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Simulation of Hybrid Energy Storage System

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I. INTRODUCTION

One of the major concerns in our day-to-day life is increase in pollution. Petroleum derivative reliance and outflows of fumes gasses and nursery gasses is a portion of the real issues. More productive and cleaner drive advances are one way to deal with these issues. The current advancement of auto power train charge travels toward this path. Consistently new models are exhibited and the presentation of module mixture (PHEV) and electric autos is booked for the up and coming years. There are elevated requirements that this starting procedure of vehicle power train charge could prompt unadulterated electric traveler auto transport one day. Mixture electric vehicles are a feasible other option to regular vehicles, offering lower emanations and enhanced gas utilization by supplementing the principle vitality source with an electric engine, fuelled by a vitality stockpiling unit. The electric motor can also act as a generator to store regenerative braking energy in the vehicle's energy storage unit. For the most part, the vehicle's vitality administration examination comprises of a half and half control methodology, which decides the heap division amid vehicle operation. Be that as it may, in light of the fact that the vitality stockpiling unit directs the vitality and power capacities of the electrical drive, the vitality administration must start at the plan phase of measuring the vehicle segments.

Despite the fact that there are various vitality stockpiling parts to look over, this paper concentrates on batteries and ultra-capacitors with determination of appropriate converter. A joined framework profits by the points of interest offered by the two advances .Batteries are high vitality thickness gadgets; while, ultra-capacitors are high power thickness gadgets. Past work around there proposed a plan philosophy of a vitality-stockpiling unit for vehicles by contrasting the vitality and power limits of the accessible innovation and measuring them to meet the heap necessities of the vehicle depicted by the normal drive cycle.

II. CONVENTIONAL HYBRID ENERGY SYSTEM (HESS)

The Battery, Motor and super-capacitor are connected in parallel to supply the load. Bi-directional buck-boost converter is used to interface the output of battery and super-capacitor. It maintains the power management of ESS in hybrid system. The load is supplied by battery and super-capacitor alternately. When vehicle runs on plane road, motor gain power from battery for rotation of wheel during constant speed. For the accelerating/decelerating power is fed from super- capacitor. While regenerative braking of motor the reverse power is utilized to charge the super-capacitor through dc/dc converter as shown in Fig.1.

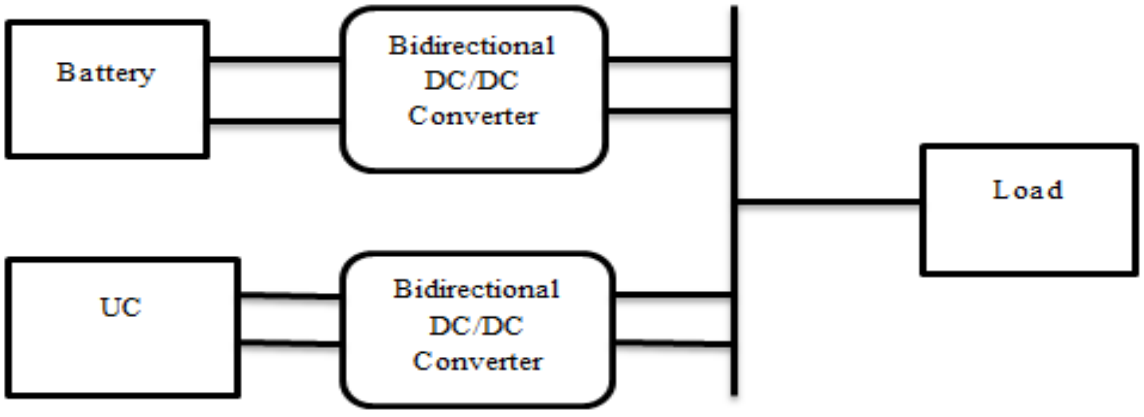


Fig. 1 Parallel Configuration of HESS

The microcontroller is used in the system, programmed such that if the load requirement is low the load is supplied from battery through converter, and if the load requirement is high then the load is supplied through super-capacitor/ultra capacitor using second converter. To sense the load requirement current and voltage, current and voltage sensors is used and is connected to microcontroller and accordingly the microcontroller transfers the pulses to gate driver circuit of respective converters and the turns on the converters according to load requirement.

