International Journal on Recent Researches in Science, Engineering & Technology (IJRRSET)
A Journal Established in early 2000 as National journal and upgraded to International journal in 2013 and is in existence for the last 10 years. It is run by Retired Professors from NIT, Trichy. Journal Indexed in JIR, DIIF and SJIF.
Research Paper
Available online at: www.jrrset.com

ISSN (Print) : 2347-6729
ISSN (Online) : 2348-3105
Volume 7, Issue 2
February 2019.
JIR IF : 2.54
SJIF IF : 4.334
Cosmos: 5.395

Received on: 03.01.2019 Published on: 28.02.2019 Pages : 5 - 13

ECO-FRIENDLY VEHICLE SYSTEM FOR EFFECTIVE TRANSPORTATION

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I. 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 peak oil, has led to renewed interest in an electric transportation infrastructure. EVs differ from fossil fuel-powered vehicles in that the electricity they consume can be generated from a wide range of sources, such as tidal power, solar power, and wind power or any combination of those. The electricity may then be stored on board the vehicle using a battery, flywheel, or super capacitors. As it is well known one of the drawbacks of the electric vehicles is the driving range. The driving range can be increased with the help of self-generation, regeneration and solar power operation. The Generator fixed with the wheels converts kinetic energy of wheel into electric energy. Regenerative braking system replaces the traditional braking system in cars which produces more heat during braking. Solar Panel which placed at the roof of vehicle converts light energy into electric energy which is stored in ultra-capacitor to drive the vehicle.

Keywords: Solar panel, Self-generation, Driving range, Regenerative braking system.

II. 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 produce zero emission to the air which means there are no toxic gasses release from the car that causes the ozone layer polluted. In twentieth century, vehicular technology such as control technology and integrative technology have been developing aggressively. Somehow, the limitation of driving mileage still becomes an obstacle for the development of electric vehicles. This problem had been tackle by using regeneration, it has become one of the ways to improve the driving range as this method can increase an EV's driving range by 8-25%. When the car starts moving then generation takes place. The generator attached to the wheels starts generation. This process is called as self generation. In this project the power can also be generated with the help of regenerative braking system. The RBS system converts the mechanical energy into electrical energy during braking operation. In automobiles whenever the brakes are applied the vehicle comes to a halt and kinetic energy gets wasted due to friction in the form of kinetic energy. Using regenerative braking system in automobiles enable us to recover the

kinetic energy of the vehicle to some extent that is lost during braking process. The energy management can be well improved through self-generation and regeneration. Hence the generated energy can be stored back in the battery and the stored energy can be used further. In this model the generated energy can be stored with the help of advanced technology such as Ultra capacitor, Hybrid energy storage system.

III. EXISTENCE

The existing electric vehicles accept electrical energy from an stored devices like battery. The power obtained from the battery applied to control system circuits for the power management and to drive the motor using ward leonard devices. Some of the feature cause consist to regenerative power generation system for enhancing the electrical to mechanical conversion efficiency.

III.A.DRAWBACK OF EXISTING MODEL

- Very poor electrical to mechanical efficiency leads to low coverage area for the given amount of power
- No electrical charging centers on National Highways, leads to very less amount of vehicles fleats on the road.
- As it is well known one of the drawbacks of the electric vehicles is the driving range.

IV. PRINCIPLE OF OPERATION

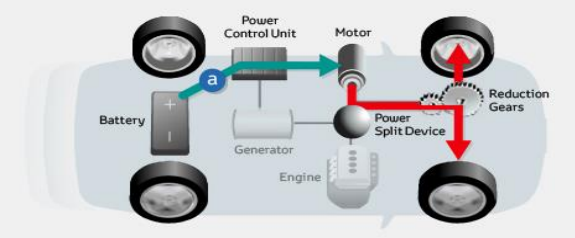

Fig 4.1. Normal Operation

IV.A. SELF GENERATION

The electric vehicle is driven by the battery. On switching the car the motor takes current from the battery. The motor converts the electrical energy into mechanical rotation and hence the vehicle moves forward when the car starts running then generation takes place. The synchronous generator attached to the wheels starts generation. Here synchronous generator has been used because it can operate at low power. When the driving speed of the car increases then generation also increases. Hence the generation depends upon the driving condition. The output of the generator is Alternating type. Hence it can be converted into DC with the help of rectifier circuit.

The rectifier circuit converts this Alternating current into pulsating DC. The pulsating DC component is passed through the filter circuit which removes harmonics . Then the DC is stored in the ultracapacitor. Hence the power can be generated without any external forces and this process is called self generation.

