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On 26th & 27th March 2015

Energy Efficient Hybrid Electric Bike with Multi -Transmission System

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ABSTRACT: In automobile sector, the need for alternative fuel as a replacement of conventional fossil fuel, due to its depletion and amount of emission has given way for new technologies like Electric vehicles. Still a lot of advancement has to take place in these technologies for commercialization. The gap between the current fossil fuel technology and zero emission vehicles can be bridged by hybrid technology. Hybrid vehicles are those which can run on two or more powering sources fuels. This technology maximizes the advantages of the two fuels and minimizes the disadvantages of the same. The best preferred hybrid pair is electric and fossil fuel. In this paper the Hybrid bike system, the power is delivered both via an internal combustion engine and electric motor. The electrical power is used to achieve either better fuel economy than a conventional vehicle, better performance and it cause less pollution. Driving mode selectivity improves this system more economical, stable and more efficient.

KEYWORDS:. Internal combustion engine, Electric motor, Fuel economy, Dual mode vehicles.

I.INTRODUCTION

One of the major problem that we face on day to day life is Energy Crisis. Our paper is one of the solutions for energy crisis. The system we implemented is a hybrid electric bike. The project has a number of benefits to both the team members as well as external benefits through increasing awareness of alternative transportation modes. Despite the environmental friendliness of the project or the projected benefits of more people relying on non-polluting modes of transport, the main reason we selected the project was for the level of interaction between us, the engineers, and our product. Designing a transportation vehicle requires consideration of mechanical objectives, electrical objectives, safety criteria, comfort, user friendliness as well as an array of other objectives which may conflict under various circumstances. We hoped that through navigating our way through this vast set of criteria the satisfaction of completing the project would be much greater than other projects we could have selected.

II. BLOCK DIAGRAM DESCRIPTION

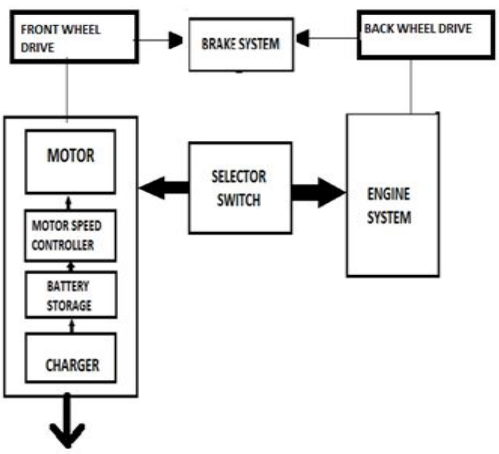

Fig 2.1 Block Diagram of HYBRID BIKE

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II.A BLDC MOTOR (BRUSHLESS DC MOTOR)

Brushless DC electric motor (BLDC motors, BL motors) also known as electronically commutated motors (ECMs, EC motors) are synchronous motors that are powered by a DC electric source via an integrated inverter/switching power supply, which produces an AC electric signal to drive the motor. In this context, AC, alternating current, does not imply a sinusoidal waveform, but rather a bi-directional current with no restriction on waveform. Additional sensors and electronics control the inverter output amplitude and waveform (and therefore percent of DC bus usage/efficiency) and frequency (i.e. rotor speed).
The rotor part of a brushless motor is often a permanent magnet synchronous motor, but can also be a switched reluctance motor, or induction motor.
Brushless motors may be described as stepper motors; however, the term stepper motor tends to be used for motors that are designed specifically to be operated in a mode where they are frequently stopped with the rotor in a defined angular position. This page describes more general brushless motor principles, though there is overlap.

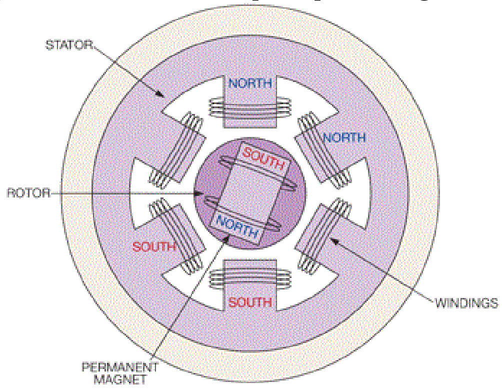

Fig 2.2 BLDC motors have a motor with a permanent magnet containg north and south poles.

Two key performance parameters of brushless DC motors are the motor constants Kv and Km (which are numerically equal in SI units). The four poles on the stator of a two-phase brushless motor. This is part of a computer cooling fan; the rotor has been removed.

