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Electrical Vehicle by Using Super Capacitor

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***Abstract*: -- Internal combustion vehicles use the fossil fuels for their operation which leads to the pollution in the environment. It emits the harmful gases such as CO2, NO, NO2, SO2, etc which leads to the greenhouse effect causing the global temperature to rise by over 7 degree Celsius globally in last 50 years. ICV vehicles use petrol and diesel which are not abundant in INDIA so we have to import the fuel required for the vehicles which are costly. The foreign exchange reserves of our county declining rapidly due to this and it puts a large pressure on the Indian economy. Electrical vehicles solve this problem but the battery-powered electric vehicles are very less efficient and take a lot of time for charging and gets discharged rapidly. The efficiency of the ICV and the battery-powered EV are less. In this paper we are discussing the electrical vehicle uses the supercapacitor. A supercapacitor OR ultra-capacitor is an electrochemical capacitor that has a very high energy density as compared to common capacitors, about 100 times greater. There are several problems in batteries such as slow charging of energy in batteries and low life cycle. Super-capacitors are going to change the entire energy storage system. Due to super-capacitors, the life cycle of the batteries would increase efficiency up to 95% life cycles. Super-capacitor energy system has good reliability, efficiency, less emission, and lower cost.**

I. INTRODUCTION

Air pollution is a major adverse effect of conventional automobiles that use conventional fossil fuels like diesel, petrol. In urban areas because of congested traffic, the condition becomes complicated. To obtain pollution free environment, more use of renewable resources in vehicle system is beneficial. More use of EV in automobiles sector with pollution free emission will reduces the consumption of fuel and preserving the environment. In this direction various are being taken at international level. Companies such as BMW, ford, Tesla, and CODA manufactured hybrid and electric cars. Authors [1] presented interaction of solar panel and battery in such a way it can continuously charged form solar system. This configuration represent the solar system impracticable and tends to ineffective operation. Hybridization of battery and super capacitor has been investigated [2]. In [3] presents an operation of photovoltaic panel - battery – super capacitor hybrid system in e-vehicles. Algorithm for battery, photovoltaic panel has been represented. Method for DC/DC converter is represented so that discharging current of battery should be within limitation and use of ultra capacitor. Transients, charging, discharging mode of ultra capacitor has been studied. In [6], modified construction of an present e-vehicle, will give efficient performance along with super capacitor and battery combination. ultra capacitor are used to supply the high current required during starting and overloading , and helping in increasing life and state of charge of battery.

II. SYSTEM CONFIGURATION

A typical system includes energy storage devices, solar panel load. Normally, all usable technology uses battery because it is having cheaper cost and easy availability. For battery charging , photovoltaic panel are not ideal because the of solar is not costant and the output is not reliable and its depend on atmospheric condition. Thus an charge and discharge duty cycle is not constant, which results in low state of charge of battery. Some applications require a very heavy current for short duration e.g. starting of motor where need of starting current is 6 to 10 times working current of motor.

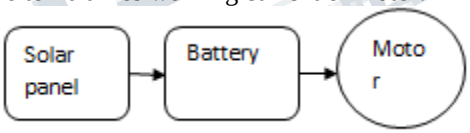

Fig1(a): Block diagram of exsting system

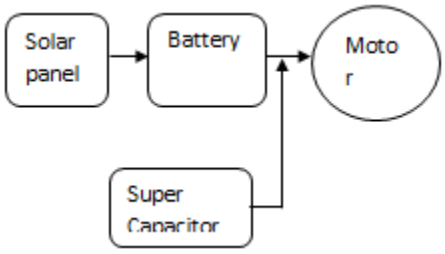

Fig1(b): Bock diagram of proposed system

Usually the current pulse requirement is fulfilled by the lead acid battery.Iin such condition the lead acid battery is big in size so that battery can supply heavy current. The heavy current required to fulfilled the requirement. Sizing battery around it would be costlier in solar system, replacement of battery takes place in 3 to 5 years depend on their use. Using battery- ultra capacitor hybrid storage energy system shown in fig1(b) reduction in size of battery and higher state of charge would obtained. Power density of super capacitor is higher than battery allowing the ultra capacitor providing peak power for shorter duration. On other side, ,battery having high energy density than super capacitor allowing the battery to store bulk

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power and supply it for longer duration. In Table 1, the comparison of battery and super capacitor is done. In the hybrid system peak requirement of load is fulfilled by the super capacitor and lead acid battery supplies the less continuous power requirements.

