Alternator Based Self Charging Electric Car

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Abstract

This paper presents you about designing an electric car with in-built charging system for charging the batteries by the energy obtained from the front axle during running. This system can acts as multi-source charging system which the battery is charged by the in-built alternator, the solar panel and the plug-in AC voltage. Thus, the battery of an Electric vehicle can be charged on both the rest and running conditions. By this method, the charges can be reclaimed from alternators that were attached to the axle of the car. This paper also involves in design of Hybrid Electric Vehicle Intelligent Control System (HEVICS) for controlling the entire operation of the vehicle including the BLDC pulse control, battery management system (BMS), charge controller and Booster circuit. By using the available software's like Proteus 8, PSIM, and Matlab the vehicle can be simulated and be verified.

By using this technique, the battery can be charged to about 16.67% of the spent energy can be reclaimed and can be utilized further.

Keywords: electric vehicles, battery charging, restricted charge, sunlight based cell, alternator, dynamo

1. Introduction

Electric drives are as of now utilized for electric vehicles by drawn the power out of the batteries. Prior to the approach of the inner burning motor, the fuel motor contributed a powerful expense towards the underlying expense and running expense, however the electric vehicle turned out to be progressively well known in late nineteenth century as it were[2]. At that period in time, the electric automobiles didn't wind up standard in light of four essential reasons; 1) starting collecting costs were high; 2) running and working costs were high; 3) travel separation were confined; and 4) speed was compelled. In the electric vehicle, we for the most part utilize an electric power and their stock is demonstrated from the battery. Battery is introduced in an electric vehicle and furthermore to be mounted with the vehicle. The presentation of an electric vehicle is more when contrasted with another kind of vehicle [3]. It additionally has most extreme yield productivity as opposed to that of inward burning motor. At whatever point the

power is utilized in the vehicle, it delivers a zero level of discharge while it is running or in the underlying condition

This procedure is absolutely outflow less. It has capacity to convey the vehicle at least time. An electric vehicle has entirely unexpected work from that of interior ignition motor. The electric vehicle system, a controller is subjected to control the switches and circuit parameters Controller is straightforwardly associated with the engine, battery and another lighting framework. The engine drives to the quickening agent pedal that is controlled through the controller. In the electric vehicle, re-chargeable batteries are for the most part utilized [2]. The battery is accused of the charging framework. The electric vehicle system the principle segment is battery, controller, and other engine, moving parts of the vehicle. [20,14]

The battery has been charged through the house power, utilized for battery charging Electric vehicle can be changed to active vitality; power can be changed over from motor vitality to electric vitality. It has a base power misfortune and most extreme yield effectiveness instead of the inside burning motor which has less yield efficiency [1, 10, 20, 14]. The engine is introduced at the back differential between the back wheels. Alternator takes a shot at the standard of electromagnetic enlistment and it additionally moves around its pivot to create power [3]. With the establishment of the alternator, it expands the scope of battery and it provides power to battery for charging, meanwhile the vehicle is in running condition than the alternator generates power in the vehicle

In principle, the air conditioner alternator can be utilized to change over mechanical vitality to electrical vitality. Utilizing this hypothesis as the principle idea of this paper is to produce electric vitality by utilizing the option system [10]. Along these lines the power produced can be utilized for charging the batteries while the vehicle is moving

2. Methodology

The standard of this idea is to use an alternator that is related with the shaft of the front wheels [3]. As the shaft, the alternator is turning that along these lines delivers the electrical essentialness used for charging the batteries. The battery is related with the motors, which are presented on back wheels. Right when these vehicle batteries are totally empowered, that can energize the improvement of the vehicle. [1].

