Advanced Wireless Sensor Network Based Remote Control for High Efficiency Street Lighting System

Mr. Amey S.Laddad
M.E Student,
Department of E&TC,
SITRC Nashik, Pune University, India.

Mrs Gayatri M Phade
Head of the Department,
Department of E&TC,
SITRC Nashik, Pune University, India.

Abstract:

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 traffic lights on the highways by glowing them only when there is traffic on the road, and this is all most impossible to detect the arrival of a vehicle manually without the presence of light. So in this situation we should think about a system which is capable of sensing the arrival of vehicle and ON the lights and turn OFF as soon as the vehicle leaves the area.

The main purpose of this paper is to design an automatic street light control using sensors like PIR, IR and also controls the intensity of street lights wirelessly using zigbee module. The system comprises of a Zigbee based remote control system that transmits the wireless signals according to the IR sensor vehicle presence detection on to the remote receiver section connected to street lights using MSP430 microcontroller. The vehicle counts displayed on the PC monitor using wireless zigbee transmission.

Index terms:

PIR, IR sensors, Zigbee modules, High power LED's, PIC, MSP430 microcontroller.

I.INTRODUCTION:

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.

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 a Microcontroller. The Microcontroller is programmed using Embedded C language.

Fig-1: Remote control based Street lights

II. RELATED WORK:

The idea behind the proposed system is to design an automatic street light control using sensors like PIR, IR and also controls the street lights wirelessly using zigbee module. Monitor. This project consists of a Zigbee based remote control system that transmits the wireless signals according to the IR sensor vehicle presence detection on to the remote receiver section connected to street lights using MSP430 microcontroller. 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 project "Remote-Control System of High Efficiency and Intelligent Street Lighting Using a ZigBee Network of Devices and Sensors" using PIC16F72 microcontroller is an exclusive project which is used to monitor and control the street light only when the vehicle is present .The vehicle presence can be detected by IR sensors. 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 MSP 430 processor.

This project consists of IR and PIR sensors using which the dependence on sensors the street lights automatically gets controlled along with intensity. The system uses PIR sensor for human presence detection, IR sensor for vehicle presence detection based on the sensor detection inputs the street light gets controlled. The vehicle count monitored count displayed on the PC monitor using wireless zigbee transmission.

III.HARDWARE DESIGN OF PROPOSED SYSTEM:

In this paper we presented an advanced wireless sensor network for automatic street light control suing wireless zigbee communication along with PIC and MSP430 microcontrollers. Zigbee based remote control system that transmits the wireless signals according to the button being pressed to the remote Microcontroller at street lights. The sensors relevant sensed data received will be fed as input to Microcontroller. The controller processes the data and acts accordingly on the street lights. Also other than Switching ON and OFF the Microcontroller, the intensity of lights can also be increased/decreased. The micro controller is also interfaced with few LED indicators to provide the health status of the device.

The proposed working model of the system consists of three sections mentioned below-

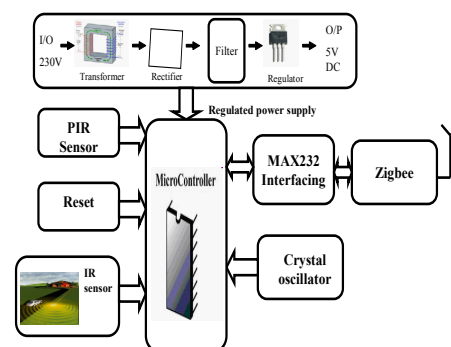### a.Transmitter or Sensor section:

Fig-1: Block diagram of transmitter section of the proposed model

The transmitter or sensor section comprises of PIC microcontroller interfaced with sensors like PIR and IR sensors. The system uses PIR sensor for human presence detection, IR sensor for vehicle presence detection. The PIR Sensor detects motion up to 20 feet away by using a Fresnel lens and infrared-sensitive element to detect changing patterns of passive infrared emitted by objects in its vicinity. PIR sensors allow you to sense motion, almost always used to detect whether a human has moved in or out of the sensors range. They are often referred to as PIR, "Passive Infrared", "Pyroelectric", or "IR motion" sensors. PIRs are basically made of a pyroelectric sensor, which can detect levels of infrared radiation. Everything emits some low level radiation, and the hotter something is, the more radiation is emitted. The sensor in a motion detector is actually split in two halves. An IR sensor is used for vehicle presence detection using an electroluminescent IR LED is a product which requires care in use. IR LED's are fabricated from narrow band hetero structures with energy gap from 0.25 to 0.4 eV. Infra red transmitter emits IR rays in planar wave front manner. Even though infra red rays spread in all directions, it propagates along straight line in forward direction. IR rays have the characteristics of producing secondary wavelets when it collides with any obstacles in its path.

