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Intelligent Street Light System with Power Saving Function

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Abstract

One of the supporting technologies for a smart city is the smart LED streetlight system, which also provides low-cost, low-power outdoor lighting with benefits for both car users and pedestrians. Sensor integration and wireless sensor modules based on ZigBee can provide an ideal platform for an innovative streetlight LED application. Psychological evidence suggests that various levels of color temperature may have a direct effect on the circadian rhythm of humans. Correlated color temperature dependent illumination therefore offers important lighting output in low visibility areas, both in terms of energy efficiency and in overcoming traffic accidents. Furthermore, real-time implementation of the proposed system shows perfect transmission-reception parameters such as throughput and signal strength among the different LED streetlights, which fulfills the wireless communication range and signal quality between each LED streetlights.

Keywords: *Street light, LED, Zigbee, Sensor, Web Server*

I. INTRODUCTION

Currently, in the whole world, enormous electric energy is consumed by the street lights, which are controlled by means of the embedded brightness sensors. They automatically turn on when it becomes dark and automatically turn off when it becomes bright. This is a huge waste of electricity. There are several attempts at reducing the waste of electricity from street lights. Often a sensor light is used, which is controlled by the brightness sensor and the motion sensor. When the motion is observed in front of the light and it is dark, it only switches on. However, when a human or a vehicle comes in front of it, it's usually too late to turn the light on. Before a person or car enters, the light should be switched on[1]. The trend of global urbanization is leading to developments in emerging technology and smart city architecture. Streetlight technology is one of the smart city growth trends. The use of streetlights is important and is often seen in large or small cities all over the world. Streetlights can give streets and public places light at night, which can minimize the risk of an accident and increase the safety of drivers and pedestrians. When streetlights are present, the chances of driving accidents and pedestrian accidents are lower[2].

The use of LED (light-emitting diode) lamps for streetlights has recently increased significantly. Compared to traditional streetlight technologies such as high-pressure sodium (HPS) and low-pressure sodium (LPS) lamps, LED based streetlight technology has significant advantages in terms of both energy consumption and optical luminescence. In addition to being eco-friendly due to its low consumption of electrical energy, it also provides many advantages, namely uniformity of illumination levels through arrays of many LED chips, visibility of the streetlight through correlated color temperature (CCT) and improvement of visual efficiency due to the high color rendering index. While LED streetlights have higher initial costs, they have a longer lifetime, which makes the cost of maintenance cheaper than HPS streetlights over time. LED streetlights often generate less heat, which simplifies the physical design, whereas HPS streetlights need a proper cooling system to maintain their temperature in the normal range. Therefore, many countries have now started replacing the HPS/LPS lamp system with LEDs for both indoor and outdoor lighting systems because of the incredible potential of LED technology and also as part of smart city applications. There is still an open field of research that we need to dig out in order for smart cities to leverage the maximum potential use of the LED streetlight system[3].

First of all, it can offer tremendous energy savings by making streetlight LED lamps smart by using a web-based management system. Second, the introduction of energy-efficient electronic sensors and the integration of wireless networked modules will provide the perfect forum for an innovative implementation of LED streetlights. Finally, the use of CCT-based smart LEDs in streetlights that are aware of weather data would be an amazing success in developing a user-friendly smart city network, which is our focus in this article. This paper explores the usage of the wirelessly networked sensor-equipped LED streetlight system with an integrated web-based management system[4]. People use a low power, low cost and low data rate wireless sensor network based on ZigBee to speak about the wireless network infrastructure (WSN). People choose ZigBee over other WSN protocols because it is more acceptable in terms of data rate, communication coverage size, as well as price for the public streetlight system. It provides a network structure of self-healing, self-forming, tree, star, or mesh topology that facilitates significant safe communication between the various elements of the streetlight[5].

Climate conditions such as rain, snow, and air pollution have serious impacts on road fatalities. Weather risks associated with reduced driver visibility have critical effects on traffic incidents. In particular, urban areas have witnessed traffic accidents today that occur due to the low visibility impact of fog or pollution. Therefore, we are inspired to build a smart LED streetlight system conscious of weather data to identify the blind spot of a driver when climate hazards such as foggy, rainy, snowy, etc. Smart City provides a system of smart health, smart electricity, smart traffic, smart houses, and smart streetlights. A communication medium such as cellular data networks, wireless local area networks (WLANs) or low-power and low-cost WSNs such as ZigBee, is needed for these various applications[6].