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III. PROPOSED HYBRID ENERGY STORAGE SYSTEM (HESS)

Fig. 3 shows the basic block diagram of Hybrid Energy Storage System (HESS) (Battery +Ultracapacitor) for the Electric vehicle. To overcome the downside of the battery worked electric vehicle, Hybrid energy storage System (HESS) is proposed for an electric vehicle. That means one or more energy storage devices are combined with a battery, to complement the each single type drawbacks. Because installing only one type of energy storage device is often insufficient, so many application use HESS. Here, HESS consist super capacitor (SC) with a battery which has complementary characteristic to that of battery.

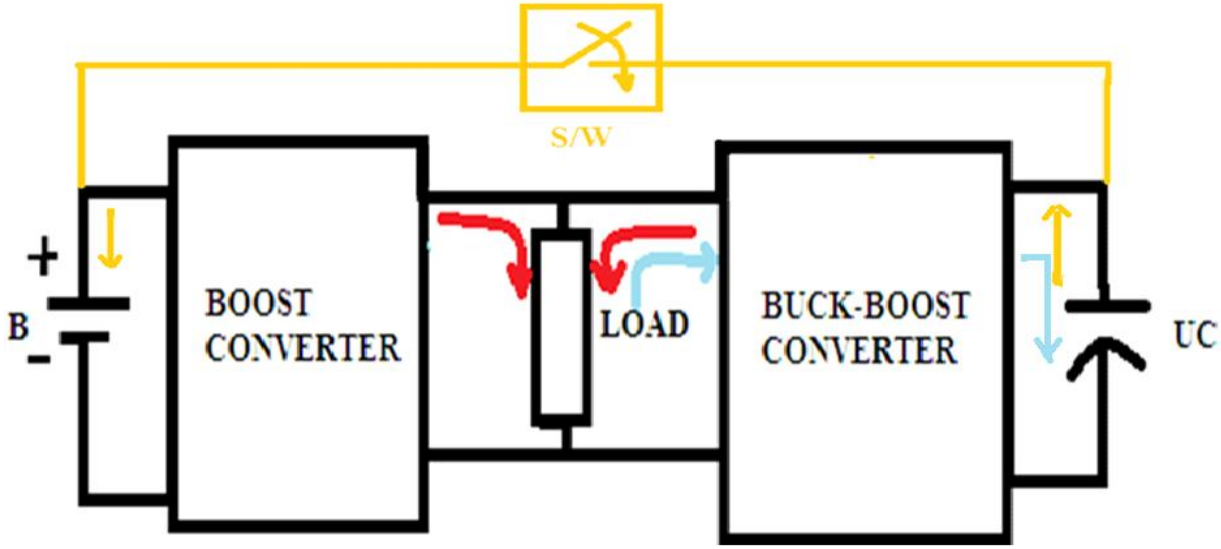


Fig.2 Proposed Block Diagram of Battery & super capacitor (SC) HESS for Electric Vehicle

Energy storage system (ESS) consist of battery and super capacitor/ultra capacitor , which is connected to a power converter and the switching controller. The controller operates with various parameters like HESS parameters and load/motor demand. Then controller switches according to load need, like boost operation during acceleration mode and buck operation during regenerative breaking.

The sensor unit senses the load current, which is drawn from battery and UC, UC SOC from UC pack and motor speed. The above three parameters are given to the control algorithm, which calculates the reference current for switching controller according to different modes. The switching controller is PI controller which acts as current control loop for the inductor of bi-directional dc/dc converter. And the bi-directional converter performs buck or boost operation as per the mode of motor/vehicle. In the case when power demand is constant battery provides power to load. The voltage of battery will be sensed by the voltage divider circuit and the current of battery will be sensed by the current sensor and these signals are passed to the Arduino microcontroller, the microcontroller will turn on the battery.

A. Case1.

Battery provides continuously constant power to the motor. The first preference for load to be supplied will be given by battery depending on load requirement.

B. Case 2.

Super capacitor provide the power to load during acceleration and recharge the battery again during deceleration period, thus SOC of super capacitor is again increased.

IV. SIMULATION RESULTS

The system is designed to obtain constant output voltage through the battery and to maintain continuity of supply to load. The continuity of supply to load is maintained through the energy stored in battery through boost converter. The objective of the simulation is to understand brief idea of this project and to identify the actual behavior of battery and super capacitor when connected across load.

