Autonomous Control for Renewable Resources

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Abstract- *Conventional street lights system is not flexible, most of the controlling is manual where as some are automated based on timer circuit. Biggest problem is to handle remote area location's manual mistakes result into power wastage. So there is a need of efficient street light system to provide wireless access for controlling it. Server which can be used to control whole city's street light and cost effective wireless network that can be used for remote access. Proposed system controls all the street lights using an Central control Unit. All the street poles are connected to a smart feeder-pillar. These feeder-pillars are controlled by remote operating unit, as per the need street lights can be switched on/off. The main motive behind implementing this project is to save energy.*

Keywords- Street light, Smart city, xbee, Energy conservation, Central control system.

I. INTRODUCTION

Street lights play an important role in any city to make it a smart-city. But we have seen such situation where our street lights are ON in presence of daylight. So we want to develop a system which will operate street lights at anytime. The motivation of this project is to design a smart lighting system which targets the energy saving and autonomous operation which is economical and affordable for the streets. Design a smart lighting system with modular approach design, which makes the system scalable and reliable. Design a smart lighting system which is compatible and scalable with other commercial product and automation systems, which might include more than one lighting systems. This paper presents a new economical solution for street light control systems. The control system consists of a control circuitry and the electrical devices. This also includes client server mechanism where user can directly interact with web based application to control the Street lights from any place with the help of remote operating unit. A street light control system has been developed to control and reduce energy consumption of a town's public lighting system. This ranges from controlling a circuit of street lights and/or individual light with remote unit and network operating protocols. This includes sending and receiving instructions via separate data networks, at high frequency over the top of the low voltage supply or wireless. Street lights are connected to the feeder-pillar. There are many feeder-pillars covering some particular part of the city. The main motivation behind implementing project is to save energy. It is an automated system designed to increase the efficiency and accuracy on automated time control, governed and pattern basis.

II. LITERATURE SURVEY

Due to the increase of environmental concerns, lighting control systems will play an important role in the reduction of energy consumption of the lighting without impeding comfort goals. As mentioned in the IEA Annex 31 (IEA 2001), energy is the single most important parameter to consider when assessing the impacts of technical systems on the environment.

Energy related emissions are responsible for approximately 80% of air emissions (IEA 2001), and central to the most serious global environmental impacts and hazards, including climate change, acid deposition, smog and particulates. Lighting is often the largest electrical load in offices, but the cost of lighting energy consumption remains low when compared to the personnel costs. Thus its energy saving potential is often neglected.

According to an IEA study (IEA 2006), global grid based electricity consumption for lighting was about 2650 TW/h in 2005, which was an equivalent of 19% of total global electricity consumption. European office buildings dedicate about 50% of their electricity for lighting, whereas the share of electricity for lighting is around 20-30% in hospitals, 15% in factories, 10-15% in schools and 10% in residential buildings (EC 2007). Public lighting in streets, tunnels, city centers, ports and squares etc. can account for about 30% of the urban energy consumption. And the maintenance costs are very high. India is facing a huge energy crisis which has to be addressed to at the earliest using devices that are energy efficient. Based on environmental and economic factors, cities need smart energy management systems urgently for energy saving, maintenance costs reduction and CO2 emission reduction.

Intelligent lighting control and energy management system is a perfect solution for energy saving, especially in public lighting management. It realizes remote on/off and dimming of lights, which can save energy by 40%, save lights

maintenance costs by 50%, and prolong lamp life by 25%. The system application in streetlight control for each lamp will reduce in street light electricity and maintenance cost, and increase availability of street light.

The sole purpose of the project is to reduce the power consumption. The Smart street light provides a solution for energy saving which is achieved by sensing an approaching vehicle using the IR sensors and then switching ON a block of street lights ahead of the vehicle. As the vehicle passes by, the trailing lights switch OFF automatically. Thus, we save a lot of energy. So when there are no vehicles on the highway, then all the lights remain OFF.

- The system application in streetlight control for each lamp will reduce in street light electricity and maintenance cost, and increase availability of street light. Average cost for one unit(Mumbai) = Rs 100/-
- Approx power that can be saved = 30%-40%
- Approx energy that the produced more per hour = 15%
- Cost of a street light per day = Rs 700/-

The system includes of a server, GUI to display and nodes which are micro controlled processed with embedded sensors measuring different parameters. Each node in the network is linked to the main server via a protocol. The analog data sensed by the sensor is converted in digital form, processed by micro-controller and then sent to the server. The master controls all the slaves .The other nodes sends the data to master and the master collects the data and further sends to server where the data is monitored and on necessary alterations process it to switch ON/OFF the nodes devices. This scenario will bring out all the above advantages specified.

