NEW TECHNOLOGY FOR ELECTRIC VEHICLE

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Abstract— **Human life can become more beautiful more safe and healthier with the help of technology. Global warming, air pollution, rising price of gasoline fuel are the key issue of 21st century. Transport system is a major cause of these entire problems. Electric vehicles are the only alternative for clean, efficient and eco friendly urban transport system. Electric vehicles are being popular across the world but they are having some problems associated with driving range, energy storage system and stored energy management. This paper presents a new strategy of energy management between battery and supercapacitors, renewable approaches to generate the electricity, new speed-torque control approach and an energy management system for electric vehicles. The main contribution of this paper is focused on torque performance improvement and range extension of an electric vehicle.**

Index Terms -Global warming, driving range, energy storage system and stored energy management

I. INTRODUCTION

Electric vehicle plays a major role to reduce global warming &keeping the people healthy. In India petroleum is imported at very large scale and very high subsidy is provided by government to the people. Which causes loss of economy growth .awareness and promotion of electric vehicle among Indians can decrease the need of petroleum which will defiantly grow up economy. Electric vehicle are two times more fuel efficient than any gasoline powered vehicle. Even assuming generation is being taken from coal fired plant. Swatch Bharat mission and smart cities projects can't be completed without the EVS. Electrical vehicles are mainly used in urban areas and are eco friendly and highly efficient. As the electrical vehicle become more popular and they will play very imported role to manage the demand from smart grid. World second large populated is waiting for smart & intelligent electric vehicle opportunities for engineers and scientist to accept the challenge of time and provide a better solution for future shortage of petroleum.

Now a day's electrical vehicle consist simple technology which is shown in following block diagram:-

Brushless Direct Current (BLDC) motors are one of the motor types rapidly gaining popularity. As the name implies, BLDC motors do not use brushes for commutation; instead, they are electronically commutated.

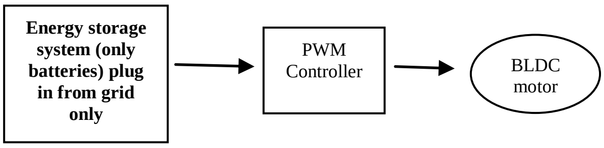

Fig.1:- Block diagram of simple electrical vehicle.

Their linear speed/torque characteristics produce predictable speed regulation. With brushless motors, brush inspection is eliminated, making them ideal for limited access areas and applications where servicing is difficult. BLDC motors operate much more quietly. BLDC motor of the hub type is widely used in the electrical vehicles.

Before the latest incarnation of electric vehicles, cars already used BLDC motors for windshield wipers, CD players, and power windows. Today's automakers use three different types of electric motors in green cars: the BLDC motor, brushed DC motor, and AC induction motor.

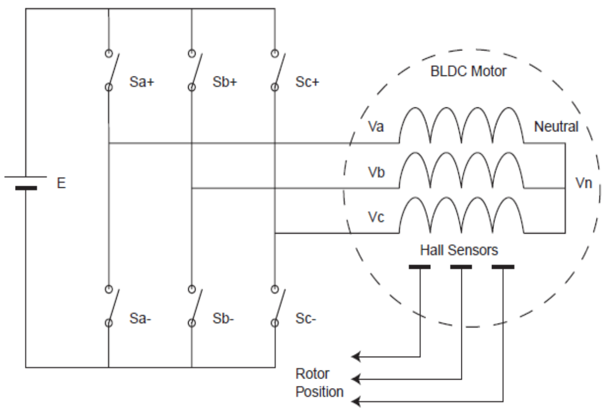

Figure 2:- Typical structure of a BLDC motor connected to a inverter

The BLDC motor has a permanent-magnet rotor surrounded by a wound stator. The winding in the stator get commutated electronically, instead of with brushes. This makes the BLDC motor:

- Simpler to maintain.
- More durable.
- Smaller.
- 85%–90% more efficient.
- Able to respond faster and at higher operating speeds.
- Simpler to control in regard to speed control and reversing.

