

Smart Lighting System To Reduce Energy Consumption

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Abstract: Energy is crucial in our daily life. It is impossible to imagine world without energy. In this paper, it is proposed to provide comprehensive survey on technologies for smart lighting system to reduce energy consumption. Factories, educational institution, Decoration and many more are the areas where maximum energy is used. Small changes like switching light on when necessary and switching light off when it is not in use will save large amount energy. This paper compares some of the smart lighting technologies.

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INTRODUCTION

Lighting is a vital part of any building. Proper lighting enhances the beauty of the room, interior spaces and provides illumination for tasks and activities. At the same time electricity is becoming more expensive while its consumption is getting higher. In order to reduce electric consumption in commercial building, an effective lighting system is necessary. Smart lighting contributes major of electrical energy consumption worldwide. People often forget to turn off the light in their house when they go out so the room is lit even when there is no need for it. Sometimes the lights continue to be on until the room is already illuminated by natural light. Consumer often unnoticed the energy that is wasted by letting this happen. Besides, this act also leads to increase in electrical bill. There is also a problem of the use of excessive amounts of light. So there is need of smart lighting system, that uses the day lighting of the room and an automatic occupancy system to shut-off when nobody in the room. In this paper, it is proposed to provide comprehensive survey on technologies for smart lighting system to reduce energy consumption.

LITERATURE SURVEY

Some of the technologies on smart lighting are summarized in the following.

Sharath Patil G.S *et al.*, 2015 [1] describes a new method on Design and Implementation of Automatic Street Light Control

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Using Sensors and Solar Panel. Here automation of street lights is done by LDR (Light Dependent Resistor) sensor. Intensity of led street lights can be controlled by IR sensor and pulse width modulation. PWM (Pulse Width Modulation) is used for intensity controlling of LED. LDR is a light dependent resistor which is having very high resistance. Whose resistance decreases when light impinges on it. This kind of sensor is commonly used in light sensor circuits in open areas, to control street lamps. This LDR mainly used to differentiate between day and night light. LDR gives the discrete output of the resistance values this analog should be converted into digital so an analog to digital converter is required which is interfaced with microcontroller. Microcontroller is programmed to increase or decrease light according to the natural light intensity. PMW IR sensor senses the vehicles on the street gives signal to the microcontroller. When vehicles are present it gives bright light. During late night low traffic density so brightness of the LED are automatically lowered. Lot of power is conserved and This model will reduce the power consumption 20-35% compared to conventional design.

Sampathkumar. S *et al.*, 2013 [2] describes an intelligent lighting system for providing the necessary luminance in a desired location. Here LED bulbs are used. PIR (Passive Infrared sensor) is used for detecting the motion of a person and corresponding lights will be turned ON/OFF in particular locality. The microcontroller controls the entire operation of the system.

Ankit Maslekar *et al.*, 2015 [3] describes Smart Energy Conservation System Raspberry Pi that monitors the electrical lighting and the running of the fans. An MCB (Miniature Circuit Breaker) is provided as a bypass switch to control the external lighting in case of a malfunction of the raspberry pi. The conserved energy can be generated in the electrical grid and this energy can be used by another

individual for different purpose. A Micro SD card is inserted into the slot on the board which acts as the hard drive for the Raspberry Pi. It is powered by USB and the video output Python language is used for programming, a web camera images of a room are captured and then compared these images with the human patterns that are stored in the OpenCV (Open source Computer Vision) software. If it fails to match then power supply is disabled. There is no need for any sensors to be installed for this system. It has an extremely low power consumption of about 2 watts (approximately equivalent to a mobile charger).

Prof. K. Y. Rajput *et al.* 2013 [4] describes the Intelligent Street Lighting (ISL) system. This lighting system integrated with sensors and controllers, designs a smart lighting system with modular approach design, which makes the system scalable and expandable. The system comprises of 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 microcontroller and then sent to the server. The master controls all the slaves. The other nodes send the data to master and the master collects the data and further sends to concentrator and server where the data is monitored and on necessary alterations process it to switch On/Off the nodes devices.