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A. Simulation of Battery supplying power to load using MATLAB

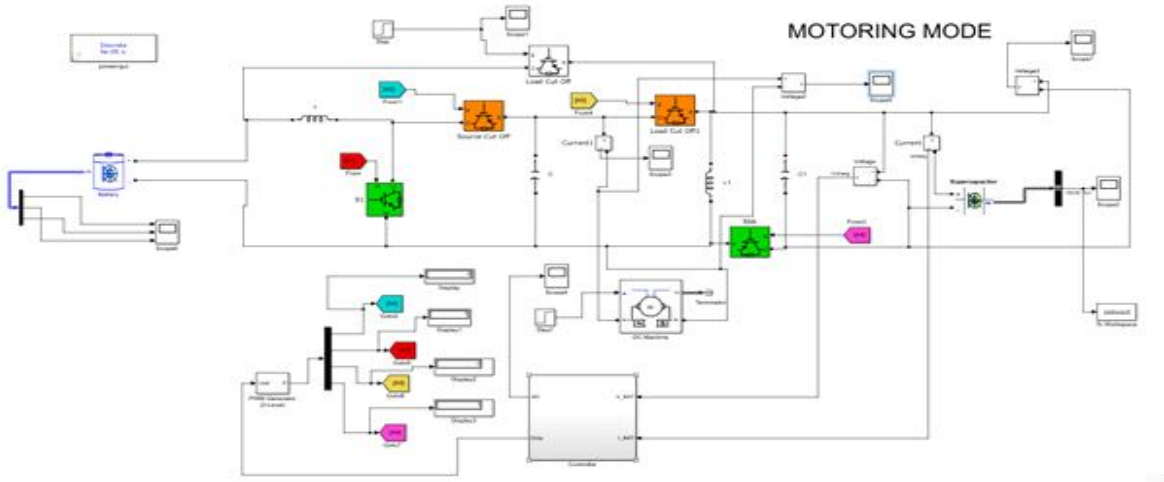


Fig. 3. Simulation of Battery supplying power to load using MATLAB

The basic block of Battery of 12V which is simply described for providing constant power to the motor. The Electric vehicle model as shown in fig.5.1 is simulated using MATLAB/Simulink software. The simulation shows battery connected to d.c motor through boost converter.

B. Dc Output Of The System Across Load

The load used in this system is D.C motor. The output of the boost converter is connected to motor. The boost converter boosts the voltage level of battery. Figure 5.2 shows voltage and SOC is discharging during constant speed o f motor.

