SMART STREET LIGHTING SYSTEM

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Abstract—Now-a-days, people are too busy, and unable to find time even to switch OFF the lights whenever not required. The conventional street light system is the potential consumer of electricity, and large amount of electricity is wasted. The consumption of electric energy is consistent and has no concern with the frequency of traffic. This study is aimed at saving electrical energy by detecting the vehicle movement on highways and by increasing the intensity of the block of street lights ahead of it and simultaneously decreasing the intensity of the trailing lights. This project requires a sensor to detect the vehicle movements and accordingly switching the intensity of the street lights. So when there are no vehicles on the highway, then all

the lights remains with low intensity. Energy consumption in metropolitan cities is increasing day by day. In every city, considerable amount of electricity is being used for the purpose of street lighting system. Sensors used on either side of the road senses vehicle movement and sends logic commands to microcontroller to change the intensity of the lamps accordingly. Thus this way of dynamically changing intensity helps in saving a lot of energy. The main aim is to save energy and to save cost. The system also detects faults in street lamps or wires and indicates it to the base station through a communication module used to send notifications in case of damage.

Keywords—vehicles movement sensing, sensors, microcontroller, street lights, energy efficiency.

INTRODUCTION

Street lights play an important role in any city by providing pedestrian safety and comfort to the public road users especially at night also for safety and security. The existing street lighting system in our streets uses old techniques that require manual intervention and lack latest technology as shown in Figure 1. Thus, the existing model is observed to be inefficient leading to wastage of manpower as well as electric power. Electricity providers always seek efficiency in the use of electricity to reduce the increase in electricity bill. Conventional street lighting is still using incandescent lamps that consume more power and lead to wastage of the electric energy used. And sodium vapour lamps are also used conventionally for the purpose of street lighting. These lamps usually emit a huge amount of heat and gases into the surroundings. Sometimes, even in daytime when there is no requirement of street lights, it is frequently seen that these lights remain ON violating the energy conservation rule. Due to some natural calamities like storm, if there is a breakage in wire, the entire system gets affected. Maintenance cost will be high in order to repair this system. Therefore the design and controlling of street lighting is an important area of work for maintaining safe transportation in our daily life. In any city, 'street lights' is one of the major power consuming factors. Basically, Energy is one of the basic needs of modern life and our daily work routine is now completely depended on electricity. In the securitysensitive areas continuous lightening is essential to protect the passengers from robbers and animals at night. Monitoring and controlling of the street lights in smart cities is a hot topic among the researchers, industry and academia. In our proposed system we use LED lamps, life span of these lamps are 50 times better that other conventional lamps.

Fig 1: *Highways with no traffic or pedistrians.*

RELATED WORK

In [1], the authors has developed a sensor node for street lights based on requirements of the industry. The function of the sensor node is to detect the movement of an object or a car with the help of PIR sensor. By default the street lamps remain OFF. When the sensor node detects an object moving past its position, the street light will turn ON automatically and transmits the data to the consecutive poles. Once the object has passed the sensor node, the light comes back to its default state or the OFF state. Through this sensor node

seems to conserves power, the number of packets transmitted across the pole is huge which makes the system complex. Also, there is always a chance of packet loss in the system. Thus, the sensor node could be further improved in the aspect of durability and compatibility.

In [2], the authors have introduced a wireless street lighting system that uses GSM technology to enhance fault detection and maintenance. The system draws the entire power from solar panels which are highly expensive in terms of programmed to consider inputs from both LDR and RTC at the same. One of the drawbacks of this system is that the ON and OFFtime of the street light is static. The system shifts to dimming mode during 12AM to 4AM, which causes inconvenience to the late night users.

In [3], an efficient street light control system was developed using Zig-Bee technology. Movement of human beings and objects are sensed with the help of IR sensor. Based on the output of the IR sensor a dimming control circuit was designed. Data from the base station are sent constantly to the Zig-Bee devices. The Zig-Bee communication is implemented using Digi-Max stream radio frequency modules whose transmission range is only few hundreds of meters. The system sends data from a particular street lamps to the central Zig-Bee node in case of failure and then measures are taken accordingly. The installation cost are comparatively high thn the conventional model. Also, the system is observed to be technically complex.

