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# Design & Fabrication of Mild Hybrid Supercapacitor Electric Vehicle

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**ABSTRACT:** In recent trend the Plug-in Hybrid Electric Vehicles (PHEVs) have an excessive opportunity due to its charging facilities and charge storage system. Electric Vehicles (EVs) not only eliminate the pollution but also make the system more efficient over traditional vehicles. State of current determination becomes a vital problem in whole area where it comprises a battery storage; because it has several drawbacks such as weak power density, longevity, etc. one probable and favorable resolution for this issue is multi-source EV. Both the batteries and Ultra-Capacitors (UC) can reduce the aforementioned disadvantages in existing systems. This project works more efficiently because of the combined designed model of both battery and supercapacitor. the particle swarm optimization (PSO) technique with Fuzzy Logic Controller (FLC) is implemented for optimal sharing of power between the battery and the supercapacitor. Supercapacitors may emerge as the solution for many application-specific for power systems. Especially, there has been great initiative in developing supercapacitors for electric vehicle hybrid power systems, pulse power applications, as well as back-up and emergency power supplies for Plug-in Hybrid Electric Vehicles (PHEVs)

**KEYWORDS:** Supercapacitor, particle Swarm optimization (PSO), Fuzzy Logic Controller (FLC), Battery, Plug-in Hybrid Electric Vehicles (PHEVs), State of current (SOC).

## I. INTRODUCTION

A capacitor is defined as a passive terminal electrical used to store energy electrostatically in an electric field separated by a dielectric (i.e. insulator). so, what is it that adds the 'super' to an ordinary 'capacitor'? In response to the changing global landscape, energy has become a primary focus of the major world powers and for the scientific community. Witnessing in today's era for global energy crisis, one such device, the supercapacitor, has matured Enough over the last decades and emerged with the potential to Assist in advancing in the energy storage for the Plug-in hybrid vehicles. in recent the world is facing a growing challenge from global climate change which mainly associated with gasses emissions by the IC engines that has increased in the interest and demand for Electric vehicles EVs. The exploration and presentation of Hybrid Energy Storage System (HESS) in areas like EVs, HEVs are getting in use very vastly. HESS comprises of various storage devices and that having robust energy ability and huge life span with the low maintenance. In this paper presentation the brief overview on the vehicle equipped with the supercapacitor and battery and a hybrid PSO-FLC controller which we are using in this mild hybrid vehicle or in 'PHEVs' for the better performance and improved efficiency. Several designs have been suggested to decrease the constant worry on the battery, in that way life span is increased. The ultra-capacitor is used as equivalent to a battery to simplify the power stresses on the battery. Here, UC would absorb energy from regenerative braking and assist the battery during discharge.

## II. RELATED WORK

Hajer Marzougui et al. exhibited a vitality the board calculation for an electrical half and half vehicle. The proposed half and half vehicle present a power device as the principle vitality source and the capacity framework, includes a battery and a Super-Capacitor (SC) as the optional vitality source. The expansion of battery and SC in energy unit-based vehicles has inordinate imminent since it allows a considerable decline of the hydrogen ingestion and an upgrade of the vehicle productivity. Yet, some synthetic responses are blended in with the energy component, so their reacting time is high.

Hui Peng et al. proposed a compound control structure for vitality the board of cross breed ultra-capacitor-battery electric drive framework. The topology ensures that the ultra-capacitor current and the battery current can be controlled exclusively. In figuring, the administration of the half breed source is associated through electrical drives. The benefits of the proposed compound control are that ultra-capacitor supplies pinnacle and wave current while battery supplies

smooth and consistent current. The fundamental current is provided by the battery, yet the ultra-capacitor can't supply enough current to dismiss aggravation.

Rui Xiong et al. proposed Battery and ultra-capacitor on top of it way to deal with approve a constant vitality controlling system for an all-atmosphere electric vehicle. Dynamic programming plan can diminish the proportion of charge/release in the battery pack, which drags out the life expectancy and builds the adequacy of the structure. In any case, for an appropriate technique, all the more critically, the ongoing application execution is likewise significant. Be that as it may, yet there is a sure hole between the reproduction and commonsense application.

