International Journal of Science and Research (IJSR)
ISSN: 2319-7064
Impact Factor (2018): 7.426

Electric Vehicle with Self-Charging Capability

Sawan

YMCA University of Sciences and Technology, Faridabad, Haryana, India

Abstract: ***Electric vehicle are bringing new revolution in automobile industries and are much better in comparison of fuel vehicle present on the roads due to its low maintenance and eco-friendly properties. The proposed work deals with the fabrication and testing of an electric vehicle with self-charging concept for two persons. The motor uses electrical energy from battery and another battery installed receives energy from two alternators attached with rotating wheel and gets charged at the same time. A 48v 850 watts BLDC motor is used which gives a peak torque of 18 nm and the alternator has the capacity to produce 12v to 14v, which is directed to DC-DC converter. Here DC voltage produced by alternator is stepped up to 26v and 26v which produces an enough current for charging the batteries connected in a set of 24v and 24v with two alternators. And for rotating motor the batteries are connected in series to sum up 48v .Thus when one battery set of 48v gives energy to the rotating motor for motion the secondary 4 batteries gets charged by the electricity produced by alternators at the same time and vice versa. Hence our observation gives a data of charging batteries using the same rotational energy and stores up to 70% of energy back to the next battery pack. Hence our vehicle is more efficient and can give more life to the vehicle for the same charge time. Hence a self-charging vehicle in light of BLDC motor and Alternator has high effectiveness, zero contamination, is planned in this anticipate.***

Keywords: Self charging, BLDC motor, Alternator, DC-DC converter

1. Introduction

A battery powered vehicle which is used in transporting the people And goods from one place to another place is called as an electric Vehicle. Electric vehicle enjoyed popularity between the late 19th Century and early 20th century due to a level of comfort and ease of operation that could not be achieved by the gasoline cars of the time. [1]

Electric vehicles are becoming popular and more prevalent due to increased cost of gasoline and concern regarding the reduction of harmful greenhouse gas emissions. Electric vehicle is provided with an electric motor as an alternative to using an internal Combustion engine, which is powered by the installed batteries. Earlier reviews of electric cars clearly stated that the electric cars are ideal because is a cleaner, quieter and more economic means of transportation as opposed to the internal combustion engine. Transport sector plays a major role in emission of carbon-dioxide it contributes to about 17-18% of the emission of carbon dioxide. [2]

Charge the vehicle using kinetic energy generated by the vehicle itself. The hybrid technologies allow for the use of electric propulsion at lower speeds and conversion to the internal combustion engine at higher speeds, therefore extending the drive time some of the earlier designs of electric cars included a means to for the electric car. More recently, total electric cars are being introduced on the market to completely eliminate the use of internal combustion and make use of In-wheel motor system on rear wheels for small electric vehicle, the combination structure of each component. The key point of In-Wheel motor system to be applied in small electric vehicle is the integration capability to meet the requirements such as wheel space, power performance, strength of components [3].

One drawback to electric vehicle is that batteries must be recharged after a certain time. Faisal H. Khan represented a new

Technique to obtain isolated dc voltage outputs from a capacitor clamped dc-dc converter. The multilevel modular capacitor clamped converter (MMCCC) has several key features that make it possible to generate ac outputs (10 KHz) from dc-dc converter circuit. [4]. such a device installed on a modern car may therefore increase the range of the battery and provide an effective means to recharge the battery while the vehicle is in motion.

Proposed work is based on the technology which overcomes the drawback of electric vehicle of being charged after a certain time interval up to a certain time. The arrangements and the manufacturing of such a vehicle have given an efficient way method of charging vehicle by its own propulsion and to store its self-generated energy to increase the efficiency of the vehicle. Which decreases the energy consumption and provides more convenient way of using an electric vehicle for the user.

2. Materials and Methods

Brushless DC Motor

Brushless DC electric motor (BLDC motors, BL motors) and also known as electronically commutated motors, are synchronous motors powered by DC electricity via an inverter or switching power supply. In the vehicle a 48 voltes motor is used which has an ampere rating of 18.5 amp and delivers a maximum power of 850 watt.

