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APPLICATION OF BLDC MOTOR IN E-BIKE

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ABSTRACT
The motor is a Brushless DC (BLDC) type that has a permanent magnet rotor, a wound stator split into three phases and Hall- Effect position sensor. The motor will be controlled by speed, position and current feedback. The position sensing will come from the built-in Hall-Effect sensor that provides the controller with the information it need to run in phase. The speed request will come from the rider via the Controller Area Network (CAN) and the current will be sensed electrically.

KEYWORDS: BLDC Hub motor, Controller, Battery, Charger, Accelerator

I.   INTRODUCTION

Today's oil prices are high and so are consumption rates Research and development that needs to be done to curb consumption. The deficiency and the rate of the oil is the major problem of this generation. To overcome from this problem we have to try best in ourselves in making a E-BIKE. The E BIKE runs with the help of electricity or 48V DC supply. . The e-bike has mainly five parts: hub motor, controller, convertor, accelerator and battery. The main function of the controller to control the function of the hub motor. The motor controller is a microcontroller based system that uses feedback to control a three-phase BLDC motor. A three- phase BLDC motor. A three phase motor consists of permanent rotor and a stator split into three phases. Three phase motor are used because they are efficient, durable and deliver constant power throughout each cycle. The drawback is a larger, more complicated controller. With a DC motor only two field effect transistors (FETs) are needed to drive the motor and provide regeneration. The Three- Phase Switcher block will be three FET half-bridges, one bridge for each phase of the motor. Each half-bridge corresponds to a stator winding and allows current flow into and out of the motor. The gate drive block will be the circuit that takes a TTL level pulse with modulated waveform for driving the FETs. The power supply the block is a switching regulator that converts the 48 volt battery to 12V. The 12V line will be created using a buck switching regulator and will be used to power the microcontroller the signal conditioning circuitry.
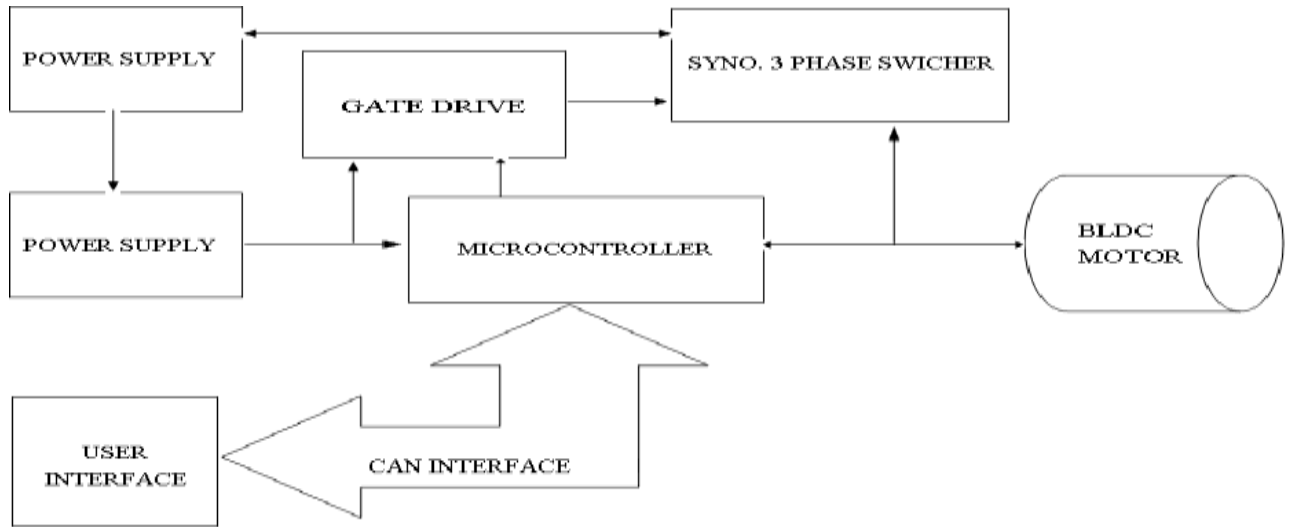
II. FLOW DIAGRAM OF E-BIKE

Figure 1(Flow Diagram Of E-Bike)