Akif Demircal et al. introduced temperature subordinate models for the battery/ultra-capacitor controlled EV to oversee capacity segments just as the drive train parts. The vitality the board of the vehicle is accomplished in two phases. The essential stage is to control the pursuit space of the strategy presenting to circumstances of ESS and vitality solicitation of the vehicle. After assurance and constraint of the inquiry space, vitality dissemination strategy is executed with PSO. None the less, these examinations intended to diminishing the use of fuel just, doesn't think about specific parameters and types of gear.

Kursad Gokce and Ayhan Ozdemir introduced a productive standard based controller plan to the consolidated battery/UC ESS. The SOC level of vitality sources is figured the weighting parameters of rule table. The charging/releasing are characterized by both the weighting parameters and conditions of vitality sources. The battery and UC present in the electric vehicles are shielded from high temperature rise and high flow beats. Right now control plot, the battery is less presented to the fast current changes.

### III. PROPOSED WORK

#### 1) Solar Power Source-

Solar power is the conversion of sunlight into electricity, either directly using photovoltaics (PV), or indirectly using concentrated solar power (CSP). CSP systems use lenses or mirrors and tracking systems to focus a large area of sunlight into a small beam. PV converts light into electric current using the photoelectric effect. generally in hybrid vehicle there are many vhechicle which can be operated using solar power for that solar panel are used by which solar panel absorb the sunlight and then convert it into the electrical energy. So that this energy can transfer to the motor to power the vehicle.

#### 2) Battery-

Electric vehicles can run on either rechargeable batteries or fuel cells that convert hydrogen into electricity. Both have zero tailpipe emissions. But when it comes to long-term sustainability, one is a clear winner, according to a new study. Battery-electric cars would be better at cutting carbon emissions, and at a lower cost than fuel cell vehicles, too, researchers report in the journal Energy. That's mainly because hydrogen fueling stations are much more expensive to install than battery-charging stations. Researchers at Stanford University and Technical University of Munich in Germany set out to analyze how large-scale adoption of both types of EVs would affect total energy use in transportation and buildings.

#### 3) Dc-Dc boost converter-

A lift converter step-up converter is a DC-to-DC power converter that means up voltage while venturing down current from its information supply to its yield load . It is a class of exchanged mode power supply SMPS containing at any rate two semiconductors a diode and a transistor and in any event one vitality stockpiling component: a capacitor, inductor, or the two in mix. To diminish voltage swell, channels made of capacitors now and again in mix with inductors are typically added to such a converter's yield load-side channel and information supply-side channel.

#### 4) Resistor-

A resistor is a detached two-terminal electrical segment that actualizes electrical opposition as a circuit component. In electronic circuits, resistors are utilized to lessen current stream, alter signal levels, to isolate voltages, predisposition dynamic components, and end transmission lines, among different employments. High-power resistors that can scatter numerous watts of electrical force as warmth, might be utilized as a feature of engine controls, in power dispersion frameworks, or as test loads for generators. Fixed resistors have protections that solitary change marginally with temperature, time or working voltage. Variable resistors can be utilized to modify circuit components, for example, a volume control or a light dimmer, or as detecting gadgets for heat, light, mugginess, power, or synthetic action.

**5) Motor-**

A DC engine is any of a class of turning electrical engines that changes over direct flow electrical vitality into mechanical vitality. The most widely recognized sorts depend on the powers created by attractive fields. Almost a wide range of DC engines have some inside component, either electromechanical or electronic, to intermittently alter the course of current in part of the motor. DC engines were the primary type of engine generally utilized, as they could be controlled from existing direct-current lighting power conveyance frameworks. A DC engine's speed can be controlled over a wide range, utilizing either a variable inventory voltage or by changing the quality of current in its field windings. Little DC engines are utilized in devices, toys, and machines. The all inclusive engine can work on direct current however is a lightweight brushed engine utilized for versatile force instruments and machines.