To safeguard the full fusion of all forms of sensor data and to make use of the information for further monitoring by Sig fox. In particular, for LED street light applications, WSNs are more promising than any other communication network organization. In order to account for traffic incidents, most existing works studied LED streetlight system regulation without taking into

account any weather data such as fog or emissions. None of the current works have introduced the weather-conscious smart LED streetlight system to the best of our knowledge. Works in and investigates the smart LED streetlight system, which also contributes to remote monitoring that is reliable, quick, correct and dynamic[7]. The research proposes a smart streetlight system consisting of brightness sensors, motion sensors and communication networks for short distances that turn on when necessary and turn off when not. Similarly, in the smart LED device proposed by authors to dim the light in the room area.

Renewable energy provides an intelligent lamp post that is operated by a remote controlled device that utilizes LED-based lightweight supply and power (solar panel and battery). It is then implemented to collect the relevant information associated with the system's management and maintenance through a network of sensors. Data is transmitted using the ZigBee protocol in wireless mode. The measuring station is located in every lamppost and consists of many modules: the presence sensor, the sunshine sensor, the failure sensor and an emergency switch. The presence sensor or PIR sensor has the task of detecting the passage of a vehicle or pedestrian causing the switching on and off of the lamps. This feature permits to activate the lamps when necessary and avoids waste of energy[8].

A. Light Sensor:-

External light intensity and ensures a minimum level of road lighting, as provided by the regulations. The sensor, which is inside the visible range, should have high sensitivity. For low-light luminance levels, this offers a photocurrent that is high enough.

B. Supervision Module:-

This sensor enhances management of faults. When the lamp is turned on, a Hall sensor detects Errors which are contrasted with the stored information that are recognized by the device. The ZigBee network reports this information to the station management team. Various sensors are shown in figure 1. These devices work together and transfer the data collected by them to a microcontroller that processes the data and chooses the relevant information.

C. Control Unit:-

The sensors move the information gathered to a controller that uses software that is then used for device management. If no fault is found, the microcontroller tests the current by storing the values in memory through the Hall sensor. All the tasks have a fixed period for time management. The lamp is switched off at the stop signal.

D. Management Centre:-

The transmission system consists of ZigBee devices which receive and send data containing information about the condition of the lamps to a terminal. The processing unit consists of a serial UART interface terminal which receives data supplied by a ZigBee device. Control can

be generalized in such a way that other electrical systems can send power consumption data to a central energy consumption adjustment system for remote switching and management[9].
The Wireless Sensor Network (WSN) consists of a microcontroller, an RF transceiver and sensors and is a series of small electronic devices. The WSN consists of 3 types of coordinator nodes, router nodes, and terminal nodes. On the lamp pole, routers and terminal nodes are positioned and coordinator nodes are kept on the lamp pole or kept with the monitoring center in the local city. Using dedicated protocols, these WSN nodes can communicate with each other. Linear topology is used by WSN. Due to the large number of street lamps present near the highways, the WSN's entire topology is split into several strip style sensor networks. In order to avoid interference, separate channels are given for each type of strip sensor. Each node acts as a router and retransmits messages to the destination node from one node. Each message is recognised. These networks are thus used to indicate environmental data. In the street lighting system, WSN helps to share data. It is important to do a periodic audit of the system and nodes. An error message should be sent to the lamp commissioner in the event of a broken connection between nodes. Then, in order to preserve network integrity, a new route must be traced[10].

II. CONCLUSION & DISCUSSION

Thus by using these two concepts of zigbee and WSN's - PIR sensors we can make highly efficient, low power consuming street light systems. There is ease of maintenance and high transmission rate of information from device to device in the systems explained. The system can be expensive, but higher lamp prices are offset by the lack of costly wiring and power network availability and slightly lower maintenance prices. Low energy consumption is produced by the supply of renewable energy through solar panels with no harmful ambient emissions and the minimization of light pollution. By using the highly economical LED technologies supplied by renewable energy supplied by solar panels, costs can be saved.

III. REFERENCES

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