At the same time, the shaft of the turns of the back wheel, this in this manner turns the post of the alternator. In this manner, the battery begins to charge as the vehicle moves [29].
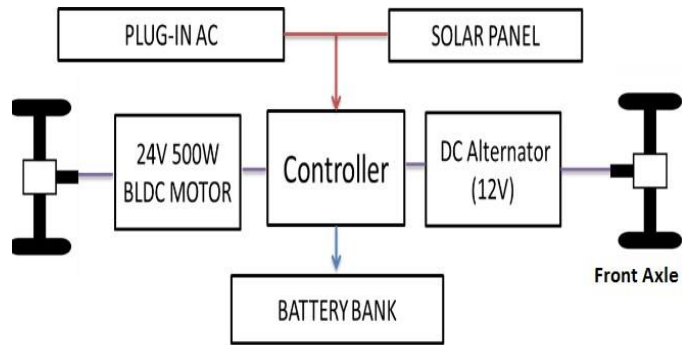
Figure 1 - System Layout

As featured over, the proposed framework is basic, appropriate and financially reasonable [2]. What should be noted and mulled over is the decision of fitting parts that coordinate the measure of the vehicle [1,20]. For model, if the maker chooses to apply this framework on a vehicle delegated little in weight and measurement, at that point the engines, alternator(s) and the batteries must be in relative extent and sizes [1, 4, 14].

3. Design Calculations

Required Torque Calculation:

$$T = F * r \tag{1}$$

$$F = m * a \tag{2}$$

Mass = 200 kg

Velocity=(0-5 Kmph) (1.38 m/sec) in 20 seconds

$$Acceleration = \frac{v}{t} \tag{3}$$

=1.38/20

a=0.069 m/sec2

∴Force= 200* .069 F =13.8N

Radius of tire = 0.25 meter

∴Torque = 20.7* 0.25

T=3.45Nm

Motor Torque Calculation:

416

$$Pout = \eta * Pin \tag{4}$$

η = 90%, PIN = 500 W, N = 2750 RPM

$$Pout = \omega * T \tag{5}$$

ω = 2π*N/60

ω = 2π *2750/60ω = 287.98 Rad

∴ 287.98 * T = 0.9*500

T = 1.56 Nm

Battery Calculation:

V =12V; 42A-h, Required current: 30amps

$$Pbattery = V * I \tag{6}$$
Pbattery = 2 * 12*30

Pbattery = 720 W/Hr

Time for discharge:

$$time = \frac{Pbattery}{Pmotor} \tag{7}$$

= 720/500

T= 1.44 Hours

T= 86.4 Minutes

By increasing the power of motor, the torque and power of the vehicle can be increased.

Energy conversion takes place from the front axle of the e car. The mechanical power is converted in to electrical power through an alternator. The figure 2 shows the front axle mechanical power conversion the mechanical torque and speed as fed as an input to the alternator
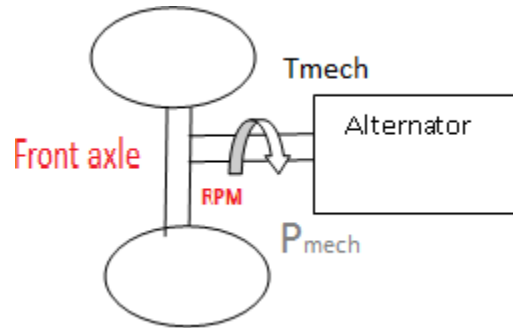
Fig 2 Front axle coupled alternator

The mechanical Power is expessed as,

(8)

$$P_{mech} = \frac{2\pi N}{} * T$$

60   *mech*

N-speed in RPM

Tmech - Torque of the system

The above equation (1) speed varies the power is varies so the generated electrical power depends on the speed of the front axle of e vehicle. The induced voltage in the alternator increases with respect to RPM that is shown in the figure 3.

