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IOT based street light monitoring system

K.TAMILSELVAN, K.S.DEEPIKA, A.GOBINATH, S.HARHINI, S.GOKHULRAJ

ASSISTANT PROFESSOR, UG STUDENTS

NANDHA ENGINEERING COLLEGE (AUTONOMOUS)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

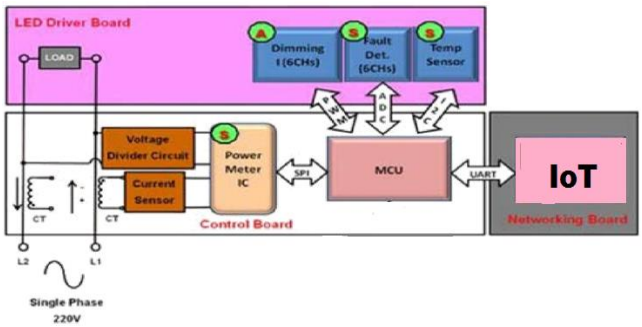
Mail id:harinisaravanan889@gmail.com,deepika.subramaniam1@gmail.com

Abstract- In this letter, we propose an energy efficient ZigBee-based outdoor light monitoring and control system that can monitor and handle outdoor lights more efficiently as compared to the conventional systems. The proposed system uses the GPS-based wireless devices which allow more efficient lamps management. The designed system uses sensors to control and guarantee the optimal system parameters. Today, population density shifts towards urban centers have resulted in the constant rise of energy consumption in cities. Due to the cost and technical restrictions of strengthening the infrastructure at the same rate, alternative energy sources must be sought in order to meet these increased energy demands. This study presents a street lighting system which consumes minimum energy from the city network. Here the lights are switched via IoT. The voltage consumed by the system is also monitored remotely.

***Key words*— embedded system, energy efficiency, lightning control system, LED lamps, IoT.**

INTRODUCTION

Energy efficiency is one of the key factor while designing indoor or outdoor lighting systems. The street lights consumes almost 30-40% of the entire city power consumption. Thus, control system able to efficiently manage the lighting is absolutely advisable. The largest expenses of a city is mainly because of street lights.A smart street light can be used to cut the municipal waste upto 50- 70%.An intelligent lighting system mainly adjusts the light based on the way it is used. The project is mainly used to track the usage of light using sensors and it is the one using the wireless system to control the energy consumption and uses reduction measures through power conditioning and control. Whenever the needed the light will be made ON/OFF remotely and the same information can be accessed through internet,which can be made ON/OFF using iot. The street light(ON/OFF Status) can be accessed from anytime, anywhere through iot based on the real time system.The street light controller is installed on the pole.

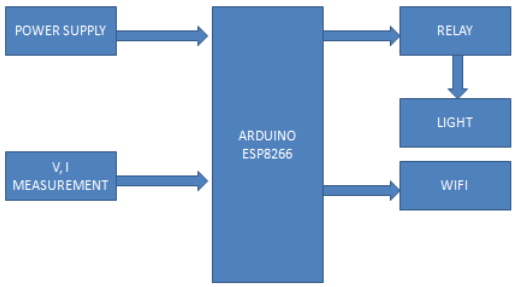


PROPOSED SMART ENERGY EFFICIENT LIGHTING SYSTEM

In this paper, we design ZigBee-based energy efficient outdoor lighting control systems.The lamps continuously monitor the intensity of the sunlight by using the sensors connected to it, and based on that intensity ESP8266 microcontroller unit (MCU) takes the decision to dim and turn the lamps on or off. Information is transferred hop by hop from one lamp to another, where each lamp has a unique address in the system. Each lamp can only send the information to the nearest one until the information reaches the coordinator.

Lamp Monitoring System

The lamp monitoring system installed in each lamp consists of several modules: the light sensor, temperature sensor, and occupancy sensor, power metering IC, MCU, ballast etc. Sensors are attached with ZigBee RCM nodes to continuously monitor the situation of the lamps. The sensors are used to observe the main parameters such as lamp-housing temperature, power consumption, and illumination condition of the place. These devices work together and transfer all of the information to MCU which processes the data and automatically sets the appropriate course of action. The detailed discussions related to the main components involved in the lamp monitoring system is given in subsections.



