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A Design of Hybrid Energy Storage System for Electric Vehicles

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ABSTRACT- Recently, Electronic Vehicles (EVs) have been attracted substantial responsiveness and so did the advance in battery equipment. Although the battery technology has been significantly advanced, the available batteries do not entirely meet the energy demands of the Electric vehicle power depletion. This latter aspect is very important for urban mobility. Although many EVs are previously available in the market. These topologies of EVs are based on the diverse combination of batteries, fuel cells, super-capacitor, flywheels, and regenerative braking systems, which are used as energy sources and energy storage devices.

KEYWORDS- Hybrid energy storage system, Hybrid energy storage system, Battery Supercapacitor, Electric vehicle, Regenerative braking

I. INTRODUCTION

The conformist vehicle widely operates using an internal incineration engine (ICE) because of its well-engineered and The performance put away fossil fuels [1-2] (i.e., diesel and petrol) and Releases gases such as hydrocarbons, nitrogen oxides, carbon monoxides, etc. The carriage sector is one of the leading contributors to greenhouse gas (GHG) Radiation. Human doings have affected the carbon cycle by adding more CO2 to the atmosphere and diminishing the natural sink of CO2 gas like forests and soils which remove/store or fix the CO2 level in the atmosphere. With the rise in fossil fuel prices,

Ecological pollution and the limited lifetime of fossil fuels have led automobile makers to look for a substitute for fossil fuels such as natural gas, hydrogen, and biofuel for the propulsion of the vehicle. Among the various developed expertise, electric vehicles (EVs)[3-4] have gained incredible attention as an alternative technology and are becoming a part of the modern transportation system. The average efficiency of ICE is 25%, which means that only 25% of the fuel is converted into useful energy and the rest of the 75% of the fuel is wasted through heat and friction losses, on the other hand, EV has the average efficiency of 78% has restrictions in terms of total mileage and refilling time as compared to an ICE vehicle. EV is the combination of different technologies, which includes multiple engineering fields such as mechanical, electrical, motorized, biochemical engineering besides

microchip technology by the combination of different technologies. EV consists of three major components motors, energy storage/ generation, and a power converter. EVs use an electric motor for propulsion and consume electrical energy stored in the batteries.EV never exhausts any pollution while running as conventional vehicles release, which makes EV an ecological vehicle, However, charging of EV requires electrical energy which can be produced from renewable energy sources such as solar, wind, and hydroelectricity-based power plants. The main issue is the cost of energy sources in electric vehicles. The cost of energy is almost one-third of the total cost of a vehicle. Automobile companies like BMW, Volkswagen, Honda, Ford, Mitsubishi, Toyota, etc., are focusing mostly on plug-in hybrid vehicles. Are focusing mostly on plug-in hybrid vehicles and HEVs. Fuel cell EVs has been regarded as zero exhaust from the engines, highly fuel-efficient, and less dependent on crude oil. In hybrid energy systems, batteries, and supercapacitors are always utilized because of the better performance on smoothing the output power at start-up transmission and various load conditions. On the other hand, PHEV and BEV requires an energy storage charging system, which introduces a new challenge to grid amalgamation. the extra need for EVs and to avoid full craving for fossil fuels. Renewable energy sources help in reducing the peak load at peak hours of power consumption and maintain the supply side management due to EV charging requirements.

II. PROPOSED SYSTEM

Figure.1 is in the proposed hybrid energy storage system collected of DC/DC converter, supercapacitors, and the

