An Advanced Intelligent Street Lighting, Monitoring and Control System Using Sensors and Zigbee Network

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Abstract

Lighting systems, especially in the public sector, are still designed according to the old standards of reliability and they often do not take advantage of the latest technological developments. Automation has created a bigger hype in the electronics. The major reason for this hype is automation provides greater advantages like accuracy, energy conversation, reliability and more over the automated systems do not require any human attention. Any one of the requirements stated above demands for the design of an automated device. The energy conversation is very important in the current scenario and should be done to a maximum extent where ever it is possible. Energy can be effectively conserved if we can control the home electrical appliances like lights, fans, refrigerators, AC, TV's etc. The main purpose of this paper is to design an advanced highly efficient street light control system through a network of sensors to collect the relevant information related to the management and maintenance of the system, transferring the information via Wireless using the ZigBee protocol. The main purpose of this paper is to design an automatic street light control using sensors like IR, IR and also controls the intensity of street lights wirelessly using zigbee module. User can monitor the status of street lights on to the PC using ZigBee and also by sending suitable formatted SMS predefined message from the ARM-7 LPC2148 microcontroller based control system.

I. INTRODUCTION:

In nowadays, we must make use of various high-tech tools and equipments to get our jobs done and make our life comfortable. With the scarcity of power resources and increase in demand for power, the world is going through a power crisis. The world is now looking forward to develop technologies for efficient power generation and utilization at the same time. In some countries high loads at peak hours have lead to blackouts in the past. So power generation efficiency alone is not important to a country but efficient power consumption pattern as well. In this situation it has become a necessity to raise awareness about the importance of giving people access to data surrounding their energy usage.

Highly interaction in human machine in daily lives has made user interaction progressively very important. Expansion of sensor based advanced technology sophisticated human force and stress along with power conservation with automation system. Power conservation, which has become a major challenge for the users and that, is the driving idea behind our project. Power conservation system can be successfully designed only when it is interfaced with automation system. This kind of power conservation systems finds their vast application in the IT companies, banking sectors, Public organizations, and large-scale industrial sectors. Here large number of

High voltage as well as low voltage devices is employed to fulfill different consumer as well as the employ needs. In this kind of scenario there is a need to replace the switches and other fuses with relays and circuit breakers to design systems, which are capable of switching very high voltage devices and also low voltage devices.

Fig-1: Image of the Existing system of Street lights

Automation is the most frequently spelled term in the field of electronics and electrical. The hunger for automation brought many revolutions in the existing technologies. One among the technologies, which had greater developments, is the sensor based alerting technology and applications designing. These had greater importance than any other technologies due its user-friendly nature. In nowadays, we must make use of various high-tech tools and equipments to get our jobs done and make our life comfortable. And the sensor is the inseparable part of human lives today. With the help of sensors detection for human and vehicle presence using IR sensors can done many works related to their civil life. The controlling device of the whole system is an ARM LPC2148 Microcontroller. The Microcontroller is programmed using Embedded C language. Some products are commercially available in market which allows home appliances controlling through internet, GSM, Bluetooth, RFID, and Wi-Fi wireless technologies. General-packet radio service (GPRS), Power-line carrier or Global Systems for Mobile Communications (GSM) transmissions. Finally, the third possibility would be the use of renewable energy sources locally available, rather than conventional power sources, with a positive effect on the environment.

An embedded system is a combination of software and hardware to perform a dedicated task. Some of the main devices used in embedded products are Microprocessors and Microcontrollers. Microprocessors are commonly referred to as general purpose processors as they simply accept the inputs, process it and give the output. In contrast, a microcontroller not only accepts the data as inputs but also manipulates it, interfaces the data with various devices, controls the data and thus finally gives the result. The proposed system "Remote-Control System of High Efficiency and Intelligent Street Lighting Using a ZigBee Network of Devices and Sensors" using ARM 7 LPC2148 microcontroller is an exclusive project which is used to monitor and control the street light only when the vehicle presence detected by IR sensors.