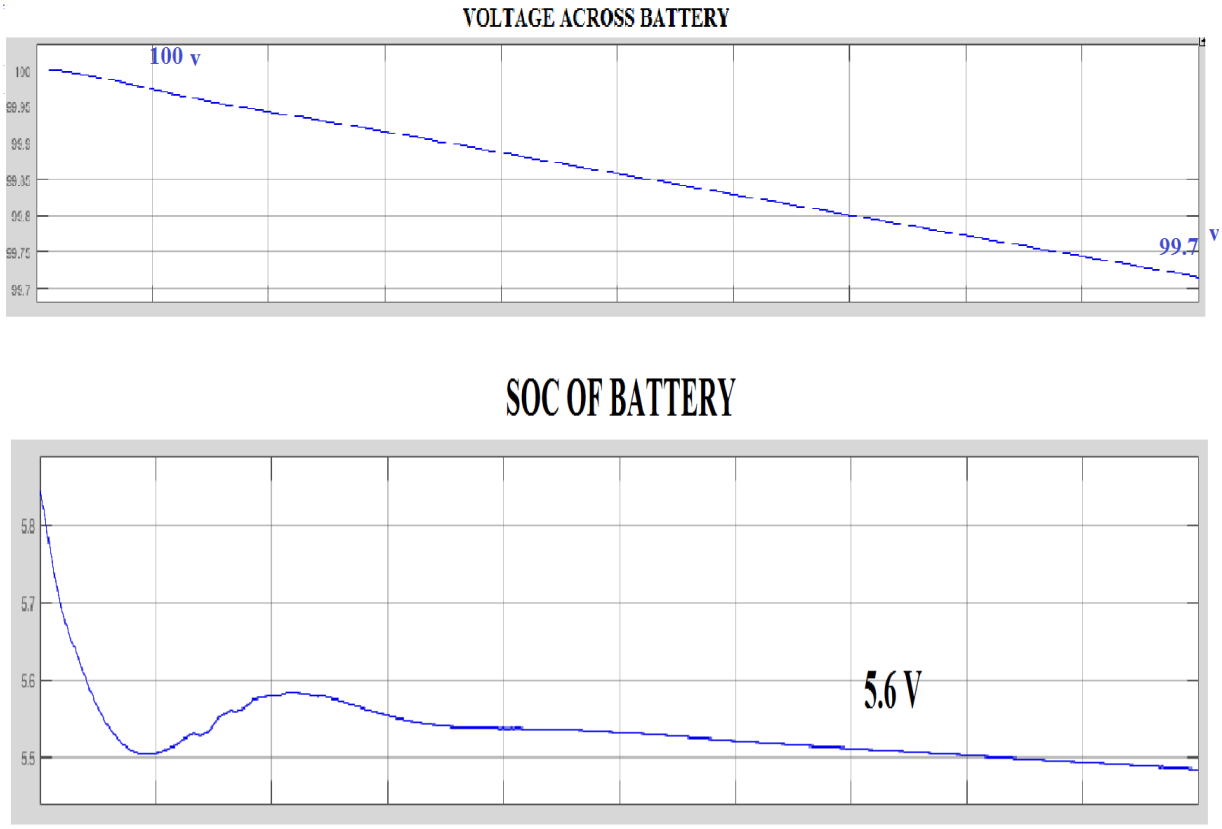


Figure.4 Output waveforms of battery for constant load.

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C. Simulation Of Battery And Super Capacitor Supplying Power To Load Using Matlab

A MATLAB /Simulink model for the battery and super capacitor , modules is developed as shown in fig5.5