Table 1: Battery versus super capacitor Performance

	Lead Acid Battery	supercapacitor
Specific Energy Density(Wh/kg)	10-100	1-10
Specific Power Density(W/kg)	<1000	<10000
Cycle Life	1000	>500000
Charge/discharge Efficiency	70-85%	85-98%
Fast charge Time	1-5h	0.3-30sec
Discharge Time	0.3-3h	0.3-30h

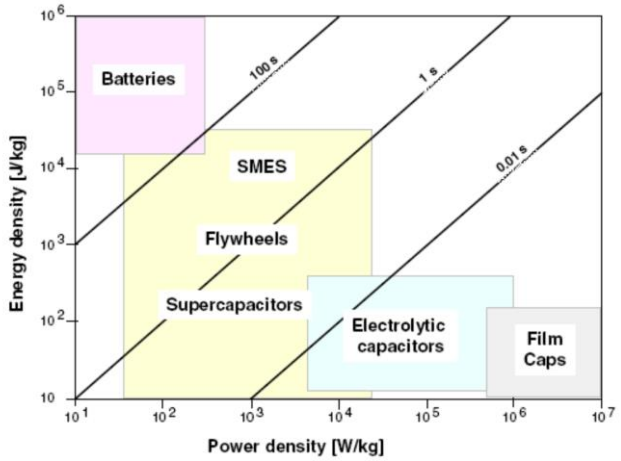

Fig2. Comparison of energy density and power density of different energy storage devises

III. SYSTEM COMPONENTS

The following section is giving an over view of the major parts of system that is making propound system.

3.1 Photovoltaic Solar Panels

The solar panels are made up of semiconductors which converts the photovoltaic irradiance in to electric power. Solar cells made up of semiconductor, like silicon. In photovoltaic panel, electric field is generated by a semiconductor, one side positive and another negative. As light collapse on PV cell, electrons are bounded and looses the semiconductor material atom. On positive and negative sides , if conductors are attached which forms an electric network , the electrons are catch in current form, electricity. Electric energy used to supply a load. The fig shows current source Iph, a series resistance Rs and diode.

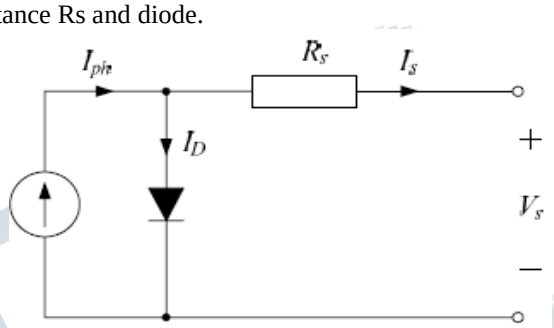

Fig3. Photovoltaic cell model

3.2 Energy storage system

The primary source of vehicle is battery bank. Bank of lead acid batteries contains various battery are connected in parallel to get higher current .A battery is having voltage of 6V and 12V, and batteries connected in serial to get required rating of voltage. The main technology of storage used in Photovoltaic solar systems is battery. The model of battery is utilized to determine the effects of state of health (SOH), and state of charge (SOC) of battery. Equivalent circuit model of battery is represented in Fig. 3. Lead acid Battery (model no DB12-65) of 12 V , 65 AH having charging current 4.5 Amp has been used .

