

# Regenerative Braking System And Solar Hybrid Car

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**Abstract-** *Stop-stop-stop-start if we make a habit of driving in city traffic, you will know it can be a huge waste of time. What's less obvious is that it's also a waste of energy. To move a car we require a big input of power and every time you hit the breaks all the energy you have a built up disappears again wasted in the break pads as heat. Would't it be good if you could store this energy somehow and reuse it next time you started accelerate? That's the basic concept of regenerative breaks, which are widely used in electric trains and the electric cars.*

**Keywords-** Regenerative braking system, Solar Panel, Dynamo, Battery, Charger.

## I. INTRODUCTION

When brakes are applied in conventional vehicle, kinetic energy is converted into heat because of the friction produced between the brake pads and the wheels. This heat gets carried out in the environment and the produced energy gets wasted and this leads to waste of energy. Large amount of the energy wasted during this process depends upon how hard and how often brakes are applied. Electric motors basically used in electric trains, cars and other hybrid vehicles which are connected to batteries. When the vehicle is running along, energy transferred from the batteries to the motors, which turns the wheels and provides vehicle with the kinetic energy which is required for motion. When brakes are applied, the whole process goes into reverse. Now, kinetic energy and the hence the momentum causes the wheels to turn the motors, now the motor starts works like a generator and producing electricity instead of consuming it. The reverse power flow occurs, charging the batteries. This recovers a large amount of the energy lost in braking, and is returned to the batteries which can be reused when the motor start off again. In practice, these brakes are used to make them slow and conventional brakes provides full control. And second source is solar which is an electric vehicle powered completely or significantly by direct solar energy. Usually, photovoltaic (PV) cells present in solar panels convert the sun's energy directly into electric energy. The term "solar vehicle" usually implies that solar energy is used to power all or part of a vehicle's forward motion. Solar power may be used to supply

power for exchanges or controls or other supplementary functions.

## II. LITERATURE REVIEW

**Chandra Mouli B R,Manjunath D V,Mohammad Abuzar,K.R.Natraj**, [1] worked on implementation and simulation of charging circuit suitable for driving for DC motors.

**Amiraj.Nigam,Neel.M.Gandhi, Ravindra Jangid, Dr.D Bankar**, [2] worked on regenerative braking with solar hybrid system for electric vehicles.

**Gou Yanan**, [3] worked on improvement of electric vehicle,a braking regenerative energy recovery of electric vehicle was designed and the structure of it was introduced.

**Dr KS Badrinarayan,Abhishek G,Bhargav Tej Reddy,Hashim Beary,Premsagar.M**, [4] worked on solar powered electric car with regenerativ braking and wireless charging.here working principle of regenerative braking has been studied to eo promote the effeciency and realizaion of energy saving in electric vehicle along with application of photov of hybriolatics in them.

**The Tesla Model S**, [5] has been treated as both a must-have big boy toy for the as well as environmentally friendly transportation tech. So greatly regarded are Tesla's electric cars, in fact, that the Model S was voted the Motor Trend Car of 2013 Car .But how do Tesla's electric cars actually work? That answer requires a bit more explanation. The basics are straight forward, but real plot lies in the details of its futuristic car tech.Electricity charges a battery to give the Model S juice for a certain period of time, not unlike your smartphone or laptop.

**VoLks wagen**, [6] have also been involved in the developed of hybrid vehicles. The VW Chico was unveiled at the 1991 Frankfurt Motor Show. Switching between the two types of motive power is automatic with the petrol engine cutting in at around 60 km/h . A hybrid diesel e l e h c Golf has also been developed. The engine gearbox drive unit only

had to be increased by 58 mm to accommodate automatic clutch on either side of the electric motor and comparisons between the Golf diesel and Golf hybrid show comparable exhaust emissions and energy consumption

