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EV Smart Regeneration Using Super Capacitor with Battery Bank

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Abstract: A EV is defined as a vehicle that can be powered by an electric motor that draws electricity from a battery and is capable of being charged from an external source. The biggest factor that determines the range of an EV is the capacity of the lithium-ion battery in the car. This paper proposes a real time optimal driving torque distribution strategy for an electric vehicle (EV) with independently driven front and rear wheels. The proposed optimal torque distribution strategy among the front and rear wheels, improves the overall energy efficiency of the vehicle, there by increasing the driving range achievable per charge cycle of the EV. The torque is optimized with the objective of minimizing the energy consumption during driving as well as maximizing the regenerative energy recuperation during the braking. Here, a real time torque distribution control system is proposed which can realize optimal distribution of driving-braking torque corresponding to the driving commands, for constant speed driving, acceleration, braking and grade climbing driving modes. The optimal torque distribution ensures minimal energy consumption, thus improving the energy efficiency of the EV. By reducing the energy consumption the driving range achievable per charge cycle is improved, realizing range extension of EV.

Keywords: Range Extension, Smart Auto-Changover, Efficiency, Battery, Super capacitor, Electric Vehicle (EV)

I. INTRODUCTION

The current range of EVs covers in average 80- 90 % of most people's needs in most countries. However the most common explanation of not buying an EV is that the range isn't sufficient[1]. Range-extended electric vehicles (also referred to as extended-range electric vehicles (EREV) or Range Extended Battery Electric Vehicle (BEVx) are defined by CARB as "a vehicle powered predominantly by a zero emission energy storage device, able to drive the vehicle for more than 75 all-electric miles, and also equipped with a backup auxiliary power unit (APU), which does not operate until the energy storage device is fullydepleted[6].Currently, battery is the primary source in an electric vehicle (EV). The bigger battery, the further distance the EV can travel. In order to feed energy to the traction motor, in normal commercial EVs, the conventional inverter is used. Battery packs for electric vehicles (EVs) are created by placing numerous lithium-ion batteries in series, typically around 100 cells in series [7]. To generate a high-voltage (HV) pack for energy storage. Typical auto trips are within the driving range of efficient electric vehicles (EVs), as almost 90% of daily car use is for

less than 40 km, while occasional trips exceed EV range.However, for the occasional extended r ange, an additional battery cost is extremely high [4]. A solution to overcome this limitation is to add a range
extender to a pure electric vehicle thereby reducing rangeanxiety. Range extenders are small ele ctricity generators operating only when required. The range extender consists of mainly three parts[5]. A combustion engine, a starter/generator and a power electronic converter. The starter/generator is used as a starter motor during engine starting and then work as a generator during the rest of the vehicle operation transforming mechanical energy to electrical energy. [9].

II. LITERATURE SURVEY

The electric revolution of mobility has left the cradle and is expected to breach the barrier of mass scale commercialization within the next 3-5 years. To achieve that goal, the issue of range must be resolved. Especially plug-in hybrid vehicles address this topic with a combination of batteries and a range extender [1]. In this paper, development technique of electricity regeneration performance with the aid of using regenerating brake for EV is studied. The electricity regeneration machine for the EV has been developed. The kinetic strength of the EV is transformed into the electric strength with the aid of using the synchronous generator, and the electric strength is charged within side the EDLC unit. It is necessary that the voltage of generator is bigger than that of the EDLC unit [2]. Electric vehicles are gaining popularity due to their low carbon footprint and ease of integration with renewable energy. They are an important element in the smart grid ecosystem. Increasing the driving range of storage driven electric vehicles is the biggest challenge facing the light weight electric vehicle industry[4]. A literature review has been performed to identify various techniques to improve the driving range. Various methods of driving range Improvement such as new storage topologies, switching techniques, motor configurations are studied[5]. A new quantitative measure called as impact factor has been derived to see the effect of each technique on the driving range, Impact factor for different methods has been calculated. It is shown that increasing the storage capacity has the highest impact factor on the driving range[7].

