SOLAR POWERED SWITCHED MODE POWER SUPPLY TO RUN RASPBERRY PI

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Abstract

A Power supply is an essential part of almost every electronic devices and the current trend is towards reducing the usage of power supply. It is thus desirable to use solar power to achieve this objective. The demand for solar energy is mainly driven by the trend towards cheaper solar cells, making it economically profitable for a larger range of applications. However, solar power has yet to reach grid parity in many geographical areas, which makes ways to reduce the cost of solar power systems important. The basic idea behind SOLAR SMPS project is the increasing over usage of electricity in this modern era. Through this proposed system over usage of electricity can be reduced by a small percentage. The function of Buck Booster helps in a Broadway to utilize the solar energy in an efficient manner. Solar energy can be stored in a battery with the help of this Buck Booster and also this battery act as a power backup.

Keywords: *SMPS, Buck boost converter, raspberry pi*

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1. INTRODUCTION

Sun is the most efficient renewable source of energy in our planet. Solar energy is a solar power derived from the sun through the use of solar panels. The photo voltaic cells in the solar panel convert light into an electric current using photo voltaic effect. The concentrated solar power systems use lenses or mirrors and tracking systems to focus large area sunlight into a small beam. Solar photo voltaic is rapidly becoming an inexpensive low-carbon technology to harness renewable energy from the sun. The international energy agency projected in 2014 that, under its "high renewable" scenario, by 2050 solar photo voltaic and concentrated solar power would contribute about 16% of the world's energy.

Many industrial nations installed significant solar power capacity into their grids to supplement or provide an alternative to conventional energy sources. SMPS offers advantages in terms of size, weight, cost, efficiency and overall performance. These have become an accepted part of today's modern electronic gadgets. The basic concept behind the switching mode power supply or SMPS is the fact that the regulation is undertaken by using a switching regulator. This uses a series switching element that turns the current supply to a smoothing capacitor ON and OFF. Basically, it is a device in which energy conversion and regulation is provided by power semiconductors that are continuously switching ON and OFF with a high frequency As a result of high efficiency and low levels of heat dissipation, the switched mode power supplies can be made more compact.

Utilization of solar energy is the most brilliant and eco friendly idea to power up the day to day gadgets and systems. By taking this idea into consideration, Switched Mode Power Supply (SMPS) is developed which fully works on solar power and hence named as Solar SMPS. Proper and uninterrupted supply of electricity is not feasible at various parts of the world. Especially, countries like India have a big problem of electricity where a large amount of electricity is generated by traditional methods. There is a great scope for solar energy in India. Now-a-days solar energy technologies have become more advanced that is able to exploit the energy we receive from the sun to provide a greater, significant amount of electricity. The major aim of the project is to save Electricity and maximize the use of renewable source of energy

2. WORKING PRINCIPLE

The project basically consists of three units, which are charging unit, storing unit and delivering unit. The solar energy is trapped with the help of solar panels; we get an unregulated dc output voltage from the panel terminals. This unregulated dc voltage is regulated with the help of a Buck and Boost converter and this comprises the first unit that is the charging unit. At the end of the charging unit regulated voltage is obtained which is stored to a battery, and this comprises the storage unit. The bucking and boosting system functions with the help of a Peripheral Interfacing Chip (PIC) IC, where the software unit is in Embedded C language. The delivering unit consists of a current booster circuit using LM7805 in order to provide the appropriate output voltage for the gadgets or systems. The entire project works on DC power and no AC power is used.

