REVIEW ON SUPERCAPACITOR AND BATTERY POWER MANAGEMENT IN ELECTRIC VEHICLE APPLICATION

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ABSTRACT

This paper presents on application of supercapacitor and battery power management in electrical vehicle. In the last few years the pollution problems and the increase of the cost of fossil energy (oil, gas) have become planetary problems. The car manufacturers started to react to the urban pollution problems in nineties by commercializing the electric vehicle. But the battery weight and cost problems were not solved. Battery power request in transient state decreases its life span. To solve this problem, the battery and supercapacitor (SCAP) hybridization, there must be good energy management between these devices which enables the reduction of the battery size and improves its life span.

This paper presents supercapacitor (SCAP) and battery modelling with an original energy management strategy in a hybrid storage technology. The studied dc power supply is composed of SCAPs and batteries. SCAPs are dimensioned for peak power requirement, and batteries provide the power in steady state. In this paper we are going to concentrate on various parameters of supercapacitor. A IOT Controller used for the digital meter which shows the speed of motor and battery level also. Batteries are directly connected to the dc bus. The originality of this study is focused on SCAP behaviour modelling and energy management strategy.

In electric vehicle applications of super capacitor have been reviewed in detail. It was found that the vehicle using supercapacitors had the better performance than those using the batteries and in general more efficient. In addition, there is a good possibility that the life of the capacitors would be equal to that of the electric vehicle. By using this combination, the overall characteristic of battery is improved and the performance of battery is improved.

Keyword: - *Supercapacitor(SCAP), Ride through, Battery, and Power Management etc….*

1. INTRODUCTION

In the last few years the pollution problems and the increase of the cost of fossil energy (oil, gas) have become planetary problems. The car manufacturers started to react to the urban pollution problems in nineties by commercializing the electric vehicle. But the battery weight and cost problems were not solved. The batteries must provide energy and peaks power during the transient states. These conditions are severe for the batteries. To decrease these severe conditions, the super capacitors and batteries associate with a good power management present a promising solution.

The difference between lead acid battery, conventional capacitor and super capacitors are listed in table 1. [1] With such advantage of supercapacitors over other conventional capacitor and battery the combined working or individual working of it is of main interest. The supercapacitors are mainly used in ride through condition. Ride through condition means the requirement of large amount of power for the short time duration. For the few second of time we can use supercapacitors [1].

Supercapacitors are storage devices which enable to supply the peaks of power to electrical vehicle during the transient states. During the steady states, batteries will provide the energy requested [2]. This methodology enables to decrease the weight and increases the lifespan of the batteries.

Table -1: Comparison of Battery and Supercapacitor

Available performance	Lead acid battery	Conventional capacitor	Supercapacitor
Charge time	1 to 5 hrs	10-3 to 10-6 sec	0.3-30 sec
Energy (Wh/Kg)	10 to 100	<0.1	1 to 10
Life cycle	<1000	>500000	>5000
Charge/discharge efficiency	0.7 - 0.85	>0.95	0.85 – 0.98
Power density	<1000	<100000	<10000

2. LITERATURE REVIEW

Our finding from that paper is that we Got an idea about supercapacitor used during ride through condition. Ride through condition means the requirement of large amount of power for the short time duration. For the few second of time we can use supercapacitors. In this paper authors Introduced combined working of supercapacitor &battery using MATLAB Simulink & basic hardware. In conclusion Supercapacitor & battery together as well as individual improve system performance [1].

Proposed strategy is implemented on a PIC8F4431 microcontroller for two dc/dc converter topology. Study of 2 dc/dc converters topologies with polynomial control strategy is presented. Supercapacitors are storage devices which enable to supply the peaks of power to electrical vehicle during the transient states. During the steady states, batteries will provide the energy requested [2].

In this paper detailed information about supercapacitors and batteries are given. Conclusion from that paper is supercapacitor overcomes the batteries soon. Replacement of batteries by super capacitor because of their inherent high power capacity & long charge/discharge cycle is discussed [3].

