Indian Journal of Science and Technology, Vol 9(16), DOI: 10.17485/ijst/2016/v9i16/92201, April 2016
ISSN (Print) : 0974-6846
ISSN (Online) : 0974-5645

E-Street Zone-Automatic Streetlight based on the Movement of Vehicles

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Abstract

Objective: This study report smart street lights in national highways which can reduce the consumption of electricity. **Methods**: Two types of energy sources viz., solar AC from TNEB were used to conduct the present study. A solar pannel is placed on top of each street light which genrates electricity in the day time and also the AC supply from TNEB will be availed during night time sytem. The electricity availed from the TNEB will be used only when solar power inadequate. Thus a hybrid network is used in this project. **Findings**: Every Street light can be integrated with an IR sensor which detects the movements of vehicles. When the sensor detects the vehicles, the street light glows with full efficiency and when there is no movement it glows with 10% efficiency. By adapting this system, the electricity consumption can be efficiently reduced. Around 20-30% of electricity can be reduced by using this system. A solar panel is being installed in this set up, so that it charges in the presence of sun light and it uses the charge effectively in the absence of sun light. The electricity supply from TNEB is also availed so that in case of bad weather conditions, when solar panels not work, uninterrupted power supply is given to street lights. A hybrid set up is being established in which both the solar power and AC from TNEB is given. Street light utilises solar power as it can and if it is not sufficient it avails AC from TNEB. **Applications/Improvements:** This set up can be enhanced further by placing approximation sensor for detecting the failed street light and sending SMS to the control department via GSM for appropriate action**.** This setup can be applied in national highways and accident free zones. It reduces the consumption of electricity.

Keywords: GSM, Street Lights, Sensor

1. Introduction

Electricity plays a very major role for the production of electricity increases consistently in India shown in Figure 1. The demand for the new alternative methods for decreasing the power consumption has gone vital now days as the production increases in one side, demand doubles in another side[1].

The consumption of electricity must be reduced in every possible method. The street lights play a very crucial role in roads especially in national highways. The usage of electricity in street lights can be reduced. Initially incandescent lamps were used for street lights. The evolution of street lights is being discussed in the above schematic diagram. Then it was replaced by Halogen then by CFL and now by LED[2]. Usage of LEDs consumes very less amount of current. Usage of sodium vapour lamp leads to heavy consumption of electriciy. The implementation of more stategies help to reduce the usage of electricity. Thus by using this smart street light system the usage of electricity can be reduced[3]. The lamp technology followed in india is being reprented in Figure 2.

There are several smart system discussed by the previous researchers[4-6] used for controlling the trafic intensity, but none of the studies, discussed about automatic streetlight based on the movement of vehicles using sensors. Thus, these study report smart street lights in national highways which can reduce the consumption of electricity.

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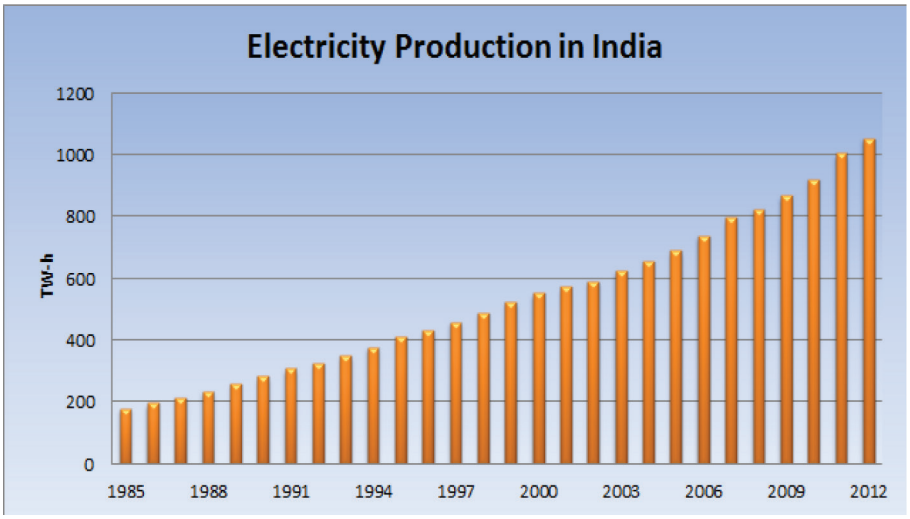

