

Smart and Intelligent Lighting Systems Using Renewable Energy: A New Approach

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Abstract- India being a country with second largest road network in the world will be highly benefitted if electrical energy usage in lighting the roads can be reduced. This paper presents two approaches and studies an aware consumer to analyze road lighting system to achieve energy efficiency. If we want to have better energy efficiency then the use of renewable energy will make the system environmentally friendly. After studying the current existing lighting systems an LED based lighting system is suggested based on renewable energy resources like Solar Photovoltaic Systems and can be considered as alternative lighting system. The equipment's required are sensors, microcontroller which can work autonomously.

I. INTRODUCTION

Electrification is the backbone of the economy for its socio-economic development. For operating street lights through intelligent and smart lighting system we will combine automation, sensors, intelligent control system with solar powered Photo Voltaic (PV) units.

We present two approaches of smart and intelligent road lighting system and the purpose is to solve the problems faced by the travelers due to the lack of light in dangerous and underdeveloped infrastructure. In the first approach the command and control unit will have to monitor the storage unit powered by solar system to take inputs from the sensors and to consider the switching and lighting system for maintaining the optimum level of lighting with energy efficiency. The second one has brightness sensor, motion sensor and a short distance communication network which will turn on before the traffic comes and will turn off or reduce the power when the traffic leaves.

II. ROAD INFRASTRUCTURE IN INDIA

Road Transport is a critical infrastructure for the economic development of a country. It impacts the pace, structure and pattern of development. The capacity of National Highways in term of handling traffic (passenger and goods) needs to keep pace with economic growth. India has the second largest road network in the world of about 58.98 lakh km. This comprises National Highways, Expressways, State Highways, Major District Roads, Other District Roads and Village Roads. The length of National Highways in India is 1,32,500 km, that of the state highways is 1,56,694 km and the other roads is 56,08,447 km as per the reports of National Highway Authority of India (2019-20).

Electrification of the highways is a major concern and absence of electrification can lead to major accidents and loss of lives, so for this effective use of renewable energy has a major role to play.

III. TYPES OF SOLAR STREET LIGHTS

• Solar Cell Panels:

The work of solar cell panel which is an electronic component is to convert solar energy into electrical energy in the form of a direct current (DC). One part converts energy from sunlight to electrical energy and generates solar power and it is sized about 10-15cm square.

This component converts energy from sunlight into electrical energy. The solar cell is generally made of Semiconductor material which is a vital component. Electric power generated by a solar cell is so small that a few solar cells must be combined to form a unit of the component.

- Solar Street Lighting Poles:

The pole forms the foundation of solar-based street lighting. As per the shape, the pole can be one of two types: single pole or double-arm pole. A solar-based street lighting pole are to be adjusted as per the road conditions. The height of the solar-based street lighting pole and the wattage of the lamp needs to be assessed, as the amount of lighting can affect the size of the irreversible area. A solar-based street lighting pole can have a height starting from 5 to 14 m. Also, the distance between poles can vary from 15 to 40 m. The distance between poles will change as per the height of the pole, the type of lamp, and the required light (brightness).

IV. PROPOSED APPROACHES

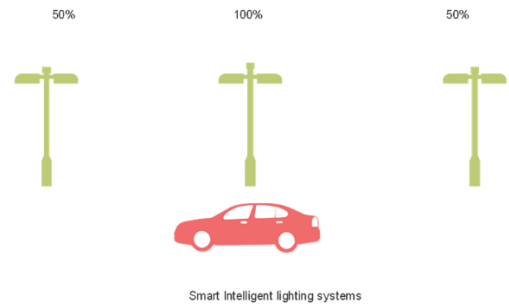
- First approach:

The design of the intelligent lighting system in this approach has to be adaptable and compatible to the proposed power supply. The DC power supply with LED and controlled with PWM (Pulse width Modulation) and dimmed through MOSFET (Metal Oxide semiconductor field effect transistor) switching systems. So as a vehicle enters in the area of the smart and intelligent lighting system the lights get switched on and as the vehicle moves the next LED get switched on and the order of switching as the first sensor is activates is the current, upcoming and the following LED modules – 50%, 100%, 50% and the after the first shifting sequence the previous is dimmed to 25% until the next shifting. By doing this the cost of lighting gets reduced and then will be an optimum utilization of electrical energy. By the changing of the lamps the illumination can also be controlled.

- Second Approach:

In this system there is a lamp unit which has power adjustable LED with brightness sensor, motion detection sensor, a communication device and a controller. Whenever there is a movement it turns on and subsequently it is communicated to the other units that a motion has been detected so that the other units can turn off or reduce power under the condition that any motion has not been detected in the defined area. So here the other units are the sensors which detects the motion. Communication device and the controller

are used when the distance between the lamp and sensor units are too large.



CONCLUSION

The LED lighting system in most of the countries are trying to develop as per the need of the citizens or market demand. So, suggesting a technology which is low cost, easy to installation and saves energy makes it more affordable.

Smart and intelligent lighting systems discussed in this paper can be implemented for highways as well as for the smart city projects to be developed in India.

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