The composition of the BLDC motor also keeps the machinery inside a vehicle cooler and thermally resistant. Plus, because the motor is brushless, there is no dangerous brush sparking. All of today's electric hybrid vehicles use a BLDC motor. Green car manufacturers often prefer BLDC motors over the alternatives because the peak point efficiency is higher and rotor cooling is simpler. The motors can also operate at "unity power factor," meaning the drive can operate at its maximum efficiency levels.

Electric Vehicle uses battery as one of its power source for vehicle motion during at low power conditions. Batteries are devices that consist of electrochemical cells and provide electrical energy converted from stored chemical energy. Generally batteries are of two types:

- Primary batteries that are disposable and secondary batteries that are rechargeable.
- Secondary batteries are preferred for vehicles as they can be rechargeable.

There are six major rechargeable batteries available today. They are as follows: lead-acid (Pbacid), nickel-cadmium (NiCd), nickel-metal hydride (NiMH), lithium-ion (Li-ion), lithiumpolymer (Li-poly), zinc-air. The basic performance characteristics of the battery which influence the design are as follows:-

Battery	Specific Energy Wh/kg	Energy Density Wh/liter	Power Density W/liter	Specific Power W/kg	Cycle life in full discharge cycles
Lead-acid (Pb-acid)	30–40	70–75	~400	~200	500-1000
Lithium-ion	90–120	200–250	400–500	200–220	500-1000
Nickel-metal hydride	50–65	140–200	450–500	~150	1000-2000
Nickel-cadmium (NiCd)	40–60	70–100	220–350	150–200	1000-2000
Lithium-polymer	100–200	150–300	>350	>200	500-1000
Zinc-air	140–180	200–220	~200	~150	200-300

Presently electrical vehicles are having so many problems associated with its battery, speed range, main reason of small driving range is the lack of capabilities of storing sufficient energy to run the vehicle for a long time batteries are used for storage system and energy storage capabilities are very poor of batteries as compare to conventional fuel used in modern vehicle.

- A proper energy management system is needed to control the energy uses, every single watt of stored energy have importance in electric vehicle.
- EVS have very poor torque and speed performance.
- They are only charged by plug in charging methods.

II. Energy Storage System

In order to increase the driving range of EV with a fixed amount of saved power, other approaches should be developed to generate power in running vehicles. Electric vehicles (EVs) include electric trains, electric buses, electric aircrafts, electric boats, electric motorcycles or even electric spacecrafts etc. This paper attempts to explain innovative methods of generating clean energy in a fast moving electric cars, electric bus, electric motorcycles and also equally applicable for all type of hybrid electric vehicle.

If other sources are found to support the charging of batteries to run any of above mention electrical system by some other source it will improve the range of EVs. It can significantly observe that the instantaneous power required is highly vary during uphill and downhill path or vehicle going through speed breaker or improper road [2]. There are various methods to generate the electricity in running EVs such.

Solar Powered Electric Vehicle

Designing a Solar Powered BLDC Motor Driven Electric Vehicle is one of the solutions for the oncoming crisis. The integrated system consisting of the solar module, charge controllers, batteries, boost converter and BLDC motor, henceforth developed into the Solar Powered Electric Vehicle. In order to achieve the required voltage, the Photo voltaic (PV) Module may be connected either in parallel or series, but it's costlier. Thus to make it cost effective; power converters and batteries are been used. The electrical charge is consolidated from the PV panel and directed to the output terminals to produce low voltage (Direct Current).

$$I = I_{sc} - I_o \left[e^{q\left(\frac{V+I.R_S}{nkT}\right)} - 1 \right] - \left(\frac{V+I.R_S}{R_p} \right)$$

Where
I- is the cell current,
V - Cell voltage.
Q - Electron charge.

K - Boltsmann's constant.
T - Temperature in Kelvin.
I_o - Reverse saturation current of the diode
N - Diode ideality factor and takes the value between one and two.