Block diagram of IoT based light controlling system

ESP8266 *Microcontroller Unit*

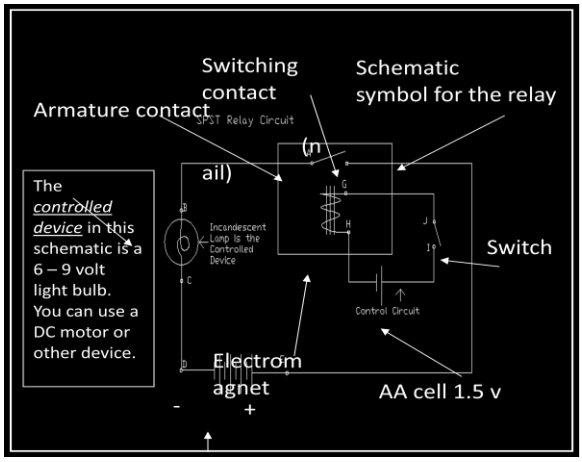
This Micro-controller has Wi-Fi capability. It can be programmed just like any other MCU, it has GPIO, SPI, I2C, UART, I2S.It has 802.11 b/g/n.

Light Sensors

Light sensors are connected to the MCU through I2C interface which observe light status in lux. A light sensor measures the brightness of the sunlight and adjusts the light intensity of the lamp to keep the light intensity up to 200 lux. The purpose of this measurement is to ensure a minimum level of illumination of the outdoor lights. Based on the sun-light intensity, the MCU drives the lamp to maintain a constant level of illumination, that is, minimum horizontal and vertical illuminance of 15 *lux* and 50 *lux*, respectively. Thus, the lamp will be turned on when the sun-light will fall below this illuminance level. This action is obviously not required during daylight time.

Basic design and operation

When voltage is supplied to the primary circuit, current flows through the coil winding to ground. Whilst doing so, a magnetic field develops around the primary coil. As the magnetic field builds, it pulls



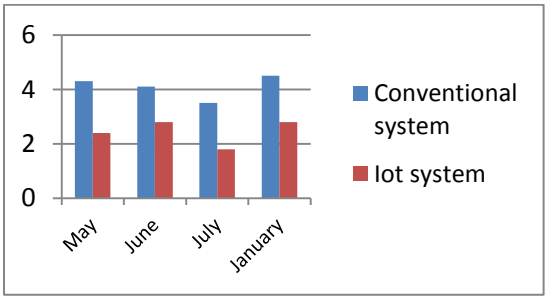
together the switch contact in the secondary circuit, thus supplying current to the component being operated.

When the relay is switched off the magnetic field is removed and the sprung plate returns the switch to the open circuit position, thus switching off the power.

Test Case Implementation And Discussions

The system is designed to modernize the traditional wired outdoor lighting system with the energy efficient ZigBee-based wireless system. The proposed prototype has been tested under outdoor scenarios to verify its validity, functionality, and performance in the real-life conditions. The LED unit that replaced the conventional lamp.Each street lights have been assigned identity to identify it remotely from the central control station. The control center is used to check the real time status of the lights and helps in detecting the faults.

To accurately analyze and compare the performance of the proposed IoT energy efficient street light system and the conventional lighting control system, the system has been tested for two extreme months of summer and winter.



Energy consumption comparison using conventional and proposed energy efficient system.

This energy reduction is due to the usage of LED lamps instead of conventional MH lamps, diming feature of LED lamps, and by using the occupancy sensors. The bar charts are plotted for the two extreme months of the year for summer and winterThe results clearly indicate that the energy consumption of the proposed IoT system decreases noticeably compared with the conventional systems.

CONCLUSION

The centralized and smartly monitoring of outdoor lights is the cost effective and energy efficient way of saving precious energy. The main aim of the system is to cut down the three important problems that our country is finding difficult to tackle.

- Energy wastage
- Reduction of HUMAN LABOUR

This system cuts down the cost of conventional system by 50-60% which improves the economy of the country and saves a huge amount of investment as it can be utilized in useful ideas.

It can adopt to the changing conditions in a more proactively and timely manner. Furthermore, the proposed system is suitable for outdoor lighting in urban and rural areas with slight modifications where the traffic can be low or high during different time intervals. The designed system is flexible, extendable, and fully adaptable to the user needs.

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