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DESIGN AND SIMULATION OF INTEGRATED STREETLAMP MANAGEMENT PV SYSTEM WITH HESS

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ABSTRACT:
In this work, the operation of a standalone streetlamp PV system is modelled considering actual outdoor operation conditions. The model integrates all components required in a stand-alone PV system: PV panel, battery, charge controller and load. Electrical characteristics of each component are based on those of a streetlamp PV system, currently tested in Singapore. Using measured irradiance data, the model is able to predict the real-time current flow, battery operating voltage and state of charge. The simulations of the streetlamp system are done using real-measured irradiance data from Singapore and Boston. We find that for a long-term, uninterrupted operation of a standalone PV system actual meteorological conditions need to be considered. The real-time simulation method presented in this work allows better defining the size of the required solar panel and the battery capacity. Here we are developing the circuit with help of ANN controller for high efficiency.

Keywords: Street light, PV System, Solar panel, LEDs, High efficiency, Controller module.

1. INTRODUCTION

Indeed, Lighting consumes about 20 percent of the electricity for a nation. Also, renewable energy utilization development permits the reduction of CO2 emission and contributes to the decrease of fossil energy dependency. In the past few years, developing energy-efficient street-lighting with light-emitting diodes (LEDs) has gained an enormous interest. LED luminaires also have the potential of increasing illumination uniformity and glare reduction, which improves both the eye comfort and the visual discrimination ability of car drivers. Traditional street lighting technologies, such as high-pressure sodium or mercury, emit light in all directions, and consequently the light distribution is difficult to control. This is why a common street luminaire usually has defects such as glare, non-uniform light pattern, upward reflected light, light pollution, and waste of energy. The association of a solar energy to High efficiency lighting technology as LEDs (Light Emitting Diodes) is the focus of this article and contributes to the development of a clean energy (Solar) and green lighting technology (LEDs). In comparing LEDs to other lamps technologies, we can say that LEDs are the Greenest lighting choice. Indeed, high power LEDs (Light Emitting Diode) devices permit the design and fabrication of street lighting units in order to replace existing luminaries which are using sodium or metal halide or CFL (Compact Fluorescent Lamp) lamps. A simple LED light bulb that can fits standard E40 bulb holders can be applied for solar powered street light system which is totally independent of power mains. The high power LEDs of last generation and technology offer a considerable alternative to a conventional street lighting with energy savings of up to 75 % and an important reduction in carbon emissions.

OVER VIEW:

The photometric properties of high power LED street lights adding to their bright, natural light color, give a uniform rectangular beam pattern that is 50% brighter and 50% larger than the oval beam pattern produced by a conventional lamp. This highly focused beam pattern allows LED lights to be spaced at much wider intervals than sodium and CFL lights. Competitors to conventional lead-acid batteries include nickel-cadmium, nickel-metal hydride, and lithium-ion, lithium-polymer, and nickel-zinc technologies.

We use measured irradiance data as an input for the PV power generation. Size of solar panel and battery capacity are defined according to the specifications of the PV streetlight system. The battery voltage and state of charge (SOC) are then obtained and compared with measured data. We find that the simulated battery charge/discharge behaviour generally agrees with the measurement results in Singapore over the investigated period. From the simulated SOC over a longer period in Singapore, we find that the chosen voltage (3.5 V) for overcharge protections was too high, since the batteries are overcharged on 27 occasions during a 30 day period. Thus, a smaller voltage value is required for the investigated system. Also, the initial design with four batteries is not enough to ensure the healthy operation of the system and one more battery is added. From the simulation results for Boston, it is found that the PV module power output is too small; - the over-discharge protection was activated 22 times during the 30 days. After adding another PV module in the PV system, the system works better and the over-discharge protection is only activated 2 times. Based on these studies, it is concluded that long-term, uninterrupted operation of the system requires careful consideration of the actual illumination conditions and needs to be designed accordingly. The presented real-time PV system simulation can help accomplishing this.

2. RELATED STUDY

The test of research in renewable energy micro generation technology is the lucky combination of efficiency and urban integration. Indeed, the application field with the biggest potential is within cities where the number of small consumers is concentrated. Obviously, in this context, the acceptance of people towards the installation of new power plants becomes essential for the success of projects. The thermal power stations are causing pollution which severely affects mankind and nature. These power stations result in causing many diseases. Also the natural resources like coal, oil, radio-active materials etc. will get extinct in near future. The other existing power generating systems like Hydro-Electrical power generating plants cannot afford much power as it is season based, although it causes less pollution. Therefore, it is of great urgency to go for nonconventional energy resources. The most popular non-conventional energy resource is solar energy which converts solar energy or solar radiation to electricity. The aim of this work is to design and implement a hybrid power generation system using wind energy and solar energy. Solar and wind are easily available in all conditions. The non-conventional energy resources like solar, wind can be good alternative source. Solar energy has drawback that it could not produce electrical energy in rainy and cloudy season so to overcome this drawback use wind energy resources so that any one of source fails other source will keep generating the electricity. Solar and wind has good advantages other than any other non-conventional energy sources. Both the energy sources have greater availability in all areas. To reduce the cost of the energy, use a solar tracker. This additional output or "gain" can be quantified as a percentage of the output of the stationary array. Gain varies significantly with latitude, climate, and the type of tracker to choose as well as the orientation of a stationary installation in the same location. Solar tracker adds to the efficiency of the system, reducing its size and the cost per KWH. In the fabricated model, the Solar Street Lamp reduces electrical grid energy consumption and serves as an example to advocate for renewable energy. The Street Lamp addresses the concern for clean energy while improving the efficiency of existing systems.