The construction of a brushless motor system is typically similar to a permanent magnet synchronous motor (PMSM), but can also be a switched reluctance motor, or an induction (asynchronous) motor. The advantages of a brushless motor over brushed motors are high power to weight ratio, high speed, and electronic control. Brushless motors find

applications in such places as computer peripherals (disk drives, printers), hand-held power tools, and vehicles ranging from model aircraft to automobiles.

The construction of a brushless motor system is typically similar to a permanent magnet synchronous motor (PMSM), but can also be a switched reluctance motor, or an induction (asynchronous) motor. The advantages of a brushless motor over brushed motors are high power to weight ratio, high speed, and electronic control. Brushless motors find applications in such places as computer peripherals (disk drives, printers), hand-held power tools, and vehicles ranging from model aircraft to automobiles.

Alternator:

An alternator is an electrical generator that converts mechanical energy to electrical energy in the form of alternating current. For reasons of cost and simplicity, most alternators use a rotating magnetic field with a stationary armature. Occasionally, a linear alternator or a rotating armature with a stationary magnetic field is used.

In principle, any AC electrical generator can be called an alternator, but usually the term refers to small rotating machines driven by automotive and other internal combustion engines. An alternator that uses a permanent magnet for its magnetic field is called a magneto. Alternators in power stations driven by steam turbines are called turbo-alternators. Large 50 or 60 Hz three-phase alternators in power plants generate most of the world's electric power, which is distributed by electric power grids.

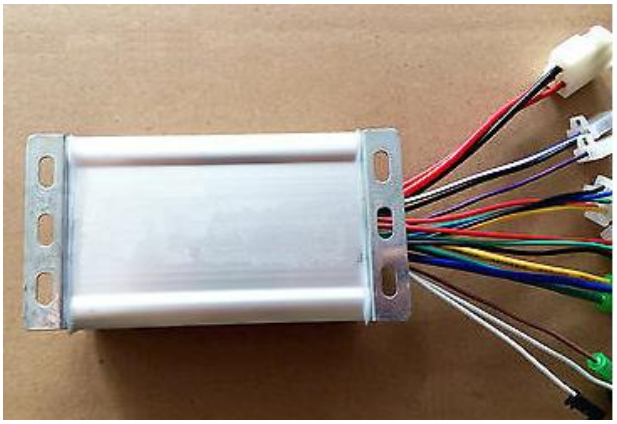
Lead Acid Batteries

The lead–acid battery is the oldest type of rechargeable battery and have a very low energy-to-weight ratio, low energy-to-volume ratio, relatively large power-to-weight ratio. These features, along with their low cost, make them attractive for use in motor vehicles to provide the high current required by automobile starter motors.

As they are inexpensive compared to newer technologies, lead–acid batteries are widely used even when surge current is not important and other designs could provide higher energy densities. In 1999 lead–acid battery sales accounted for 40–45% of the value from batteries sold worldwide excluding China and Russia, and a manufacturing market value of about $15 billion Large-format lead–acid designs are widely used for storage in backup power supplies in cell phone towers, high-availability settings like hospitals, and stand-alone power systems. For these roles, modified versions of the standard cell may be used to improve storage times and reduce maintenance requirements.

Motor Controller

A motor controller is a device or group of devices used to control the electric motor. That includes a manual or automatic means for starting and stopping the motor, selecting forward or reverse rotation, selecting and regulating the speed, regulating or limiting the torque, and protecting against overloads and faults.



Every electric motor has to have some sort of controller. The motor controller will have differing features and complexity depending on the task that the motor will be performing. The simplest case is a switch to connect a motor to a power source, such as in small appliances or power tools. The switch may be manually operated or may be a relay or contactor connected to some form of sensor to automatically start and stop the motor. The switch may have several positions to select different connections of the motor. This may allow reduced-voltage starting of the motor, reversing control or selection of multiple speeds. Overload and over current protection may be omitted in very small motor controllers, which rely on the supplying circuit to have over current protection. Small motors may have built-in overload devices to automatically open the circuit on overload. Larger motors have a protective overload relay or temperature sensing relay included in the controller and fuses or circuit breakers for over current protection. An automatic motor controller may also include limit switches or other devices to protect the driven machinery.

