

Solar powered Luo Converter based Smart Street Lighting using Arduino UNO

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Abstract

This paper proposed the solar powered Luo converter based smart street lighting using Arduino UNO. In this paper the LED lamp is controlled over Arduino UNO through Luo converter. Three modes of operation are proposed to control the LED lamp. The modes are 1). The LED lamp is OFF during day time. 2). The LED lamp is ON with low brightness. 3). The LED is ON with high brightness. The simulation circuit for solar with Luo converter is developed using MATLAB/Simulink and the control circuit is developed using Proteus software to produce PWM pulse.

Key Words: Solar panel; Luo converter; LED; Arduino UNO.

1 Introduction

Solar power is becoming more popular because of its versatile, more benefits to the people and the environment. Solar power is the one of the most alternative to replace the fossil fuels like coal, gas and nuclear power. The buck converter with discontinuous mode of operation is presented in [1]. In this paper flexible dimming mechanism is presented. The power saving in LED light system is proposed in [2] with current balancing transformer. In [3], Integrated Buck Flyback converter is proposed for dimmable power supply with high power factor. However most of the converters, the component counts are relatively high.

The voltage lift technique is used due to economic and simplicity. The voltage lift and super lift technique are presented in [5] used to boost the voltage. The arithmetic progression technique is used to increase the voltage stage by stage in voltage lift technique and geometric progression is used in super lift technique presented in [6]. In [7], incremental conductance algorithm is designed and simulated for solar photovoltaic cell. The super lift Luo converter is designed for photovoltaic system and simulated for standalone and grid connected system [8]. In [9] super lift Luo converter with closed loop system is designed to obtain desired output range. In this paper, Solar powered Luo converter is proposed to connect to LED lamp with power saving technique using sensor.

2 CIRCUIT DESCRIPTION

The block diagram of solar powered Luo converter based Smart Street lighting using Arduino UNO is shown in figure.1. It consists of solar panel, charge controller, battery, Luo converter, LED lamp, Arduino UNO, PIR sensor and gate driver circuit. In this circuit, the power generated from solar panel is used to charge the battery through charge controller. The P&O algorithm is used to extract maximum power from solar panel. The extracted power is directly fed into the battery. The output port of the battery is connected to the Luo converter. The output of Luo converter is connected to the LED lamp. The PIR sensor is used to detect the vehicle. The output of the sensor is given to the Arduino UNO. The Arduino will generate the signal and trigger the MOSFET switch through driver

circuit. The circuit diagram of the solar power Luo converter based Smart Street lighting using Arduino UNO is shown in figure.2

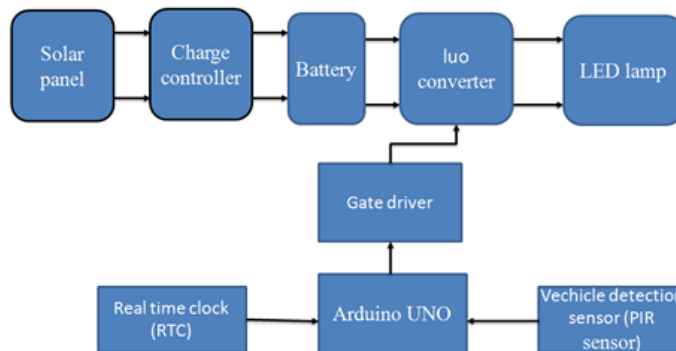


Fig.1 Block diagram of solar power Luo converter based Smart Street lighting using Arduino UNO.

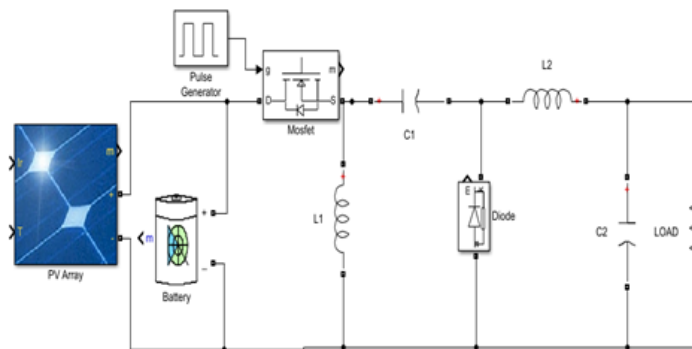


Fig. 2 Circuit diagram of solar power Luo converter.