III. PROPOSED MODEL

Smart street light monitoring system using Xbee wireless module. Their aim is to monitor the health of street lamps and forward monitored result to the control station. Inside the lamp module, it consists of light dependent resistors (LDR) module, microcontroller module and transmission module. The lamp module communicates with the control centre through wireless

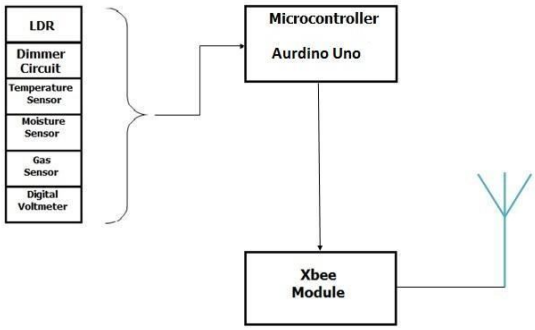

Fig.1 Block Diagram of Street pole.

using Xbee. The microcontroller will process the data and send the data to the transmission module. In the transmission module, there is wireless Xbee that transmit the data through wireless to the smart feeder-pillar. Smart feeder-pillar will monitors each of the street lamp status, as well as controls the operation of the street lamps. This paper aims at designing and executing the advanced development in embedded systems for energy saving of street lights. Nowadays, human has become too busy, and is unable to find time even to switch the lights wherever not necessary. This paper gives the best solution for electrical power wastage. Also the manual operation of the lighting system is completely eliminated.

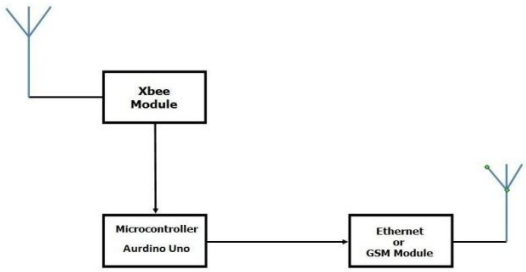

Fig.2 Block Diagram of Feeder-pillar.

IV. DEVELOPMENT

The smart system is developed using Arduino Uno microcontroller kit. Arduino is an open source hardware kit with 8-bit Atmel AVR pre-programmed on-board Microcontroller kit, with boot loader that uploads programs into microcontroller memory. In this project we are using some sensors, such as LDR, DTH11, ACS712, etc. and wireless device xbee to accomplish the objective of the projects.

ARDUINO UNO R3: Arduino Uno R3 as shown in fig 3. The specifications are ATmega328 microcontroller, operating voltage at 5v, input voltage 7 to 12v, input voltage limit up to 20v, digital I/O pins 14, analog pins 6, DC current 40mA, flash memory 32KB including 0.5KB used by boot loader. SRAM of 2KB, EEPROM of 1KB and clock speed of 16 MHz some of the Features of Arduino UNO are power: can be USB connection or external power supply, with 7 to 12 volts recommended. The Arduino UNO provides power pins for other devices, the variants are 5V 3.3V and Vin I/O, REF pin for optional power.

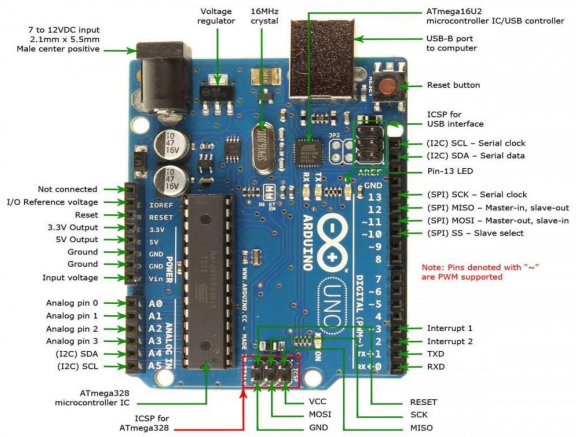

Fig.3 Arduino Uno Board.

Light Dependent Resistor (LDR) sensor: Light Dependent Resistor as the name suggests the resistance is dependent upon the light incident on it. The theoretical concept of the light sensor lies behind, which is used in this circuit as darkness detector. The LDR is a resistor as shown in Fig. 2 Figure.2. Light dependent resistor (LDR) The LDR resistance changes with intensity of light, with increase in light intensity the resistance offered by the sensor decreases and with decrease in light intensity the resistance offered by the sensor increases. Hence it acts as variable resistor with change in light intensity. These helps in finding the amount of light intensity at that instant of time and thus helping in regulating the lighting of our lighting system accordingly. Mathematical representation of LDR can be given as,

$$Resistance \propto \frac{1}{Intensity\ of\ light}$$

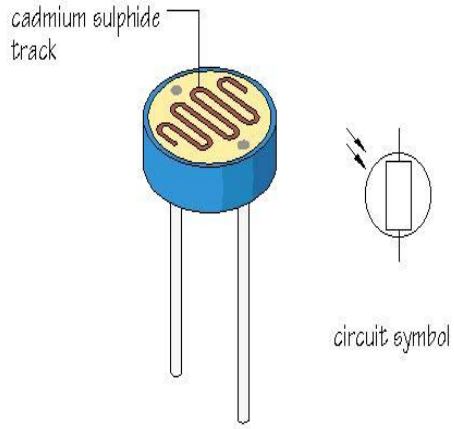

Fig.4 LDR.