### III. BLOCK DIAGRAM

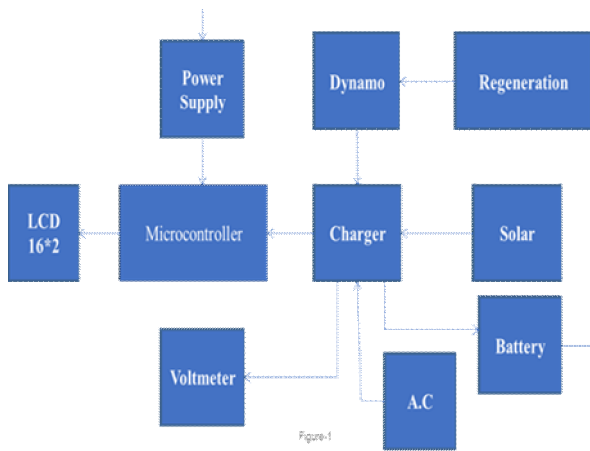


Figure 1.

Here we have three sources namely regenerative , solar and AC. When breaks are applied friction is produced and heat energy is generated .output is given to dynamo which converts mechanical energy into electrical energy. Output from solar , AC and dynamo is given to charger circuit. Output from charger circuit is given to microcontroller .power supply is designed and its output is given to microcontroller in order to operate it. Microcontroller output is given to LCD to display which source is available at given time. Voltmeter is used to show voltage produced by solar panel and regenerative mechanism.

### IV. WORKING PRINCIPLE

#### A) REGENERATIVE BRAKING SYSTEM:

Regenerative braking is a braking method that utilize the mechanical energy from the motor by converting kinetic energy into electrical energy and sent back into the battery source. The regenerative braking system can convert acertain amount of its kinetic energy to charge up the battery, using the same principle as an alternator. In regenerative braking mode, motor is used to slow down the car when the driver applies force to the brake pedal then the electric motor works in opposite direction thus slowing down the car. While running backwards, the motor acts as the generator and recharge the batteries as shown in fig 2. Meanwhile in fig 1 shows the car in normal running condition whereas the motor turning forward and taken energy from the battery. By using regenerative braking, it vastly reduces the reliance on fuel,

boosting fuel economy and lowering emissions . These types of brakes work successfully in driving environment such as stop-and-go driving situations especially in urban city. The regenerative braking system provides the greater part of the total braking force during low speed and stop-and-go traffic where most of deceleration is required. In the regenerative braking system, the braking controller is the heart of the system as it controls the on whole the process of the motor. The functions of the brake controller monitors the speed of the wheel, compute the torque, rotational force and generated electricity to be fed back into the batteries. During the braking operation, the brake controller directs the electricity produced by the motor into the batteries.

#### B) Solar Power

A solar vehicle is an electric vehicle powered completely or significantly by direct solar energy. Usually, photovoltaic (PV) cells restricted in solar panels adapt the sun's energy directly into electric energy. The term "solar vehicle" usually implies that solar energy is used to power all or part of a vehicle's propulsion. Solar power may be used to provide power for communications or controls or other supplementary functions. Solar vehicles are not sold as practical day-to-day transportation devices at present, but are primarily demonstration vehicles and engineering exercises, often sponsored by government agencies. However, circuitously solar-charged vehicles are extensive and solar boats are available commercially.

#### C) Ac Source

In ac source ac supply is taken and passed through step down transformer so step down transformer converts 230 v to 12 v.then 12 v supply is passed through bridge rectifier which keeps the positive polarity of the supply.Then we have filter block which removes the ripple content in supply.after that we have ic 7805 voltage regulator which gives output 5v as per the requirement.

### V. WORKING OF REGENERATIVE

#### A) BRAKING SYSTEM

Regenerative braking systems takes benefit of this duality. Whenever the electric motor of a hybrid car begins to reverse direction, it becomes an electric generator or dynamo. This generated electricity is put into a chemical storage battery and used later to supremacy the car at city speeds. Regenerative braking takes energy in general wasted during braking and turns it into usable energy. It is not, however, a

continuous motion machine. Energy is still misplaced through friction with the road surface and other drains on the system. The energy composed during braking does not bring back all the energy lost during driving. It does recover energy efficiency and assist the main alternator. Regenerative braking is a benefit of hybrid electric vehicles, whereby some of the translational energy of the vehicle is captured and returned to an energy storage device when the brake pedal is applied. This is different from conventional braking, in which a car is slowed through friction and the energy of the car is lost through waste heat. The energy recaptured by regenerative braking might be stored in the battery.