From this paper we studied Supercapacitor & their application in electrical vehicle in place or in combination of batteries which is given in that paper. In result Vehicles using the SCAP had better performance than those using batteries. Also test data are shown for hybrid supercapacitor [4].

3. CONSTRUCTION

3.1 Supercapacitors

Supercapacitor is also called ultracapacitor or electrochemical double layer capacitor. Supercapacitors are energy storage devices that are governed by the same fundamental equations as conventional capacitors but utilize higher surface area electrodes and thinner dielectrics to achieve greater capacitances (up to 5000F). This allows for energy densities greater than those of the conventional capacitors and power densities greater than those of the batteries. The internal components of a super-capacitor are current collectors, electrodes and dielectric material.

The non-Faradaic ultra-capacitors are constructed from carbon-based electrodes, an electrolyte and a separator. They store charge electrostatically since there is no transfer of charges between the electrode and the electrolyte. When voltage is applied, ion in the electrolyte diffuse across the separator into the pores of the electrode of the opposite charge however the electrodes are designed to prevent the recombination of the ions. A double-layer of charge is produced [3]. This double layer coupled with increase in surface area and decrease in the distance between electrodes allow EDLC to achieve higher energy density than conventional capacitors, even though this device is electrochemical there is no chemical reaction taking hence the process of charging is reversible and very high cycle life is achievable in the order of 106 cycles.

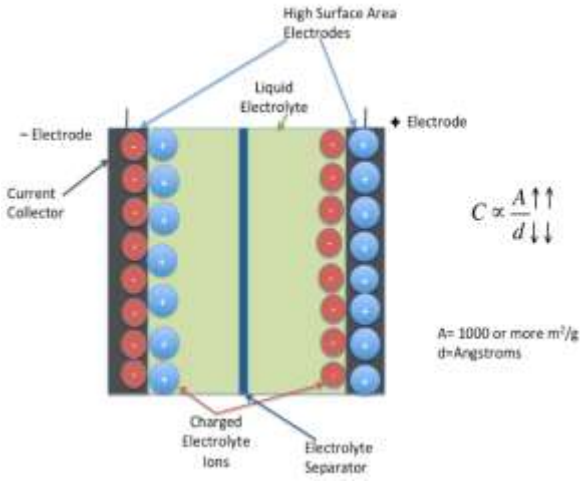

Fig -1: Schematics of an electrochemical double-layer capacitor

3.2 IOT Controller

The purpose of controller is to operate as an automatic switch between supercapacitor and battery. The controller used is microcontroller. Most probably the action of the controller is based on the condition at load side.

Qorvo's innovative ultra-low-power wireless data communication controller chips enable smart home applications and the internet of things our radio communication chips are optimized for remote controls, smart home gateways, and end devices, each with their specific features and needs. The RF silicon combines ultra-low power features with best in class range and high reliability for full home coverage.

Fig -2: IOT controller

4. WORKING

4.1 Basic Block Diagram

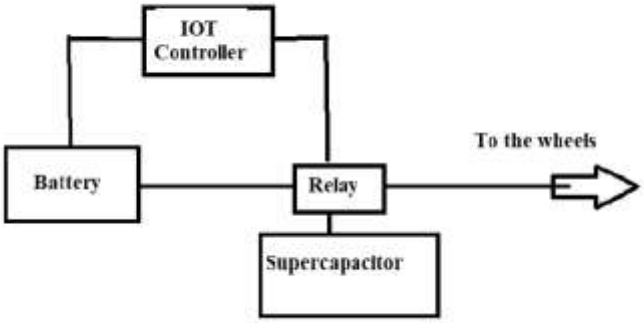

Fig -3: Basic block diagram

In this paper, we are analyzed the combined working of battery and Supercapacitor. We are familiar about the various use of battery in many applications like electrical vehicles, UPS etc. In the comparison of battery and

Supercapacitor is as shown in TABLE 1. From the analysis table, Supercapacitor is very efficient as compare to battery.

In this scheme the working of Supercapacitor and battery is studied individually and combinely. The main concept of this scheme is that the battery should be protected during extreme condition [1]. The scheme consists of three main components battery, Supercapacitor and IOT controller.