Fig4. BOSS65L Battery model

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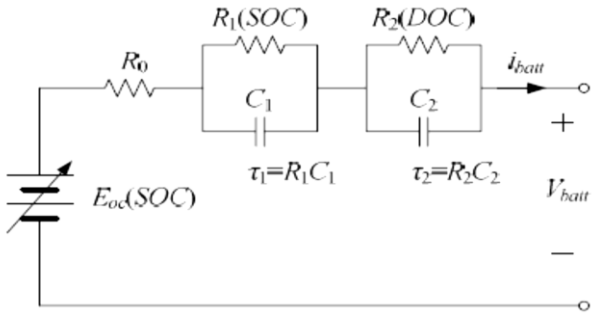

Fig5. Battery model

Where,
SOC stands for state of charge of the battery
DOC stands for deep of charge of the battery

E0 is the OC voltage when the battery is in state of full charge.

3.3 Super Capacitor

The super-capacitor is known as double layer capacitor or ultra capacitor different by conventional capacitor whose capacitance is very large. It stores energy in the form of a stable charge. Applying a voltage difference in between plates which charge capacitor. Super capacitor requires 10 sec for charging. The charging characteristic of super- capacitor is same as battery and charging current is controlled by charger. The super capacitor can charge and discharge for an no. duty cycles. The lead acid battery, which has a fixed cycle. Super capacitor of 16 V, 430 Farad having mass 5.50 Kg has been used . This Super capacitor can stores 2.85 Wh/Kg energy.

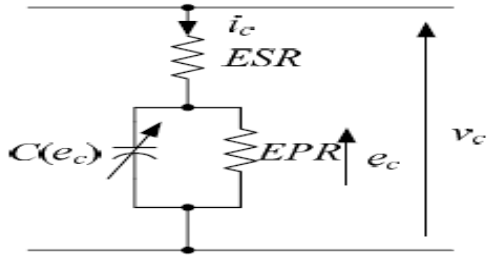

Fig6. Supercapacitor equivalent circuit model

Fig7. BMOD0430 E016 Super capacitor Model

IV. BATTERY VOLTAGE CONTROL THROUGH LED

Battery having open circuit voltage 12.63 V, it will operate upto 12 V. Microcontroller gets 5V supply voltage using IC 7805. Potential divider circuit is giving 25% of available battery voltage. This voltage appears at ADC0 pin of Microcontroller (ATmega 32 A) .From the blink of LED, the available battery voltage is known. Here AVR microcontroller gets a battery voltage and initialize it. Microcontroller compares value with store value of 2.98 V (25% of 12 V).If it matches, microcontroller makes LED glow continuously .if not microcontroller compares it with value of 2.75 V(25% of 11 V) . If it matches, microcontroller makes LED glow for 1 sec ,if not ,for value of less than 2.75 , microcontroller makes LED glow for 0.1sec.Same procedure for super capacitor is carried out for knowing the super capacitor available voltage.

V. EXPERIMENTAL SETUP OF THE SYSTEM

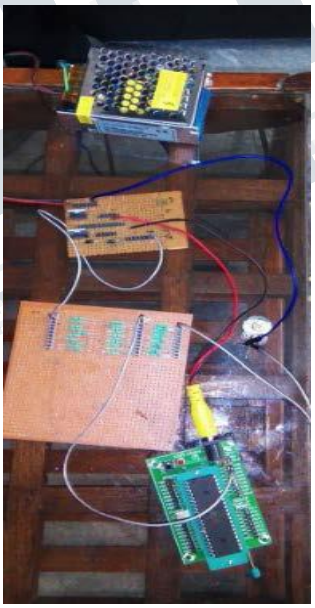

Fig8. Experimental setup for ADC Read and LED glow

VI. CONCLUSION

According to the energy configuration, following advantages are made;

1. Its provides better conditions for working and increase battery's operating life and SOC.
2. Efficiency is improves because the battery can supply power to motor directly without voltage drop.
3 .The life of battery is increased.
4. The introduction of green photovoltaic panel extract energy from sun, which increases of green energy.

5. Introduction of regenerative braking, i.e., recovering energy from brake, used energy, wasted in the brakes.
6. In the total project (undertaken by the college interacting with the consultant, with action period of march2015 – march 2016), intelligent charger for vehicle-to-grid power will be action. The scheme includes bidirectional energy meter.

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