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Self Generative Electric Vehicle

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***Abstract*-Transportation accounts for about one-fifth of global energy use and passenger vehicles account for about ten percent of energy-related carbon dioxide emissions. During the last few decades, environmental impact of the petroleum-based transportation infrastructure, along with the fear of peaking oil prices, has led to renewed interest in an Electric transportation infrastructure. Electric Vehicles (EVs) differ from fossil fuel-powered vehicles. The way electricity is consumed in EVs can be generated from a wide range of sources such as solar power, tidal power and wind power or any combination of these. The generated electricity may then be stored on board by using a battery, flywheel, or super capacitors. EVs include road and rail vehicles, surface and underwater vessels, electric aircraft and electric spacecraft. As it is well known one of the drawbacks of these electric vehicles is their driving range. The driving range can be increased with the help of Self-generation and Regeneration operation. Regenerative braking system replaces the traditional braking system in cars as the traditional braking system produces more heat during braking. Therefore the Regenerative braking system ensures high capability of energy storage in braking conditions and under normal operation.**

***Keyword*- Regeneration, self-generation, super capacitors, hybrid energy, high frequency charge controller.**

I. INTRODUCTION

There are a variety of clean vehicle technologies and fuels in development and in use, but electric vehicles represent one of the most promising technologies for reducing oil use and cutting emissions. The invention of electric vehicle (EV) is a miracle, as it produces zero emission into air which means there is no toxic gases released from vehicles. Now a days, the number of EVs have increased.

In twentieth century, vehicular technology such as control technology and integrative technology have been developing aggressively. But, the driving range is still an obstacle for the development of electric vehicles. This problem can be tackled by using regeneration . Regeneration can increase an EV's driving range by 8-25%. In this project the power can be generated with the help of Regenerative Braking System (RBS).

The RBS system converts the mechanical energy into electrical energy during braking operation. Using this system in automobiles, enables us to recover the kinetic energy of the vehicle to some extent that is lost during braking process. The energy management can also be improved through self generation.

In this model the generated energy can be stored with the help of advanced technology such as Ultra capacitors. A new type of shock absorber: hydraulic electromagnetic energy regenerative shock absorber (HESA), which can simultaneously implement the function of damping vibration and regenerating a portion of dissipated energies generated from passing through the damping hole. Reduction of vehicles' power consumption can be achieved by recovering energy from a passive suspension system, especially for electric vehicles. To achieve energy saving, the energy dissipation in a shock absorber has been investigated by many researchers.

Electromagnetic shock absorbers transform the relative motion between chassis and wheels to linear or rotary motion in an electrical machine in order to generate power. Hence, vibration energy is converted into

electricity to recharge battery or power other devices [1]. A electric vehicle energy recovery system is proposed, that converts the braking energy into electric energy which charges the battery. Using rectifier and filter, changing the frequency of driving motor generation, the recovery system efficiency is about 60%. The electric vehicle realizes the function of energy recovery, increases the driving mileage [2].

P Hsu, et.al. [3] proposed the application of electric motors as the primary actuators of an active suspension system of a road vehicle. In particular, the authors focus on the power recovery property of such a system. The amount of potentially recoverable power and suspension force are determined based on a power spectral density analysis and computer simulations.

They determined that an active system on a mid-size car can potentially recover up to 100 W power per wheel in a highway driving condition. However, such a system consumes power at lower speed city driving condition. Jolly. M, et.al. [4] proposed that the potential energy regeneration in vibration control system is investigated. Such control system holds the possibility of self sustainability by alternatively extracting and releasing energy originating from the vibrating system in a controlled non passive manner.

To be self sustaining, more energy on an average must flow out. Nakano k, et.al. [5] proposed that a new kind of semi-active energy regenerative suspension vibration energy as well as to reduce the suspension cost and demand for motor rated capacity. The system consists of an energy regenerative damper and a DC-DC converter based energy regenerative circuit. The circuit can be used to improve the system's energy regenerative performance and to continuously regulate the motor's electromagnetic damping force.

Therefore, although the motor works as a generator and damps the isolation with an external power source, the motor's damping force is controllable. Pratibha Patel,et.al. [6] proposed, two methods to utilize the kinetic energy that is usually wasted, by converting it into either electrical energy or into mechanical energy. Regenerative braking system can convert the kinetic energy into electrical energy.

It can also convert the kinetic energy into mechanical energy, which is supplied to the vehicle whenever needed with the help of a flywheel. U.Sudhakar , et.al. [7] proposed Regenerative Braking System for hybrid/electrical vehicle which is a key technology for improving the efficiency of the automobile by 20-40% depending on the size of the motor. Energy normally dissipated in the form of heat is directed by a power transmission system to the energy storage device during deceleration. It helps to save fuel in hybrid vehicles and to reduce emissions of Carbon dioxide and pollutants.