This system will be helpful to generate energy in both (static and dynamic) conditions of vehicle.

Wind Alternator

If this wind energy is used to extract some power in such a way that it does not create any component of force or thrust opposite to the direction of the propulsion of the vehicle, then this gained energy can be used to produce electricity to charge up the battery of the electric vehicle itself.

The air flow through the vehicle is given by,

$$Q = C_v A v$$

Where, Q = flow rate in cubic meter per second.
C_v = opening effectiveness
A = Area in square meter

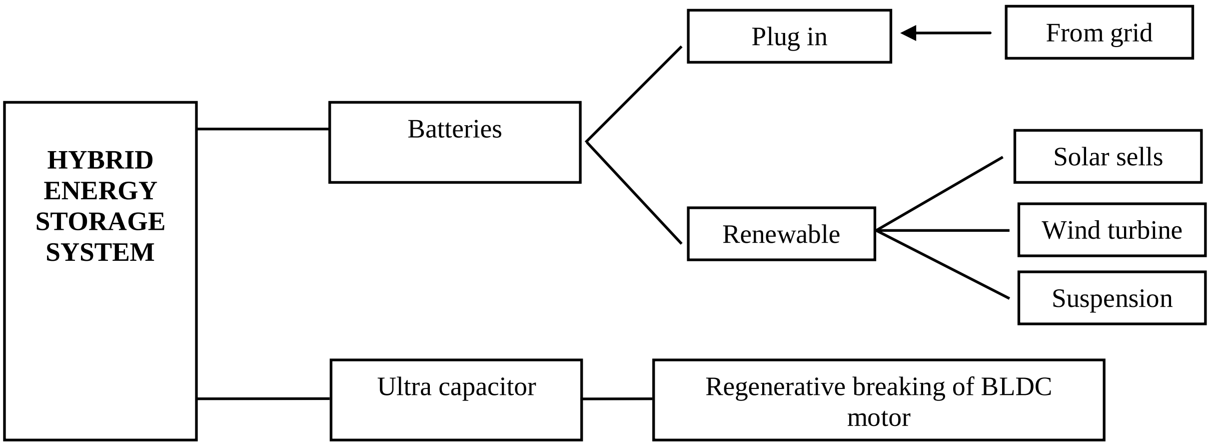

Figure 3:- Structure of a Energy storage System.

v = air velocity in m/s
This equation (1) will determine the amount of air flow through the vehicle inlet area.

Output power from a wind turbine is given by,

$$P_T = 0.5\ C_P\ \rho\ Q\ v^2$$

Where,
P_T = Power output from the turbine in watt.
C_p = Power co-efficient
(Assuming, C_p = 0.4 for the design)
ρ = air density; 1.225 kg/m^3.
Q = air flow in m^3/s.
v = air velocity in m/s

Regenerative Breaking:-

The brushless DC motor has been widely used in EVs. Conventional EVs use mechanical brakes to increase the friction of the wheel for deceleration purposes. Thus, the braking kinetic energy is wasted.

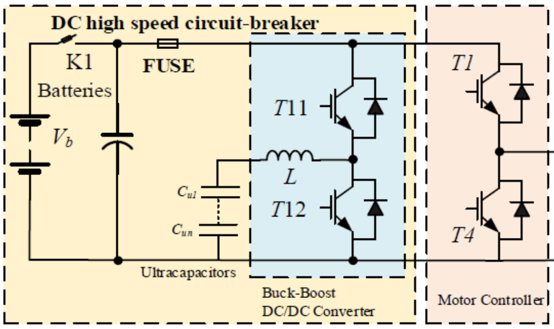

Fig. 4:- Regenerative Breaking

With this problem in mind, this paper will discuss how to convert the kinetic energy into electrical energy that can be recharged to the battery pack. As a result, regenerative braking can realize both electric braking and energy savings. A potential of 30% of brake energy can be recovered with the proposed strategy.