DC alternator acts as a generator to produces electrical voltage. The induced emf of the generator as expressed as

$$E = \emptyset * N \tag{9}$$

The equation (8) shows that generated voltage influenced by magnetic flux ꞷ and speed of the front axle N
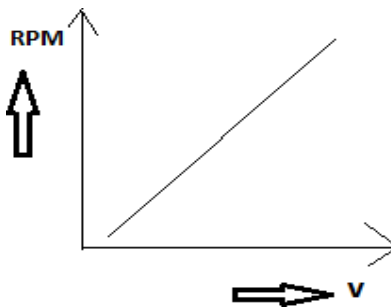
Fig 3 Relation between voltage vs RPM

4. Solar Panel, Battery & Controller Specifications

A Single Phase 220V 50Hz AC Supply has used for charging purpose and the power supply is rectified to 24V DC Supply for charging the battery.

Table 1. Solar Panel and Battery Specifications

Solar Panel	
PARAMETER	**RANGE**
Maximum power (W)	200
Optimum power voltage (Vmp)	18.2
Optimum operating current (Imp)	10.99

Open circuit voltage (V_{OC})	22.0V
Short circuit current (I_{SC})	12.12A
Solar cell: (mm)	125 x 125
Number of cell (pcs)	12 x 6
Surface maximum load capacity (Pa)	2400
Standard test conditions	.5, 1000W/m^2, 25°C (+/- 2°C)

Battery

Nominal Voltage	12V*2
Nominal Capacity	42Ah

5. Hardware Implementation

This proposed technique of a car alternator made a self generated electric car while running conditions. Thus, we obtained a car which has a capacity to charge the battery at the time of running itself.
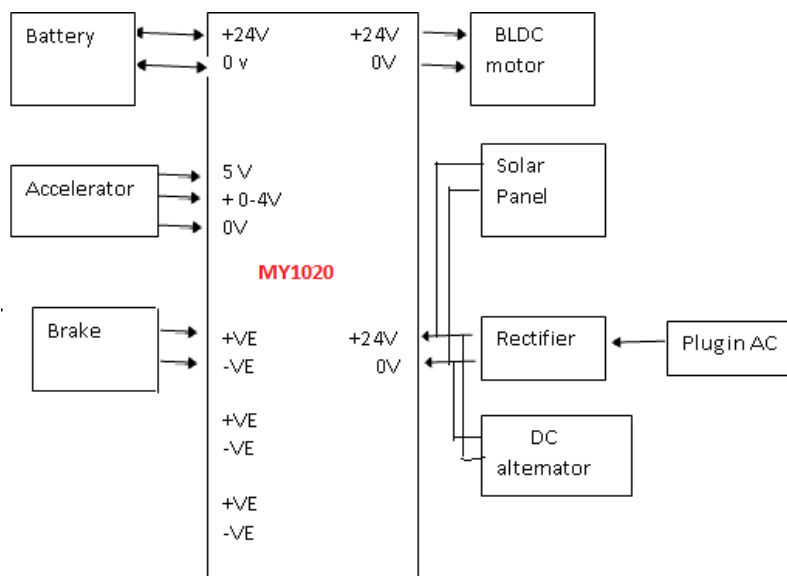

Fig 4.MY1020 Controller connection of e car system

The controller, which is used in this vehicle system, is MY1020 Single purpose motor controller. Here, this controller controls the entire activity of the electric vehicle including speed control, charge control, brake control, lighting control and the BMS control. An electronic speed control follows a speed reference signal (derived from a throttle lever, joystick, or other manual input) and varies the switching rate of a network of field effect transistors (FETs). By adjusting the duty cycle or switching frequency of the transistors, the speed of the motor is changed. The rapid switching of the transistors is what causes the motor itself to emit its characteristic high-pitched whine, especially noticeable at lower speeds.

This method improves the charging sources of electric vehicle and it increases travelling distance meanwhile reducing the idle charging time

A 500W motor has a capacity to carry limited load, increasing the capacity of motor and the battery may lead to the increase in load capacity. In addition, the charging capacity during run time is achieved in such a way that, this system can charge up to 16.67% of the spent energy while running. The voltage obtained from alternator is about 14V while it is rotating at a speed of 900RPM.

