Implementation of an Automated Solar Street Light System

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Abstract

Automatic Street Light Control System is a simple yet powerful concept, which uses transistor as a switch. By using this system manual works are 100% removed. It automatically switches ON lights when the sunlight goes below the visible region of our eyes. This is done by a sensor called Light Dependant Resistor (LDR) which senses the light actually like our eyes. It automatically switches OFF lights whenever the sunlight comes, visible to our eyes.This project is based on the idea of maintaining maximum utilization and minimum loss of available energy. The plenty of solar energy available during the day time is stored in a solar cell and the stored energy is used to glow the street lights during the whole night. Also the system provides a power saving mode of operation by adapting the method of automation. A dark sensor and a light sensor provides the automatic "ON"/"OFF" facility to the street lights, so that it will glow automatically when it is required(i.e. when the surrounding will be dark) and it will be turned "OFF" automatically if sufficient light is available in the surrounding. Again the auto intensity control mechanism has been applied by the help of a microcontroller to control the light intensity of the luminaries as per the requirement. Hence the loss of energy due to unnecessary glow of the street lights can be avoided.

Keywords– PV module, DS1307, intelligent Street light, LDR (Light depending Resistor) etc.

1. Introduction

This project is based on the idea of maintaining maximum utilization and minimum loss of available energy. The plenty of solar energy available during the day time is stored in a solar cell and the stored energy is used to glow the street lights during the whole night. Also the system provides a power saving mode of operation by adapting the method of automation. A dark sensor and a light sensor provides the automatic "ON"/"OFF" facility to the street lights, so that it will glow automatically when it is required(i.e. when the surrounding will be dark) and it will be turned "OFF" automatically if sufficient light is available in the surrounding. Hence the loss of energy due to unnecessary glow of the street lights can be avoided.

The solar street light has been designed after too much research work. Its uniqueness and best features can make it the most preferable choice in rural area. With gradual development in this research, new features are being added to increase the efficiency.

The proposed model may be considered as the third generation of street light which is also known as intelligent street light. The intelligent street light control system uses the latest international intelligent street light energy-saving control technology.

Automatic Street Light Control System is a simple and powerful concept, which uses transistor as a switch to switch ON and OFF the street light automatically. By using this system manual works are removed. It automatically switches ON lights when the sunlight goes below the visible region of our eyes. It automatically switches OFF lights under illumination by sunlight. This is done by a sensor called Light Dependant Resistor (LDR) which senses the light actually like our eyes.

2. Problem Definition

•   The traditional lighting system has been limited to two options ON and OFF only, and it is not efficient because this kind of operations meant power loss due to continuing working on maximum voltage.

•   Hence, wastage of power from street lights is one of the noticeable power loss, but with the use of automation, it leads to many new methods of energy and money saving.

•   Street lights are in working functionality over the whole night that consumes a lot of energy and reduces the lifetime of the electrical equipment such as electric bulb etc.

•   Especially in cities' streetlights, it is a severe power consuming factor and also the most significant energy expenses for a city. In this regard, an intelligent lighting control system can decrease street lighting costs up to 70% and increase the durability of the equipment.
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3. Objective

• The main aim behind the research of designing the system is to find a way for maximum utilization of available energy with minimum.

• To design an efficient impedance-based and robust automatic street light system for highways and cities.

• To develop the LDR sensor based module with energy efficiency purpose.

• To increase productivity of street lights and less power consume.

• To ensure stability and reliability of the power supply system in the country to boost economic growth.

4. Literature Review

• *Prof. Sakshee Srivastava et. al. April 2013.*

In this paper , is all about to control the power consumptions at the streets and eliminating manpower. This includes controlling a circuit of street lights with specific Sensors, LDR and Microcontrollers during day and night. The project has scope in various other applications like for providing lighting in industries, campuses and parking lots of huge shopping malls. This can also be used for surveillance in corporate campuses and industries**.**

• *Zain Mumtaz et. al. July 2019*.

In this paper , The proposed work is accomplished by using Arduino microcontroller and sensors that will control the electricity based on night and object's detection. Meanwhile, a counter is set that will count the number of objects passed through the road. This system can be easily implemented in street lights, smart cities, home automation, agriculture field monitoring, timely automated lights, parking lights of hospitals, malls, airport, universities and industries etc

• *M.S.H. June et. al. 2018.*

In this paper, an arduino based low-cost solar street light system has been designed. The objective of this work is to design an automatic control and fault and obstacle detection system for street lamps. This work includes three features: the sunlight sensing and control on/off of the street lights, the traffic sensing and fault reporting system. The microcontroller used is arduino mega 2560 which has to be programmed for these three tasks. This could be applicable in Bangladesh, which might provide a low-cost alternative to the existing street lighting system.

