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Energy Efficient Street Lighting System

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Abstract:
In today's energy deficient scenario the prerequisite to conserve energy is of prime importance. A unit of energy conserved is more valuable than the unit of energy generated. The project discoursed is an energy efficient street lighting system which has been fabricated and tested. The PIR sensor used in the project detects any human or no human intervention and generates a signal which elicits the microcontroller and further actions are executed. The LDR used detects the presence of sunlight and activates the whole projects only during night time making it automatic. The LED lamps were used for illumination which are most energy efficient compared to other luminaries.

Keywords*: Illumination, LED, Street Lighting, Energy conservation, Efficient Lighting*

1. Introduction

The street lights which are implemented today in India are customarily a simple lamp linked with the grid power. These lamps are switched on in the dusk and turned off at dawn. The illumination of the lamp remains persistent throughout the period of its operation irrelative to the traffic or the pedestrians on the road. Thus the energy is squandered during idle road conditions when there are no activities. The need ascends to acquire the smart technology which can sense the road or the pedestrian activity and amend its illumination levels. This will not only save the energy but also can lead to hefty savings in annual billings. The project instigated is the solution to the addressed problem; it's a breakthrough technology which can lead to smart city lights if the project is scaled up. The cost of smart technology involved is returned as it pays back in few years of operation in the form of abridged annual expenses.

2. Methodology

The project is real time deployed using 8051 microcontroller, PIR sensor and LDR. The system is arranged in the fashion as shown in the block diagram. The LED lamps used are known for their energy efficient operation and flexibility in illumination variance. The LDR detects the presence of sunlight and automates the system to be active only during dusk, resulting in automatic switching of lamps. The PIR sensor further enhances the energy efficiency of the project by maintaining the higher illumination during the traffic on the road else lamps are dimmed to conserve energy. The sensors are coupled to the microcontroller which decides the switching sequence and time slots for the period of precise illumination. Microcontroller is programmed appositely, engender entire system is automated.

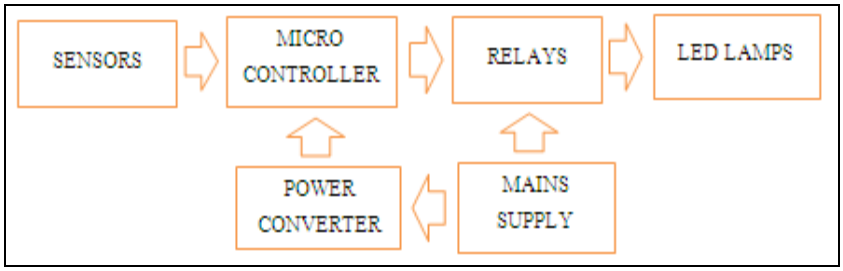

Figure 1: Block diagram of the system components

3. System Description

LDR is connected to the microcontroller which is prioritized to activate the whole circuitry of the system. LDR detects the sunlight and keeps the system to be un-operational until there is no light incident on the LDR. Upon dusk LDR activates the system and PIR sensor is operational and continuously monitors the movements in the vicinity of the sensor. As soon as the PIR sensor detects any movements it generates the signal which is amplified by the internal PIR signal amplifier which is further fed to the microcontroller. The microcontroller activates the timer and the high brightness relay to drive the LED, after the set time lapse the relay switches back to default low brightness relay condition. The time slot of the high brightness is programmed in the microcontroller and in case of persistent detection of movement high brightness relay is continuously switched.

As the LDR is prioritized and activates the whole system which results in zero standby power consumption of the system making it more efficient in operation. The LED lamps can be connected in parallel and entire array of such lighting system can be coupled to the system using apposite relays. This scheme of brightness controlled street lighting can save considerable amount of energy and lead to higher efficient economics of operation. The circuit diagram of the designed system is shown as below,

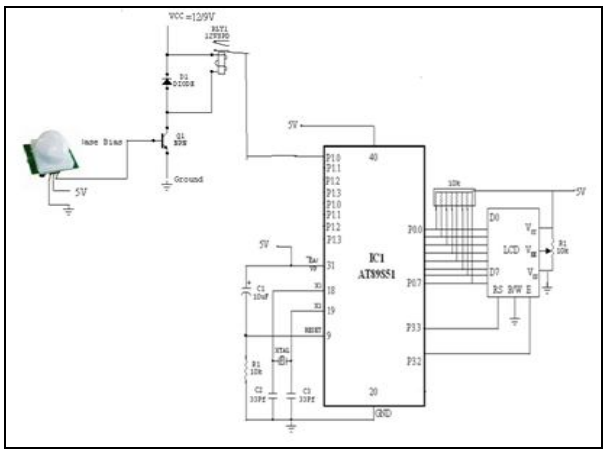

Figure 2: Circuit diagram of microcontroller connected with the sensors and display

The program execution of the microcontroller can be represented in the form of flow chart as below:

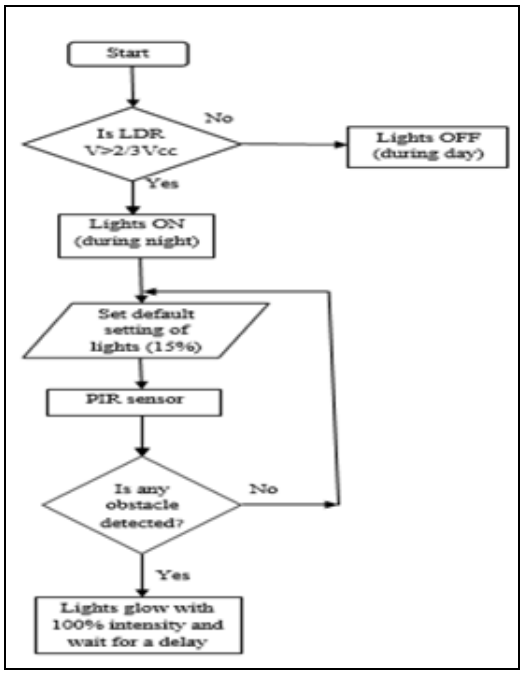

Figure 3: Program execution flow chart

4. Results and Discussions

The voltage and current readings are tabulated and analyzed for high and low illumination of a LED. A 12v, 20Watt LED is used for the project and the respective voltage and current parameters are noted down. Assumptions made for analysis is that lamp glows for high brightness for 3 hours and low brightness for 9 hours of operation. The energy saving statistics can are graphed as below.

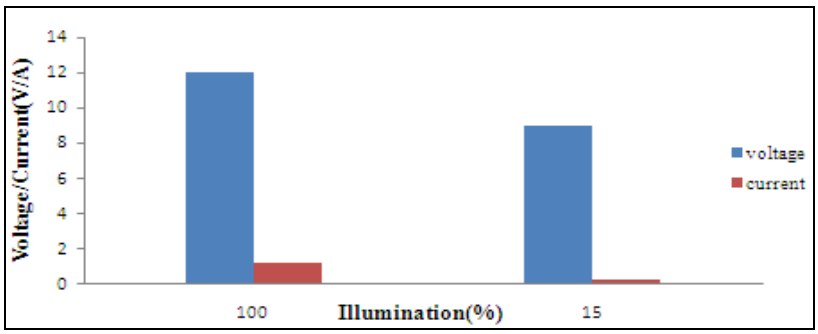

Figure 4: Variation of Intensity with Voltage and current

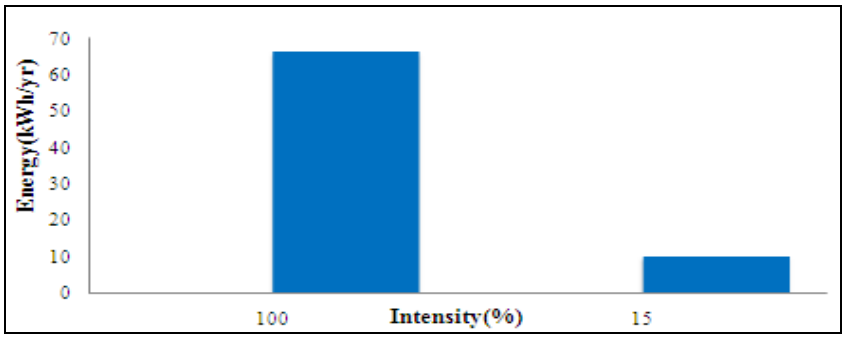

Figure 5: Variation of yearly Energy consumption for a single LED intensity

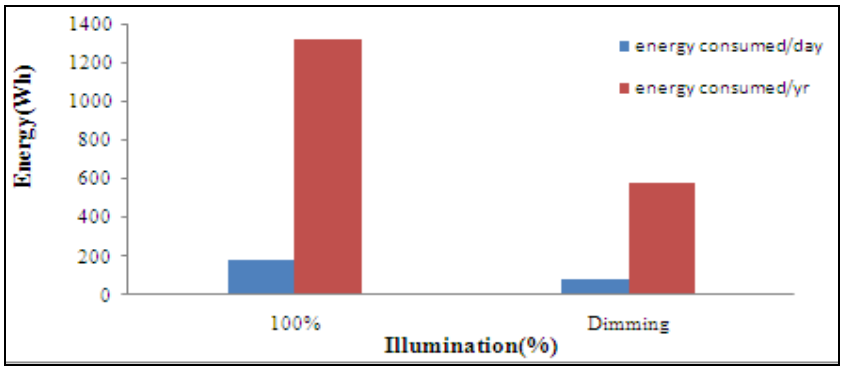

Figure 6: Variation of Energy consumed by single and 20 LED's with illumination

5. Conclusion

The following conclusions have been derived from the experimental work on Solar lighting system.

- The experimental observations indicated that proposed lighting system can save about 60.1% of energy as compared to the existing lighting system.
- The present designed system is appropriate for street lighting in remote as well as urban areas where traffic is low at times.
- The circuits developed are simple in nature and automatic, which avoids manual operation and flexibility in design.

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6. References

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