Specifications

•	800 watt
•	Max torque = 33Nm@150rpm
•	48Volt
•	Max speed of electric motor :35km/hr

II.B BATTERY STORAGE

LEAD ACID BATTERY

The lead–acid battery was invented in 1859 by French physicist Gaston Planté and is the oldest type of rechargeable battery. Despite having a very low energy-to-weight ratio and a low energy-to-volume ratio, its ability to supply high surge currents means that the cells have a relatively large power-to-weight ratio. These features, along with their low cost, makes it 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. 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. Gel-cells and absorbed glass-mat batteries are common in these roles, collectively known as VRLA (valve-regulated lead-acid) batteries.

Due to the freezing-point depression of the electrolyte, as the battery discharges and the concentration of sulfuric acid decreases, the electrolyte is more likely to freeze during winter weather when discharged.
During discharge, H+ produced at the negative plates and from the electrolyte solution moves to the positive plates

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where it is consumed, while HSO_4^- is consumed at both plates. The reverse occurs during charge. This motion can be by diffusion through the medium or by flow of a liquid electrolyte medium. Since the density is greater when the sulfuric acid concentration is higher, the liquid will tend to circulate by convection. Therefore a liquid-medium cell tends to rapidly discharge and rapidly charge more efficiently than an otherwise similar gel cell.

Fig 2.3 Lead acid battery

II.C BRAKING SYSTEM

Brakes are used to reduce or cease the speed of motors. We know that there are various types of motors available (DC motors, induction motors, synchronous motors, single phase motors etc.) and the specialty and properties of these motors are different from each other, hence this braking methods also differs from each other. But we can divide braking in to three parts mainly, which are applicable for almost every type of motors
During braking, the motor fields are connected across either the main traction generator (diesel-electric locomotive, hybrid electric vehicle) or the supply (electric locomotive, electric vehicle) and the motor armatures are connected across braking grids (rheostat) or the supply (regenerative). The rolling wheels turn the motor armatures and when the motor fields are excited, the motors act as generators.

Types of Braking

i) Dynamic Braking.
ii) Regenerative Breaking

Dynamic braking

Dynamic braking is the use of the electric traction motors of a vehicle as generators when slowing. It is termed *rheostat* if the generated electrical power is dissipated as heat in brake grid resistors, and regenerative if the power is returned to the supply line. Dynamic braking lowers the wear of friction-based braking components, and additionally regeneration reduces energy consumption.
During dynamic braking, the traction motors, which are now acting as generators, are connected to the braking grids of large resistors which put a large load on the electrical circuit. When a generator circuit is loaded down with resistance, it causes the generators to resist rotation, thus slowing the train. By varying the amount of excitation in the traction motor fields and the amount of resistance imposed on the circuit by the resistor grids, the traction motors can slow the train to about 5 mph (8 km/h) (for a direct current "transmission" system; for an alternating current "transmission" system, the traction motors can slow the train to nearly 0 mph (0 km/h)).
Locomotives with a direct current "transmission" system always use series-wound traction motors as these motors produce their maximum tractive effort at "stall", or zero mph, thereby easily starting almost any train. This method, however, dissipates all the energy as heat in the motor itself, and so cannot be used in anything other than low-power intermittent applications due to cooling limitations. It is not suitable for traction applications.

Regenerative Braking

Regenerative braking takes place whenever the speed of the motor exceeds the synchronous speed. This baking method is called regenerative braking because here the motor works as generator and supply itself is given power from the load, i.e. motors. The main criteria for regenerative braking is that the rotor has to rotate at a speed higher than synchronous speed, only then the motor will act as a generator and the direction of current flow through the circuit and direction of the torque reverses and braking takes place. The only disadvantage of this type of braking is that the motor has to run at super synchronous speed which may damage the motor mechanically and electrically, but regenerative braking can be done at sub synchronous speed if the variable frequency source is available.

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II.D PETROL MODE SPECIFICATION

Engine Displacement	59.90cc
Engine Type	Single Cylinder, 2 stroke
Cooling type	Forced air cooled
Starting	Kick start
Mileage	45kmpl
Max power	3.5 bhp@5500rpm
Max torque	4.5 Nm@5000 rpm
Top speed	60 kmph

II.E ELECTRIC MODE SPECIFICATION

TECHNICAL DETAILS	
Motor (BLDC HUB Motor)	800 W
Battery Type	VRLA Deep Discharge
Battery (VRLA Deep Discharge)	20 Ah
Electricity Consumption	3.2 Units/Charge
Charging Time	6 to 8 Hrs