The super capacitor, a peak energy storage of 100 F, 56 V and 400 A, is able to accept the kinetic energy during breaking the vehicle of the mass 1500 kg from the velocity 60 km/hour and regenerate it during next speeding up [8]. Losses such as dissipation in the suspension, appears to be a weakness in present evaluation procedures as they relate to fuel economy and pollution level testing.

Correlation with computer simulations has allowed the development of deterministic road roughness model which permits the prediction of energy dissipation in both the tire and suspension as functions of road roughness, tire pressure and the vehicular speed.

If this wasted energy could be transformed into electrical energy, an external power supply will not be required [9,10].

II.EXISTING METHODOLOGY

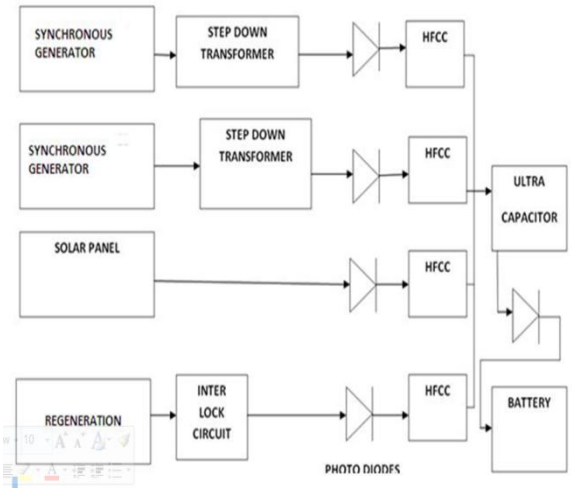

Fig.1 Block diagram of existing electric vehicle

Vehicle we are using doubly fed induction generators instead. This is because synchronous generators have several disadvantages.

III.SYSTEM MODEL

In this project we are going to use two doubly fed induction generators attached to the front wheels for self generation operation in electrical vehicle. Two DC motors are coupled to the back wheels for converting mechanical energy to electrical energy during braking. A photovoltaic roofing is provided to further improve the efficiency.

The power generated from all these sources can be stored in an ultra capacitor which is a high density energy storage device

1. Embed four relay boards:

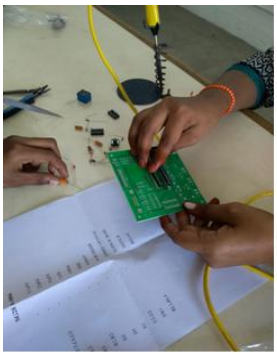

Fig. 2 Embed four relay.

This is a 5V 4-Channels Relay module, It can be controlled directly by a wide range of microcontrollers such as Arduino, AVR, PIC, ARM and MSP430.4 relays are included in this module, with "NC" ports means "Normally connected to COM" and "NO" ports means "Normally open to COM". This module also equipped with 4 LEDS to show the status of relays.

2. Regen board:

Fig.3 Regen board.

This board contains of transistors, wide range of capacitors, diode and resistors for regenerative operation. The diodes are used as rectifiers for the conversion of AC to DC obtained from doubly fed induction generators.

3. Doubly fed induction generator

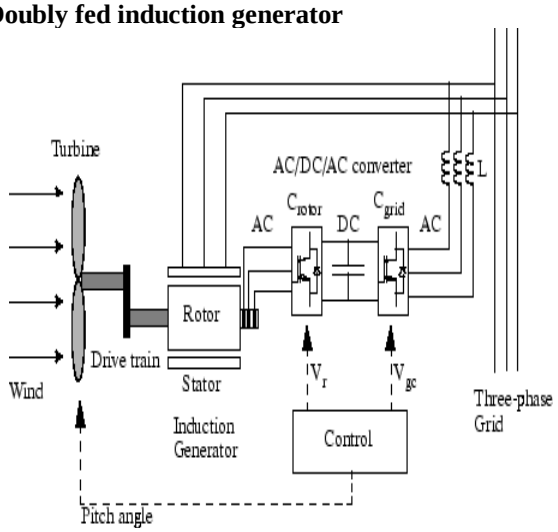

Fig.4 doubly fed induction generator.

In Doubly-fed electric generators both the field magnet windings and armature windings are separately connected to equipment outside the machine. By feeding adjustable frequency AC power to the field windings, the magnetic field can be made to rotate, allowing variation in generator speed.

The principle of the DFIG is that rotor windings are connected to the grid via slip rings and back-to-back voltage source converter that controls both the rotor and the grid currents.

Thus rotor frequency can freely differ from the grid frequency. By using the converter to control the rotor currents, it is possible to adjust the active and reactive power fed to the grid from the stator independently of the generator's turning speed.