In [4], a time based intensity control for optimizing the energy conservation of the street lamp has been developed. The astronomical clock of the particular geographical area is studied to generate statistical data. The system uses microcontroller, real time clock and MOSFET circuit for controlling the intensity of the LED light. Through the energy disadvantages. The MOSFET have high impedance and low electricity. Also, MOSFET's have very low resistance. The systems observes the intensity of the streel light is calibrated against PWM(Pulse Width Modulation) based on the observed data. The limitation of the system is that, it doesn't adapt to the unknown pattern or variations in the atmosphere.

A system was developed using piezo electric sensors to detect the movemeent in the roads and a microcontroller MSP430 as the brain to control the processes in [5]. Piezo electric sensors are used to detect the vehicles by sensing their vibrations. These sensor will cost about Rs.10/- to Rs.15/-. The piezoelectric sensors are buried under the road surface with some layers in order to detect the vibrations.

The author in [6] is sensing the street lights using computer vision and image processing techniques. This system utilizes the camera to capture the images of the vehicles or pedestrian. Then accordingly the lights of particular streel will be ON.The camera that they have placed is a network camera. Internally it has all control mechanisms.

In [7], the system consists of two nodes namely, the master node and the slave node. Public street light intelligent control and managemeent system is made up of a PC and a number of sub-node components. PC is installed in the general management office of street lamp system, sub-node host computers are instaled in the street management office(a transformer), and the guest computers are installed in every street lamp control box. PC bears general configuration of multimedia PC, with GPRS communication interface and broadband network interface. Each of the sub-node computers is made up of a host computer and a number of guest modules.

For the automated monitoring and intellectualized management of the street light system, a system is designed in [8]. A GPRS communication and dual-core architecture based on Smart objective alliance (SPI) coommunication is used for this purpose. A similar approach based on IPv6 and IPSO alliance has been used to wirelessly monitor the sites of street lamps and their faults.

In [9], they also proposed GPRS and computer based intelligent street light control system. A multi-sensory array is used to collect the different type of information like sound, light, infrared and street environment.

In [10] an algorithm is proposed by the authors to control the brightness level of street lights according to the frequency of pedestrian. The embedded adaptive intelligence scheme has been used to make the street lights energy efficient. Different level of brightness has been adjusted in embedded system and the results are computed with the help of simulations. Energy consumption levels are compared with other brightness adjusting techniques at different parameters like number of traffic on road, speed of travelling and the geographic location of street lights.

METHODS AND MATERIALS

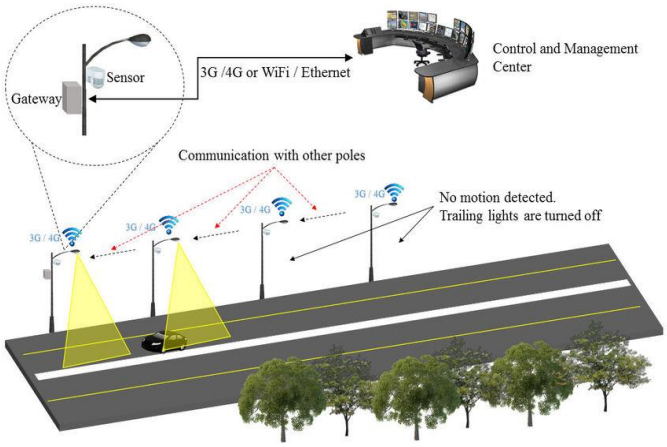

Fig2: *System Architecture of Proposed System.*

We are designing a less complex system, thus the components required is also less, Figure 3 describes the components and the flow of operations. There will be less man power involved for installation operation and maintenance. Hence system requires small space for installation and less power consumption.Automation of street

lights where the street lights are automatically controlled which increases energy efficiency and cost savings of things. This also detects defective street lights and they can be controlled remotely as shown in Figure 2, the system architecture. In traditional systems there is no option of dimming of lights depending upon the objects present on the road where as in our project we have tried to provide this system which will help to save energy as well as cost.

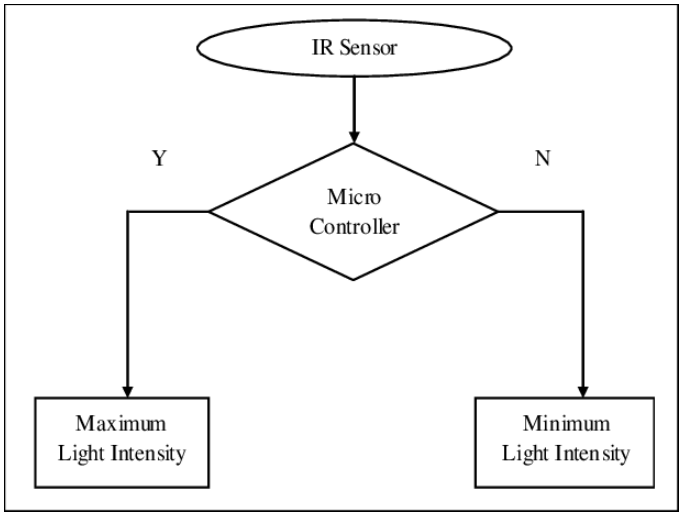

Fig3:*Flow Chart of the System*

The required components are Arduino UNO microcontroller, Active IR sensor, power supply, Blynk Application, smart phone and LEDs.

