

# International Journal of Innovative Research in Science, Engineering and Technology

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## Design and Remodeling of SI Engine Vehicles to Electric Vehicle

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**ABSTRACT:** As the usage of fuels and the emission of toxic gases from the vehicles goes increasing now a days, the future relies more on renewable energy sources. The best alternative for the conventional SI engine is the electric vehicle. It comprises of BLDC motor which has the features of emission free transportation, low maintenance cost and less audible. The chemical energy from Lithium ion battery is converted to electrical energy for the purpose of primary charging. The speed and torque performance in this vehicle is increased compared to existing electric vehicles. The specification of this electric vehicle is Bevel type Gearwheel assemble. The forward/reverse switch helps to move the vehicle in forward or reverse direction as required.

**KEY WORDS:** BLDC Motor, Lithium ion Battery, Battery Management System (BMS), Charger, Bevel type Gearwheel assemble, Forward/Reverse Switch, and Throttle.

### I. INTRODUCTION

One of the most emerging technologies in the present scenario is the development of electric vehicle. The purpose for remodelling of SI engine is to maintain emission free transportation and efficient use of renewable energy sources. It widely plays a major role on upcoming generation and better technological solution on future. The piston part in the existing engine system is replaced by the BLDC motor driver in the vertical position. The Bevel type Gear wheel assembly changes the position of motor shaft from vertical position to horizontal position. With the help of this gear assembly, the efficiency of the vehicle is increased compared to the existing electric vehicle especially in Hill stations.

This electric vehicle comprises of Brushless DC Motor and Driver, Lithium ion battery and its charger, Battery Management System (BMS), Bike engine with Bevel type Gearwheel assemble, throttle and then a Forward/Reverse Switch for a reverse option. This vehicle is driven with the help of lithium ion battery which is coupled with the Brushless DC Motor. This motor is driven using the BLDC Driver which has the advantages like practically they require no maintenance and have a long life. Battery Management System (BMS) is used to protect the lithium ion battery from overcharging and some other faults.

### II. LITERATURE SURVEY

**Nasser H. Kutkut** et al proposed the scheme which involves charge equalization of a battery system in an electric Vehicle. This enhances the uniformity of the battery cells, so that it improves the life of the Battery. In this paper, the author proposed the basic technique which utilizes a simple isolated dc-to-dc Converter with a capacitive filter along with the multiwinding transformer [1].

**Giorgio Rizzoni** et al have described the repeatable and systematic process to explore hybrid electric vehicle power-train design concepts for a large variety of vehicles. It consists of typical parts such as power-train components which

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includes internal combustion engines, electric energy storage and conversion devices which includes batteries and electric motors. In this paper, the author proposed a framework for the generic classification of hybrid drive train components for the purpose of modelling and analysis of energy usage in hybrid vehicles [2].

**Khwaja M. Rahman** et al have discussed about the gearless wheel motor drive. In this paper, the author specifically designed for fuel cell electric and hybrid electric vehicle. This system involves a liquid-cooled axial flux permanent-magnet and it is designed to meet the direct-drive requirements. It consists of some techniques to increase the machine inductance in order to improve machine constant power range and high speed efficiency. It reduces machine spin loss and also optimises the placement of magnets in the rotor to reduce cogging and ripple torque [3].

**Kukhyun Ahn** et al has proposed the stimulation based design optimization of an electric vehicle propulsion system which requires integration of a system model with detailed models of the components. Especially, a high-fidelity interior-permanent-magnet(IPM) motor model. This model is necessary to capture important physical effects such as magnetic saturation. The system optimization is required to maintain adequate model fidelity with acceptable cost. This paper presents the resulting optimal design and associated energy efficiency for a variety of drive cycles [4].

**Mitesh M. Trivedi** et al has discussed about Design & Development of E-bike (Electric bicycles). It describes about the typical parts of E-Bike, they are Brushless DC Motor (Hub Motor), Throttle(Accelerator), Battery Storage(12V), Chain driver, Frame & other common bicycle parts. In this paper, the motor is activated by a throttle. By pedalling, electric motor can be controlled with pedal-assist and also it consists of a sensor to identify the pedaling force, pedaling speed or both. By using the brake sensing action, the Motor was disabled [5].

**Madhvi Sharma** et al have discussed about the sustainable and personal mobility solutions which have traditionally revolved around the utilization of bicycles. This paper uses the innovative solution as “Redemption springer forks” in front suspension with electric motor for assistance. This e-bike was incorporated with battery and an electric motor (BLDC Motor) which used by the propulsion method. In Particular, BLDC motor is used because of the main advantage that they do not have brushes [6].

