



Design and Development of User-Friendly Automated Lightening System Using Solar Energy

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ABSTRACT

Electricity is a very important part of our daily life on which road lighting system is one the most important parts of the urban and public sector. Here traditional road lighting system is controlled manually which is costly and more power is wasted in this system. And there are some areas where the supply of the electricity is difficult for the geographical position or the high cost of maintenance. This paper proposes a user-friendly Automatic Solar Panel Based LED Street Lighting System and home charger using Light Dependent Resistor (LDR) to reduce power consumption in Road Lighting System and to have uninterrupted electricity supply to light bulbs and run fans both in cities and rural houses. As it is a user-friendly system for the road lightening, the battery will be charged by solar panels and if the battery does not work it can be controlled by the direct current when the greed current supply is present. When the sunlight falls upon the surface of LDR the road will be remained OFF but in the absence of sunlight, the road lights will be ON. In the home charger system, it will be charged by a solar panel and contains a fan which is controlled manually and a bulb which is lightened automatically or manually in the absence of any light.

Keywords: Road lighting, Home charger, Light Emitting Diode (LED), Light Dependent Resistor (LDR), Solar panel, Automatic lighting

INTRODUCTION

Bangladesh is one of most densely populated country in the world where a large number of people most of them are living in rural areas deprived of the benefit of electricity. Thousands of kilometres busy roads, many river Ghats and a large number of bridges are in the dark. Although the production of electricity in our country is less than the demand, a huge amount of electricity is consumed for the road lighting system. As a developing country like Bangladesh, with a population of about 150 million, is greatly challenged in providing energy for its people. Day by day the demand for electricity is increasing and it has already nearly double the country's generating capacity. About 42% of the country's population has no access to electricity [1]. Supply is further constrained by frequent power outages, especially during periods of peak demand. Limited electrification, energy shortage and heavy reliance on a single primary energy source (i.e., natural gas that fuels 85% of the country's power generation) all contribute to low access to energy [2]. As a result, load shedding has become a daily phenomenon in this country. The shortage of electricity creates more load shedding not only in rural areas but also in the urban regions, even in the industrial areas by Rahman and Amin [3]. The severe situation of the shortage of electricity and its negative impact has motivated us towards this research, since there is a great opportunity to use renewable energy such as solar energy for providing electricity in rural areas and also meet the increasing demand in urban areas of Bangladesh who are the most deprived from the electricity. In this system, a solar system is used to restore electrical energy in a rechargeable battery. Then this electrical energy is used in an automated lightening system where automatic light switch circuit is intended to be connected to the rechargeable battery. Saad *et al* gave the best solution for electrical power wastage and also the manual operation of the lighting system was completely eliminated [4]. Oke *et al* showed that an automatic Street Light Control System is a simple yet powerful concept, which uses transistor as a switch and told at presents how solar energy is being harnessed to power street light and virtually removes manual works to 100% [5]. A smart road lighting system is designed which switch ON/OFF street lights automatically and reduce power consumption and maintenance cost [6-8].

Ahmed *et al* develop a system in which the street light is driven by solar energy and apart from this it also controls its intensity from dusk to dawn depending upon the brightness. A case study is also done to show advantages of solar led street light compare to that of traditional street light [9]. Govinda *et al* design energy efficient based controller for controlling the Light Emitting Diode (LED) based street lamp via appropriate lighting levels control. Their LDR based project main idea is to develop an application which can control the electricity usage in street lights or saving the energy when it in use [10]. A modern optimize management and efficient street lighting system is designed which is higher automatic, more credible and efficient for long-distance monitoring and control system [11]. The main concerns of this paper are (i) To design an automated user-friendly road lighting system using solar energy instead of traditional current supply (ii) To design a model for user-friendly home charger system for ensuring uninterrupted current supply. This paper is organized as follows- In the first section, the system verification, testing and prototypes making have been described in methodology. And in the second section, the result has been discussed then the last section includes the conclusion of the paper.

METHODOLOGY

In this road lighting system the circuit will light bulbs at the nightfall and disconnects it in the morning. This type of light such as a new street-smart controller is designed, with dual functions including timing control and automatic photoelectric control [12-13]. An Automatic Solar Panel Based LED Street Lighting System is designed with wireless communication technology and various sensors to facilitate reduced power consumption [14-15]. The brightness based Smart Solar-Powered LED Street Lighting System for a Greener Community is designed which reduces power consumption and it automatically activates and deactivates lighting depending on the hours whereby daylight is sensed [16]. Here two types of lighting systems have been developed. One is street lighting system and another is home charger system. In the street lighting system, the whole day battery will be recharged by solar panels. There was also an AC supply and the two supply will be connected to the switching circuit by a relay which connects such a way that provides the continuous flow of current. For any failing of supply dc current, it will supply ac current. Now the LDR which is one kind of switch base on the resistance, when the solar light on it helps to open the circuit otherwise close the circuit. For this LDR bulb lighted in the night and off in the day. The procedure by which it is done described below:

System Components

The main component that is used in the system as sensor device is a Light Dependent Resistor (LDR) or a photo resistor whose resistivity is a function of the incident electromagnetic radiation. Hence, it is light sensitive devices. The other components that are used in this system are BC547 NPN transistor, resistor, solar panel, battery, diode, LED light, 12V SPDT relay etc.