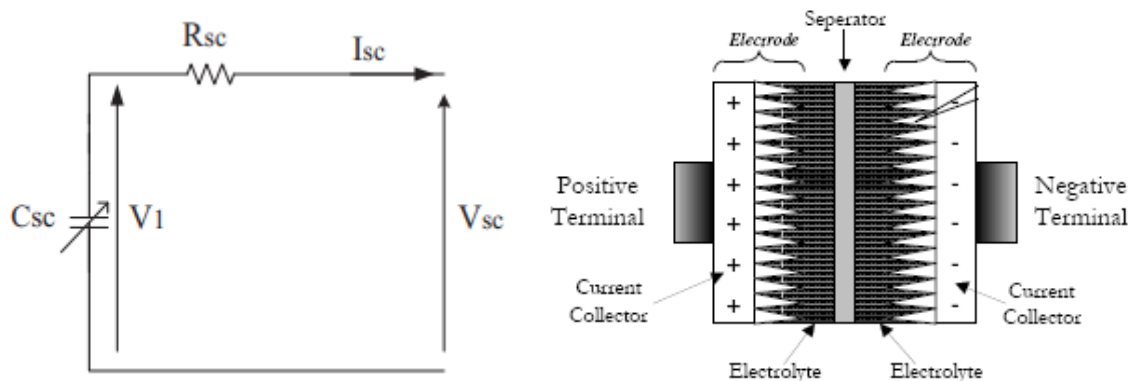
**6) Supercapacitor-**

A supercapacitor (SC), likewise called a ultracapacitor, is a high-limit capacitor with a capacitance esteem a lot higher than different capacitors, yet with lower voltage restricts, that overcomes any issues between electrolytic capacitors and battery-powered batteries. It normally stores 10 to multiple times more vitality per unit volume or mass than electrolytic capacitors, can acknowledge and convey charge a lot quicker than batteries, and endures a lot more charge and release cycles than battery-powered batteries. Supercapacitors are utilized in applications requiring numerous quick charge/release cycles, as opposed to long haul minimal vitality stockpiling — in autos, transports, trains, cranes and lifts, where they are utilized for regenerative braking, momentary vitality stockpiling, or burst-mode power delivery.[2] Smaller units are utilized as force reinforcement for static arbitrary access memory (SRAM).