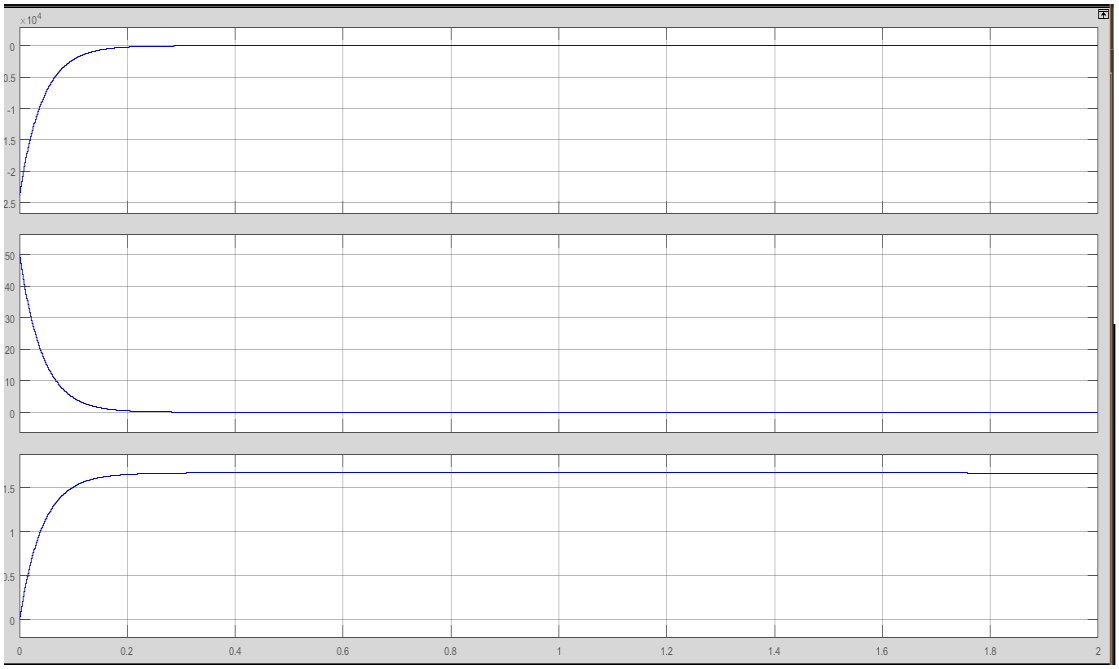


Fig 6.Output across super capacitor Volatge, Current , SOC during acceleration

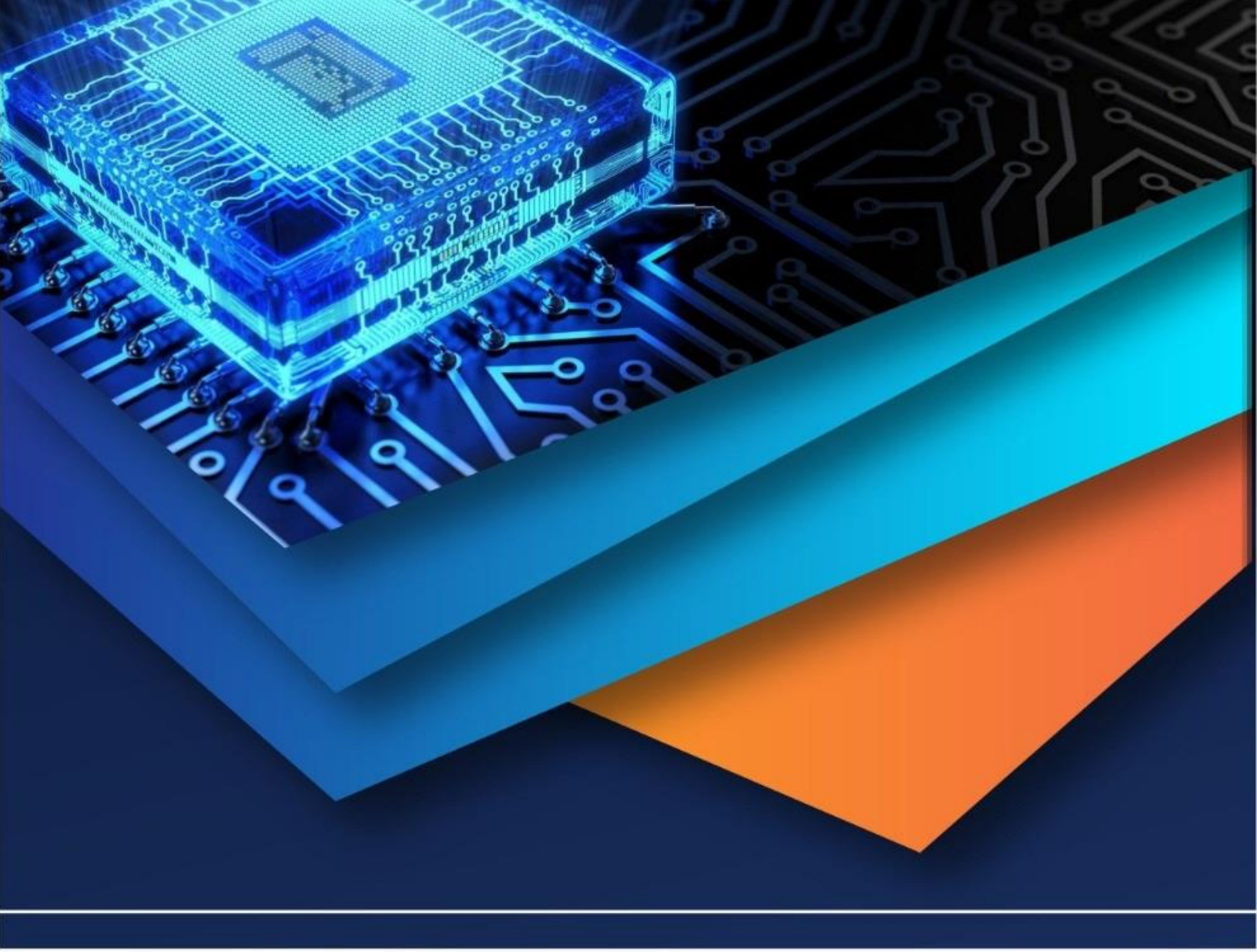
V. CONCLUSION

Simulation and prototype implementation of hybrid energy storage system is presented in this dissertation. Battery is combined with high specific power device such as super capacitor, as super capacitor supplies most transient power required by the load and also protects battery unit from rapid power fluctuations. The state of charge (SOC) is maintained during the constant and accelerated speed of vehicle. To reduce the losses in DC-DC converters bypass switch is used for exchanging energy between two energy sources which improves the overall system efficiency.

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