IV.B. REGENERATION

The brake is a device that decelerates the moving object or prevents an object from accelerating. Brakes uses friction to convert kinetic energy into heat. As the brake pads rub against the wheels excessive heat energy is generated. This heat energy dissipates into the air wasting upto 30% of the generated power. Regenerative braking technology capture the energy created by braking process back into the system in the form of charging the battery for further use.

The energy generated during braking depends on the driving system. When the driver steps on the brake pedal of an electric or hybrid vehicle, the brakes put the vehicle's electric motor into reverse mode, causing it to run backwards, in order to slow the car's wheels. When the wheel runs backwards, then the motor acts as an electric generator, producing electricity which is then stored back into the vehicle's batteries.

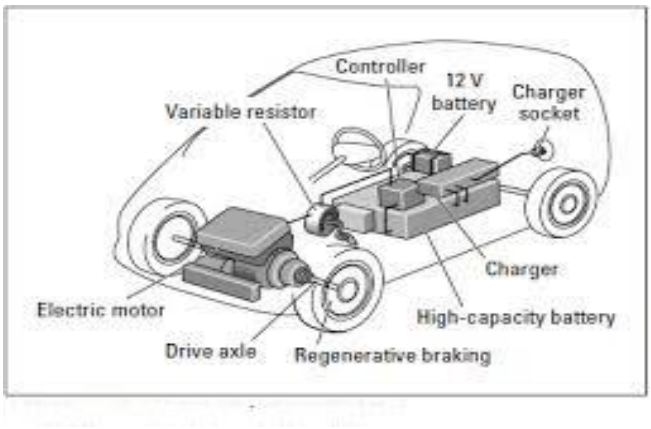

Fig 4.2.Regeneration in EV

Many modern hybrid and electric vehicles use this technique to extend the range of the battery pack. In regenerative braking system the controller plays a vital role because it controls the overall process of the motor. The main purpose of the controller is to monitor the speed of the wheel, calculate the torque, and the generated electricity to be fed back to the batteries. Under braking condition the controller directs the current generated directly into the batteries or capacitors.

IV.B.i. ADVANTAGES OF REGENERATIVE BRAKING SYSTEMS

- Improved Performance.
- Improved Fuel Economy- Dependent on duty cycles, power train design, control strategy, and the efficiency of individual components.
- Reduction in Engine wears.
- Reduction in Brake Wear- Reducing cost of replacement brake linings, cost of labor to install them, and vehicle down time.
- Emissions reduction- engine emissions reduced by engine decoupling, reducing total engine revolutions and total time of engine operation.
- Operating range is comparable with conventional vehicles- a problem not yet overcome by electric vehicles.

IV.B.ii. LIMITATIONS OF REGENERATIVE BRAKING SYSTEMS

- The main limitation of regenerative brakes when compared with dynamic brakes is the need to closely match the electricity generated with the supply. With DC supplies this requires the voltage to be closely controlled and it is only with the development of power electronics that it has been possible with AC supplies where the supply frequency must also be matched (this mainly applies to locomotives where an AC supply is rectified for DC motors).
- Regenerative braking is necessarily limited when the batteries are fully charged. Because the additional charge from regenerative braking would cause the voltage of a full battery to rise above a safe level, our motor controller will limit regenerative braking torque in this case.
- Increases the total weight of vehicle by around 25- 30 Kilograms.

IV.B.iii. APPLICATIONS OF REGENERATIVE BRAKING SYSTEMS

- For recovering Kinetic energy of vehicle lost during braking process
- One theoretical application of regenerative braking would be in a manufacturing plant that moves material from one workstation to another on a conveyer system that stops at each point
- Regenerative braking is used in some elevator and crane hoist motors.
- Regenerative Braking Systems are also used in electric railway vehicle (London Underground & Virgin Trains).