Thus, here we have obtained nearly the quarter of the spent energy while driving and it leads to the extra distance coverage while running. The charge time of the battery is also reduced.

The experimental setup of e car as shown in figure 5(a) & 5(b). The solar panel has placed on the top of the vehicle to receive the solar radiation in the angle of 90^{0} to obtained high amount of power generation

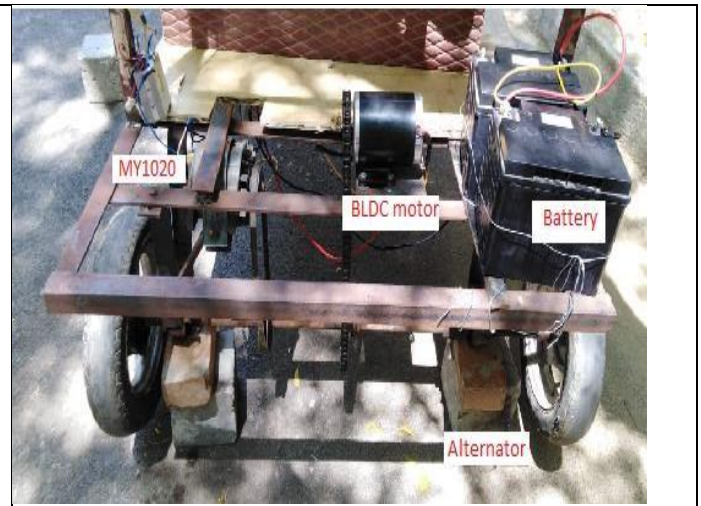**Table 2 BLDC motor specifications**

BLDC	
PARAMETER	RANGE
Operating Power:	500W
Operating Voltage:	24 V.
Rated Current:	Rated: 27.4A, No Load: 2.5A.
Rated Speed:	2750 RPM.
Rated Torque:	1.9 N.M.

Fig .5(a) Overall experimental setup of E car proposed system of E car

Fig .5(b) Experimental setup of

The car has only one gear ratio, and the motor simply runs in the opposite direction to make the car go in reverse. Some custom-built electric cars with DC motors also have this feature, using an electrical switch to reverse the direction of the motor, but others run the motor in the same direction all the time and use a traditional manual or automatic transmission to reverse direction

5.1 Energy Regenerated
Energy Output by alternator for 1 hour = 24*12

= 288 Watts/Hr.
Total run time at single charge = 1.44 Hours

∴ Approx. Energy Generated at full run
= 288*1.44

= 414.72 Watts

6 . Conclusion

There is an enhancement of key features in proposed framework, which separates and differentiates the system from the existing power flow system, which had been implemented for electric vehicles [1]. The proposed technique self generating module which generates energy while e car running at specified RPM and it has been utilized to increases the battery energy and reduces the battery discharge time period while comparing it with the normal vehicles. The amount of energy generated can be used for the future usage This technique has been implemented in e vehicle and hardware setup experimental results shows that battery energy level improves of 16.67 % of its total energy capacity.

422

The improvement of electric cars extents above one hundred kilometers with a lone charge are open in the market anyway there are a couple of issues, for instance, esteem, travel go and time period of charging of battery [20]. Methodology for controlling the time period of battery charging and the openness of trading the batteries at the most ideal arranging, the electric vehicle is prepared for travelling more than hundreds of kilometers without experiencing even one snapshot of charge from the batteries, considering the way that the vehicle is automatically charging its batteries

5. Future Expansion

- The convention IC engines will be partially replaced by the Electric motors.
- Development in machines manufacturing may lead to generate more than 80% of energy from the moving vehicle.

- The advancement of semiconductors may result in developing the highly advanced controllers for controlling electric vehicle.

6. Declaration:

On behalf of all authors, the corresponding author states that there is no conflict of interest.

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