3 SIMULATION MODEL AND RESULT DISCUSSION

The figure.3 shows MATLAB/simulink model of solar powered Luo converter based DC-DC converter. The configuration parameter is shown in Table.1.

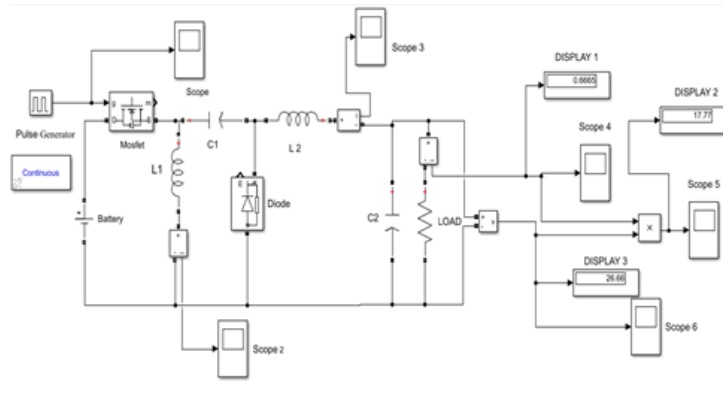


Fig. 3 Simulation circuit of solar power Luo converter

Table .1. Configuration parameter

Parameter	Specification
Solar panel	(12V / 50W)
Lead Acid Battery	12V, 26Ah
MPPT	12V, 5A
MOSFET	IRLZ44N
Diode	UF4007
LED lamp	15W, 24V
Arduino UNO	16 MHz quartz crystal
PIR sensor	HC-SR501
RTC	DS1307
12V to 5V regulator IC	PZIN51001339
Capacitor	10uF
Inductor	10mH

The figure.4 shows the output voltage waveform of solar panel. From this the output of solar panel is 27V. The solar current waveform is shown in figure.5 and shows that current value is 0.67A. The solar panel input power waveform is shown in figure.6 and the value of power is 17W.

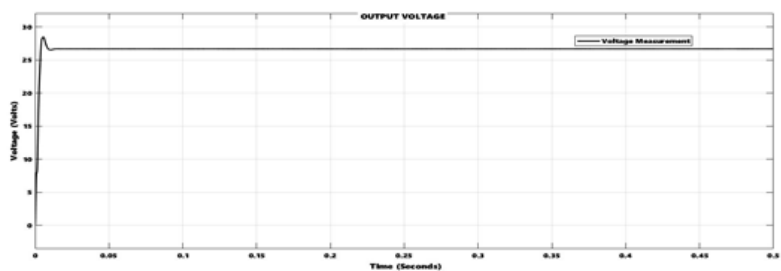


Fig.4 Solar panel output voltage

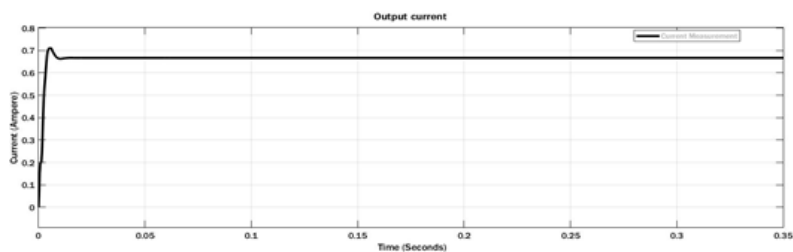


Fig.5 Solar panel output current waveform

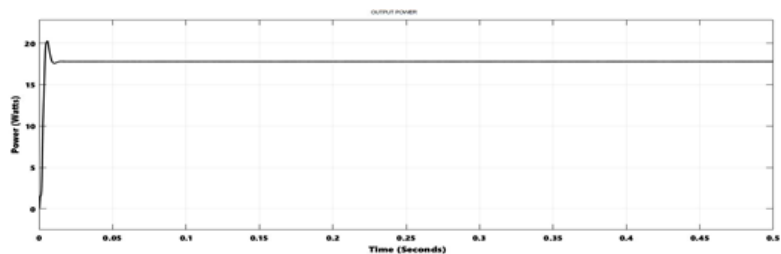


Fig.6 Solar output power waveform

The figure.7 shows the Arduino UNO controller circuit diagram using proteus software. The three modes of operation of controlling methods are shown in figure 8, figure.9. and figure.10 respectively.