4.Ultra capacitor

Fig.5 Ultra capacitors

Electric double-layer capacitors, also known as super capacitors, electrochemical double layer capacitors (EDLCs) or ultra capacitors are electrochemical capacitors that have an unusually high energy density when compared to common capacitors, typically several orders of magnitude greater than a high-capacity electrolytic capacitor.

5. PIC16F877 Microcontroller

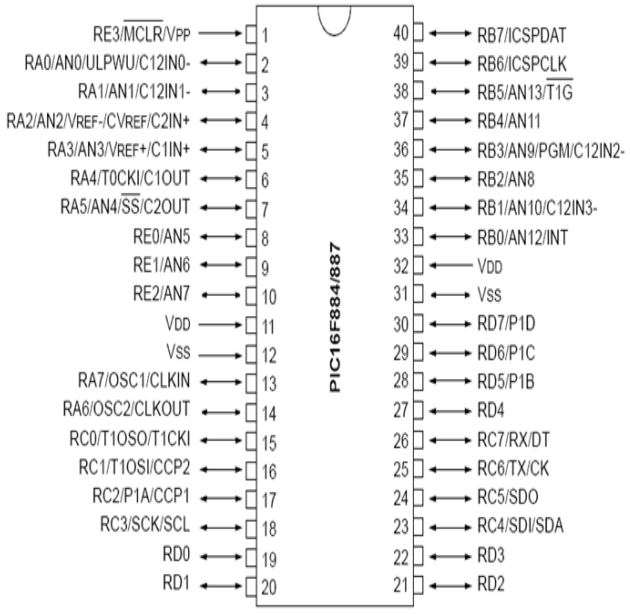

Fig.6 Pin diagram of PIC.

The PIC16F877A features 256 bytes of EEPROM data memory, self programming, an ICD, 2 Comparators, 8

channels of 10-bit Analog-to-Digital (A/D) converter, 2 capture/compare/PWM functions, the synchronous serial port can be configured as either 3-wire Serial Peripheral

Interface or the 2-wire Inter-Integrated Circuit bus and a Universal Asynchronous Receiver Transmitter (USART). All of these features make it ideal for more advanced level A/D applications in automotive, industrial, appliances and consumer applications.

6. DC motor

A DC motor is any of a class of rotary electrical machines that converts direct current electrical energy into mechanical energy. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electro mechanical or electronic; to periodically change the direction of current flow in part of the motor.

DC motors were the first type widely used, since they could be powered from existing direct-current lighting power distribution systems. A DC motor's speed can be controlled over a wide range, using either a variable supply voltage or by changing the strength of current in its field windings.

7. Switching circuit

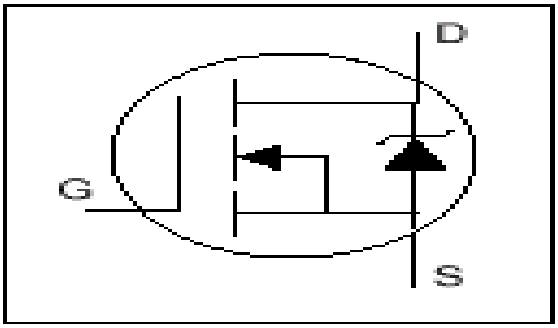

Fig.7 Power MOSFET

The technique used is the pulse charging technique. This is trickle method in boost charging system. A high end high frequency charging technique will be employed to charge the battery.

This method reduces the charging time. For example if cell phones are charged using this way, then the cell phones will not get heated up. The switching circuit consist of the 555 timer and a MOSFET. The 555 timer works as the astable multivibrator which produces pulses of required frequency. IC 555 employed here as an astable multi vibrator to produce continuous square wave for charging.

8. Solar panel

A photovoltaic (PV) module is a packaged, connect assembly of typically 6x10 photovoltaic solar cells. Photovoltaic modules constitute the photovoltaic array of a photovoltaic system that generates and supplies solar electricity in commercial and residential applications.

Solar panels and electric cars are like two peas in a pod. One gives you the ability to travel emissions-free and the other allows you to power your life without spending a fortune.

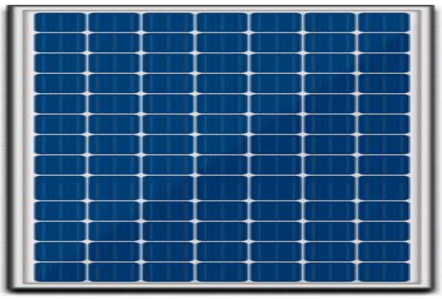

Fig.8 Solar panel

IV.PROPOSED METHODOLOGY

In this project we are going to use two doubly fed induction generators for self generation of energy from the vehicle during running operation. Regeneration is achieved by connecting two DC motors to the back wheels of the vehicle. A solar panel is also used as roofing to the vehicle.