III. PROBLEM STATEMENT

Although the evidence of the positives has become very clear, there are also some downsides that each individual needs to consider before they decide to make an electric car their next big investment. Electric cars are limited by range and speed. Most of these cars have a range of about 50-100 miles and need to be recharged again. You just can’t use them for long journeys as of now, although it is expected to improve in the future. EVs currently have a lot of battery problems, such as the fact that the vehicle's speed range is extremely low, to over come this problem designing of system with supper capacitor is required. Energy storage devices can be batteries or large capacitors, and the generator/motor is used to determine the conversion of mechanical strength to electric strength.

IV. METHODOLOGY

The system comes with an electronic control unit (ECU), which is used to control the charge-discharge state of the battery or large capacitor and ensure that the final battery power is within the specified range.

A. BLOCK DIAGRAM:-

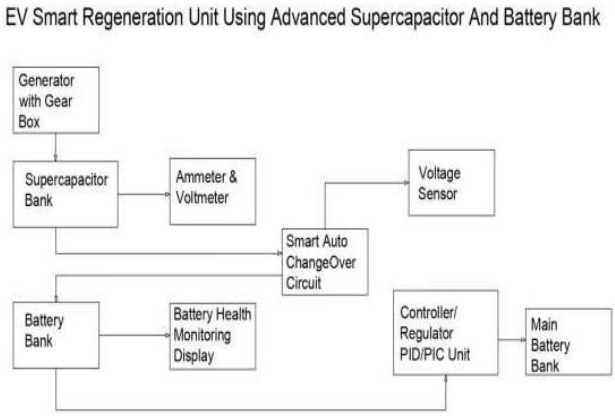

Fig.1 EV Smart Regeneration Unit using Advanced Supercapacitor and Battery Bank

Electric vehicles use electricity to charge their batteries instead of using fossil fuels like petrol or diesel. Electric vehicles are more efficient, and that combined with the electricity cost means that charging an electric vehicle is cheaper than filling petrol or diesel for your travel requirements. As we see block diagram ―EV Smart Regeneration using Super Capacitor with Battery Bank‘‘ as we see there is different section are present generator is present which is connected with gear box which will produce mechanical energy into electrical energy , a generator works on the principle that a voltage is induced in a conductor coil when it is rotated in a magnetic field. The rate at which the coil rotates in the magnetic field determines the amount of voltage induced in the coil. The output of DC generator that is given to the super capacitor bank which will stored the energy in chemical form Super capacitor Controlled Fluctuation Voltage and gives the constant output voltage and energy storage undergoing frequent charge and discharge cycles at high current and short duration and also super capacitor bank ammeter and voltmeter also connected for motoring and display voltage and current ,output of the super capacitor bank given to the smart auto changeover circuit. With an automatic changeover switch, the home's power is automatically switched over During an outage, eliminating the need for manually switching. But with a manual changeover switch, the homeowner must flip a switch to turn the power draw from the commercial grid to the generator, with this Voltage sensor sense the voltage level of battery bank and feed to the Auto Change Over and Auto Change Over is stop the supply to the battery bank. Smart auto changeover circuit input feed to the auxiliary battery bank it work when main battery level below 75% and it charge with wheels of vehicles and charge the battery through smart auto change over circuit start the charge the battery, As well as battery health monitoring display battery storage capacity and when it shows below rated value it give indication to charge the auxiliary battery. The output of auxiliary battery bank is feed to controller/regulator PID/PIC unit which feed to main battery. controller/regulator PID/PIC unit works when main battery level is decrease at their rated value and it gives constant regulated required voltage to the main battery.

V. RESULT

Effectively a capacitor in such position basically works as a filter if the DC supply is from a rectifier circuit, and it filters out any ripples or fluctuations in supply. Otherwise when a supply source is connected,

it is the source which is supplying energy to the circuit, and not the capacitor, which smoothness the ripples by supplying from its stored energy till rectifier voltage goes above its terminal voltage.
A super capacitor module can be connected directly across a battery and the combination can be connected to a load. In this case, the battery is the main power source, and capacitor takes care of any sudden change in current requirements due to fluctuations in load conditions. This serves to safeguard the battery from deep discharge and extends its life. Your 12V power supply has inside one or more capacitors at its output already. They are usually electrolytic caps. Adding your super-cap will improve ripple and a little hold-up time to your existing power supply, but not much. Ripple means charging and discharging here.