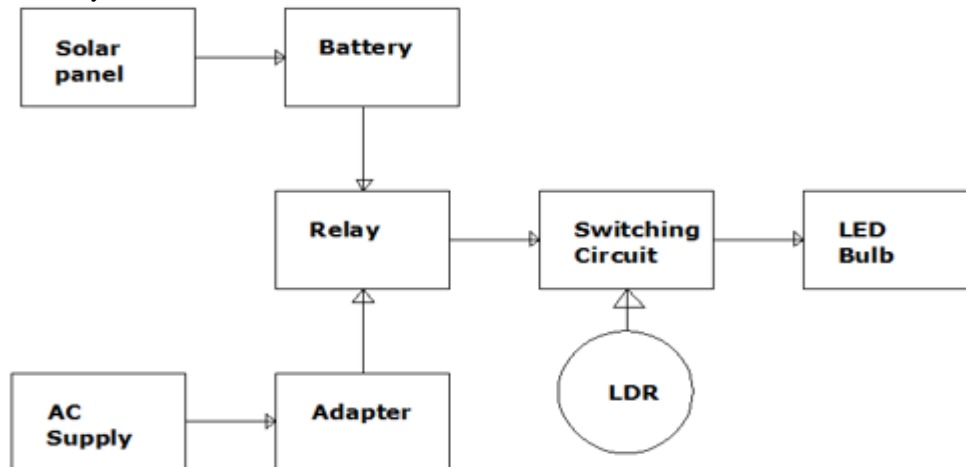


Fig.1 Block diagram for Road Lightening System

System Conceptual Model

According to the sequence of energy transfer and the components, the blog of the system is developed. In the blog diagram one Fig. (1) shows the road lighting system and in the blog diagram, two Fig. (2) shows the home charger system and those two figure are drawn by Auto CAD 2007.

Software Architecture

According to these block diagrams, the circuits of this system have been drawn and tested by using a software named Proteus V7.10. (Fig. 3). By the circuit diagram all system have been described and also voltage, current, connection have been tested. It also shows the validity of the circuit.

System Prototype

After testing the circuit in the software the actual setup is done according to the circuit diagram and using the components. Then the prototype of this system are made Fig. 4.