DC to DC Converter

A DC-to-DC converter is an electronic circuit or electromechanical device that converts a source of direct current (DC) from one voltage level to another.

Practical electronic converters use switching techniques. Switched-mode DC-to-DC converters convert one DC voltage level to another, which may be higher or lower, by storing the input energy temporarily and then releasing that energy to the output at a different voltage. The storage may be in either magnetic field storage components (inductors, transformers) or electric field storage components (capacitors). This conversion method can increase or decrease voltage. Switching conversion is often more power-efficient (typical efficiency is 75% to 98%) than linear voltage regulation, which dissipates unwanted power as heat. Fast semiconductor device rise and fall times are required for efficiency; however, these fast transitions combine with layout parasitic effects to make circuit design challenging.[5] The higher efficiency of a switched-mode converter reduces the heat sinking needed, and increases battery endurance of portable equipment.

Operation

In operation, the BLDC motor is driven by set of 4 drive batteries which are connected in series to provide 48 volts and 60 Ah respectively. The motor connected to sprocket in rear axle through a chain drive system propels the vehicle and hence acts as a drive train. As the vehicle begins to move, the two pulleys keyed to rear axle connected to alternator spindle through a belt begin to rotate, this rotates the pulleys of alternators, which disturbs the magnetic Flux thereby generating the voltage and current which is directed towards the dc-dc converters connected with two alternators which steps up the voltage to charge another set of four batteries connected in set of two making a sum of 24volts for charging using alternators current. When one battery set gets discharged, another battery set charged as a result of propulsion comes in the workplace of main battery and another begins to charged and vice versa.

Despite of all these things the vehicle built upon an iron rod chassis. The body is made up of iron sheet. Mig welding is used for the management of the parts of the vehicle. A 3:1 gear set is set for the propulsion purpose to provide desired torque during different driving conditions. The same gear set is used in the alternators operation through axle.

3. Principles and methods

The manufactured vehicle stores its own energy and works on the principle that when a conductor moving relative to a magnetic field develops an electromotive force (EMF) in it (Faraday's Law). This EMF reverses its polarity when it moves under magnetic poles of opposite polarity. Typically, a rotating magnet, called the rotor turns within a stationary set of conductors wound in coils on an iron core, called the stator. The field cuts across the conductors, generating an induced EMF (electromotive force), as the mechanical input causes the rotor to turn. The generated voltage is then treated by a dc-dc convertor which steps up the voltage to charge another battery set. A cut out is used which automatically switches the batteries on a certain low voltage in use.

The development of semiconductor electronics in the 1970s allowed the commutator and brushes to be eliminated in DC motors. In brushless DC motors, an electronic Servo system replaces the mechanical commutator contacts.[5][6][7] An electronic sensor detects the angle of the rotor, and controls semiconductor switches such as transistors which switch current through the windings, either reversing the direction of the current, or in some motors turning it off, at the correct time each 180° shaft rotation so the electromagnets create a torque in one direction. The elimination of the sliding contact allows brushless motors to have less friction and longer life; their working life is only limited by the lifetime of their bearings.

Brushed DC motors develop a maximum torque when stationary, linearly decreasing as velocity increases. Some limitations of brushed motors can be overcome by brushless motors; they include higher efficiency and a lower susceptibility to mechanical wear. These benefits come at the cost of potentially less rugged, more complex, and more expensive control electronics. Two key performance parameters of brushless DC motors are the motor

constants K_T (torque constant) and K_e (back EMF constant also known as speed constant $K_V = 1/K_e$).