b. Receiver or Street light section:

Remote-Control System of High Efficiency and Intelligent Street Lighting Using a ZigBee Network of Devices and Sensors
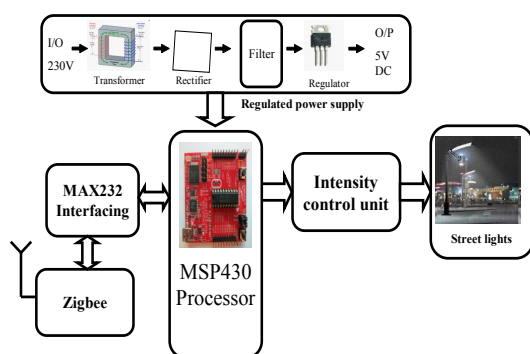2. Receiver section

Fig-1: Block diagram of receiver section of the proposed model

The receiver or street lights controlling section comprises of MSP 430 Microcontroller interfaced with zigbee module and street lights.

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. The typical distance of a ZigBee transmission range, depending on the environment conditions and the transmission power, shifts from tens to hundreds of meters, and the transmission power is deliberately kept as low as possible (in the order of a few milliwatts) to maintain the lowest energy consumption. The Microcontrollers used in the project are programmed using Embedded C language.

The MSP430 is a mixed-signal microcontroller family from Texas Instruments. Built around a 16-bit CPU, the MSP430 is designed for low cost and, specifically, low power consumption embedded applications. MSP low-power microcontrollers (MCUs) from Texas Instruments (TI) are RISC-based, mixed-signal processors that include smart analog and digital peripherals and offer a number of additional options such as low-power embedded RF and security such as AES encryption. MSP microcontrollers offer the ultimate solution for a wide range of low-power and portable applications. TI provides robust design support for MSP MCUs including technical documents, training, tools, and software.

The MSP430 microcontroller family offers ultra-low power mixed signal, 16-bit architecture that is perfect for wireless low-power industrial and portable medical applications. This book begins with an overview of embedded systems and microcontrollers followed by a comprehensive in-depth look at the MSP430. The coverage included a tour of the microcontroller's architecture and functionality along with a review of the development environment. Start using the MSP430 armed with a complete understanding of the microcontroller and what you need to get the microcontroller up and running! It includes contents such as: Embedded Electronic Systems and Microcontrollers; The Texas Instruments MSP430; Development; A Simple Tour of the MSP430;

Architecture of the MSP430 Processor; Functions, Interrupts and Low-Power Modes; Digital Input, Output and Displays; Timers; Mixed-Signal Systems - Analog Input and Output; Communication; The Future - MSP430X; and, Appendices. It details C and assembly language for the MSP430. Companion Web site contains a development kit. Full coverage is given to the MSP430 instruction set, and sigma-delta analog-digital converters and timers.

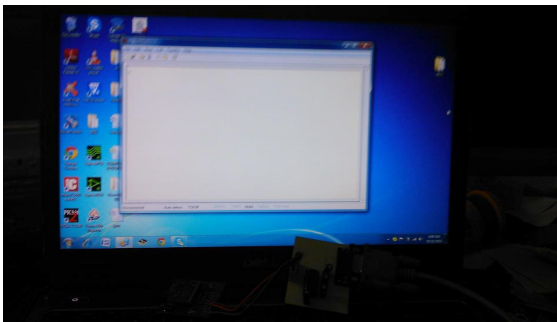## c.Monitoring or PC section:

Fig-3: HyperTerminal window on monitor

In the remote monitoring section of the proposed system we interface the zigbee module directly to PC for monitoring the street lights data of working. The remote controlling section consists of PC, zigbee transceiver module and a battery for the module to enable. 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 zigbee module 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 PIR and IR sensors and the system wirelessly controls using Zigbee technology.

This system can be extended 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.

REFERENCES:

[1] Gezer C, Niccolini M, and Buratti C, "An IEEE 802.15.4/ ZigBee based wireless sensor network for energy efficient buildings" (2010) 2010 IEEE 6th International Conference on Wireless and Mobile Computing, Networking and Communications, WiMob'2010, art. No. 5645021, pp. 486–491, 2010.