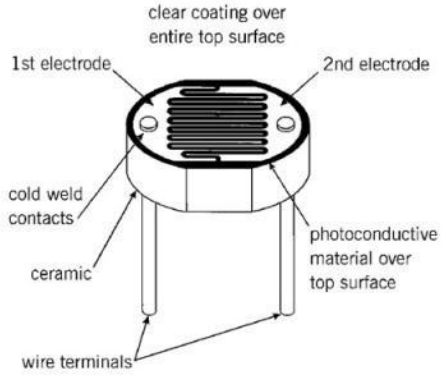

Fig.5 LDR description.

***DTH11 sensor*:** DHT11 is a Humidity and Temperature Sensor, which generates calibrated digital output. DHT11 can be interface with any microcontroller like Arduino, Raspberry Pi, etc. and get instantaneous results. DHT11 is a low cost humidity and temperature sensor which provides high reliability and long term stability.

Fig.6 DHT11.

ACS712: Acs712 is hall effect based current sensor. It can measure both direct current and alternating current. It is a linear type sensor. This is very a famous integrated circuit designed by Allegro. It has features of noise cancellation, very high response time. Output error is about 1.5 percent but it can tackle with some intelligent programming and multiplying

measured value with standard error of sensor. If you give dc current to its input, it will give proportional dc voltage at the output of sensor and if you give ac current at the input of acs712, it will give you proportional ac voltage at the output.
This acs712 sensor consists of a linear Hall Effect circuit along with copper conduction path. Copper conduction path is located around the surface of the die. When ac or dc current passes through a copper conduction path, it produces magnetic field. This electromagnetic field interacts with Hall Effect sensor. Hall Effect circuit converts this electromagnetic field into proportional voltage either ac or dc depending on input current type. This output voltage is measured with the help of arduino or any microcontroller.

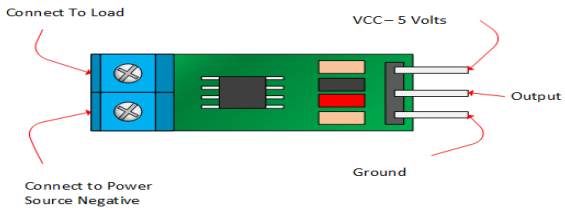

Fig. 7 ACS712.

Zigbee: Zigbee is a device used to send and receive wireless data. It is considered one of the Zigbee families. Zigbee or simply xbee has a feature that is can be easily connected to the air interface UART (RS232)/USB cable.

Fig.8 Xbee.

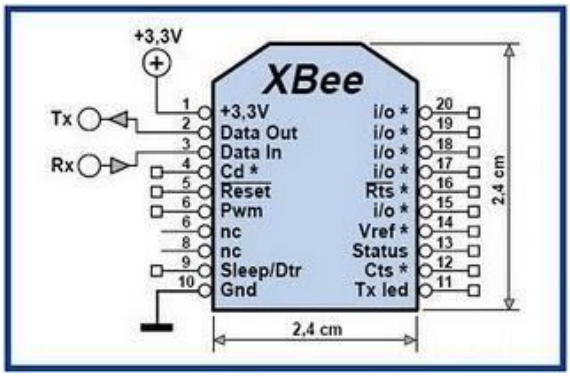

Fig.9 Pin Configuration of Xbee.

V. CONCLUSION

- Consume least power and still provide optimum lighting
- Shield out maximum financial benefits in solar farms
- Acts as watchdog against grid energy theft
- Enhance safety on roads (streetlight & headlamps)
- Better and pleasant vision in office and classroom boards

VI. RESULT

- Remote on/off, Dimming and on-site Status Check.
- System Fault Detection/Alarm.
- Anti-theft Detection/Alarm.
- Energy Consumption Report.
- 24-hours Online Monitoring.
- Reduce energy use by up to 40%.
- Reduce maintenance by up to 50%.
- This project consist of spatially using autonomous devices embedded along with sensors which monitor the environmental parameters like sound, fog, temperature, carbon monoxide emission.

VII. ACKNOWLEDGEMENT

Throughout the whole process of the final year project, We had gained a lot of knowledge and experience. Unlike the ordinary course subject, final year project are able to train us in independently and practically on handling a project. This is a very valuable and precious experience where it cannot be obtain in ordinary studies or books and it would be a good training for the undergraduate student before entering their career life. Hence, we would like to thanks University of Mumbai [MU] for offering this unit in our Engineering course. Besides that, we would like to express our deepest gratitude to Prof. Sagar Mhatre, our project guide, for offering this project to us. During carrying out our project, Prof. Sagar is a great source of support and guidance where he taught us how to handle a project effectively, how to deal with problems, and idea with his optimism and humors. Although we are handling different part in this project title, throughout the whole progress we are helping each other and learning together in order to bring a great success to this project. In addition, everyone is willing to share his every single knowledge and findings without any hesitation. Throughout the whole project, we always helps each other in solving problems and finding solution for every single obstacle we faced. Hence, we have worked together efficiently and effectively.

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