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ScienceDirect

Procedia Technology 21 (2015) 547 – 551

Procedia Technology

SMART GRID Technologies, August 6-8, 2015

Intelligent Street Lights

Y M Jagadeesh[a], S Akilesh[a], S Karthik[a*], Prasanth[a]

[a]*Panimalar Engineering College, Chennai -600 123, India*

Abstract

In today's world, more amount of electricity is consumed due to street lights. This is due to continuous operation of lighting during the night time. In order to reduce the electricity consumption and wastage of energy, the system that has to combine the existing network with intelligence to think itself. This newly developed concept will enable the street lights to adjust automatically based on the real time traffic conditions and change according to naturalistic condition (Full moon). This paper is concerned with the development and implementation of Low cost Sensor based Street Lights with dynamic which in turn reduces the energy consumption and CO_2 emission. It consists of IR sensor, PIR sensors, low cost embedded controller and storage device.

Peer-review under responsibility of Amrita School of Engineering, Amrita Vishwa Vidyapeetham University

Keywords: Lighting control; Dynamic Control; Sensor; Detection; Embedded controller; Energy crisis;

1. Introduction

Electricity is one of the common demands for the people among the world, though it can be produced but it is not satisfying the exact demand. To overcome this, electricity during unused hours must be saved and it is very hard for the human to monitor and control. In today's world, 60% of the electricity produced is used for the street lighting due to its continuous operation during night time. In order to minimize the electricity consumption, wealthy technology has to be implemented for the street lighting system. This paper discusses about the Dynamic Street Lighting System, which reduces the wastage of energy and CO_2 emissions. The system would intelligently adapt the lighting levels based on the weather conditions and traffic density. These lighting levels or intensity will be adjusted dynamically through the sensors and microcontroller according to the current density of the lane. An external feature has also been included in this system, so that street lights will adapt lightning based on the naturalistic features like full moon day, lights will glow half of its normal intensity.

*Corresponding author. Tel.: 919003143429.
E-mail address: karthik.dec94@gmail.com

Peer-review under responsibility of Amrita School of Engineering, Amrita Vishwa Vidyapeetham University
doi:10.1016/j.protcy.2015.10.050

2. Architecture of Smart Street Light

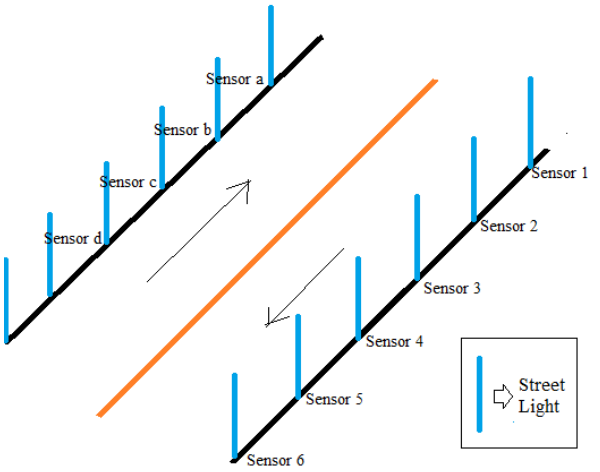

Fig.1 IR and PIR Sensors in Lane

The architecture consists of several IR and PIR sensors placed at both the ends of the lane to detect the density of passersby. These sensors are placed at a certain distance and it transfer the information among itself when is vehicle is detected. The sensors communicate with each other through wired connection. Here wired connection is used in order to reduce the cost. The implementation of Smart and Dynamic Street Lighting System provides an easy way to reduce the energy consumption and CO_2 emission. This system has the capability of real time flow control. Each sensing part consists of both infrared and PIR sensors to detect the flow. In this two sensors are used to improve it accuracy of detection. These sensors are connected to the microcontroller in which data has been processed and adjust the lighting levels. Whenever the passer is identified by sensor, it will communicate to neighbouring street lights, which will brighten the surrounding lights. The Street lights will dim to low voltage level when no activity is identified and brightens to high voltage level when movement is detected. Due to increase in industries, this system will play major role in saving the electricity without affecting the comfort zone. Fig. 1 shows the schematic diagram of dynamic street lighting system with IR and PIR sensors in lane.