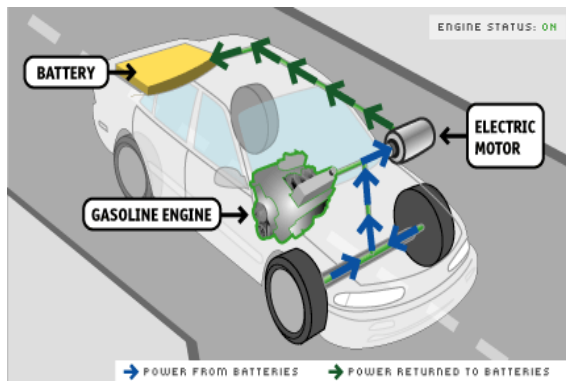


Figure 2.

**B) CHARGER**

Effectiveness of a solar system depends on the weather conditions. Usually the solar panel gets four to five hours of bright sunlight in a day. If the weather is cloudy or rainy, it affects the charging process and the battery does not attain full charge. This simple hybrid solar charger can determine the problem as it can charge the battery via both solar power as well as AC mains supply. When output from the solar panel is greater than 12 volts, the battery charges using the solar power. When the output drops below 12 volts, the battery charges through AC mains supply.

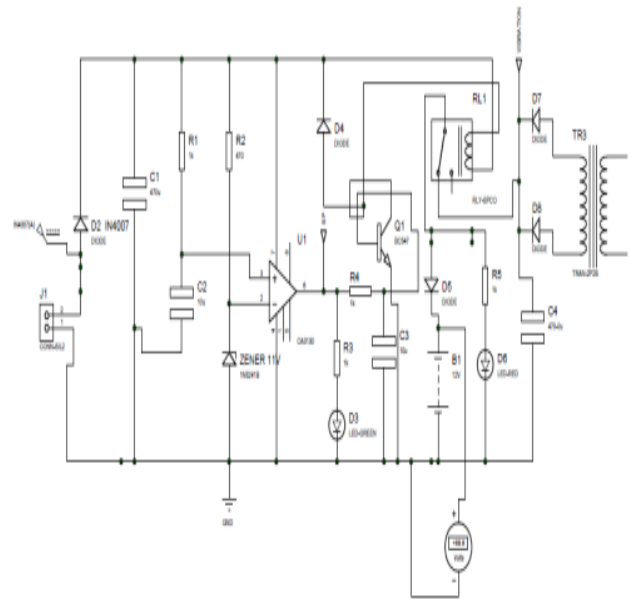


Figure 3.

**WORKING OF CHARGER CIRCUIT**

The hybrid solar charger shown in the figure, which is built around a 12V,10W solar panel (connected at SP1). Operational amplifier CA3130 (IC1), transistor BC547(T1), 12V single changeover relay (RL1), step-down transformer X1 and a few other components. In bright sun light, the 12V, 10W solar panel provide sup to 17 volts DC with 0.6-ampere current. Diode D1 provides reverse polarity guard and capacitor C1 buffers voltage from the solar panel. IC1 is used as a simple voltage comparator. Zener diode ZD1 provides a reference voltage of 11 volts to the inverting input of IC1, while the IC's non-inverting input gets voltage from the solar panel through R. When output from the solar panel is 12 volts or more, zener diode ZD1 conducts and provides 11 volts to the inverting terminal of IC1. Since its non-inverting high and the same is indicated by glowing green LED1. Transistor T1 then conducts and relay RL1 energizes. Thus the battery gets charging current from the solar panel in the course of the normally-open (N/O) and common contacts of relay RL1. LED2 indicates charging of the battery. Capacitor C3 is used to clean switching of transistor T1. Diode D2 protects T1 from back EMF and diode D3 prevents the discharge of battery current into the circuit. When output from solar panel drops below 12 volts, output of the comparator gets low and the relay de-energizes. Now the battery gets charging input gets a higher voltage at this time, the output of the comparator turns current from the transformer-based power supply through the normally closed (N/C) and common contacts of the relay. This power supply consist of step-down transformer X1, rectifying diodes D4,D5, and smooth capacitor C4.