II. RELATED WORK:

Intelligent information appliance is the main direction of development in the appliance control field. Intelligent appliance network has small amount and low speed of data transmission; there are many appliances in family and it needs more network capacity. The proposed remote-control system can optimize management and efficiency of street lighting systems. It uses ZigBee-based wireless devices which enable more efficient street lamp-system management, thanks to an advanced interface and control architecture. It uses a sensor combination to control and guarantee the desired system parameters; the information from the sensors is transferred point by point using ZigBee transmitters and receivers and is sent to a control terminal for street lights controlling using ARM 7 LPC2148 microcontroller. This project consists of IR and LDR sensors using which the dependence on sensors the street lights automatically gets controlled along with intensity. The system uses IR sensor for vehicle presence detection, LDR sensor

for sunlight presence detection based on the sensor detection inputs the street light gets controlled.
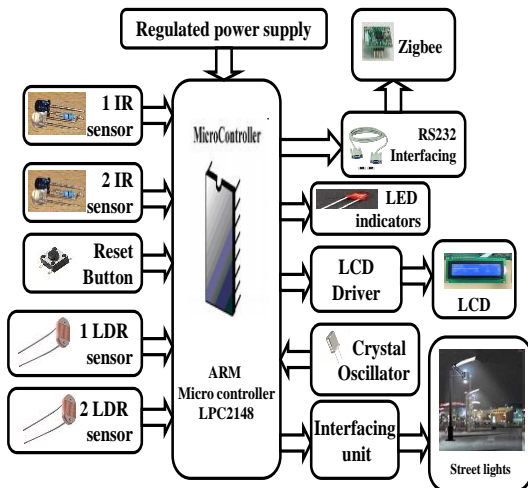
STREET LIGHT SECTION:

Figure- 2.Blcok Diagram of the proposed system at street light section

We used wireless zigbee communication for monitoring the status of street lights controlling from street light section to the Control or monitoring section interfacing with PC. Zigbee is a PAN technology based on the IEEE 802.15.4 standard. Unlike Bluetooth or wireless USB devices, Zigbee devices have the ability to form a mesh network between nodes. Meshing is a type of daisy chaining from one device to another. This technique allows the short range of an individual node to be expanded and multiplied, covering a much larger area.

Zigbee is new wireless technology guided by IEEE 802.15.4 Personal Area Network standard. It is primarily designed for the wide ranging controlling applications and to replace the existing non-standard technologies. It currently operates in 868MHz band at a data rate of 20Kbps in Europe, 914MHz band at 40kbps in USA, and the 2.4GHz ISM bands Worldwide at a maximum data-rate of 250kbps.
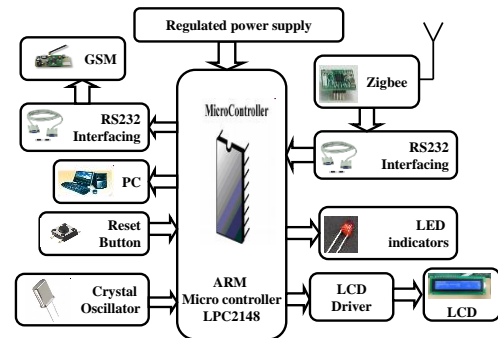
MONITORING SECTION:

Figure- 3.Blcok Diagram of the proposed monitoring section

At the monitoring section the data which received from Zigbee modules is fed as an input to the ARM 7 LPC2148 microcontroller. The microcontroller takes the responsibility to sends the status of monitored street light data onto the PC using serial communication RS232 cable and using GSM modem the system sends SMS alerts directly to the authorities.

At the street light section the control is implemented through a network of sensors like LDR and IR sensors to collect the relevant information related to the management and maintenance of the system, transferring the information via Wireless using the ZigBee protocol. The field of the ZigBee we can also find ZigBee systems similar to (the) lighting systems in structure and management.

II. PROPOSED METHODOLOGY:

In this paper we are presented an efficient street light automation system that can be interconnected using sensors like LDR, IR and also monitors the street lights wirelessly using zigbee module and also using GSM modem sends SMS alerts to the authorities. The entire proposed system consists of two sections-

Street light section consists of ARM 7 microcontroller, LDR sensors, IR sensors at enter and exit of the high way, Street lights with interfacing

circuits, LCD for displaying the status and also wireless zigbee module.

Monitoring section consists of ARM 7 microcontroller, Zigbee module, PC interfacing using RS232 cable, LCD for displaying and GSM modem for SMS monitoring alerts.

The major modules used in the proposed system are given below:

a. ARM-7 LPC2148 Microcontroller:

In the Proposed street light automation system we used the **ARM-7** microcontroller is a is a RISC microprocessor architecture from Advanced RISC Machines Ltd. The ARM7 architecture is made up of a core CPU plus a range of system peripherals which can be added to a CPU core to give a complete system on achip. It offers several architectural extensions which address specific market needs, encompassing fast multiply and innovative embedded ICE support.