Vehicle + driver mass = Total weight
Kinetic Energy: KE = ½ mv2 (m is mass in kg, v is velocity in m/s)
Capacitor Energy: ECAP = ½ CV2 (C is capacitance in Farads, V is capacitor voltage in Volts)
Capacitor Charge: QCAP = CV (C is in Farads, V is in Volts, Q is in Coulombs)

III. Speed and Torque Control Circuit

A novel electronic gearing is proposed in the propulsion system for an electric vehicle driven directly by a wheel motor. This electronic gearing assembles the parallel and serial connections of batteries and motor windings into four gears to accommodate various driving patterns in the permissible range of speed and torque.

Fig.5:- Wheel motor assembly, stator and rotor.

The objectives of this invention are to extend the speed range of constant power, as well as to improve the driving performance and efficiency of the vehicle. When the wheel motor operates at the stage of high-speed and low-torque, the batteries are then connected in serial to achieve high voltage and the resistances are connected in parallel to dispatch the main current into branches. The electric propulsion system of electric vehicles is composed of batteries, a wheel motor and its electronic drive. And low-torque, the batteries are then connected in serial to achieve high voltage.

Fig shows the configuration of a 4-battery connection consists of three modes: 4-in-parallel, parallel of 2-in-series, and 4-in-series, as shown in Fig The internal resistances, capacities and terminal voltages are respectively denoted by Ri, Ai and Vi.

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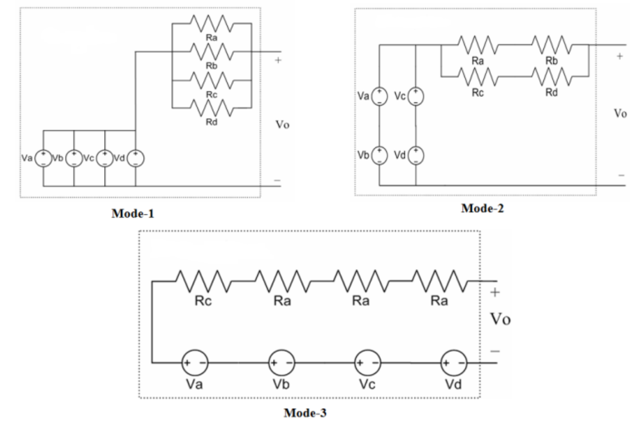


Fig.6:- Battery connection modes

Fig shows the configuration of a 4-battery connection consists of three modes: 4-in-parallel, parallel of 2-in-series, and 4-in-series.

Modes	**Voltage**	**Current**
I	Vo=Va=Vb=Vc=Vd	A=Aa+Ab+Ac+Ad
II	Vo=Va+Vb=Vc+Vd	A=Aa+Ac=Ab+Ad

III	Vo=Va+Vb+Vc+Vd	A=Aa=Ab=Ac=Ad.

Table.1:- Modes voltage and current

as shown in Fig The internal resistances, capacities and terminal voltages are respectively denoted by Ri, Ai and Vi, where i=a,b,c,d. The series and parallel connection of battery have been successfully invented and implemented on electric vehicle extending the range of constant and improving the efficiency of the propulsion system.

IV. Energy Management System

Energy source models and a new control state-based EMS is introduced for light electric vehicles for next-generation transportation. The logic sequences of the vehicle EMS under the operating control strategy directly influences the energy harvesting of the light electric vehicle from the three renewable sources.

	Four wheelers	Two wheelers
BLDC Motor	800W-1.5KW	250W-800W
Head light	230W	35W
Parking lights and indicators	50W	20W
Horn, music system, speaker	100W	10W
Power window	350W	-
Wiper	60W	-
Other	500W	10W

Table 2:-Electric vehicle's total load estimation

Once the start button is triggered, processors determine the battery capacity and load. Then, based on the control algorithm, the EMS determines which energy sources should be activated. The battery also functions as a storage device that receives charges from the renewable or through plug-in. The is the secondary energy source of the vehicle. It starts supplying energy to the load and, at the same time, recharges the battery when the battery capacity is low.