[2] Lee, J.D. ; Nam, K.Y. ; Jeong, S.H. ; Choi, S.B. ; Ryoo, H.S.; Kim, D.K., "DEVELOPMENT of ZigBee based Street Light Control System" Power Systems Conference and Exposition,2006. PSCE'06, IEEE PES, pp. 2236–2240.

[3] Wu Yue, Shi Changhong, Zhang Xianghong, Yang Wei, "DESIGN of new intelligent street light control system", 8th Conference on Control and Automation, ICCA 2010, art. No. 5524348, pp.1423–1427.

[4] "White LED Driver Circuits for Off-Line Application using Standard PWM Controllers" intersil® Application Note AN1387.0 (Source: Online)

[5] "Dimming LEDs via PWM and CCR" LUTRON® Application Note 360 (Source: Online)

[6] P. Baronti, P. Pillai, V. Chook, S. Chessa, A. Gotta and Y. Hu, "Wireless sensor networks: A survey on the state of the art and the 802.15.4 and ZigBee standards,communications," 2007.

[7] C.-Y. Lin, W.-C. Peng and Y.-C. Teseng, "Efficient in Network moving Object Tracking in wireless Sensor Networks," vol. 5, no. 8, pp. 1044-1056, 2006.

[8] Y.-C. K. S.-P. L. H.-W. &. H.-F. Tseng, "Location tracking in a wireless Sensor Network bu mobile Agents and its Data Fusion Strategics," vol. 4, no. 47, pp. 448-460, 2004.

[9] Q. Li, M. DeRosa and D. Rus, "Distributed Algorithm for Guiding Navigation Across a Sensor Network," 2003.

[10] K. Gill, S.-H. Yang, F. Yao and X. Lu, "A ZigBee-Based Home Automation System," IEEE Transactions on Consumer Electronics, vol. 55, no. 2, pp. 422-430, 2009.

[11] S. Kim, J. . S. Kang, H. . S. Park, Y. J. Kim and D. Kim, "UPnP-ZigBee Internetworking Architecture Mirroring a Multihop ZigBee Network Topology," IEEE Transactions on Consumer Electronics,, vol. 55, no. 3, pp. 1286-1294, 2009.

[12] H. S. Kim, J.-H. Song and S. Lee, "Energy-Efficient Traffic Scheduling in IEEE 802.15.4 for Home Automation Networks," IEEE Transactions on Consumer Electronics, vol. 53, no. 2, pp. 369-374, 2007.

[13] I. A. Zualkernan, A. R. Al-Ali, M. A. Jabbar, I. Zabalawi and A. Wasfy, "InfoPods: Zigbee-Based Remote Information Monitoring Devices for Smart-Homes," IEEE Transactions on Consumer Electronics, vol. 55, no. 3, pp. 1221-1226, 2009.

[14] K.-i. Hwang, B. Jo Choi and S.-h. Kang, "Enhanced Self- Configuration Scheme for a Robust ZigBee-based Home Automation," IEEE Transactions on Consumer Electronics, vol. 56, no. 2, pp. 583-590, 2010.

[15] M.-S. Pan, C.-H. Tsai and Y.-C. Tseng, "The Orphan Problem in ZigBee Wireless Networks," IEEE TRANSACTIONS ON MOBILE COMPUTING, vol. 8, no. 11, pp. 1573-1584, 2009.

[16] Y. Yao, P. Li, Z. Ren and S. Shi, "A Borrowed Address Assignment algorithm based on Inheritance Relation for ZigBee networks," pp. 454-457.

[17] Y.-K. Huang, A.-C. Pang, P.-F. Liu and W.-N. Chu, "NATZigBee: NAT-based Address Assignment for Scalable ZigBee Networks," IEEE INFOCOM, pp. 1-9, 2012.

[18] J. Wilson, V. Bhargava, A. Redfern, P. Wright, "A Wireless Sensor Network and Incident Command Interface for Urban Firefighting. Mobile and Ubiquitous Systems," Networking & Services, Volume 00. 2007: IEEE Computer Society Washington, DC, USA.

[19]

Mrs Gayatri M Phade, working as Professor of Head of the department of E&TC,ME EXTC, Diploma in Business Management, Diploma in Software Management Perceiving PhD from SNDT University Mumbai. Worked for Different Universities: North Maharashtras University, Dr Babasaheb Ambedkar university, Mumbai University, Yashwantrao Chavhan Open University and Pune University.Membership: ISTE, IETE, IEI, CSI, IEEE.

[20]

Mr. Amey S. Laddad, Pursuing M.E. VLSI & EMBEDDED SYSTEMS Pune University 23 year's age, 3 Years of Working Experience