V. PROPOSED MODEL BLOCK DIAGRAM

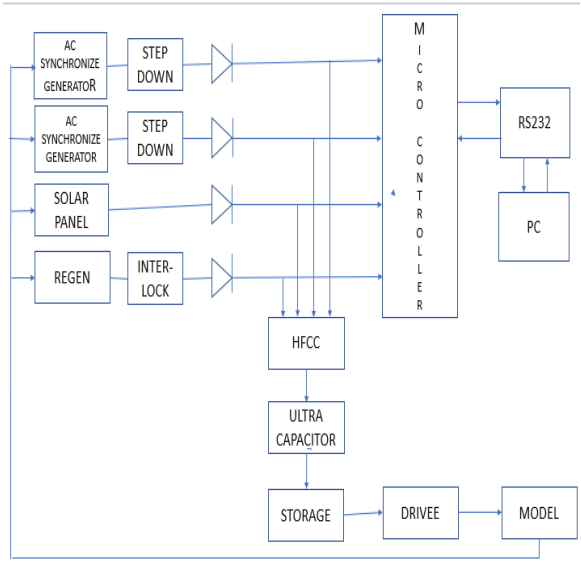

Fig 5.1. Block Diagram

VI. HARDWARE IMPLEMENTATION

Fig 6.1. Hardware Picture

VI.A. SYNCHRONOUS GENERATOR

The rotating and stationary parts of an electrical machine can be called as rotor and stator respectively. The rotor or stator of electrical machines acts as a power-producing component and is called as an armature. The electromagnets or permanent magnets mounted on the stator or rotor are used to provide magnetic field of an electrical machine. The generator in which permanent magnet is

used instead of coil to provide excitation field is termed as permanent magnet synchronous generator or also simply called as synchronous generator.

VI.A.i. GENERATOR WORKING PRINCIPLE

The principle operation of synchronous generator is electromagnetic induction. If there exists a relative motion between the flux and conductors, then an electric motive force is induced in the conductor.

VI.A.ii. ADVANTAGES OF SYNCHRONOUS GENERATOR

- Constant Voltage.
- Constant frequency.
- Capability to deliver active as well as reactive power.

VI.B. 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 electromechanical 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. Small DC motors are used in tools, toys, and appliances. The universal motor can operate on direct current but is a lightweight motor used for portable power tools. Larger DC motors are used in propulsion of electric vehicles, elevator and hoists, or in drives for steel rolling mills. The advent of power electronics has made replacement of DC motors with AC motors possible in many applications.

VI.C. ULTRA CAPACITOR

Fig 6.2. Ultra Capacitor

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.

- Energy Storage Device
- 10 - 100 Times the Power of Batteries
- 1000 Times the Cycle Life of Batteries
- Faster Charging Time
- 1,000,000+ Times the Energy of “Regular” Capacitors

Electrical energy is stored as charge in the electric field between its plates and as a result of this stored energy, a potential difference, that is a voltage, exists between the two plates. During charging (current flowing through the ultra capacitor from the connected supply), electrical energy is stored between its plates.

Once the ultra capacitor is charged, current stops flowing from the supply and the ultra capacitors terminal voltage is equal to the voltage of the supply. As a result, a charged ultra capacitor will store this electrical energy even when removed from the voltage supply until it is needed acting as an energy storage device. When discharging (current flowing out), the ultra capacitor changes this stored energy into electrical energy to supply the connected load. Then an ultra capacitor does not consume any energy itself but instead will store and release electrical energy as required with the amount of energy stored in the ultra capacitor being in proportion to the capacitance value of the capacitor. The amount of energy stored is proportional to the capacitance C and the square of the voltage V across its terminals giving.

$$E = \frac{1}{2}CV^2 = \frac{CV^2}{2} = \frac{QV}{2} = \frac{Q^2}{2C} \; Joules$$

where E is the energy stored in joules.

VI.D. BATTERY

Fig 6.3. Battery

A battery is a source portable electric power. It is a reservoir, which may be used repeatedly for storing energy. Energy is charged and drained from the reservoir in the form of electricity, but it is stored as chemical energy. The most common storage battery is the lead-acid battery. Lead-acid batteries are inexpensive, relatively safe and easily recyclable, but have a low energy-to-weight ratio. Sealed Lead Acid batteries are used in many applications where cost is more important than space and weight, typically preferred as backup batteries. The sealed lead acid batteries are charged using constant voltage, with a current limiter to avoid overheating in the initial stage of the charging process. Sealed lead acid batteries can be charged infinitely, as long at the cell voltage never exceeds the manufacturer specifications (typically 2.2V).

VI.D.i. WORKING

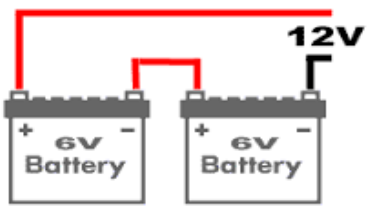

Fig.6.4. Battery Connection

In this project 12v lead acid battery is used to drive motor. Here the 12v is obtained by connecting two 6v batteries in series.