A. Hardware Photo

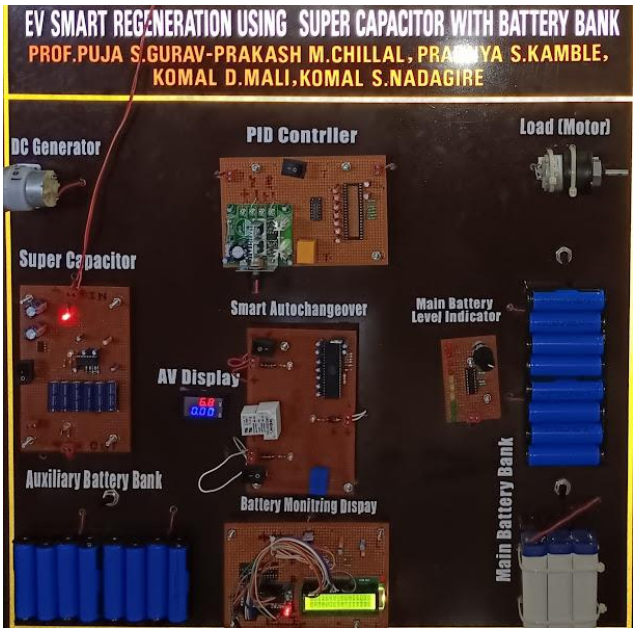

Fig.2 Main Project

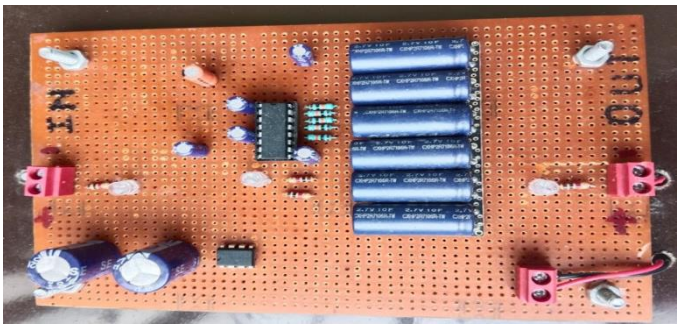

Fig.3 Supercapacitor Bank

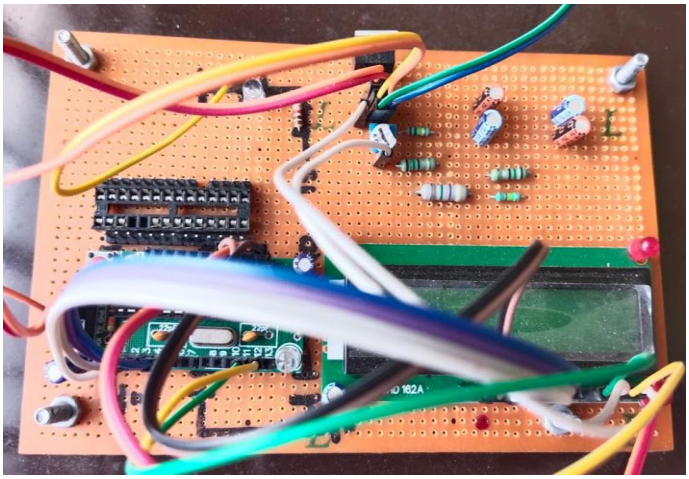

Fig.4 Battery Monitoring Display

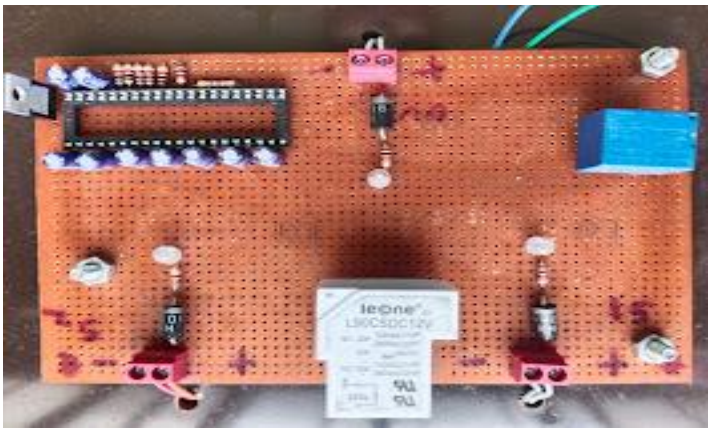

Fig.5 Smart Auto Change Over

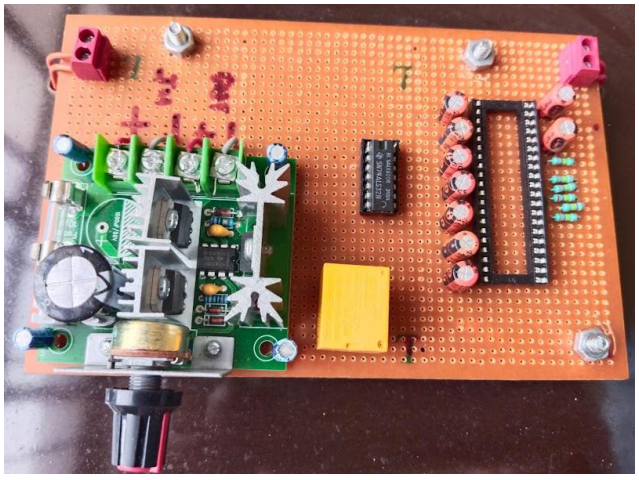

Fig.6 PID/PIC Controller Regulator

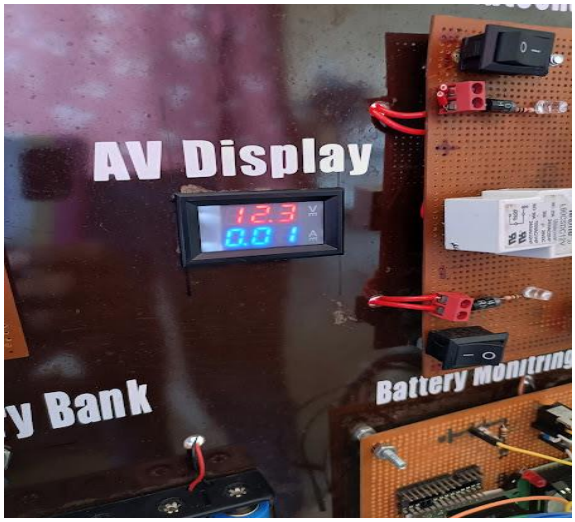

Fig.7 Voltage and Current Display

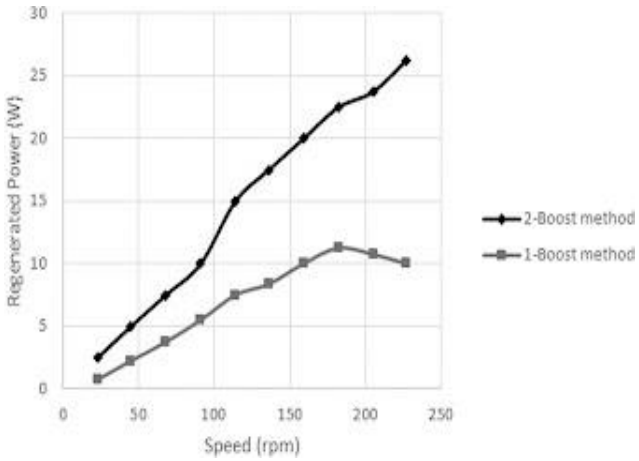

Fig.8 Regenerated Power and speed

B. Comparison of various Regeneration of EV

Regeneration methods	Speed (rpm)	Regenerated power (watt)
Plug in hybrid EV	60	10
Gravity force	65	10.5
Battery electric vehicles	75	13.5
Active control of hybrid source	70	13

Supercapacitor method	100	18

VI. CONCLUSION

In this paper we examined what is solution are currently available in order to increase the range of EV. This solution presents EV generation using its own wheels/front wheel and improving EV generation to store energy in batteries. Due to regeneration using this system the dependency on fossil fuel will be reduced. This system will minimize the running cost of electrical vehicle and improve the range of EV. Several super capacitor models are presented, whilst agreeing that the multi-branch model is able to describe both the super capacitor dynamic and long term static behavior by taking into consideration the redistribution effect. The voltage regulator is in idle state when the super capacitor is undergoing redistribution. However, the DC voltage gain ratio was limited due to the presence of parasitic. Therefore, the boost mode has to be activated when the buck-boost mode was unable to meet the DC voltage gain ratio requirements, typically when the supercapacitor voltage is low compared to the output voltage

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