The feedback control system regulates the vehicle system to follow the control strategy in the EMS. Two feedback measurements, the battery and the vehicle speed, are used to calculate the demand of the system. Because the battery is the main source, supercapacitor is used as supportive source.The main function of the developed control strategies is to support the EMS of the battery and SC under load conditions as the primary, secondary respectively.

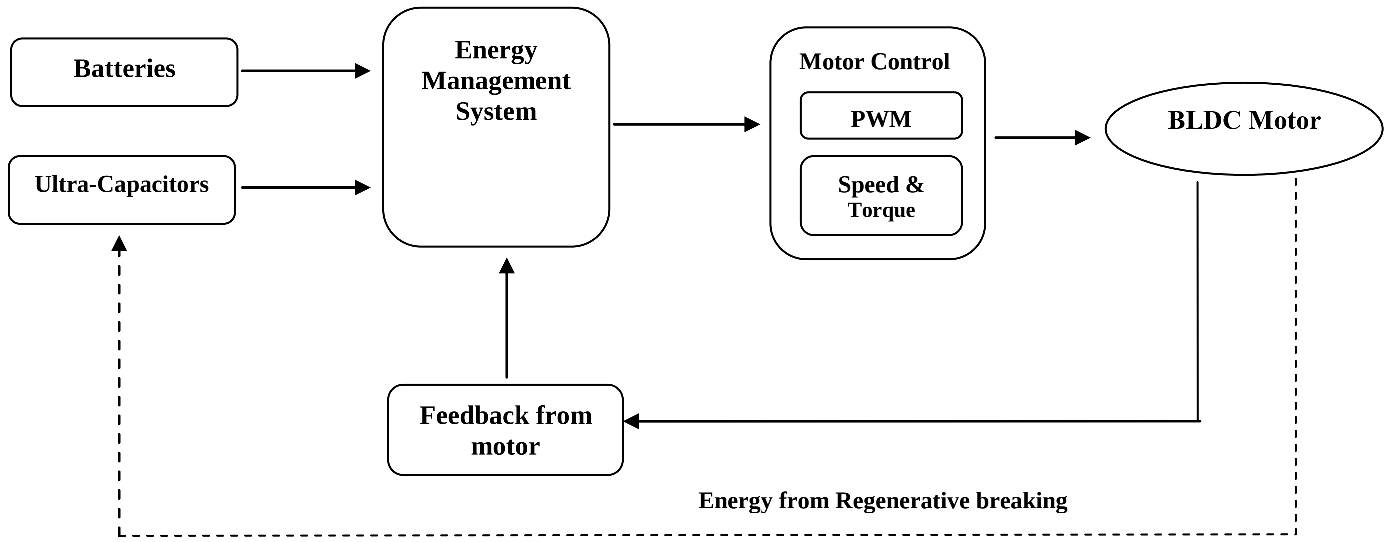
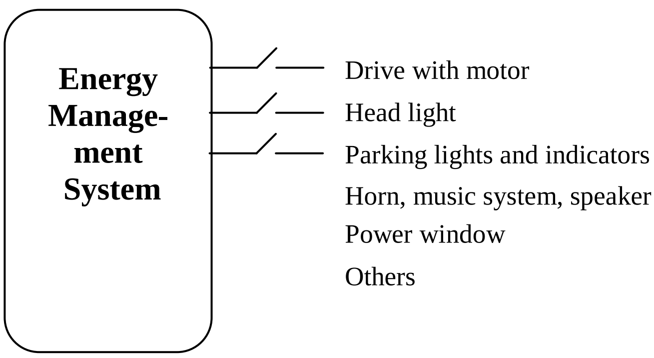


Fig. 7 Energy Management System

The EMS controls all of the energy sources that have different tasks in delivering power to the load. The battery is the main energy source of the vehicle.

The optimal use of the EMS is a trade-off between fuel saving with pure electric driving and motor-assistance and the battery charging cost, which counterbalances the use of electric energy.