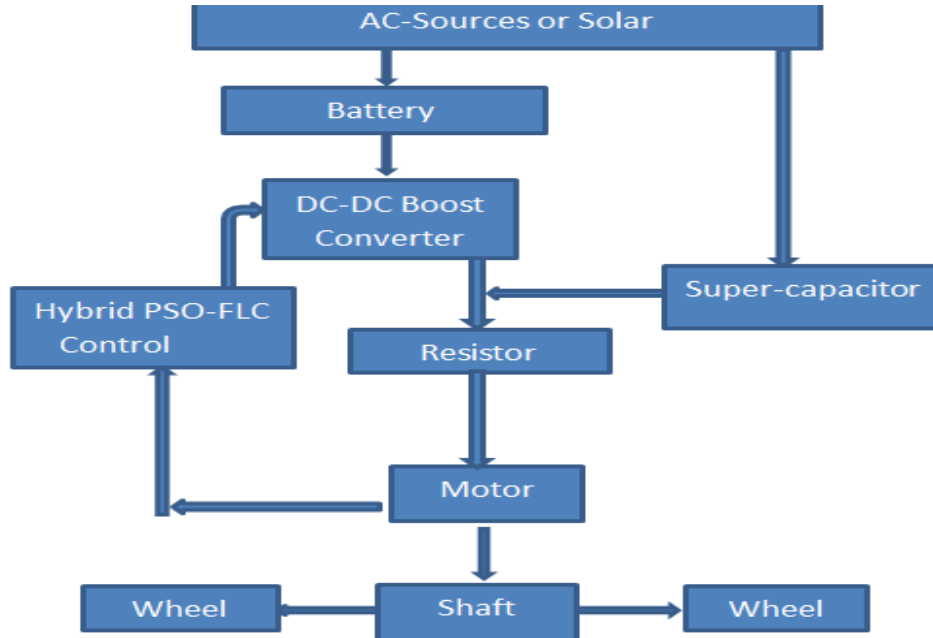
**7) Hybrid PSO-FLC Controller-**

PSO is a multi-agent search technique and an excellent tool for optimization problem in power system. And also it is very powerful and well established meta-heuristic optimization algorithm; it has robust principle, less number of constraints and it is easy to be executed with fast convergence rate; it is frequently applied to optimize the FLC, which is able to balance the energy trading with the PHEV, while the EMS is completely based on FLC. PSO is used to resolve the profitable and environmental related problems, so in this work it is selected to execute an efficient optimization algorithm which increases the exploitation of generation and reduces the operating cost of the power system. And also used to attain the economical load assignment with minimal value to enhance the utilization of energy resources. From this PSO it is used to optimize the effectiveness of uncertainties of the input variable forecasting, so, the EMS selects the PSO strategy to resolve the optimization issues in EV, which reduces the computing time and enhanced the proficiency of the system.

**III. CIRCUIT DIAGRAM AND BASIC CELL CONSTRUCTION OF SUPER CAPACITOR**



#### IV. WORK IN FLOW OF MODEL



We have used the AC source as the main power supply and also give a connection of the solar pannel which is an additional support to the battery and super-capacitor for charging purpose. The super capacitor provides the additional power to the motor whenever it is needed. It assists in mountain areas such as for the slant roads it provides more power to climb easily. Then from the battery power is frist supply to the dc to dc converter to amplify the current or voltage and the load to be stable for risistor. the resistor is used for to lessen th current stream and signal voltage with the stable current line to the motor with the help of dc to dc converter. the motor is also connected to the hybrid PSO-FLC control unit fpr optimization of problem in the power supply in the motor by the battery. the hybrid PSO-FLC control unit study the signal from the motor to detcet any problem or not and then provide the signal to the DC to DC converter to process the power. lastly the motor runs the shaft which is connected to the wheels. so by the above flow chart we came to konw how the vehicle and its components works.

#### V. RESULTS AND DISCUSSION

The simulation results of the proposed PSO-FLC methodology is performed using the MATLAB/SIMULINK. The analysis of hybrid sources in PHEV is made by two storage devices such as battery and ultra-capacitor. The type of battery used in this proposed methodology is Nickel Metal Hydride battery and PMSM is used as the HEV load. EV is a forthcoming solution to the issue of transportation and pollution. The proposed controller is utilized to perform charging/ discharging of the UC, it depends on battery's SOC. The specifications of the battery, UC and HESS is simulated for a fixed load (i.e., PMSM motor) with the time duration of 200 seconds. The implementation of the proposed methodology is analysed in terms of SOC of the battery, torque and speed of the motor. While related with the existing system, this combination having very low cost and compact size with other operating features like better speed and voltage limit. Energy density, power density and efficiency increases with the help of above-mentioned ESS; similarly, inclusive price is also very less. The protection of battery and its cost is more significant since it directly comparative to the price of development and proficiency. If the vehicles weight rises at that time efficiency is reduced which increases the cost. The charging/discharging process has increased by using ultra-capacitor.

#### VI. CONCLUSION

This paper proposed an effective Energy Management System based on PSO-FLC algorithm for hybrid energy storage devices like battery and ultra-capacitor. In proposed EMS, the FLC is executed with the appropriate rule inference and the PSO algorithm is used for enhancing the membership functions of the FLC. This proposed methodology



implemented in MATLAB Simulink and much better than existing methods. The obtained results from various analysis designate that the proposed EMS helps to produce more electric energy than the required energy to satisfy the load demand under different time variations and environmental conditions. Similarly, same process is utilized to the regenerating braking mode to save the energy at the instance of vehicles slowdown where the energy will decrease. The battery lifetime increase by using ultra capacitor. In future work, the design of HRES will be improved by adding the additional backup system for storing the excess energy to avoid power losses.

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