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Automatic Power Management And Monitoring System For Electric Vehicles

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ABSTRACT: In this paper, electric vehicle technology which is recharged in the combination of multi sources (when it is plugged in to a power source from the grid and also from renewable energies like solar). However the solar radiation never remains constant. It keeps on varying throughout the day. The need of the hour is to deliver a constant voltage to the grid irrespective of the variation in temperatures and solar insolation. We have designed a circuit such that it delivers constant and stepped up dc voltage to the load. At various insolation levels, the load is varied and the corresponding variation in the input voltage and current to the buck-boost converter is corrected and noted. These electric vehicles help to keep the environment clean by reducing the amount of toxins emitted from standard exhaust systems and lower operating cost than the conventional internal combustion engine based vehicle. The main objective of this project is used to improve battery performance/efficiency as well as life together using converter and also monitoring the system using PIC16F877A. The effectiveness of the system is verified through the simulations using Simulink/ MATLAB (R2013a) package.

Keywords: Buck Boost converters, PIC16F877A, GSM, GPS, PIR, Piezoelectric Buzzer. etc.

I. INTRODUCTION

In recent years, shortage of petroleum is considered as one of the most critical world-wide issues, costly fuel becomes a major challenge for customers so we developed electric vehicles but the driving range is still too limited. In many remote or underdeveloped areas, direct access to an electric grid is impossible. A typical solution of this problem is renewable energies like photovoltaic inverter system would make life much simpler and more convenient. So we are proposes system to recharging with multi sources in an electric vehicle with constant voltage. That can improves battery performance and life. These electric vehicles help to keep the environment clean by reducing the amount of toxins emitted from standard exhaust systems and lower operating cost than the conventional internal combustion engine based vehicle.

A. *Existing technologies*

Electric vehicle are operated by using batteries that are recharged through plug in from grid. In these processes, it can take lot of time to recharge the battery and also associates less power package so driving range is too limited. Then only customers are used to drive small distances, that batteries are not discharge fully. At this state, again it recharging the battery means electrons are affected in battery that causes reduce battery life and performance. There are proposed many ways to improve battery performance and life using converters, semiconducting devices, etc. Recently, research into the field of power management in battery has continued to receive much attention in academia.

a) A power converter for battery used in the Plug-in Hybrid Electric Vehicle is proposed, which could charge and discharge the battery effectively. The system is composed of two parts: a three phase full bridge PWM rectifier and a DC/DC converter. The PWM rectifier is utilized to rectify the three phase AC to DC voltage, which should be higher than the battery terminal voltage. The DC/DC converter is constructed by a buck-boost circuit, which is a buck circuit under charge mode and a boost circuit under discharge mode. The direct current control (DCC) algorithm is responsible for rectifying the AC output and diminishing the total harmonics distortion. The proportional-integral controller and bang- bang controller is to control the charging current and voltage.

b) The design and performance of a 6-kW, full-bridge, bidirectional isolated dc-dc converter using a 20-kHz transformer for a 53.2-V, 2-kWh lithium-ion (Li-ion) battery energy storage system. The dc voltage at the high-voltage side is controlled from 305 to 355 V as the battery voltage at the low-voltage side varies from 50 to 59 V. The maximal efficiency of the dc-dc converter is measured to be 96.0% during battery charging, and 96.9% during battery discharging. Moreover, this paper analyzes the effect of unavoidable dc-bias currents on the magnetic-flux saturation of the transformer. Finally, it provides the dc-dc converter loss breakdown with more focus on the low-voltage-side converter.

c) The hybrid electric vehicle has come to the forefront as the leader for alternative fuel vehicles. With the increased demand for HEVs, more research has gone into the improvements of these vehicles. In order to achieve better performance in terms of miles per gallon, speed, and power, researchers have focused on many elements of the vehicle and how these elements affect the overall vehicle performance. One such element that has been a highly discussed topic has been the battery systems. Current battery technology has been a limiting factor when it comes to some aspects of the overall performance of the vehicle.

d) A new battery/ultra-capacitor hybrid energy storage system is proposed for electric drive vehicles including electric, hybrid electric and plug-in hybrid electric vehicles. Compared to the conventional hybrid energy storage system design, which uses a larger DC/DC converter to interface between the ultra-capacitor and the battery/DC link to satisfy the real time peak power demands, these design uses a much smaller DC/DC converter working as a controlled energy pump to maintain the voltage of the ultra-capacitor at a value higher than the battery voltage for the most city driving conditions. The battery will only provide power directly when the ultra-capacitor voltage drops below the battery voltage. Therefore, a relatively constant load profile is created for the battery.