The chemical reaction involved during charging and discharging oflead acid battery is as follows,

Pb + 2H2SO4 + PbO2 -----DisCharging PbSO4 + 2H2O + PbSO4--Charging

VI.D.ii. DISCHARGE

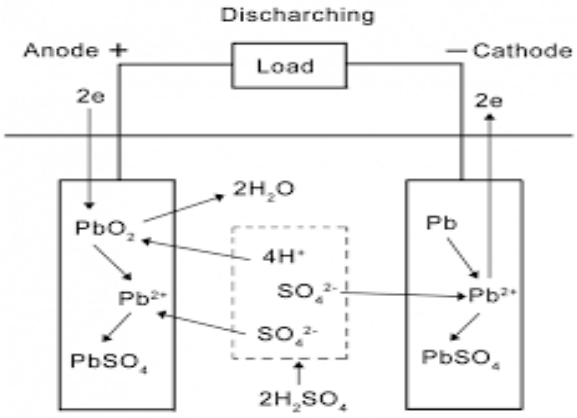

Fig 6.5. Discharge Of Battery

During the discharge portion of the reaction, lead dioxide(positive plate) and lead (negative plate) react with sulfuric acid to create lead sulfate,water and energy.

VI.D.iii. RECHARGE

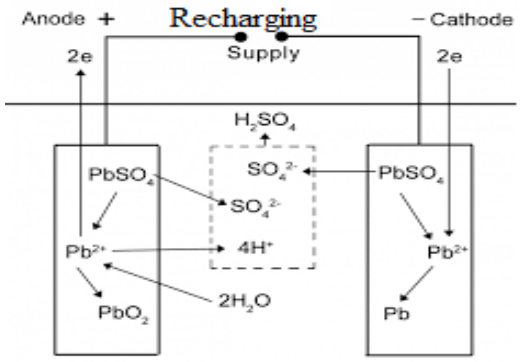

Fig 6.6. Recharging Of Battery

During the recharge phase of the reaction, the cycle is reversed. The lead sulfate and water are electro-chemically converted to lead, lead oxide and sulfuric acid by an external electrical charging source.

The use of less antimony, or using calcium, cadmium, or strontium in place of antimony, results in less gassing and lower water consumption.

VI.E. SOLAR PANEL

Photovoltaic solar panels absorbs sunlight as a source of energy to generate electricity. A photovoltaic (PV) module is a packaged, connected assembly of typically 6x10 photovoltaic solar cells. Photovoltaic modules constitute the photovoltaic array of a photovoltaic system that generates and supplies solar electricity.

Fig.6.7. Solar Panel in Working Model

Solar Panel which placed at the roof of vehicle which converts light energy into electric energy. The obtained energy is stored in ultra capacitor which is used to drive the vehicle.

VII. SOFTWARE REQUIREMENTS

VII.A. VISUAL BASICS

Visual Basic is a third-generation event-driven programming language and integrated development environment (IDE) from Microsoft for its Component Object Model (COM) programming model first released in 1991 and declared legacy during 2008. Microsoft intended Visual Basic to be relatively easy to learn and use. Visual Basic was derived from BASIC, a user-friendly programming language designed for beginners, and it enables the rapid application development (RAD) of graphical user interface (GUI) applications, access to databases using Data Access Objects, Remote Data Objects, or ActiveX Data Objects, and creation of ActiveX controls and objects.

VII.A.i. LANGUAGE FEATURES

- Like the BASIC programming language, Visual Basic was designed to accommodate a steep learning curve.
- Programmers can create both simple and complex GUI applications. Programming in VB is a combination of visually arranging components or controls on a form, specifying attributes and actions for those components, and writing additional lines of code for more functionality.
- Since VB defines default attributes and actions for the components, a programmer can develop a simple program without writing much code.
- Forms are created using drag-and-drop techniques.
- A tool is used to place controls (e.g., text boxes, buttons, etc.) on the form (window). Controls have attributes and event handlers associated with them.

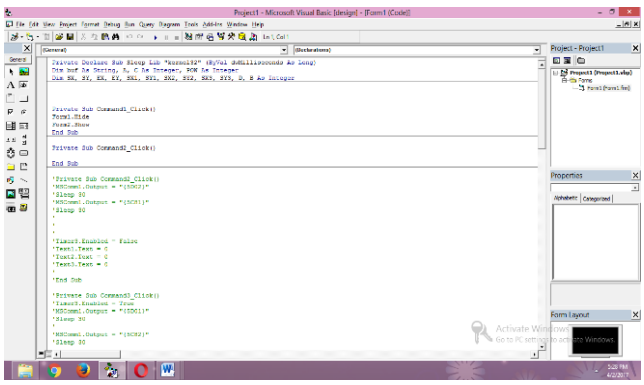

Fig 7.1. Visual Basic Image

VIII. CONCLUSION

Regenerative braking is one of the important systems in electric vehicle because it has the ability to save the waste energy upto 8-5%. The regenerative braking system has been improved by the advanced power electronic component such as ultracapacitor, DC-DC converter (Buck-Boost) and flywheel. The ultracapacitor 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.

In conclusion, 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 fuzzycontroller or PID controller.

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