**Esther Salmeron-Manzano** et al has described about the old fashioned recreation product because of the less pollution. This electric bicycle is a type of electric vehicle based on a traditional bicycle to which an electric motor has been added to help propel it. This is because it is an ecological and environmental, then its source of energy is a battery. It plays a more important role because they were an economic and simple option for urban transport problems. The batteries of the electric bicycles can be recharged by connecting them to a plug or when pedaling in some gears [7].

**C. Nagarajan** et al [3,5,10] has explained about the smart electric bike which is eco-friendly. The author concerning about the different ways by which can save energy in different sectors. In this paper, the author considered about the automobile sector where we are converting old petroleum bike to electric bike. This electric bike includes electrical motor instead of combustion engine and Li-ion battery which is coupled with this motor. It uses an electric energy as a primary source [8].

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### III. BLOCK DIAGRAM

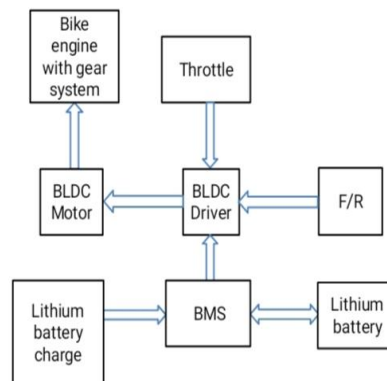


Fig1. Block diagram of proposed solution

### IV. DESCRIPTION OF PROPOSED METHOD

Our solution is to design an electric vehicle that replaces the conventional SI engine. It is designed for the purpose of limiting atmospheric pollution.

In this the piston part in the existing engine system is replaced by the BLDC motor driver in the vertical position. The Bevel type Gear wheel assembly changes the position of motor shaft from vertical position to horizontal position. With the help of this gear assembly, the efficiency of the vehicle is increased compared to the existing electric vehicle especially in Hill stations.

Lithium ion battery is used for the primary charging to the motor. The batteries are connected in series - parallel combination. If the battery is connected in series and parallel, it provides voltage and current respectively.

The SI engine can be replaced in place of BLDC motor driver when required.

### HARDWARE REQUIREMENTS

#### Lithium ion battery:

- The TP4056 is a low-cost Lithium Ion battery charger controller IC.
- It supports a constant current – constant voltage charging mechanism for single cell Li-Ion Battery.
- It is available in 8-pin SOP package and requires very minimum external components in order to build a Lithium Ion battery charger circuit.

#### Lithium ion battery charger:

- Lithium based batteries are a versatile way of storing energy; they have one of the highest energy density and specific energy(360 to 900 kJ/kg) among rechargeable batteries.
- Most lithium-ion batteries are charged to 4.2v per cell, higher voltages could increase capacity, but reduce service life.
- And lower ones can increase battery charge cycles at the cost of less run time.

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Fig2. Lithium ion battery

### E-Bike motor controller:

The KU63 motor controller is small and lightweight and well suited for 250W motors.

- BLDC motor 36V 250W
- Maximum current 12A
- Motor HALL sensor or sensorless operation
- Battery undervoltage detection ~27.7V
- Overtemperature protection
- Brake high voltage level and low voltage level input

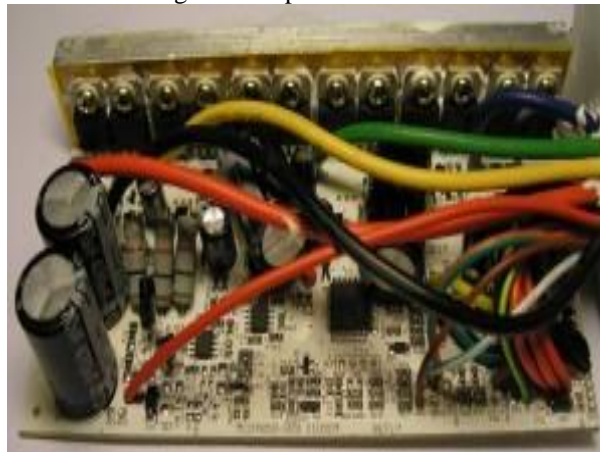


Fig3. Controller

### BLDC Motor:

- The BLDC motor is widely used in applications including appliances, automotive, aerospace, consumer, medical, automated industrial equipment and instrumentation.
- The BLDC motor is electrically commutated by power switches instead of brushes.
- Compared with a brushed DC motor or an induction motor, the BLDC motor has many advantages:
  - ✓ Higher efficiency and reliability
  - ✓ Lower acoustic noise

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- ✓ Smaller and lighter
- ✓ Greater dynamic response
- ✓ Better speed versus torque characteristics
- ✓ Higher speed range
- ✓ Longer life



Fig4. BLDC motor

### Throttle:

- The Italian made Domino twist throttle is high quality with a five wire output and a built in micro switch for added safety.
- The potentiometer can be configured in a 2 or three wire mode outputting either 0-5K or 5K-0 ohm.
- The potentiometer in this model is weather sealed to IP67.
- Domino offers an identical model that is IP54. IP67 = Dust proof & water proof to 10 feet under IP54 = Limited dust protection & water resistant to splashes
- Five wire output.
- Includes microswitch.
- Comes with matching 5" grip for opposite side.
- Comes with mating Tyco Superseal 5 connector with pins and seals.
- Fits 7/8" handle bars.
- Max potentiometer voltage 40V, max microswitch voltage 24V.