e) A single-phase bidirectional AC-DC converter and bidirectional DC-DC converter is proposed to transfer electrical power from the grid to an electrical vehicle (EV) and from an EV to the grid while keeping improved power factor of the grid. In first stage, a 230 V 50 Hz AC supply is converted in to 380V dc using a single-phase bidirectional AC-DC converter and in the second stage, a bidirectional buck–boost dc-dc converter is used to charge and discharge the battery of the PHEV (Plug-in Hybrid Electric Vehicle). In discharging mode, it delivers energy back to the grid at 230V, 50 Hz. A battery with the charging power of 1.2 kW at 120V is used in PHEV. The buck-boost DC-DC converter is used in buck mode to charge and in a boost mode to discharge the battery. A proportional-integral (PI) controller is used to control the charging current and voltage.

B. Proposed system

In the proposed system consists of two main components, one is positive buck boost converter (i.e. DC to DC converter) and another one is PIC16F877A. Converter is used to managing the input sources from renewable energies or grid, then controller is used to monitoring the system and displaying the status for user reference. This system overcomes the drawbacks of previous system like battery efficiency and life, driving range, recharging battery, etc. this method greatly simplifies the recharging system in electric vehicle. The proposed system will be presented and verified in detail in this paper.

II. SYSTEM ARCHITECTURE

This section describes the conceptual design of a flexible and low cost electric vehicle infrastructure is follows below.

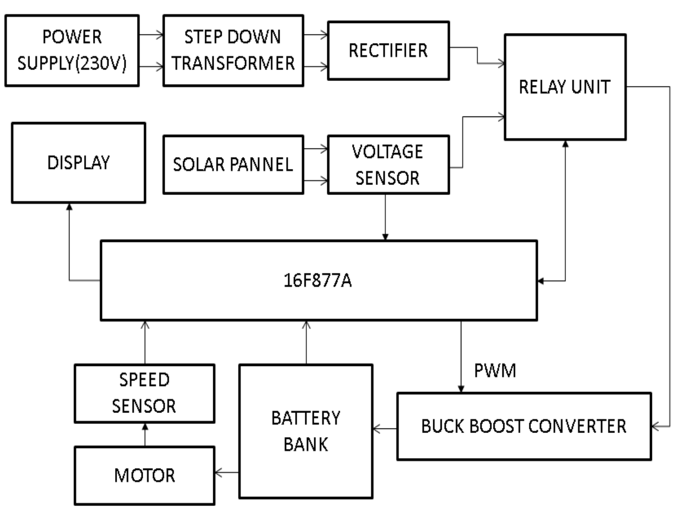

Fig. 1 Power Management Block Diagram

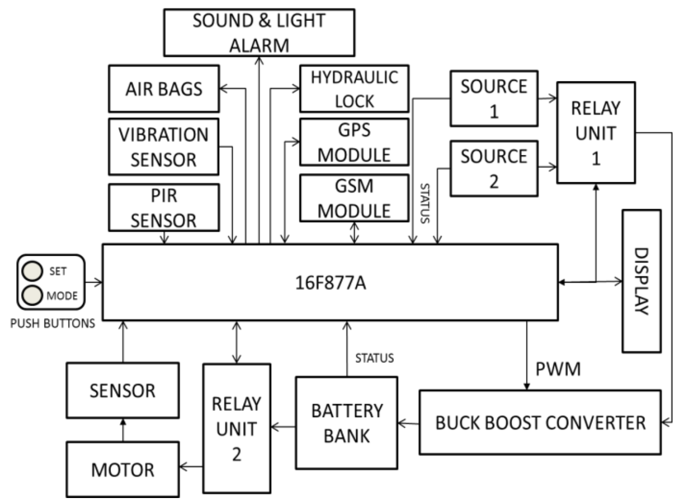

Fig. 2 Monitoring System Block Diagram

Fig. 1 and Fig. 2 describes the process of the electric vehicle power management and monitoring system. The detailed description of the proposed system is as follows:

- Normally electric vehicle are operated by using battery (i.e. lithium ion battery). In a proposed system, that is recharged in frequent manner by using grid and also from solar energy. These are operated as like previous method electric vehicle.
- Both input source are interfaced into the relay, that relay unit is controlled by controller
- Then relay unit is connected into converter, because the outputs of photovoltaic systems are varied if the battery is directly recharged means that causes reduce battery life.
- Converter is used to produce constant output voltages that will help to improve battery performance. The output of the buck boost converter is the input of battery bank.
- Each device in the block diagram is connected to the controller, because the controller is used to monitoring the process of system and displaying the status of the system through display (i.e. like liquid crystal display).
- In Fig. 2 consist of air bag, PIR sensor, GPS module, GSM module, etc.
- The user gives inputs through mobile to module.
- Then it should response as per the input conditions.
- So these systems prevents from theft also.

III. CIRCUIT DESCRIPTION

2.1 Converter operation: The bidirectional dc-dc converter shown in Figure1 is operated in continuous conduction mode for forward motoring and regenerative braking of the dc motor. The MOSFETs Q1 and Q2 are switched in such a way that the converter operates in steady state with four sub intervals namely interval 1(t0-t1), interval 2(t1-t2), interval 3(t2-t3) and interval 4(t3-t4). It should be noted that the low voltage battery side voltage is taken as V1 and high voltage load side is taken as V2. The gate drives of switches Q1 and Q2 are shown in Figure 3. The circuit operations in steady state for different intervals are elaborated below.

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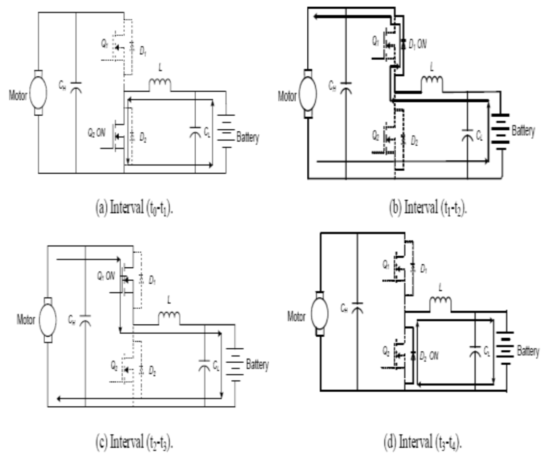

Fig 3. Converter operating modes.

2.1.1 Interval 1(t0-t1): At time t0, the lower switch Q2 is turned ON and the upper switch Q1 is turned OFF with diode D1, D2 reverse biased as shown in Figure 2(a). During this time interval the converter operates in boost mode and the inductor is charged and current through the inductor increases.

2.1.2 Interval 2(t1-t2): During this interval both switches Q1 and Q2 is turned OFF. The body diode D1 of upper switch Q1 starts conducting as shown in Figure 2(b). The converter output voltage is applied across the motor. As this converter operates in boost mode is capable of increasing the battery voltage to run the motor in forward direction.

2.1.3 Interval 3(t2-t3): At time t3, the upper switch Q1 is turned ON and the lower switch Q2 is turned OFF with diode D1, D2 reverse biased as shown in Figure 2(c). During this time interval the converter operates in buck mode.

2.1.4 Interval 4(t3-t4): During this interval both switches Q1 and Q2 is turned OFF. The body diode D2 of lower switch Q2 starts conducting as shown in Figure 2(d).

2.2 Converter design: The bi-directional converter is designed based on the input supply voltage and output voltage requirement to drive the electric vehicle at desired speed. The converter power topology is based on a half bridge circuit to control the dc motor.

IV. CONTROL STRATEGY

The control circuit of the bidirectional converter is shown in Figure 4.To control the speed of the dc drive; one possible control option is to control the output voltage of the bidirectional converter. To control the output voltage of the bidirectional converter for driving the vehicle at desired speed and to provide fast response without oscillations to rapid speed changes a PI controller is used and it shows satisfactory result. In this control technique the motor speed ωm is sensed and compared with a reference speed ωref. The error signal is processed through the PI controller. The signal thus obtained is compared with a high frequency saw tooth signal equal to switching frequency to generate pulse width modulated (PWM) control signals.

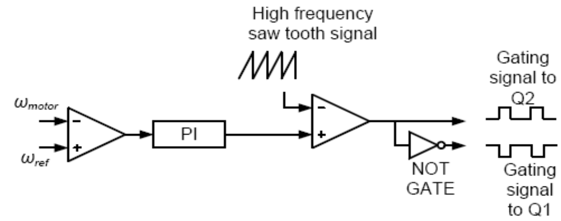

Fig 4. Control of the bidirectional dc-dc converter.

