. In an embedded system it is better to communicate with wireless devices. This wireless communication can be achieved through optical or RF communication. RF modules are most commonly used for consumer home appliances.

3) TV Tuner Card: A TV tuner card is a television tuner that receives the television signal by a computer. The interfaces for TV tuner cards are either PCI bus expansion card or the newer PCI Express (PCIe), but PCMCIA, Express Card, or USB devices also exist. The card consists of a tuner and A/D converter. There are different types of tuner cards are available on the market.

V. SIMULATION RESULT

The simulation result will be a five stage process. The first stage shows the simulation of PIR sensor. The PIR Sensor [21] will helpful to detect the presence of human. Whenever the presence of human detected this information will send to the microcontroller. From microcontroller the information will be passes to the base station through zigbee devices.. Here we are using switch instead of PIR sensor only for simulation purpose. The presence of human will be detected next step is to measure the intensity level of light. So the second stage will be the LDR Sensor simulation that mainly used for the purpose of measuring the intensity of the light. For measuring the intensity of the light here we are using CRO. In day time intensity of light will be high so no need of light system. When the intensity of light is low that

time necessary of the street lighting. Here we are using a torch-LDR. First of all the torch will be kept near by the LDR sensor that shows maximum light intensity. When we remove the torch slightly that indicates it reduces the intensity level so the light will be starts to glow.

The third stage will be the MIC section. The MIC will be helpful to identify the certain problem that will causes dangerous situations like accidents or other attacking things. Here we are setting a frequency 25Hz. When the sound will be higher than that level the information will be send to the authorized base station.

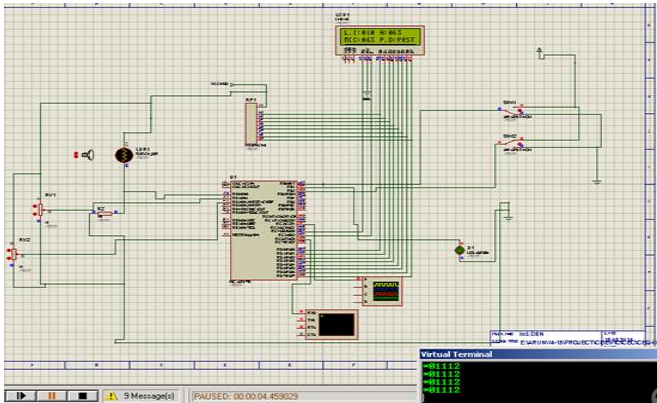


Fig.6. Overall Simulation Result

The fourth stage is the Hall Effect sensor simulation. This sensor will be useful to measure the current level. Here we are using variable resistor instead of Hall Effect sensor. The final stage is the simulation of emergency switch and here we are using switch in case of emergency situation.

VI. IMPLEMENTATION RESULT

This is the implementation result of the street lighting system and the system will helpful to the person when they need light at the night. Here we are using three different types of sensors to detect various parameters. The figure 7(a) represents the monitoring station of the proposed system and it containing PIR sensor, LDR sensor, Hall Effect sensor and so on. Here we are using a LEAD ACID BATTERY that will be charged by a solar panel from sunlight and here we are connecting two 6volts batteries that are in series. These batteries are connected to a power supply. The supply will be distributed to each module like microcontroller, Hall effect sensor, PIR sensor and so on.

Wcs2720 hall effect current sensor detecting the current used by the system. It is very useful to identify how much amount of current will be used by the system. The PIR sensor mainly used to identify the passage of vehicles or human using the infrared radiation emitting from the body. The LDR sensor module is used to measure the intensity level of the sunlight. The MIC is mainly used to detect the sound. These are the input modules and they are work together. Transfer the information to the microcontroller. From microcontroller the information will be passes to the base station through the zigbee modules.



Fig.7 (a) .Monitoring station of the proposed system



Fig.7 (b). Base station of the proposed system

This is the base station of the proposed system that consisting of Zigbee network for communication and RS232 serial communication protocol. From the monitoring station the information is received to the zigbee receiver of the base station. From Zigbee receiver the information will be passes to the authorized persons system via RS232 connector.

VII. CONCLUSION

This paper describes a new intelligent street lighting system that will helpful to the person in any helpless situations. The system combined the three technologies and forms a new improved version of the street lighting system which provides better efficiency and power saving. The system uses a wireless camera for finding what will be happening near by the lamp post. If there any problem, then it wills reaches the corresponding authorized person through the base station.

This system will work automatically so we can increase the lamp lifetime. The proposed systems will be applicable in urban and rural areas and also in remote control areas. In future we can avoid the system black out problem.

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