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Fig5. Throttle

### Battery Management System(BMS):

A battery management system can be comprised of many functional blocks including: cutoff FETs, a fuel gauge monitor, cell voltage monitor, cell voltage balance, real time clock (RTC), temperature monitors and a state machine. There are many types of battery management ICs available. The grouping of the functional blocks varies widely from a simple analog front end that offers balancing and monitoring and requires a microcontroller (MCU), to a standalone, highly integrated solution that runs autonomously.



Fig6. Battery management system(BMS)

### Bevel type Gearwheel assemble:

Spiral bevel gears have their teeth formed along spiral lines. They are somewhat analogous to cylindrical type helical gears in that the teeth are angled; however, with spiral gears the teeth are also curved. The advantage of the spiral tooth over the straight tooth is that they engage more gradually. The contact between the teeth starts at one end of the gear and then spreads across the whole tooth. This results in a less abrupt transfer of force when a new pair of teeth come into play. With straight bevel gears, the abrupt tooth engagement causes noise, especially at high speeds, and impact stress on the teeth which makes them unable to take heavy loads at high speeds without breaking. For these reasons straight bevel gears are generally limited to use at linear speeds less than 1000 feet/min; or, for small gears, under 1000 rpm.

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Fig7. Spiral Bevel type assemble

### V. CONCLUSION

The development of electric vehicle is going to be the most adoptable technology in the future. This is because of the reasons of reduced noise and air pollution, reduced usage of non-renewable energy sources and the efficient use of energy. The piston part in this vehicle can be replaced by the SI engine system when required which is not possible in the existing electric vehicle. The luxury of the SI engine vehicle cannot be changed by using this methodology. Moreover, these vehicles are eco-friendly and require less maintenance.

### REFERENCES

- [1] Nasser H. Kutkut, Design Considerations for Charge Equalization of an Electric Vehicle Battery System. IEEE transactions on industry applications, vol. 35, No. 1, January/february 1999.
- [2] Giorgio Rizzoni, Unified Modeling of Hybrid Electric Vehicle Drivetrains. IEEE/ASME Transactions on Mechatronics, vol.4, No. 3, September 1999.
- [3] C.Nagarajan and M.Madheswaran - 'Stability Analysis of Series Parallel Resonant Converter with Fuzzy Logic Controller Using State Space Techniques' - Electric Power Components and Systems, Vol.39 (8), pp.780-793, May 2011
- [4] KhwajaM.Rahman, Application of Direct-Drive Wheel Motor for FuelCell Electric and Hybrid Electric Vehicle Propulsion System. IEEE transactions on industry applications, vol. 42, No. 5, September/October 2006.
- [5] E Geetha, C Nagarajan, "Induction Motor Fault Detection and Classification Using Current Signature Analysis Technique", 2018 Conference on Emerging Devices and Smart Systems (ICEDSS), 2nd and 3rd March 2018, organized by mahendra Engineering College, Mallasamudram, PP. 48-52,2018
- [6] KukhyunAhn, Electric Vehicle Design Optimization: Integration of a High-Fidelity Interior-Permanent-Magnet Motor Model.IEEE transactions on Vehicular Technology, vol. 64, No. 9, September 2015.
- [7] Mitesh M. Trivedi,Design & Development of E-Bike. NOV 2017 | IRE Journals | Volume 1 Issue 5 | ISSN: 2456-8880.
- [8] Madhvi Sharma, R&D On Electric Bike. International Research Journal of Engineering and Technology (IRJET), Volume: 05 Issue: 02 | Feb-2018.
- [9] Esther Salmeron-Manzano, The Electric Bicycle: Worldwide Research Trends. Received: 26 May 2018; Accepted: 18 July 2018; Published: 20 July 2018.
- [10] C. Nagarajan, M.Madheswaran and D.Ramasubramanian- 'Development of DSP based Robust Control Method for General Resonant Converter Topologies using Transfer Function Model'- Acta Electrotechnica et Informatica Journal , Vol.13 (2), pp.18-31, April-June.2013
- [11] SunikshitaKatoch, Design and Implementation of Smart Electric Bike Eco-Friendly.International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075, Volume-8, Issue- 6S4, April 2019.