A. Hardware Description

i. Arduino Uno : The Arduino Uno is a microcontroller board based on the ATmega328 (data sheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), analog inputs, a 16MHz ceramic resonator, a USB connection, a power jack, and a reset button. This contains all the required support needed for microcontroller.

ii. Sensor : Sensor is placed in each street light pole to detectthe flow of traffic and pedistrians. It sends signal to microcontroller, here active IR sensor are used.

iii. LED: LED bulbs are placed as street lights. To vary the intensity of these LED bulbs we consider the value from IR sensor.

iv. Smart Phone : Smart Phone is basically used to run the blynk application developed to control the street lights.

B. Software Description

i. Arduino IDE: Arduino consist of both a physical programmable circuit board (often referred to as a Microcontroller) and a piece of software, or IDE (integrated development environment) that runs on your computer, used to write and upload computer code to the physical board.

ii. Blynk Application : This platform is used to develop the application which helps in controlling the entire hardware components through the user interface.

C. Modules

Entire system is divided into 3 modules.

i. Object Detection : IR sensors placed at each pole detects the objects movement and pass the signal to the Arduino Uno microcontroller.Basically IR sensors has transmitter and reciever parts. When the transmitter transmits the IR rays it calculates the time taken for the IR rays to hit the object or obstracles and return back at the receiver.

ii. Processing : Here in this module all the pre-processing tasks are made. When the application is running, where the application consists of a user interface. Anybody who are residing in that particular street has control to that street lights by having this application in their smart phones. They can even turn ON the street lights when it becomes dark and turn them OFF when it becomes bright in the morning.When the IR sensor sends signal to the Arduino Uno microcontroller, if it indicates that the object is detected then the code written in Arduino IDE specifies the action to be taken when that condition is achieved.

iii. Final Action : Based on the value received at the Arduino Uno microcontroller from the IR sensor it makes decision and performs different actions that is dimming of street lights. Indicating emergency conditions, like fire accidents there are made by using buttons in the streets like SOS buttons to indicate a buzzer sound in the central control place.

RESULTS AND DISCUSSION

When we saw that there is huge amount of electric power wastage and man power wastage , we came up with this idea that we certainly need a better street lighting system that exist today as there is no proper maintenance of street lights. Even today we can see that many street lights are turned ON even during sunlight in morning, and also in national highways and ring roads without any traffic which leads to wastage on non-renewable resources like electric energy and man power.

Basically, in our system we are giving complete authority to the people residing in the street. They can have control to that street lights of that street by having a application in their smart phones. In the evening, say at 6:00 PM they can turn ON the street lights using the button control in the application interface. Where when these street lights are turned ON they are initially at 20% intensity. IR sensors are used at each street light poles to detect the vehicles and pedistrians, when it is detected the intensity of street lights are made to 100%. In any faulty conditions like fire accidents, faults in street light bulbs, breakage in wires or cables are notified to the central control management by showing a pop-up message in the application. This way the system can be used in various places, such as in classroom to detect the presence of students in order to vary the intensity of lights if students present or to switch ON the lights else to switch them OFF, and in school corridors to vary the intensity of lights based on movement of objects. Other places like Hospitals, Malls, Airports and Industries can make use of such timely managed lights.

CONCLUSION

Due to advancement in technology, we have millions of roads around the world and each day a very huge amount of energy is wasted because of the conventional street light system.This work has been presented to save the electrical energy in the street light system. Our proposed model is different from other systems, as our system not only monitor, control and on/off the lights but also utilize the energy intelligently. We have presented the reliable, fast and power efficient street light mechanism to switch off and dim the light by taking into account the pedestrian and vehicle speed and rate of flow. In this we find that it has potential to save the energy during the nights not only at highway but also suburb and residential areas. It will ultimately reduce the energy consumption and carbon emission.

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