3. PROPOSED SYSTEM

The pole is made up of cast iron, at the top of the pole the sail type wind blade is attached which is attached with dynamo and wind turbine. The blades are made of unsaturated polyester, fiber -reinforced epoxy composite material sail type design. The wind turbine having a sail type blade is capable of rotating about 360 degree. The movement of wind turbine is based on the two small spur gear attached with dynamo. Then the solar panel is attached below of wind blade adjustment. Solar panel consists of number of silicon cells, when sun light falls on this panel it generate the voltage signals then these voltage signals given to charging circuit. Two LDR sensors are attached at the

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end of panel and the panel is attached with gear mechanism for tracking the direction of sun. The worm gear arrangement is attached along with motor and sensor and order to achieve the movement of the panel with the direction of sun. The base where panel is fixed is having two limiting switches. A limit switch with a roller-lever operator is installed on a gate on a canal lock and indicates the position of a gate to a control system. Two ball bearings are attached at the end of the tracking which helps for supporting the tracking devices. The ball bearing is a type of rolling-element bearing that uses the balls to maintain the separation between the bearing races. Fig.1shows the working of solar tracking system which consists of solar panel, LDR sensor, control unit, motor and battery as main parts.

The equivalent circuit of the battery model used in this work is shown in Fig. 3. It has two-RC networks, which was found to be robust for modelling both single battery cells and large format batteries. The voltage source is defined as the battery open circuit voltage (OCV), and the series resistor is denoted by Rs. The tests for the model parameterization were conducted on a MACCOR Series 4600A Automated Test System at SERIS. The system has a current range of 1 A and a voltage range of 5 V. It can be programmed to run multi-step tests, with the modes of operation including constant current, constant voltage, constant power and constant resistance. The tested battery is the HETER HTCF-18650 LiFePO4 battery with a nominal capacity of 1400 mAh and a rated voltage of 3.3 V. It was connected to the MACCOR test system using a Molded True 4-Wire Kelvin Cell Holder of AA size. The ambient temperature during the tests was around 26 ºC. Theoretically, all component parameters in the battery model could be multivariable functions of SOC: discharge/charge current, temperature and life-cycle number. To simplify the simulation process, only the dependence on SOC was considered, which corresponds to the operation of a non-degraded battery under testing conditions. In 2004 AbuSharkh and Doerffel published a rapid battery test method to establish the quantitative correlations between the circuit components and SOC.

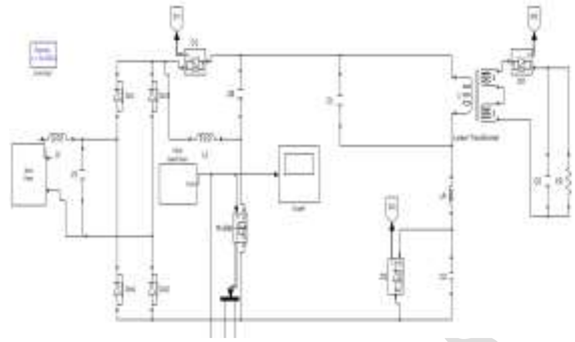

Fig.3.1. Simulation Model.

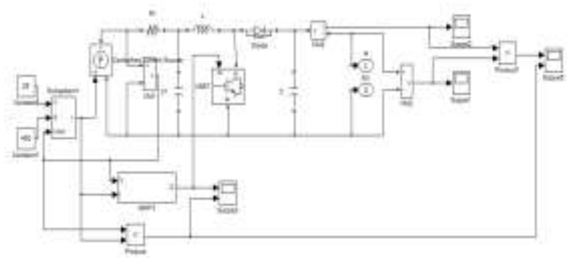

Fig.3.2. MPPT algorithm at Solar panel.

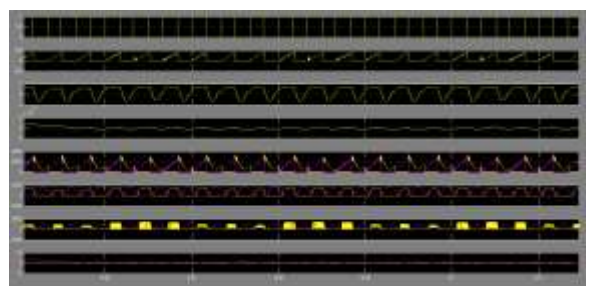

Fig.3.3. Final results at Outputs.

4. CONCLUSION

Solar energy is transmitted from the sun light by electromagnetic radiation. The solar energy transforms to the electric with necessary device (Photovoltaic Devices). The use of PV power system becomes attractive because of high reliability, low maintenance requirement as they don't have moving parts of generating electricity, low running costs, suited to most location and long life expectancy for main components. The solar LED street lighting is performed the solar electric to the battery storage and solar light controller. At the summary of this paper, the size of solar panel is expressed the capacity of LED Lamp as design and specifications, features and benefits of solar LED street lighting.

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