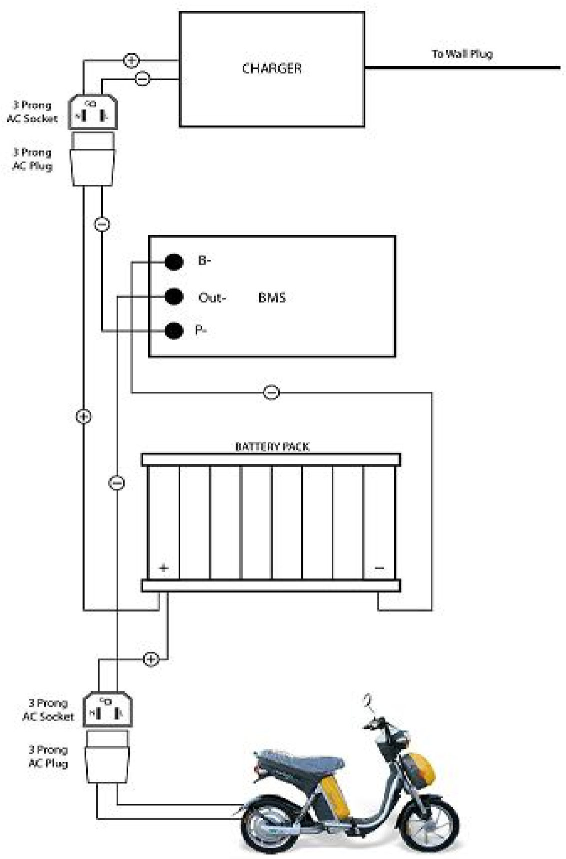

Fig 2.4 Electric section wiring diagram

Technical Specifications of HYBRID BIKE	
Engine Displacement	59.90 cc
Engine Type	Single cylinder, 2- stroke, forced air cooled.
Engine Starting	Electric/ Kick start
Maximum Power	3.5 bhp @ 5500 rpm
Maximum Torque	4.5 Nm @ 5000 rpm
Top Speed	60 kmph
BLDC Motor	800W
Battery Type	VRLA Deep Discharge
Battery Spec.	12V,20Ah(4 nos)
Rear Brake	Drum brakes 130 mm dia
Front Suspension	Telescopic Suspensions at front
Rear Suspension	Helical spring and Hydraulic damper
Front Tyre	2.75 X 10
Rear Tyre	2.75 X 10
Wheelbase	120 mm
Width	1,220 mm
Height	1,060 mm
Length	1,685 mm
Weight	7,9.5 kg
Petrol Tank Capacity	3.5 litres

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II.F BRUSHLESS DC MOTOR CONTROLLER

Features:

1) Rated voltage: DC48V
2) Rated power: 500W (this controller also can work properly for 48V 800W brushless DC Motors)
3) Rated current: 30A (limit current)
4) Under-voltage protection: DC41.5V+-0.5V
5) Current limited: 30A±0.5A
6) Efficiency: ≥83%
7) Consumption :< 1.5W
8) Controller category: Brushless direct current
9) Applicable model: electric bicycle, electric scooter, electric vehicle, electric tricycle etc..

Functions:

1) Super low noise when starting up
2) Speed limit/3 speed
3) Under-voltage protection
4) Under-current protection
5) Cruising control
6) Backward/Reverse function (for tricycle)
7) Water proof

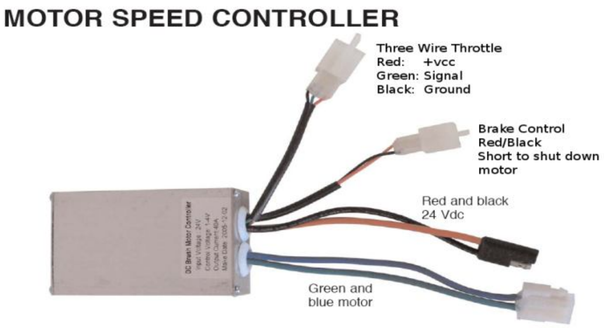

Fig 2.5 BLDC Motor speed controller

Connections to controller:

- Three wire throttle control for speed control
- Brake control for controlling supply to motor
- Input supply from battery
- Output to motor

2.G BATTERY CHARGER

Electric Bike Chargers are designed to fulfill all kind of power requirements of Electric Bike battery charging which operates in wide AC input range (170 - 300VAC) and to withstand the adverse Indian power conditions. These are designed with high frequency switching technology that makes product highly reliable, cost effective, compact in size and light in weight.