In SI units K_T and K_V are the same constant:

$$K_t = \frac{\text{newton meter}}{\text{Amp}} = \frac{\text{Kilogrammeter}^2}{\text{Amperesecond}^2}$$

$$K_e = \frac{\text{Volt second}}{\text{Radian}} = \frac{\text{kilogrammeter}^2}{\text{amperesecond}^2}$$

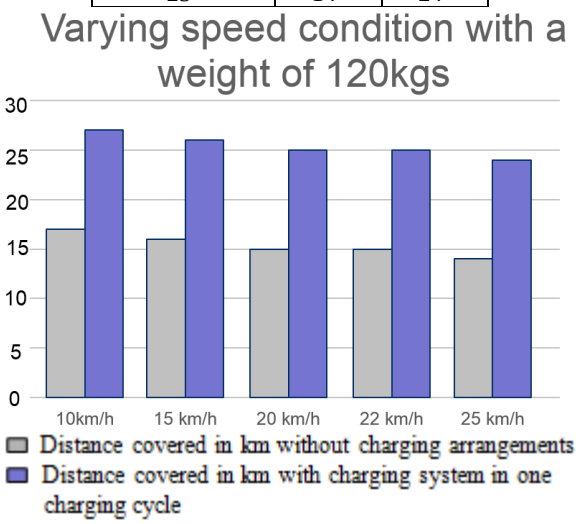
4. Observations

A battery electric vehicle with self-charging capability is made with all required connections and support on the firmly made chassis suitable to carry two passengers or a weight of 200 kg. The outcome of vehicle was expected to supply the adequate amount of current to charge the secondary battery set or vice versa.

The connections made so far provided the supply to the batteries at the time of motion of vehicle using its own propulsion energy. The outcome of the made arrangements is observed number of trials. A set of 4 lead acid batteries with specifications as 12v and 60Ah is used in the work. The supply from these batteries is found to be useful in giving vehicle a power for 2hrs hours of propulsion. The output of the arrangement is observed for number of times with varying load. During the course the rotational energy is extracted by an alternator and transferred to dc to dc converter where it is stepped up. This is finally supplied to the another battery set to recharge charging of battery by vehicles own propulsion is observed for number of trials using Multimeter and output so noted is shown in graphs below.

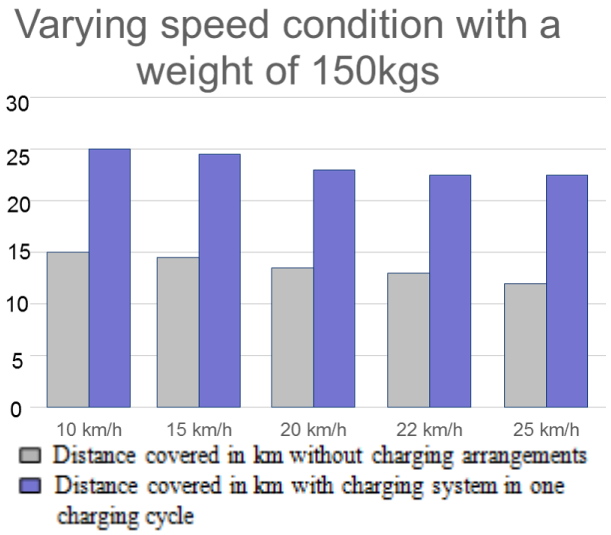
1) Readings of distance covered with varying speed with a load of 120 kg

Speed (km/hr)	Series 1	Series 2
10	17	27
15	16	26
20	15	25
22	15	25
25	14	24



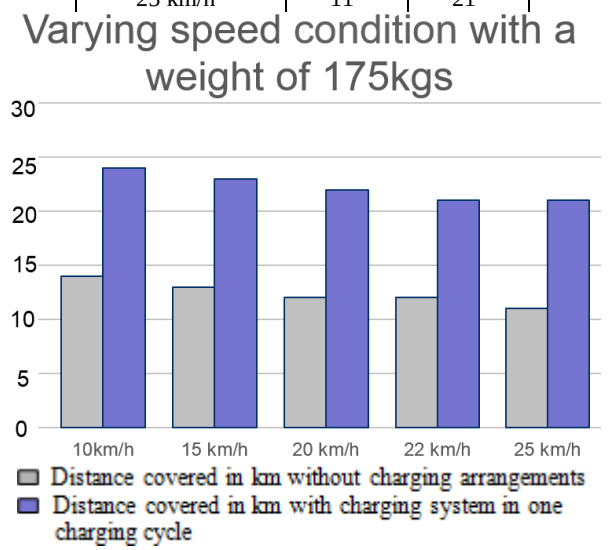
1. Readings of distance covered with varying speed with a load of 150 kg