Liu Chee Wei *et al.*, May 2011 [5] describes a method on Modular Intelligence Control System (MICS). It is integrated with the most different types of sensors to control the lights effectively. MICS is a robust system where it performs well not only under ordinary conditions but also under unusual conditions (e.g. power interruption). MICS and IHAS (Intelligent Home Automation System) are integrated. MICS divides into two types of module: input module and light module. Each module has a controller to process the input/output signal. Controller will communicate with the management console (IHAS) through serial communication. Input Module receives the input from the sensor (Digital or Analogue Signal). Light Module produces the output signal to control the lighting (via PWM or Pulse). Lights intensity can be controlled through PWM, voltage pulse or by just turning ON or OFF using digital output (with relay assist).

Mustafa Saad *et al.*, [6] describes method on Automatic Street Light Control System Using Microcontroller. To indicate a day/night time two sensors are used which are Light Dependent Resistor (LDR) sensor and the photoelectric sensors to detect the movement on the street. The microcontroller PIC16F877A is used as brain to control the street light system, where the C-programming language is used for developing the software to the microcontroller. This system has been designed and implemented as prototype system.

CHALLENGES

Some of the challenges faced by smart lighting system are as follows.

Led Glare And Shadowing : On the design side, luminaries strong glare and shadowing can be problematic. An issue that manufacturers responded can be fixed by switching from Device On Board (DoB) to Chip on Board (COB).

Led Dimming Not As Smooth As Claimed : The dimmable capabilities of LEDs are not smoothly. LEDs dim in steps appears choppy compared to conventional lighting, and do not always perform according to expectations.

Lack Of Color And Measurement Standardization: Lack of LED industry standards for Color Correlated Temperature (CCT) and data presentation also continue to trouble designers, when it comes to picking the right bulbs for projects. Even having same CCT range, the colors are completely different. Manufacturers have responded to PLDA that this can be overcome if there are only three types of color temperature bulbs: 2,700K, 4,000K, 6,500K.

Thermal Management: Manufacturers are increasingly able to control heat dissipation as LED efficacy improves. Higher efficiency has resulted in less heat loss, and make products better suited for hot climate applications. Technological advancements have enabled innovations in LEDs that now enable heat sink free bulbs.

Interchangeability: Clients expect long lifetimes for LED lights that tend to last at least 30 years, making component interchangeability increasingly important.

Need for lower costs : Yet, costs still remain as a barrier to introduce users to the new technology. Lighting designers have to fight onto manufacturers behalf to get price on, if it is above 30 percent than it is difficult to get it through. The dilemma for manufacturers is a balance between costs and product functionality. The right light at the right time at the right place is good.

APPLICATIONS

Some of the applications are listed below.

Human Motion Tracking: Smart lighting controls the system based on human motion tracking. Proper illumination and color temperature depend on human activities. Infrared and thermal spectrum provides useful information robust to the lighting condition. The activity modes such as study mode and watching TV mode were estimated and the illumination and color temperature of the LED lighting system were controlled in real time according to the estimated activity.

Smart City: There is a growing demand for energy efficient solutions in different areas. The improvement of the quality of service and the reduction of resource waste is the goal of new solutions. Smart city needs technologies like street lighting

system which reduces the consumption of energy and supports the economic growth of city leads to economical growth of country.

Enhancing Sleep Quality With The Blue Spectrum Light: Using smart lighting system color of light can be controlled. Studies of human circadian rhythm imply that the blue spectrum of visible light is good for human sleep. Augmenting or diminishing the presence of this blue spectrum can affect sleep quality.

Energy Efficiency: Saving energy using need-based lighting management in homes and offices: By collecting and identifying real time data about occupants, incident sunlight and light-field sensing, Smart lighting system can optimize the required light output in both day and night. By maximizing light usage in the appropriate places expected energy savings are between 40-70% higher than simply adopting CFL bulbs.

Indoor Navigation: Indoor navigation can enable easier directional access and improve information in high traffic buildings.

Smart Grid Control: The smart grid is a modernized electrical grid that uses information and communications technology to gather and act on information, such as the behaviors of suppliers and consumers, in an automated fashion to improve the efficiency, reliability, economics, and sustainability of the production and distribution of electricity.

SUMMARY

Lighting is a large and rapidly growing source of energy demand and greenhouse gas emissions. At the same time the savings potential of lighting energy is high even with the current technology, and there are new energy efficient lighting technologies coming on the market. Energy efficient lighting also includes considerations of the control of light and the use of daylight. A sustainable lighting solution includes an

intelligent concept, high quality and energy efficient lighting equipment suitable for the application.

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