Fig.4 ARM-7 LPC2148Microcontroller

b. GSM modem

The GSM modem provides the communication mechanism between the user and the microcontroller system by means of SMS messages. It is capable of receiving a set of command instructions in the form of Short message service and performs the necessary actions. We will be using a dedicated modem at the receiver module i.e. and send the commands using SMS service as per the required actions.

Fig5. GSM modem

c. LCD Display module:

One of the most common devices attached to a micro controller is an LCD display. A **liquid crystal display** is special thin flat panels that can let light go through it, or can block the light. Some of the most common LCD's connected to the many microcontrollers are 16x2 and 20x2 LCD displays. It means that 16 characters per line by 2 lines were displayed and 20 characters per line by 2 lines were displayed, respectively. Liquid crystal displays are usually abbreviated as **LCD's**. These displays are often used in battery-powered devices, such as digital watches, since they require very little amount of electricity consumption.
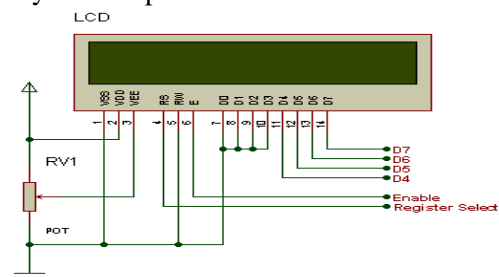

Fig.6 LCD module

d. Zigbee module

ZigBee is a wireless communication technology based on the IEEE802.15.4 standard for communication among multiple devices in a wireless personal-area network (WPAN). ZigBee is designed to be more affordable than other WPANs (such as, for example, Bluetooth) in terms of costs and, above all, energy consumption. A ZigBee personal-area network (ZBPAN) consists of at least one coordinator, one (or more) end device(s) and, if required, one (or more)

router(s). The network is created when a coordinator selects a channel and starts the communication, henceforth, a router or an end device can join the network.

Fig.7 Zigbee module

Monitoring or PC section-
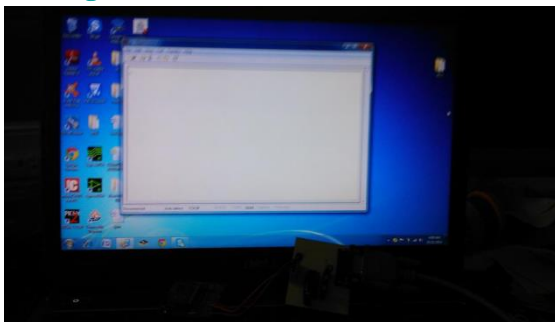
Fig-8: HyperTerminal window on monitor

In the remote monitoring section of the proposed system we interface the RS232 cable with ARM microcontroller directly to PC for monitoring the street lights data of working. User needs to follow the steps to connect hyper terminal of the PC.

START—All Programs—Accessories—Communications—Hyper Terminal—now the user should can enter a suitable name for his/her hyper terminal (Ex-abc)—now needs to select com port (generally COM1) —one dialogue box gets opened—need to enable the restore setting button to select the properties of select communication—hyper terminal window gets connected.

Connect a microcontroller at the com port of PC using DB-9 Serial RS-232cable.

IV CONCLUSION:

An existing remote street light monitoring and control system was designed such that the intensity of the street light would automatically controls using sensors data base from LDR and IR sensors and the system wirelessly monitors using Zigbee technology. This system also has an extended feature of sending SMS alerts about the status of street lights using GSM. The GSM module will send the information regarding the status of street lights to the respective authorities.

In future we can use this power conservation in order to control devices automatically in industries, hospitals, homes etc. This kind of automation provides greater advantages like accuracy, energy conversation, and reliability and more over the automated systems do not require any human attention. As the energy conversation is very important in the current scenario and should be done to a maximum extent where ever it is possible. In future we can use it in several applications by adding additional components to this project. The controlling of devices can be done using mobile phone technology, personal computers, touch screens, remote controls etc. The monitoring and controlling devices are done by using different sensors according to the information we can make alterations. This system provides sophisticated remote control over the energy consumption of LED Lighting system. GUI developed makes the job easier for any user with little computer knowledge. This system can be used to control the lighting at the odd hours of the night and hence provides way to save unnecessary usage of energy. By creating a proper network with ZigBee, this system can be deployed to control and monitor more street lighting system spread over a vast area. This project can be extended using GPRS module. GPRS module can be used to monitor and control the street lights, traffic lights, etc using predefined weblink. The project can be extended using wireless Wi-Fi network using which the devices can also be controlled using voice application and also touch application from android mobile and also from PC.

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