Figure 1. Electricity Scenario of India

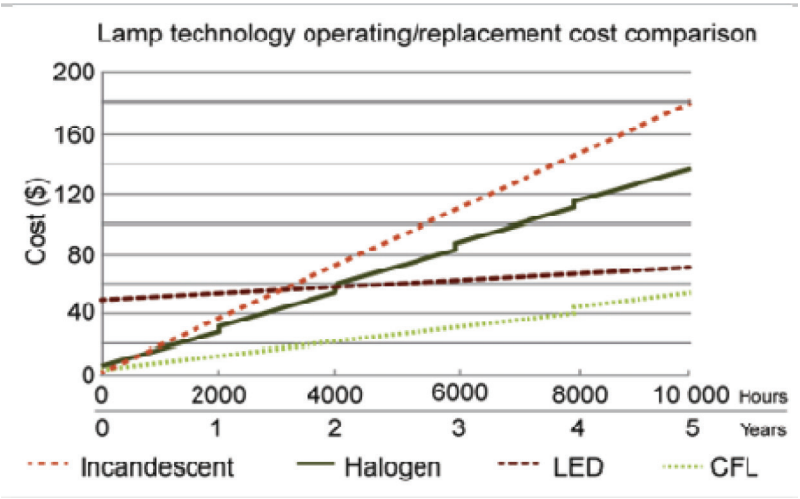

Figure 2. Lamp Technology followed in India

2. Energy Saving Street Light Control System

2.1 Energy Source

Two energy sources were used for this project. One is solar and the other is AC from TNEB. A solar pannel is placed on top of each street light which genrates electricity in the day time and also the AC supply from TNEB will be availed. The electricity availed from the TNEB will be used only when solar power inadequate. Thus a hybrid network is used in this project.

2.2 Voltage Controller Circuit

The circuit shown in Figure 1 represents the voltage control process. Actually 230v AC supply is being step down to 12V AC supply. This is done using a step down transformer. This 12V is coverted into pulsating DC by using a bridge rectifier. This pulsating DC is filtered by an electrolytic capacitor of 100 micro F-470 microF. The filtered dc being un regulated IC LM7805 is used to get 5V constant at its pin no 3 irrespective of input DC varying from 9V to 14V. This regulated DC is being further filtered from noise by a electrolytic capacitor of 10 microF. The voltage controller circuit is being shown in Figure 3.

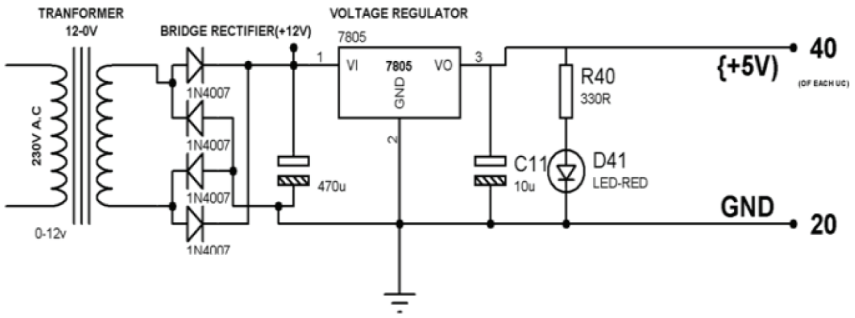

Figure 3. Voltage Controller Circuit

2.3 Working of Energy Saving Street Light Control System

IR sensor is being placed 10 m before each street light. When this sensor senses the vehicle movement, the street light glows with 100% illumination. In the other case the street light glows with 10% efficiency. This is made possible by using PIC microcontroller.The LED glows with 10% illuminationuntill the sensor senses. When the sensor senses the vehicle movement, it sends the signal to the PIC microcontroller which uses the language "EMBEDDED C" to communiacte and make the LED to glow with 100% illumination[7]. Here 10% illumination refers to the minimum efficinency of the lamp and 100% illumination refers to the maximum efficiency of the lamp. The proposed model is being reprented in a block diagram in Figure 4.