4.2 Proposed Work

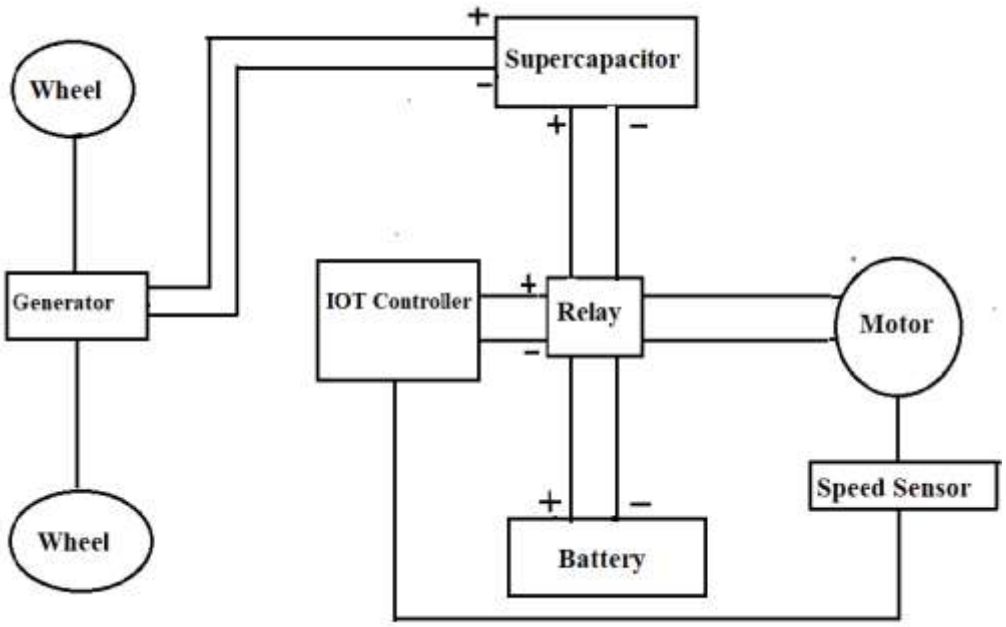

Fig -4: Generalised block diagram of the proposed system

At the start weight of the vehicle is more because of that no momentum and this is the time when vehicle consume more power to launch the vehicle from starting stage. At the starting vehicle requires more torque & constant current which is not possible in battery for that purpose supercapacitor is used at the initial level to launch the vehicle from start to speed up to 20 to 25 km/hr. After reaching speed up to 25 km the charge controller stops current from supercapacitor and starts battery current to run the vehicle.

Initially supply from the generator is given to the SCAP then it charges supercapapacitor charges within sec. power through supercapacitor boost up by dc/dc converter and given to motor. Then motor starts and gives the mechanical energy to wheel. when the vehicle reach the steady state or weight of vehicle is zero, then supply through supercapacitor is cut by using relay. Then by using battery supply is given to run vehicle.

5. ADVANTAGES

- Charges in seconds.
- Service life of vehicle is high.
- High power density.
- High efficiency.
- Wide operating temperature range and Environment friendly.
- Much longer shelf and cycle life than batteries.

6. DISADVANTAGES

- Super capacitors have much lower energy density than lithium batteries.
- The energy storage (kwh) requirement using supercapacitor is much smaller than using batteries.
- Higher self-discharge.

7. APPLICATIONS

- Hybrid - electric transient buses in the us and china.
- Electric braking system in passenger cars.
- Recently in stop go hybrid vehicles.
- Telecommunications
- Power quality
- Reliability requirements for uninterruptable power supply (UPS) installations.
- Computer system

8. CONCLUSIONS

Thus in this paper we concentrated on the operation of supercapacitors during ride through condition. With the help of supercapacitors the life of battery is increase. By using this combination, the overall characteristic of battery is improved and the performance of battery is improved. The use of supercapacitor and battery together as well as individual improve the system performance.

9. REFERENCES

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