V. Battery requirement for automotive application

Mainly Nickel-Metal hydride (NiMH) and Lithium-ion batteries are used in vehicular application due to their characteristics in terms of high energy density, compact size and reliability. The battery is being recharged by the regenerative capabilities of the electric motors which are providing resistance during braking helping to slow down the vehicle. The lithium-ion battery has been proven to have excellent performance in portable electronics and medical devices .The lithium-ion battery has high energy density, has good high temperature performance, and is recyclable. The promising aspects of the Li-ion batteries include low memory effect, high specific power of 300 W/kg, high specific energy of 100 Wh/kg, and long battery life of 1000 cycles. These excellent characteristics give the lithium-ion battery a high possibility of replacing NiMH as next-generation batteries for vehicles.

VI. SIMULATION RESULTS

Performance of the dc motor drive with the above battery model and bidirectional converter is simulated under different speed command. The simulations are carried out using MATLAB/SIMULINK. The inductor parasitic resistance and MOSFET turn-on resistance are not considered in this case. For the test condition of the proposed drive topology the following values of the different components of the converter are considered. A separately excited DC motor model is used as load to the bidirectional dc-dc converter. The motor rated at 5 hp, 240 V, and 1750 rpm. Principal parameters of the bidirectional converter are: L = 1600 μH, CH=470 μF, CL = 470 μF, fSW =20 kHz Battery voltage=48 V. Battery capacity=16 Ah, SOC=88%.

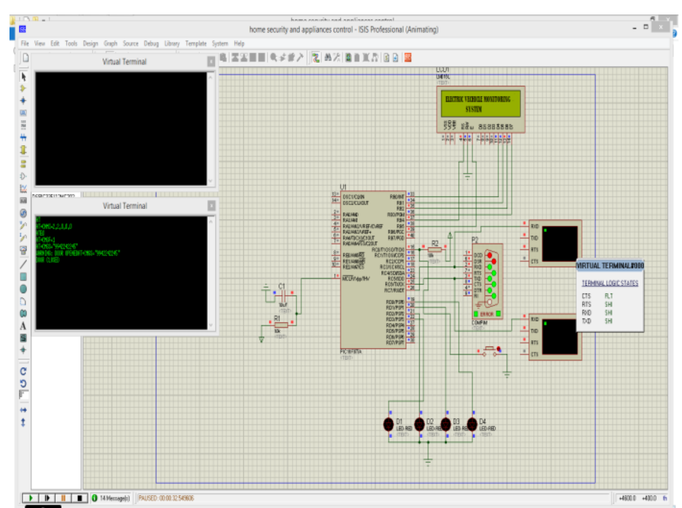

Fig 5. Simulation of monitoring system

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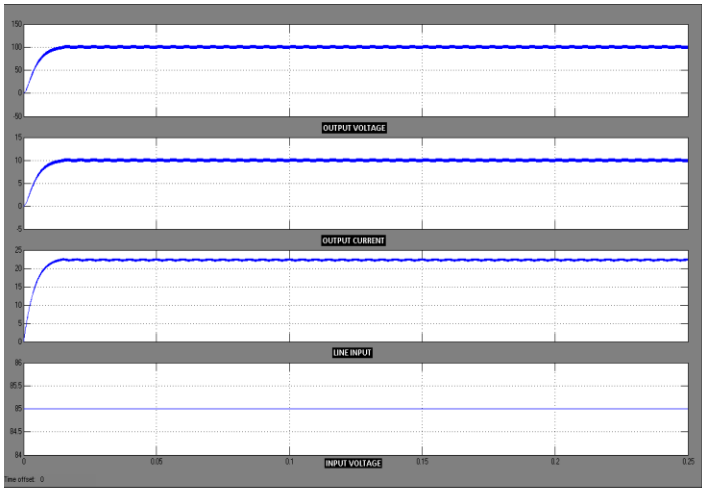

Fig 6. Output Waveform for Buck Boost Converter

VII. CONCLUSION

In this work we demonstrate the performance of a battery operated electric vehicle system and it shows satisfactory performance at different driving condition. The proposed control technique with PI controller find suitable for this electric drive. The overall cost and volume of the battery operated electric vehicle is less with the least number of components used in the system.

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