2.4 Description of Smart Street Light System

The most prominent way of describing its working is done by the means of control systems shown in Figure 5. There are two types of systems namely open and closed loop systems. An open loop is a system in which the output is not dependent on the input. It has very high stability. It

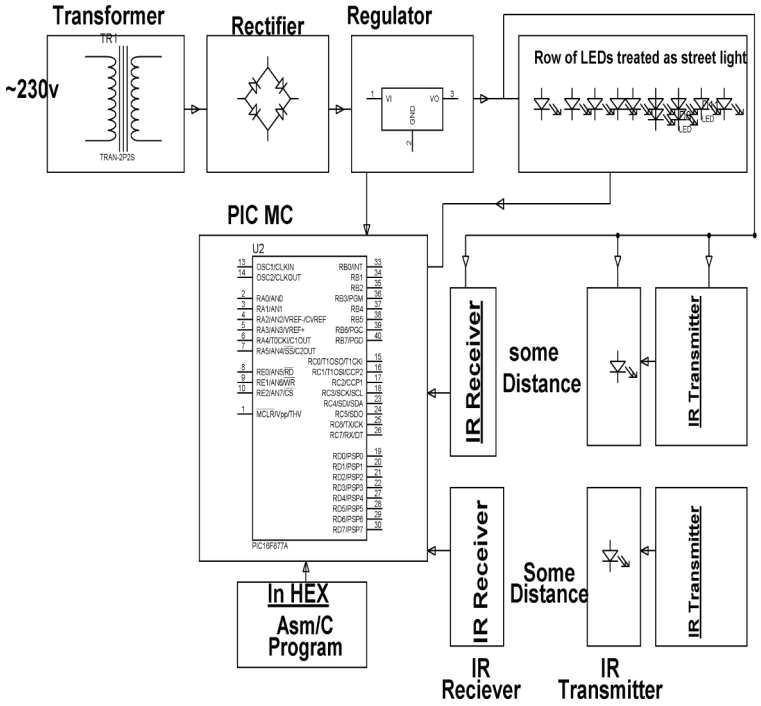

Figure 4. Block Diagram representing the Project

does not depend on the controller action. The signal flow is unidirectional. No feedback system is present[8].

It is used for maintaining constant intensity of street lamp. Depending on vehicle movement, this project detects the vehicle movement with the help of sensors. The intensity should be increased as vehicle approaches nearer and should decrease as vehicles passes away. This is achieved by means of sensors as a feedback path. This is similar to closed loop systems.

The flow chart for increasing intensity of light is shown in Figure 6. IR receiver and transmitter are used as a feedback signals. Whenever there is a positive output from IR sensor the controller increases the intensity of the light by means of Pulse Width Modulation technique (PWM). When the sensor is in off state the intensity of the light goes back to its initial position.

2.5 Characteristics of Energy Saving Street Light Control System

The square wave duty cycle response for different intervals of time is given below in Figure 7. The term duty cycle defines the proportion of time interval of ON state. A low duty cycle corresponds to low power, because the power is OFF for most of the time. Duty cycle is expressed in percentage. If it is 100%, the cycle is fully ON. The power loss in the switching devices is very low which plays a very big advantage in PWM. There is practically no current when the switch is OFF and there is no voltage drop when the switch is ON. PWM works also well with digital controls, which, because of their ON/OFF nature, can easily set the needed duty cycle. High power is supplied to the load if the switch is ON for prolonged time[9].

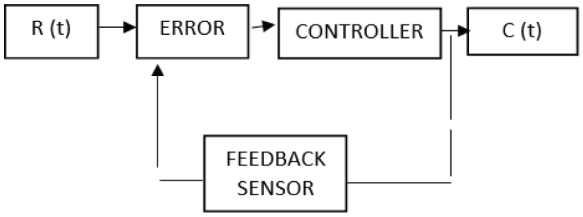

Figure 5. Feedback Signals

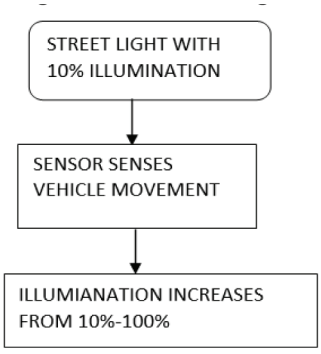

Figure 6. Flow Chart for Increasing Intensity of Light

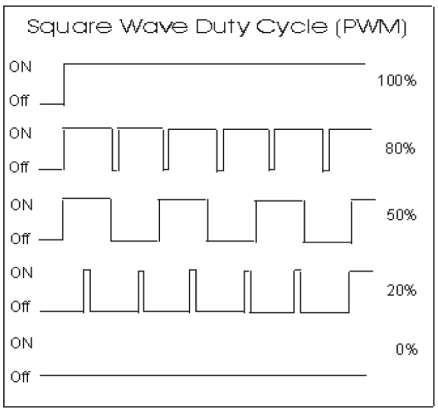

Figure 7. Pulse width modulation

3. Implementation of Smart Street Light System

There are two basic modes of operation.