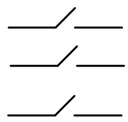


Fig. 4:- Load and EMS

In this paper, an overview of different energy source models and a new control state-based EMS is introduced for light electric vehicles for next-generation\ transportation. The logic sequences of the vehicle EMS under the operating control strategy directly influences the energy harvesting of the light electric vehicle from the three renewable sources.

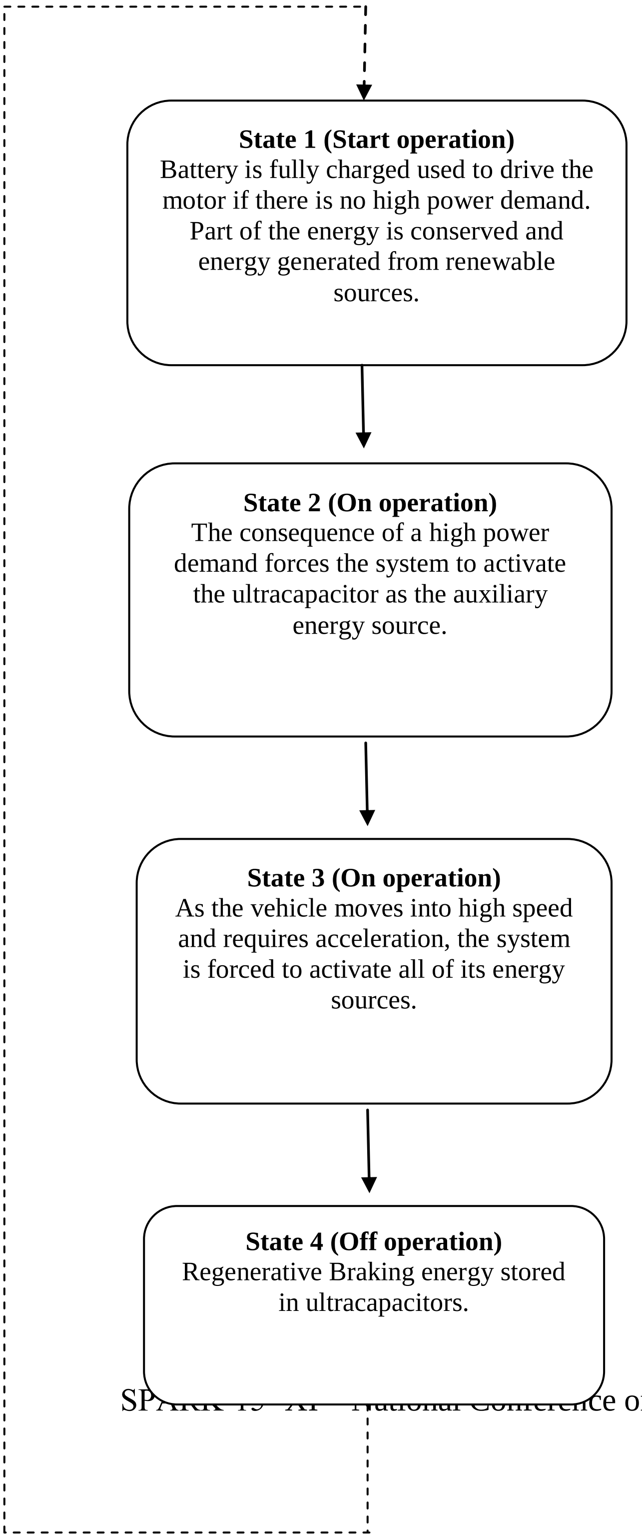


Fig. 4 Full Operation

IV. CONCLUSION

In the field of automobile sector, this kind of experiment is new. By implementing this system on an automobile, the fuel efficiency of an automobile increases without hampering environment. Moreover, the cost of the project is low and could be recovered within three years. The concept of placing regenerative breaking, photovoltaic solar cells, wind turbines, vehicle suspension is presented for the very first time by us. We believe it requires more research and elaborate analysis which we expect to continue in future.

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