2.1 Block Diagram of Dynamic Street Lights

Fig.2 shows the block diagram of dynamic street lighting system. The block diagram consists of various subsystems like Sensing Unit, Microcontroller unit and the Lighting system. The Sensing unit consists of both IR and PIR sensors to detect the density of the lane. Low power microcontroller is attached with sensing unit to adjust the intensity level of lighting based on density. The microcontroller is connected to the lighting system. This whole unit gets powered from the batteries. The sensing unit will prescribe internal communication for the clearance of lights along the path.

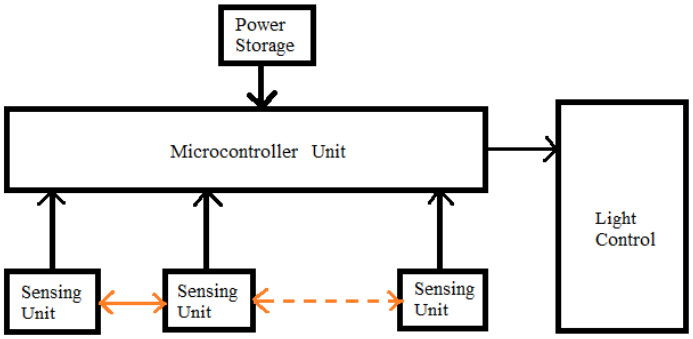

Fig. 2. Basic Block Diagram of Dynamic Street Lighting System

3. Detection and Street Light Control

3.1 Detection Unit

Detection unit consists of Infrared sensors and Passive Infrared sensors on each side of the lane which detects the density or flow of the lane and sends the data to the microcontroller for processing. These sensing units are placed on both sides of the road to an individual operation on each side. These sensing units will communicate each other during its operation. When a person is detected in lane it brightens the lights and also brightens its neighboring lights, so that person can be surrounded by safe circle of light. This is achieved due to communication between the sensors. This dynamic control of street lights overcomes the wastage of electrical energy which is the most needed in today energy crisis. In this Dynamic control, the detection unit plays an important role to sense the density of the lane and perform corresponding actions through microcontroller.

3.2 Street Light Control through Computing

From the sensing unit, the data is transferred to the microcontroller in which dynamic control of street light is performed, the flow chart of which is given in Fig. 3.

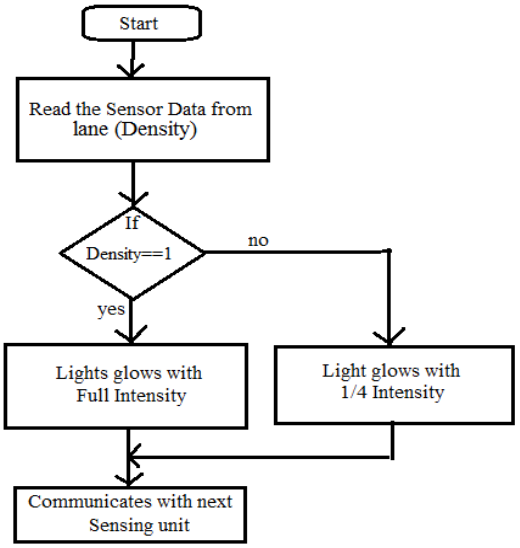

Fig..3 Flow Chart of Dynamic Street Lighting system

The flow chart describes about brightness control in the Dynamic Street Lighting System. Initially all the values about the density are read through sensing unit. At first it checks that is there is any movement in the lane then it divides into two sub division.

I. If there is any movement of data then the lights glows at its higher brightness and communicate with neighbouring sensor to brighten the nearby lights.
II. Else the lights will glows to the quarter of its original brightness and communicate with neighbouring to do the same operation.

Therefore the system allows high brightness for higher density and less brightness for lower density. The line with the less density flow will save the electricity for future and reduces the CO_2 emissions. In this system, the counter control of street lights is also included. The counting operation is performed in the microcontroller itself. There will be a Full Moon Day in every 30 days. The counter is made to run whenever the counter reaches the multiples of 30 then the light will dim to 25 of its original brightness. The implementation of the system in city explores 60% of electricity savings and thereby reduction in CO_2.