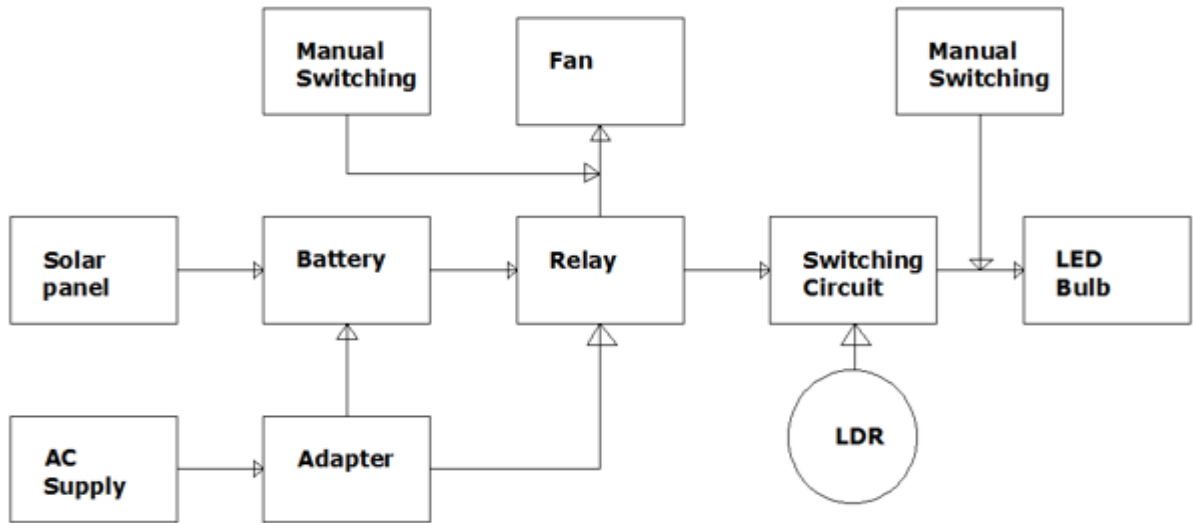


Fig. 2 Block diagram for Home Charger System

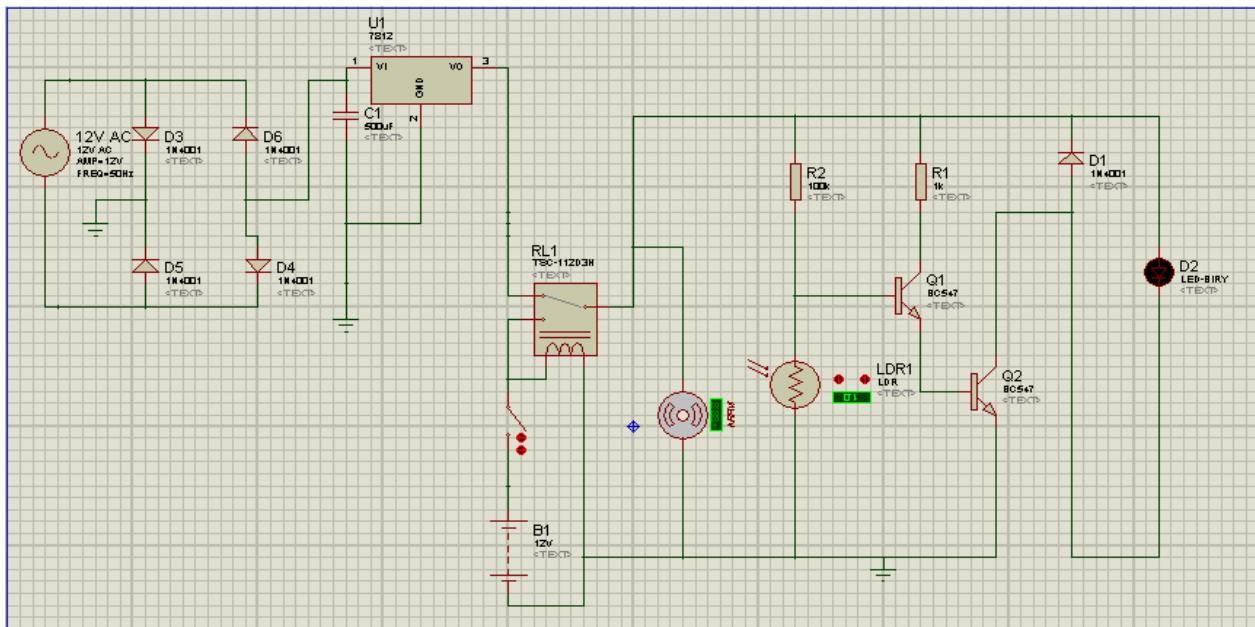


Fig.3 Circuit Diagram By Proteus Version 7.10



Fig.4 Prototype of the System

RESULTS AND DISCUSSION

The paper aims to design a user-friendly automated road lighting system and home charger system and to reduce the use of traditional current supply by using solar power as well as to find the application areas of solar power. In this paper, LDR has been used instead of the micro controller which has made the system less complicated. Also, the system is designed in such a way that it will work continuously without interrupting the current supply. As the system can be used both as partial automated and fully automated, it can be used in any remote areas or places in any situation. For these reasons the proposed system is more user-friendly than any other system. For designing the circuit block diagrams are shown in figure 1, figure 2 and figure 3 is done by software for testing the circuit and finally, the total system is showed in figure 4. After connecting this circuit figure 5 shows that it is working properly. Mainly this system can be used in different adverse areas where electricity is important but difficult and costly to supply such as the island, mountain areas and villages and some places where the small number of light is needed but costly to maintain with the manual effort like Ghats, small markets and village roads etc. As the system is user-friendly it can be used in general places where AC supply is present.

As the weather of our country is becoming warmer day by day, average solar discharge fluctuates from 4 to 6.5 kWh in a square meter [16], a huge area of Bangladesh is deprived of electricity and a huge amount of electricity is wasted in road lighting this proposed system will be more effective in the future.



Fig. 5 Prototype of lighting system

CONCLUSION

This work elaborates the design and construction of automatic street control system circuit. LDR sensor and the manual switch are the two main conditions in this system which helps to do the desired work according to the specific conditions. The street light has been successfully controlled by LDR circuit. This work aims to reduce the drawbacks of the current street lighting system and find a solution to save power. This is done by replacing sodium vapour lamps by LED and adding dimming technology to it. It also provides an effective measure to save energy by preventing unnecessary wastage of electricity, caused due to manual switching of street-lights when it is not required. And a solar home charger which reduces the wastage of electricity due to charging by current. A fan is adjusted by home charger which controlled manually. As solar discharge fluctuates following the pattern of dry and wet seasons in Bangladesh from 4 to 6.5 kWh in a square meter. The highest level of radiation is accessible from March to April whereas the least from December to January and the average sunlight hours vary between 6.69/7.6 h, 6.16 h, and 4.81 h respectively in winter, summer and monsoon seasons. As the system works properly and there have huge opportunities so this system is versatile, extendable and totally adjustable to user needs.

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