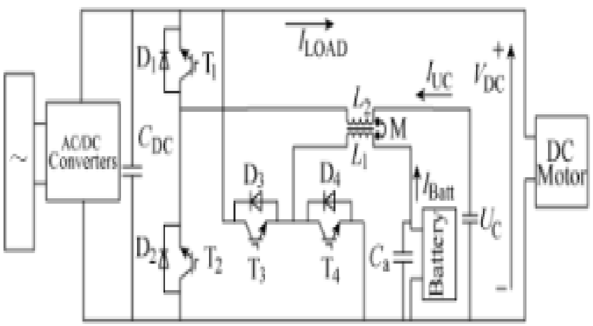

Figure 1: Topology of the hybrid energy storage system

li-ion battery. DC/DC converters consist of four IGBT adjustments T1~T4 and its corresponding diode (added battery) tube D1~D4, and an integrated magnetic structure self-inductance L1、L2 and mutual inductance M, which share a core inductor. The battery pack provides power to the smooth DC motor. The supercapacitor deals with the instantaneous state of peak power supply. The the buff management system of electric vehicles determines the electrical energy flow according to the load demands. The converter has five main operating modes (mode due to the additional battery pack change). Table 1 shows the specific the operation mode of the hybrid energy storage system corresponding to energy flows and operating mode

DC-DC converter. Then, the maximum number of laps can be obtained when both the battery and supercapacitor arrives at the minimum state of charge values set in the constraints, while the capacity loss of the battery is evaluated with the average current of the battery during the whole scenario. There is quite a lot of existing literature to model the capacity loss of the lithium-ion battery. The capacity loss model is mostly validated by discharging the battery with a constant current C rate, and haven't found any work that can predict the battery capacity loss dynamically with validated experimental work. Thus, we choose to estimate the capacity loss of the battery with the average load as much previous work did.

Table 1: Different types of EVs

Table 1 – Different features of the different types of EVs.

	BEV	HEV	PHEV	FCEV
Traction power	Electrical motor	Electrical motor ICE	Electrical motor ICE	Electrical motor
Energy system	Battery UC	Battery ICE UC	Battery ICE UC	FC Battery UC
Energy source	Charging power station	Fuel pump Gasoline	Charging power station Fuel pump Gasoline	Hydrogen fuel
Advantage	Zero emissions Independence on fossil fuels	Less emissions Long-distance covered	Less emissions Long-distance covered	Zero emissions High efficiency
Disadvantage	High initial cost Battery replacement	Dependence on fossil fuels Higher cost	Dependence on fossil fuels Higher cost	Hydrogen fuel storage High cost of fuel

III. EXPERIMENT

Finally, the paper makes an experiment to observe changes in the current of batteries and super-capacitors with step changes in the load. In order to fulfill the conditions in a laboratory environment, we built a small-scale experiment and adopted a boost cap PC2500 super-capacitor, which switches are HGTG30N60A4D IGBT, and the voltage and current sensor are respectively LV 20-P and LA100-P. TMS320F2812 DSP is selected as a feedback and control system. The values of inductors L1, L2, and M were 2mH, 50μH, and 50μH. The actual values of these devices.

The excellent ability of the proposed HESS in response to the acceleration and braking conditions of electric cars. For energy storage systems with super-capacitors, when t =3 and the load step-ups, the battery current is smooth and doing a slow controlled Ramps meanwhile ripple in current, which will reduce the life of the battery. Compared with the proposed HESS, it is not suitable for electric vehicles.shows in table no.2.

Table 2: Experimental Equipment and circuit parameters

Experimental Data	
DC side Voltage/*V*	V_{dc}=20
Battery/*V*	V_{batt}=12
Super Capacitor	The initial charge state 80% lead acid battery 6 maxwell boost cap PC2500 series connection 450F, the primary state of charge 15V.
Switching frequency/kHz	f_s =20
Sampling time/μs	T_{st} =20
DSP model	TI-TMS320F2812
L_1, L_2/μH	1.938 mH, 54.5687
M/μH	52.7866
Switch model	HGTG 30 N 60 A 4 D IGBT
Voltage sensor	LV 20-P
Current sensor	LA 100-P

IV. CONCLUSIONS

In this Proposal, a new hybrid energy storage system for electric vehicles is designed based on a Li-ion battery power dynamic limitation rule-based HESS energy management and a new bi-directional DC/DC converter. Due to all these reasons, developing countries are focusing mainly on EV implementation replacing the ICEV with HEV for combating the ever-growing pollution.

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