### C) DYNAMO

Inside dynamo a permanent magnet is rotated in middle of some coils of wire. Rotating the magnet instead of the coils has an advantage that the slip rings are not required. The rotating magnet produces a changing magnet field and this generates electricity in the coils of wire. The summit of the dynamo is touched against the rim of the tyre which rotates when vehicle is moving.

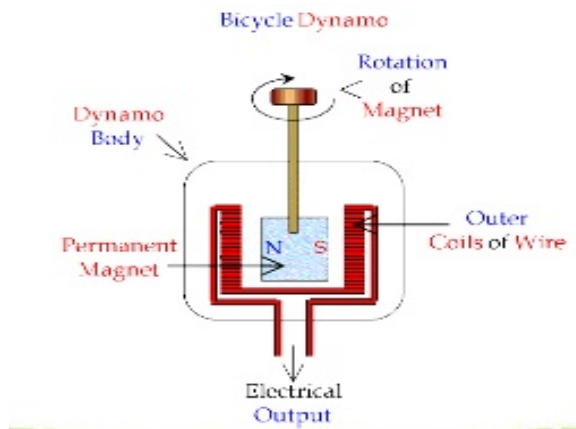


Figure 4.

### VI. ADVANTAGES & DISADVANTAGES

#### A. Advantages

1. Increase overall energy efficiency of a vehicle.
2. Improve performance.
3. Emission Reduction

#### B. Disadvantages

1. Vehicles can only be repaired by professionals.

### VII. CONCLUSION

For the first stage project presentation the required research work has been completed and the validation of project has been proved. Hence it can be said that the aim of the project “Regenerative braking system and solar hybrid car” can be achieved successfully.

### REFERENCES

- [1] Chandra Mouli B R, Manjunatha D V, Mohammad Abuzar, K.R. Nataraj “Implementation and simulation of charging circuit suitable for driving a dc motors” Department of ECE (SJBIT Bangalore) ISSN:2347-2820, Volume-1,Issue-2, 2013.
- [2] Amiraj Nigam , Neel M Gandhi, Ravindra Jangid, Dr. D S Bankar” Regenerative braking with solar hybrid system for electric vehicles” IJESC Journal of Electrical Engineering, ISSN 2321-3361, PP 4833-4836, May 2016.
- [3] Gou Yanan ,”Research on electric regenerative braking system and energy recovery” IJHIT Journal of Electrical Engineering, ISSN: 1738-9968, Vol.9, No.1(2016) PP-81-90.
- [4] Dr K N Badrinarayan , Abhishek G, Bhargav Tej Reddy, Hashim Beary, Premeagar M “Solar powered electric car with regenerative braking and wireless charging” IRJET Journal of Mechanical Engineer, ISSN-2395-0056, Volume:03 Issue :05, May-2016 .
- [5] Pulkit Gupta, Anchal Kumar,”Regenerative Braking Systems(RBS) (Future of Braking System), IJMPE, ISSN: 2320-2092,Volume-2,Issue-5, May-2014
- [6] Ayush Goel, Rajveer Mittal, “Renewable Source Of Mobility:A future Prospect”, IJAREEIE, ISSN:2320-3765, volume-5,Issue-6,june-2016.
- [7] T.Balmurgan, Dr.s.Manoharan, “Design of Solar/Electric Powered Hybrid Vehicle System With Charge Pattern Optimization for Energy Cost”, IJET, ISSN:0975-4024.
- [8] Amrit Anand Mahapatra, s.Gopalkrishna” Regenerative Braking in Induction Motor Drives in Applications to Electric Vehicles” 2014 IEEE Students Conference on Electrical, Electronics and Computer Science, 2014.
- [9] Douglas J. Nelson, “Rotating Inertia collision on forward motion and Regenerative Braking for Electric Motor Driven Vehicles “ IEEE, 2015.
- [10] P Dumitru, T Radu, O Marian, “Photovohaics changing the face of the big cities – electric bicycles supplied by solar panel “ 49th International Universities Power Engineerin Conference(UPEC), 2014,2-5 Sept.2014.