3.1 During Summer

The availability of natural sunlight can be estimated at different sessions throughout the day. Hence the Pulse Width Modulation (PWM) technique is applied to control the maximum intensity of street lights at different time periods.

3.2 During Winter/Monsoon

The climatic changes may vary diversely. So it is difficult to determine the natural availability of sunlight at different intervals in a day. So, the street lights are programmed to operate in a fixed intensity of 15% when there is no vehicle movement and switches to glow up with its maximum intensity when the vehicle movement has been detected.

This two way operation of street lighting systems is implemented by means of microcontroller circuit. Thus an efficient way of street lightning control system can be implemented.

3.3 Performance Characteristics

The graphical representation of the performance of system is explained in Figure 8. From the Figure 8, it may be observed that

- During 7 p.m. to 5 a.m. when there is a movement of the vehicle in the highway - 100%.
- During 7 p.m. to 5 a.m. when there is a movement of the vehicle in the highway - 80%.
- During 4 p.m. to 7 p.m. when there is a movement of vehicle in the highway - 50%.
- During 4 p.m. to 7 p.m. when there is no movement of vehicle in the highway - 20%.
- During 5 a.m. to 4 p.m. when there is brightness from natural sunlight.

4. GSM Module Set Up

Further the project can be enhanced by using appropriate sensors for detecting GSM modem for appropriate action[10]. This concept can be explained in detailed manner using matrix. Each street light is being denoted by matrix element. The left and right lane is taken as row 1 and row 2. Street lights are being taken area wise. When the computer displays A12 is indicated as not working, it states that first row second lamp in right side is not working[11].

$$\begin{vmatrix} A_{11} & A_{12} \\ A_{21} & A_{22} \end{vmatrix}$$

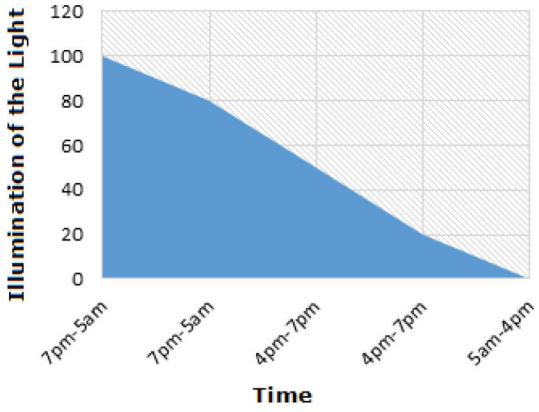

Figure 8. Graphical representation performance of the lighting system

Further A can be denoted be represented by the area code. For example 33 where Chennai 33 is west Mambalam. Similarly each area in a city is taken and represented by its code no.

$$\begin{vmatrix} 33_{11} & 33_{12} \\ 33_{21} & 33_{22} \\ 33_{31} & 33_{32} \end{vmatrix}$$

5. Conclusion

At present India is a country facing serious demand in electricity. If this scenario exits the GDP of the country becomes poor. Since electricity plays a prominent role in full filling the very basic requirement of the citizen. This study is looking to take to the next level installing temperature sensors. Thus, this study plays a very smart role in this smart environment. Earlier studies proved 10% of electric power consumption for street lighting, whereas, this study reduced to 30% of electric power construction by using sensors. The main application of proposed study is used for detecting the failed street light and sending SMS to the control department via GSM for appropriate action. The study results can be applied in national highways and accident free zones for reducing the consumption of electricity.

6. Acknowledgement

The authors sincerely place gratitude to their parents and teachers, for their support and guidance for completing this project. This authors wish to extend their thanks to Dr. R. Murugan, Associate Professor, Mrs. D. Chandrakala, Assistant Professor, and Mr. V. Vijeesh, Assistant Professor, EASWARI Engineering College, Chennai-89 for their valuable input to complete this study.

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