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# Supercapacitor Vehicle

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***Abstract*—***Transportation a nascent necessity of a human being, but as we know the current condition of fuels i.e it is exhausting. So we need an alternative fuel that can not only provide efficiency but also is affordable. Yes you can use electricity, vehicle should use supercapacitor as its fuel. This paper gives a basic idea of implementation of supercapacitors in roadways and railways. Basic changes observed can be removal of overhead wires in railways, fumes emmited by car cause pollution will be reduced to a great extent. Also a new idea proposed in of electric vehicles.*

***Keywords—Supercapacitor, Electricity, Electric Vehicle, SuperCap Car, UltraCap Train.***

## I. INTRODUCTION

Traveling a need to be fulfilled, by any means but roadways and railways can be preferred for everyday work or for a routine. Supercapacitor vehicle, a vehicle which can be charged quickly and used for a longer period. The name itself suggests capacitor i.e a vehicle using capacitor to store charge and electricity as its fuel.

## II. NEED OF SUPERCAPACITOR VEHICLE

Fuels in use are in extinction as they are the non renewable sources, for example petrol, diesel are not abundantly available. To overcome the extinction or just reduce use of such non renewable resources, there must be a replacement, which can be used in high quantity with quality in less price. Electrical energy can be stored and used. But it too has limitations, to overcome all these problems we need to use supercapacitor vehicle. A supercapacitor vehicle can br used in roadways and railways by various modifications.

## III. SUPERCAPACITOR

A capacitor is an electrical device stores energy in the form of static electricity (electrostatic) between two electric plates when a potential difference is applied across it. A supercapacitor is a high capacitance capacitor with values higher than other capacitors. They store 10 to 100 times energy per unit volume or mass than electrolytic capacitors. It accept and delivers charge much quicker than batteries and it can tolerare more charging and discharging cycles than batteries. It has low energy density and high power density. It can tolerate about one million charge and discharge cycles. Itsing time is from 1 to 10 seconds. Discharge is dependent on the applications. It has various names such as ultracap supercap, goldcap etc. There are three types of supercapacitors. Basic structure of a supercapacitor is shown in Fig 1.

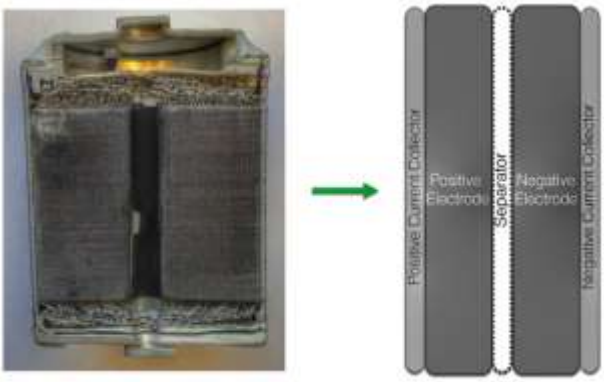


**Fig 1 : Simplified Structure**

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### 3.1 Working of a Supercapacitor (Charging mechanism)

Connect the electrodes to an energy source due to which a potential difference is applied across it. Consider the negative electrode, due to the potential difference the positive ions are attracted to the negative electrode same process is seen in the positive electrode. Potential energy is stored in electric field between ions and electrodes. Electrodes and ions are held with very strong electric field. We can increase the efficiency of a supercapacitor by increasing the surface area, reducing the distance between the electrodes and by replacing the air gap between electrodes by an insulator. Charging mechanism is shown in Fig 2.

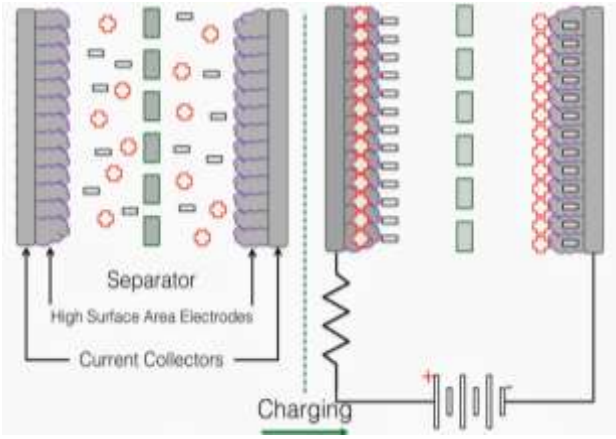


**Fig 2 : Charging mechanism**

### 3.2 Charging time of Supercapacitors

Charging time can be calculated by following equation:

$$t = \frac{C \cdot (U_{\text{charge}} - U_{\text{min}})}{I}$$

Where t is time, C is Capacitance, Ucharge is charging voltage, Umin is voltage after discharging and I is the current. If a application needs constant power, let P be constant power required and same parameters mentioned above we get time t as:

$$t = \frac{1}{2P} \cdot C \cdot (U^2_{\text{charge}} - U^2_{\text{min}}).$$

### 3.3 Types of Supercapacitors

#### 3.3.1 Electrostatic double layer capacitor (ELDCs)

ELDCs are made of activated carbon electrodes or derivatives of higher electrostatic double layer capacitance. It works on Helmholtz double layer at the interface between surface of a conductive electrode and an electrolyte.

#### 3.3.2 Electrochemical pseudocapacitors

They are produced from a metal oxide or conductive polymer electrodes which have a high amount of electrochemical pseudocapacitance, additional to EDLCs.

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### 3.2.3 Hybrid capacitors

They are basically lithium-ion capacitors, cathode of which is made of activated carbon and anode is carbon material pee-doped of lithium ions.

## IV. IMPLEMENTATION IN REGULAR APPLICATIONS

### 4.1 Previous implementation of supercapacitors

In 2010 in Shanghai, a capabus i.e. a bus with supercapacitor (EDLC) as its fuel was implemented which needed to be recharged after completing a distance of 3 miles (4.8 kilometers). It was recharged at every stop. Supercapacitors also accumulate energy on braking, adding an advantage to whole system.

There a research going on about it that the new generation capabus could be made hybrid by adding solar panels giving additional energy to the bus, solar panels were 20% efficient, but due to advancement new solar panels are 53% efficient according to latest research, so all new hybrid design increases the efficiency to a good extent, so predicted distance travelled could be 20 miles (32 kilometers). Recharging stations can also be equipped with solar panels.

### 4.2 New way of implementation in India

#### 4.2.1 Implementation in Indian Railways

India has one of the largest railway networks in the world, more specifically in its financial capital let's consider the western railways, which covers a total distance of 77 miles (124 kilometers). The whole system works on electricity with overhead wire connection which carry 25 kilo Volts of Voltage, as the train use three phase induction motors and in old trains dc series motors. These systems cost a lot due to high voltage requirement.

To reduce all the disadvantages, we can implement supercapacitors in this system and which can be charged quickly on a stop. In western railways distance between each stops vary from minimum 1 kilometers to maximum 12 kilometers, for an instance train starts from a station which further has four stations in a radius of 4 kilometers, so according to old system of supercapacitors the train can be recharged after completing 4.8 kilometers, if a new system i.e the hybrid system comprising of supercapacitors and solar panels, so the train can travel a distance of 32 kilometers due to which a recharging unit can be installed on a station about 30 kilometers away from the initial stop or starting point of the train, in sucha way we can remove the overhead wires so automatically the cost required will be reduced, due to the hybrid system building cost of recharging unit will also be reduced.

#### 4.2.2 Implementation in Roadways around the Globe

As seen above supercapacitor is implemented in capabus in Shanghai, a supercapacitor network can be added in cars with solar panels in addition we can produce more efficient vehicles.

## V. COST

Costing depends on various application, for a capabus its energy cost is one-tenth of diesel bus. For a train or a tram system, cost of overhead wiring and energy generations cost to a great extent. At an extent this idea saves lot of energy in terms of initial and maintenance costs.

## VI. CONCLUSION

### 6.1 Advantages

1. Instant charging.
2. More power.

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3. More durable.
4. Cheaper, saves economy up to $200,000 (INR 1,42,33,000) up to a lifetime of fuel savings.
5. Non-flammable.
6. Can tolerate 1 million recharge cycles.
7. Reduces pollution as it replaces fuels which emits $CO_2$ fumes.

### 6.2 Disadvantages

1. Big size.
2. Discharges very quickly as compared to other fuel resources.

The aim of this article is to present a new revolution in electric vehicles, use of supercapacitor to store charge in form of electrical energy and use it in railways and roadways.

This idea reduces time, money, increases durability, reduces pollution etc.

In conclusion, main aim is to save our environment and also a research in electrical vehicles.

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