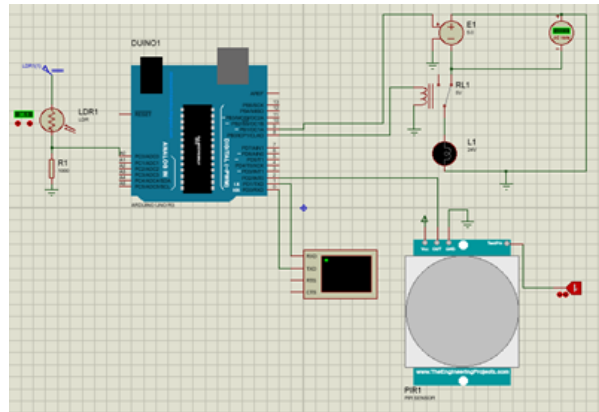


Fig.7 Arduino UNO controller circuit diagram using Proteus software

Mode:1-Day time LED off condition:

When intensity of sunlight is > 40 lumens (Day time), The output voltage will be "zero". Therefore lamp is in OFF condition.

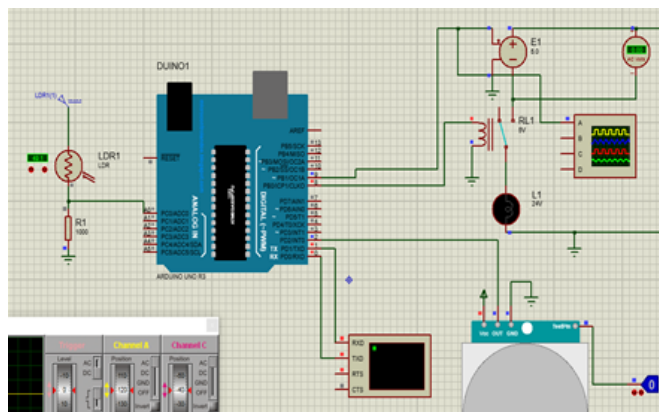


Fig.8 LED lamp OFF condition

Mode:2-Evening LED ON condition Low brightness :

When intensity is reduced less than 40 lumens, LED lamp started to ON with low brightness since no person and vehicles is detected (PIR sensor = 0).

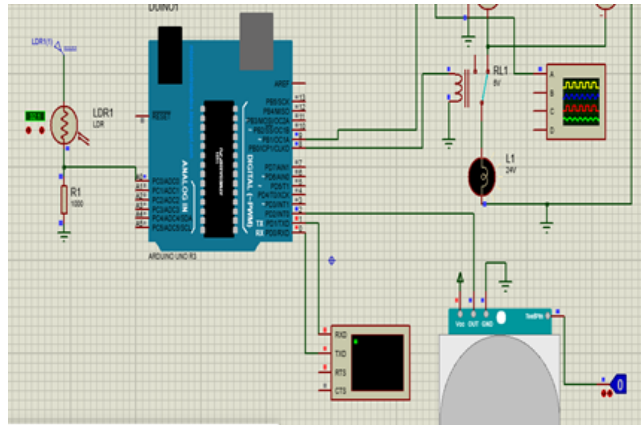


Fig.9 LED lamp ON (low brightness) condition

Mode:3-Evening LED ON condition high brightness Person detected :

When intensity is reduced less than 40 lumnes, LED lamp started to ON with high brightness since any person or vehicle is detected (PIR sensor = 1).

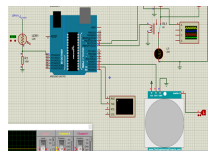


Fig.10 LED lamp ON (High brightness) condition

4 CONCLUSION

In this paper, solar powered Luo converter based smart street lighting using Arduino UNO is proposed. The Luo converter is developed using MATLAB/Simulink. The control circuit is developed using Proteus software to control the lamp. From this simulation results, its verified that Luo converter is used to reduce ripples and the LED lamp is effectively controlled using Arduino UNO.

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