Speed (km/hr)	Series 1	Series 2
10	15	25
15	14.5	24.5
20	13.5	23
22	13	22.5
25	12	22.5



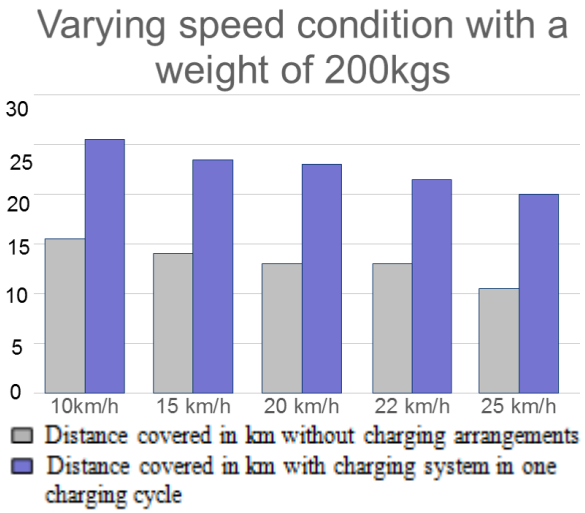
2. Readings of distance covered with varying speed with a load of 175 kg

Speed (km/hr)	Series 1	Series 2
10km/h	14	24
15 km/h	13	23
20 km/h	12	22
22 km/h	12	21
25 km/h	11	21



3. Readings of distance covered with varying speed with a load of 200 kg

Speed (km/hr)	Series 1	Series 2
10	15.5	25.5
15	14	23.5
20	13	23
22	13	21.5
25	10.5	20



4. Conclusions

The proposed work is defined to design an electric vehicle for use in closed circuit areas like golf clubs, tourist sites, industrial circuit, hospital corridors and lawns. The conventional electric vehicle works on a concept of plug in charging which is the main target of the work and is replaced by a new concept of self-charging. From the plotted graphs we concluded that the vehicle covered a longer distance when we installed a charging system in it with a set of secondary battery set. The vehicle was tested number of times for the supply to charge secondary batteries from DC-DC converter powered by alternators. The alternator used was successful in generating 12v-14v using the rotational energy from the wheels under motion. The DC-DC converters attached with alternators steps up the voltage to the 24v-25v DC which results in charging the batteries which is again used as a source battery when primary battery loses its energy.

References

[1] Suhas V, Sukeerth Calastawad, Phaneesh M, Swaraj S, Performance of a battery electric vehicle with self-charging capacity for its own propulsion,e-ISSN:2395-0056,p-ISSN:2395-0072,Volume:02 Issue 03, june-2015.
[2] Faisal H. Khan, Leon M. Tolbert, "5KW Multilevel DC-DC Converter for Hybrid Electric and Fuel Cell Automotive Applications".
[3] "Design Data Handbook Third Edition" by K.Mahadevan and K.Balaveera Reddy.
[4] Donghyun Kim, Kyeongho Shin, Youngkwang Kim and Jaeseung Cheon, Integrated Design of In-Wheel Motor System on Rear Wheels for Small Electric Vehicle, World Electric Vehicle Journal Vol. 4 Pg000597- ISSN 2032-6653 - © 2010 WEVA.
[5] Chi-Jen yang (2010)."Launching strategy for electric vehicles: Lesson from China and Taiwan". Technological Forecasting and Social Change (77):831-834.
[6] Moczala, Helmut (1998). Small Electric Motors. London: Institution of Electrical Engineers. pp. 165–166. ISBN 085296921X.
[7] ^ Jump up to: [a] [b] [c] [d] Xia, Chang-liang (2012). Permanent Magnet Brushless DC Motor Drives and Controls. John Wiley and Sons. pp. 18–19. ISBN 1118188365.
[8] ^ M. Gopal. Control systems: principles and design. 2nd ed. Tata McGraw-Hill, 2002. Page 165.
[9] Battery Types and Characteristics for HEV Thermo Analytics, Inc., 2007.Retrieved 11 June 2010.
[10] Reference books With Electric Machines, Power source Energy, Department of EEE