The hybrid energy from all the sources is stored in an ultra capacitor which is a high density energy storage device and the justification is done by connecting a LED to it. Two 6V batteries are used to power the vehicle for starting the vehicle. REGEN board is used for regenerating operation. The board consists of wide range of capacitors and diodes.

The diodes are used for rectifying operation, to convert the ac output of doubly fed generators to dc. The embed four relay consists of four relays for interfacing each source of energy to the computer.

An analog to digital converter is used to convert the analog output to digital values. Visual basic coding is used for starting and braking the vehicle using START/STOP command and also used to graphically represent power generated from the vehicle. Seperate graphs are obtained for solar, regeneration and self generation.

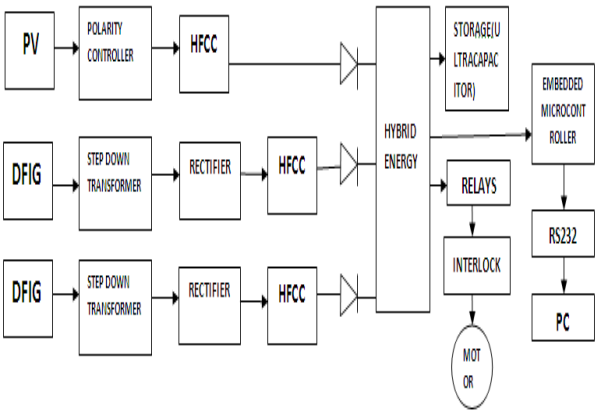

Fig. 9 Block diagram of self generative EV

V. RESULTS

1. Hardware results

The shown figure 8 is the hardware design of the self generative electric vehicle. Two DFIGs are attached to the front wheels. Two DC motors are attached to the back wheels. Solar panel roofing is done during running. Ultra capacitor will store the hybrid energy.

Fig.10 Hardware Setup of the vehicle.

2. Software results

The graph shown below gives details about the power obtained from solar, regeneration and self generation from DFIG. The overall efficiency is improved by 50-60%.

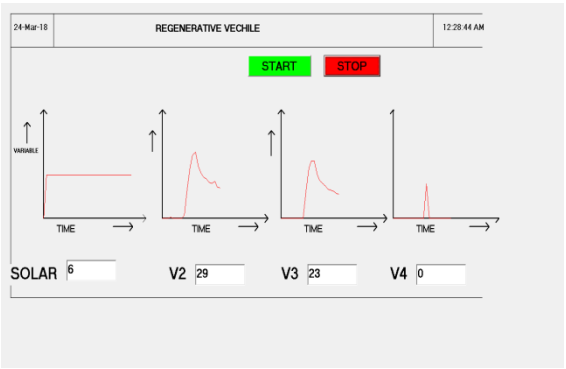

Fig. 11 Output graph of the hybrid power.

DFIG can operate over wide range of speed variations, and the power of the machine rises up twice of its rated power, which allows to increase its power density. Electric drive vehicles have on-board efficiency of around 80%, 20% of this power consumption is due to inefficiencies in charging the batteries.

Since we have used DFIGs, there is a minimization in charging the batteries. While integrating PV, the study has been done to see the effectiveness of using solar for improving the efficiency and the driving range. It was found that the efficiency can be improved from 9-12%. Different panel technologies like mono and polycrystalline silicon PV panels can be used in the future to further improve the efficiency. Regenerative braking is a major energy saver because it recycles nearly half of the 80% of kinetic energy wasted by a moving vehicle.

When compared to a conventional braking system, the efficiency is greater. This particular system has a wide scope for further development and energy savings. The driving range of electric vehicle can be improved from 8-25%.

VI.CONCLUSION AND FUTURE SCOPE

Regenerative braking is one of the most important systems in electric vehicle because it has the ability to save the energy in the range of 5-8%. The regenerative braking system has been improved by the advanced power electronic component such as ultra capacitors, DC-DC converter (Buck-Boost) and flywheel. The ultra capacitor that helps in improving the transient state of the car during starting, provide a smoother charging characteristic for the battery and boost up the overall performance of the electric vehicle system. The Buck-Boost converter helps maintaining the power management in the regenerative braking system such as boosting the acceleration. Finally, the flywheel is used to enhance the power recovery process through the wheel of the car. Thus, the regenerative braking is a tremendous concept that has been developed by Engineers. In the near future, regenerative braking techniques can be further developed by using different methods either by fuzzy controllers or PID controllers. Regenerative braking systems require further research to develop a better system that captures more energy and stops faster. All vehicles in motion can benefit from these systems by recapturing energy that would have been lost during braking process. Future technologies in regenerative brakes will include new types of motors which will be more efficient as generators, new drive train designs which will be built with regenerative

braking in mind and electric systems which will be less prone to energy losses.

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