4. Experimental Setup

4.1 Density Detection

The sensors are placed at both ends of the road. It consists of both infrared and passive infrared sensors. These sensors are used to detect the density of the lane. These sensors will give digital output which is either 0v or 5v depends upon the detection. Suppose if the movement is detected in the particular lane it gives output of 5v else output voltage is 0. These output values are processed through Atmega128 microcontroller. The microcontroller is programmed to analyze the density of the lane and gives a dynamic control to the intensity of street lights. By this system, the street lights can think of themselves and adjust the intensity of lights. The street lights will be turned off and on automatically by using light dependent resistors. In this system, microcontroller remains in the sleep mode during day time and switches to active mode during dark period. This operation is made automatic by the witness of natural light.

4.2 Microcontroller and Lighting Control

The microcontroller act as a common to all the sensing units but lighting control is achieved individually for every sensor for the better accuracy. The density of the lane is detected through sensing unit and received to the microcontroller. This microcontroller performs the dynamic light intensity control and transfers the signal to the lighting system. This dynamic control is achieved through pulse width modulation in Atmega128. Normally the lighting systems are of LED and sodium vapour lamps

5. Working Concept

Initially IR and PIR sensors are laid on both sides of the roads based on the density of movement. These sensors are connected to common microcontroller. For a single street a single microcontroller is enough to perform the operation. The sensor senses the data about the density of the lane and transfers the signal to the microcontroller. Each and every lane has its sensors which establish internal communication between them. The microcontroller fetches the instruction from the sensing unit and analyzes the density of the lane which in turn controls the intensity of street lights. The small model of the system is shown in the Fig.4. The microcontroller processes the data as per the flow chart. These processed signals are transferred to the lighting system in which the intensity of light is varied. It transfers the signal to the nearby light to perform the necessary action based on the movement.

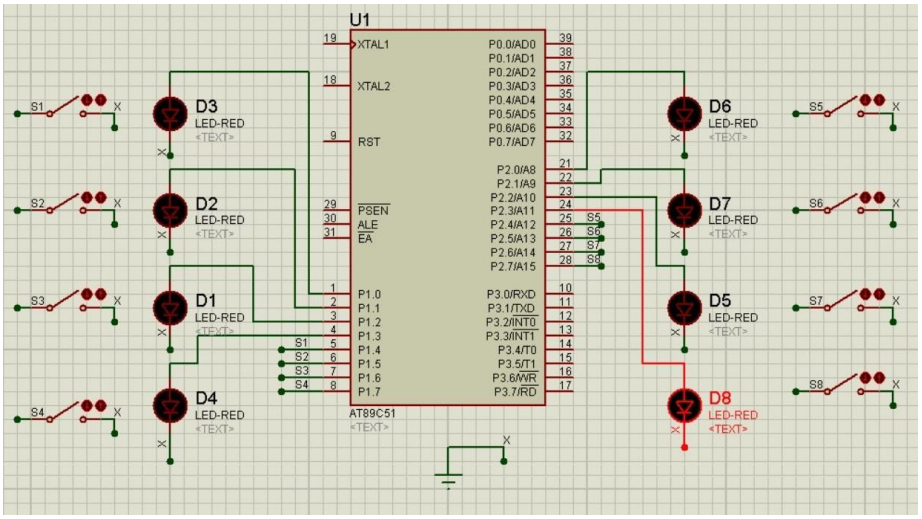

Fig. 4 Simulation output of microcontroller for dynamic street lighting system

6. Results

The result includes the successful operation of dynamic street lighting system. It reduces the wastage of energy in unused hours. This system controls the intensity of the lights based on the density of lane. This system can also be called as Intelligent Street lights or Smart Street lights which think of themselves.

7. Conclusion

This paper presents the low cost intelligent street light system through sensors for the reduction in electrical energy. This Dynamic Street Lighting System is experimented through IR and PIR sensors and the outputs are obtained through proteus7 simulation software. By introducing this system, the energy crisis in today's world can be reduced to some extent.

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