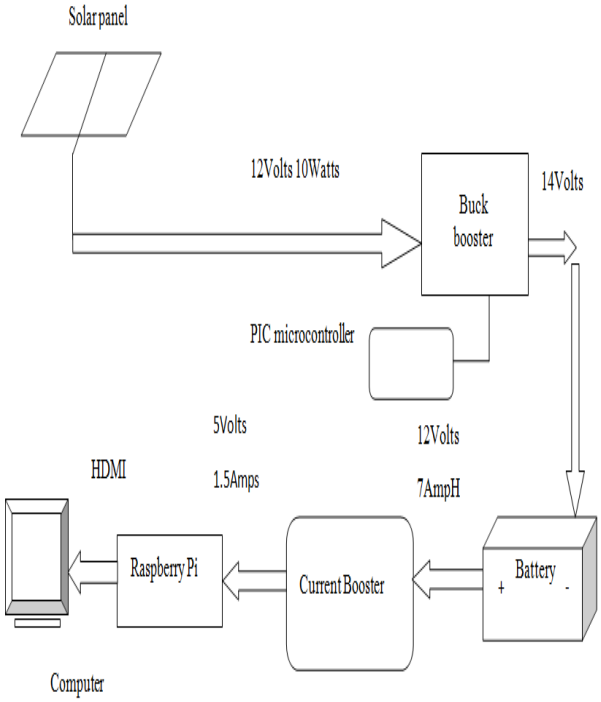

Fig -1: Block Diagram

3. HARDWARE IMPLEMENTATION

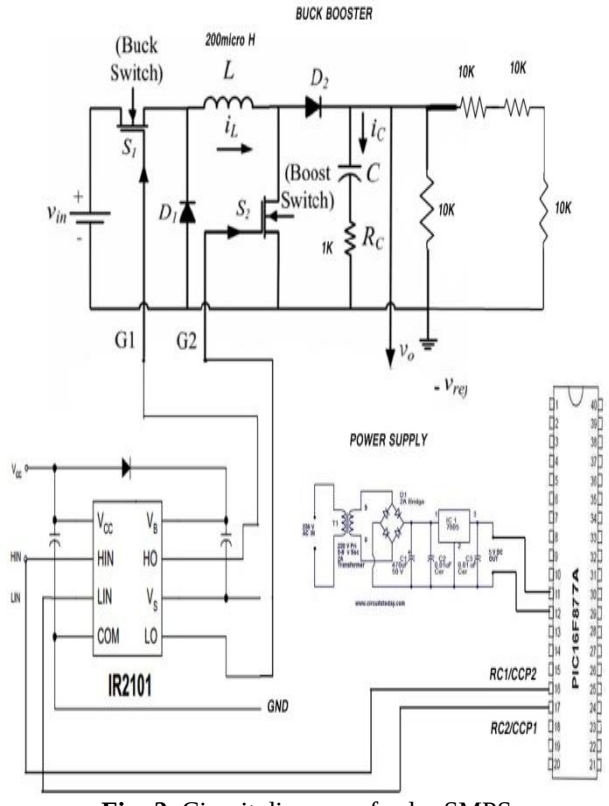

Fig -2: Circuit diagram of solar SMPS

The project describes a noble method of utilizing a normal buck booster unit for charging a battery via a solar panel. For this purpose the preferred components, presuming the battery to be charged is 12Volts rated.

After connecting the panels, it was observed that the panel output was varying. In order to avoid this problem, buck booster circuit was introduced and it was observed that regardless of changes in the input the output remains constant that is 14Volts. A current booster circuit using LM7805 was used at the terminals of the battery and it was observed that the current was increased to 1.5Amps at the output USB pin which is essential to power up a Raspberry Pi.

4. TESTING AND RESULTS

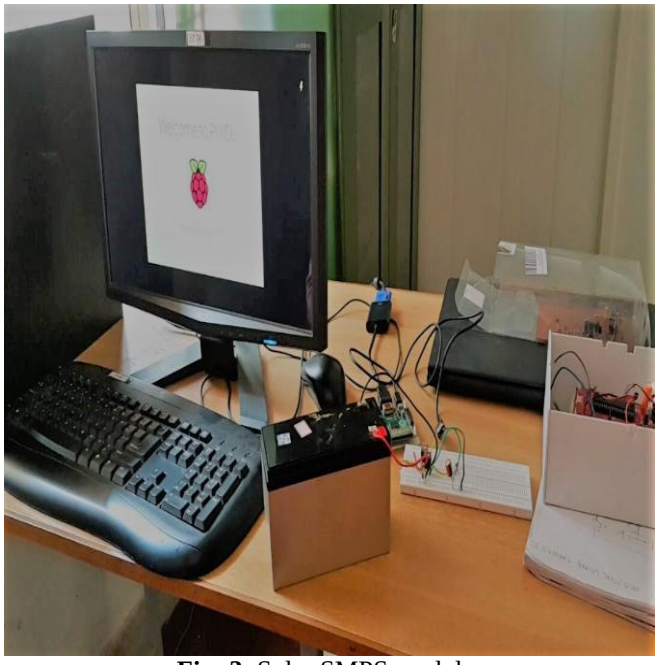

Fig -3: Solar SMPS module

The charging unit, storing unit and the delivering unit were assembled together. Output voltage and current was observed and tested at each unit separately. The entire setup was then connected to a monitor via a Raspberry Pi with the help of a HDMI cable. Mouse and keyboard were connected to the ports of Raspberry Pi. The observations of the final output were made depending upon the amount of time the Raspberry Pi was continuously running under the battery.

Table -1: Observations of the Raspberry Pi made by connecting different loads

Charge on battery	Load connected without battery	Working time	Load connected using battery	Working time
12.7 volts	Monitor, mouse	2 hours	Monitor, mouse	3 hours
12.7 volts	Monitor ,mouse, keyboard	1 hour 30 mins	Monitor ,mouse, keyboard	2 hours 45 mins

Table 1 shows the amount of time for which the Raspberry Pi and the load worked smoothly using battery and without using battery.

The output voltage of solar panels was varying from 6V – 18.6V depending on the amount of sunlight it receives. According to the test results the equipment can be operated at various weather conditions

A small demo was performed to test the discharge behavior and the working time of the battery. Initially, the battery was charged to 12.7Volts. Loads were connected to the Raspberry Pi.After Forty-Five minutes of continuous working; it was observed that only 0.2Volts have been drained from the battery

5. CONCLUSION

Undistributed power supply is the current interest to several power utilities all over the world. However it is often affected by certain disturbances. The proposed system SOLAR SMPS focuses on smooth functioning of a Linux based minicomputer (using Raspberry pi) with the help of an SMPS which is powered from the solar energy. In the future, we could have more efficient, SMPS aimed at a better converter doing the most effective conversion process.

REFERENCES

[1]. “Microcontroller and Embedded Systems” Mazidi, M, A/Mazidi, J.G.Pearson Education, VTU 4 Sem ECE Reference textbook
[2]. “Tiny AVR Microcontrollers for the Evil Genius” Dhananjay V Gadre, published by Tata McGraw Hill, Released in 2011
[3]. “Microcontroller and embedded Systems” D.V.Ramane, H.R.N Ramane, S.R.n Gadakh, S.S.n Demse, V.M.n Bapat, Vision Publications, Released on 2012.
[4]. “Electronic Devices and Circuit Theory” Robert L., Boylestad and Louis Nashelsky, Tata McGraw Hill, Released in 2009.
[5]. “Operational Amplifiers and Linear ICs” David.A.Bell, Ramakant A. Gayakawad, Robert.F.Coughlin & Fred.F.Driscoll.