5. Block Diagram
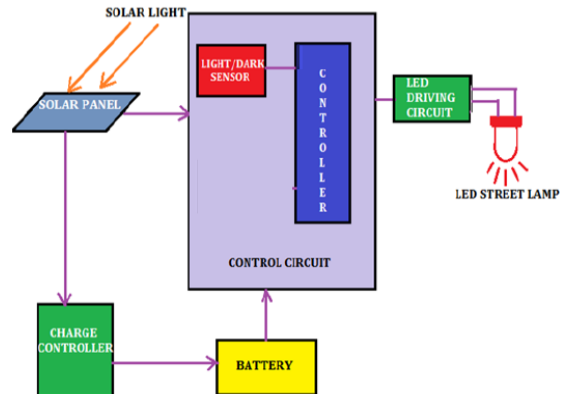
6. Working

The arrangement of all the system components are shown in the block diagram in figure 5.The whole day, sun light falls on the solar panel which consists of PV modules. The solar panel converts it into electrical energy which is stored in the battery. The current produced by the PV module flows through a charge controller circuit before charging the battery. The charge controller is used to prevent overcharging and to protect the battery from overvoltage which could reduce the battery life. The streetlights are equipped with a light sensor and a road-user sensor. The light/dark sensor is used to detect the surrounding light intensity and send the information to the microcontroller, so that it can decide whether the street lights should be turned "ON" or "OFF". Another sensor here used is an IR sensor which can also be called as vehicle detector or road-user sensor. This sensor is activated for particular time duration (i.e. after 12:00am to 5:00am for this case). After 12:00am, when the street light turns "OFF", the IR sensor gets activated as per the timer setting.

When any vehicle or person comes along the road, then it detects the presence of an object and sends the information to the microcontroller; then as per the command send by the microcontroller the lights turn "ON". Then after the object passes the road, the lights again turns "OFF" automatically. The detection range of the sensor node is assumed to be 13m. Each Street light has its own sensor to detect the moving object. Before the object reaches the light it turns "ON" by sensing the coming object. Then after the moving object crosses the light and move on forward, the light turns "OFF" by gradual dimming intensity and the next light's sensor starts its operation.

7. Flow of Energy in a Solar PV System
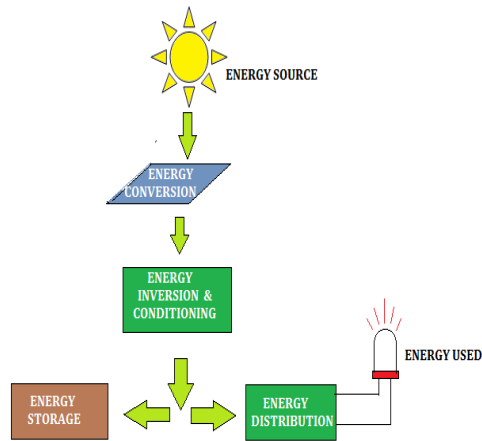
8. Power Saving Features Of Automatic Solar Street Light

• The proposed model may be considered as the third generation of street light which is also known as intelligent street light. The intelligent street light control system uses the latest international intelligent street light energy-saving control technology.

• The main aim behind the research of designing the system is to find a way for maximum utilization of available energy with minimum wastage or loss.

• To achieve this, the methodologies adapted in such a manner and each and every circuit component is so chosen that the available energy utilization is optimized as per the expectation.

• The main features of a solar street light those provide the power saving facility are-
· Use of solar energy
· Automatic "ON/OFF" mechanism
· Auto intensity control
· LED Luminary.

9. Results and Discussions

Providing street lighting is one of the most important and expensive responsibilities of a city. Lighting can account for 10–38% of the total energy bill in typical cities worldwide. The energy demanded for various schemes of street lights can be evaluated by the following equation

$$e(N) = \sum_{n=0}^{N} P_{\max} \varphi T \quad (1)$$

Where, $e(N)$= Energy consumed by the street light
N= Discrete time steps
Φ= luminance output of the street light
Pmax= Maximum power rating of the light source
T= Duration of single time step n
From the above equation(1), it can be clearly detected that the energy consumed by the street light is directly proportional to its luminance output and also it is directly proportional to the time duration of illumination.

As in the proposed model a strong emphasis has been done on the control of these two factors, hence our model can meet the expectation of optimum energy saving.

Compared with other control systems, it has better application prospects, especially easy to integrate itself with wind/photovoltaic-LED/fuel cell/solar energy system.

10. Advantages

By using this automatic system for street light controlling ,we can reduce energy consumption because the manually operated street lights are not switch off properly even the sun light comes and
Also not switched on earlier before sunset
• Low cost
• Automated operation
• Low power consumption
• Very flexible
• Easy to manufactured

11. Disadvantages

• In sunny and rainy days, on and off time differ notice which is one of the major disadvantages of using timer circuit or manual operation for switching the street light system.

12. Conclusion

The effectiveness of the proposed street light model can be considered as a best proposal from energy saving point of view. It is not only the way to save energy but also an idea to make a proper utilization of available solar energy which is radiating everyday without being used. Though the initial investment is very high, still it can be considered as to be economic if we will think about a long term period, because we are using here the solar energy, which is available free of cost. Hence after the installation no more payment is to be given regarding electricity. Also the automatic solar street light system is completely Noiseless, Smoke-free and free from fire hazards. Hence it will not only save the electricity bill but also will illuminate the path in an eco-friendly way.

13. Scope of work

We can save the energy for the future use and we can control the losses of the power. We can implement this project for the home lamp or night lamp of the room. This is also used for the signals.

The Streetlight controller using ldr based Light intensity & traffic density, in the todays up growing countries will be more effective in case of cost, manpower and security as compare with today's running complicated and complex light controlling systems. Automatic Street Light Controlling System puts up a very user friendly approach and could increase the power.

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