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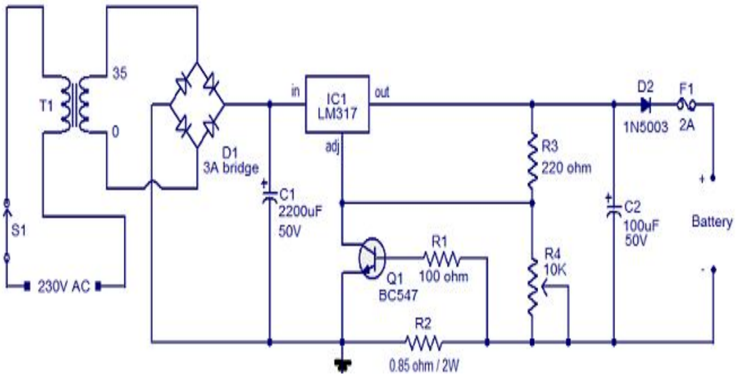

- *Fig 2.6 Battery charger unit block diagram*

SALIENT FEATURES
- Designed to meet adverse Indian power condition
- Two stage battery charging (CC-CV Float and Boost Mode).
- Wide Input Operating Range (170VAC - 300VAC).
- Non Resettable Accurate Safety Timer for enhanced Battery Protection.
- Accurate Battery Charging Current Limit.
- Battery reverses polarity protection.
- Overload protection.
- Over Temperature shutdown with auto recovery

SPECIFICATION:

INPUT SPECIFICATIONS	**48V,2.6A**	**48V,4.5A**
Input Voltage Range	180VAC-300VAC-50/60Hz	190VAC-300VAC-47/63Hz
Inrush Current	<30APeak @ 230VAC,Cold start@25°C	<30APeak @ 230VAC,Cold start@25°C
Input Current	<1.8A rms @ 180VAC and output full load	<2.0A rms @ 180VAC and output full load
OUTPUT CHARACTERISTICS		
Output float Voltage	54.8VDC±0.5V	54.8VDC±0.5V
Output Boost Voltage	58.8 VDC±0.5V	58.8 VDC±0.5V
Output current max	2.6Amp	4.5Amp
Line &Load Regulation	Tolerance ±5% Measured at the cable end	Tolerance ±5% Measured at the cable end
Ripple	<300mV.Pk-Pk	<600mV.Pk-Pk
Output Over Current limit(Min)	2.6Amp@180VAC Input	4.4Amp@180VAC Input
Output Over Current limit(Max)	2.8Amp@230VAC Input	4.6Amp@230VAC Input
PROTECTIONS		
Output overload protection	Available	Available
Output short circuit protection	Available	Available
Output over voltage Protection	Available	Available
Over temperature shutdown with auto recovery	Not Available	Available
Battery reverse protection	Available	Available
Non Resettable accurate safety timer for enhanced battery protection	Not Available	Available
SAFETY & EMI		
Safety	Designed to meet IEC 60950	Designed to meet IEC 60950
EMI	CISPR22 / FCC Class-A	CISPR22 / FCC Class-A
MECHANICALS		
Out side dimensions	W=72.0mm,D=153.0mm,H=45.0mm	W=126.0mm,D=196.0mm,H=90.0mm
AC Input connection	3 Pin AC plug with 2 core cable directly	3 Pin AC plug with 2 core cable directly
DC Output	soldered to the PCB Provision of polarised Detatchable 3 Pin plug.	soldered to the PCB Provision of polarised Detatchable 3 Pin plug.
Enclosure	Plastic	Metal

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III. COMPARISION

HYBRID BIKE	PETROL BIKE	ELECTRIC BIKE
1. DUAL SOURCE OF ENERGY 2. HIGH EFFICIENCY 3. LESS POLLUTION 4. LESS ENERGY CONSUMPTION 5. HIGH DRIVING STABILITY	1. SINGLE SOURCE OF ENERGY 2. HIGH POLLUTION 3. HIGH FUEL COST 4. HIGH TORQUE	1. LOW EFFICENCY 2. LOW POWER 3. POLLUTION FREE 4. NOISE FREE 5. LESS TORQUE 6. LESS DRIVING STABILITY

IV. ADVANTAGES

- Low operating cost
- Dual-source of energy
- Less pollution
- Ease to select any source
- Less energy consumption

V. FUTURE ENHANCEMENT

- Automatic selection of driving mode.
- Charging using solar power.
- Charging while running on petrol.
- Gas fuel can also be used as a source.

VI.CONCLUSION

The hybrid bike can be powered by dual source such as gasoline and electricity. Compared to ordinary bikes this hybrid bike is more efficient and economic. This hybrid bike will be a new innovation in automotive era, it is more eco-friendly because it cause less pollution. The hybrid bike is a better solution for hiking fuel cost day to day.

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