Component Details
The main component which is used for designing the "Electric Bike" is given below with their rating:-
1. Hub Motor
2. Controller
3. Converter
4. Battery
5. Accelerators
6. Charger

Hub Motor
The motor of the E-Bike is a permanent magnet DC type with a nominal power of 350W. It is produced in China. The motor constants had to be determined by measurements because there is no data sheet available. Measurements have been made with blocked motor, at constant speed with variable load, an idle curve has been recorded and a rundown test has been made.
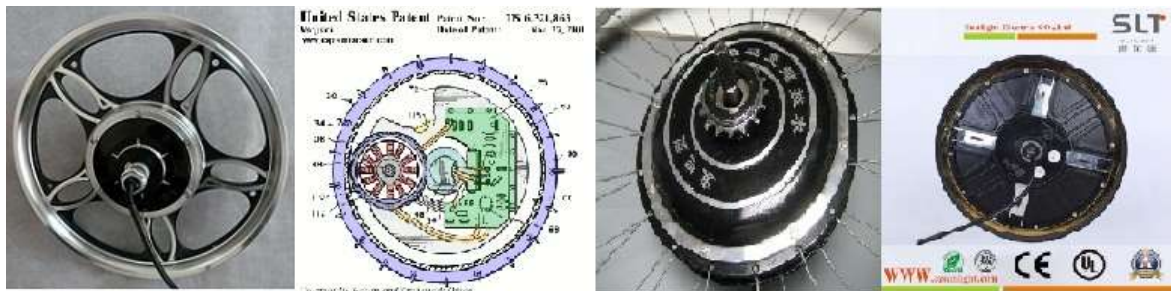

Figure 2 (Hub Motor)

Rated Power: 350W/800W
Size: 16inch
Rated Current: 1A
Rated Voltage: 48V/60V
Material: Aluminium alloy
Coil Material: Copper Wire
The Power Properties: DC
Structure And Installation Method: IMB

Features of 350W brushless e-bike dc hub motor.
- High torque, light weight
- 2. High Efficiency, low Noise
- 3. Long Working Life
- 4. High Efficiency ($\geq$ 78%)

Technical of 350W brushless e-bike dc hub motor

Table 1

Voltage	Current	Power	Speed	Size	Brake style
48V/60V	1.0 A	350W/800W	420±10 rpm/ 460±10rpm	16inch	disc drum

How To Install Hub Motor
The easiest way to mount a hub motor and secure the back wheel is to orient your bike upside down resting on its handlebars and seat, if you don't have a bike stand available
Some key guidelines:
- Remove original front wheel
- Orient the hub motor so that, when facing forward, the disc brake is on the left-hand side of the bike and the electric cables are on the right. .
- If the bike does not have disk brakes, the disk rotor can optionally be removed from the hub. Removing the disc will expose the inside workings of the hub via the bolt- holes. The holes need to be filled with the bolts and small washers.
- Check if the axle can be slid inside the slot in your fork there's difficulty, then a small amount of filing may be necessary.
- The hub motor axles are ground flat to 10mm on 2 edges ideally, your bicycle dropout slots will also be 10mm wide and the motor will slide into place.
- If your axle does not slide into the dropouts, some minor modification is required by using a file to a) enlarge the dropout slot and/or b) file down the axle flats so the axle slides snugly into the dropout
- "Note: When filing is required, only enlarge enough for a snug ft Avoid over filling.
- After ensuring that the axle sits deeply and snugly into the dropout slots, the axle must be secured tightly to the fork using the washers, lock washer, and axle nut. The inner washer is designed to fit inside the quick release recess. If the nut gets loose, the torque of the electric hub motor is sufficient to cause the axle to spread the dropouts apart and spin out, possibly severing the power and Hall Effect wires and causing the wheel to detach from the bicycle.
- On one side of the axle, wires exiting through the axle prevent the washers and nut from being removed. The smaller diameter washer, larger diameter washer, lock washer, and axle nut must be secured so they all sit flat against each other.
- On the opposite side there is an option to exactly mirror the first side. Alternatively, depending on your bike geometry and if you have a quick release lip, you can eliminate one of the smallest diameter washer or larger washer. The diagrams above illustrate each case Next follow the washer by the lock washer and then the nut.
- The axle nuts must then be fastened tightly as all the torque of the motor is transferred to the frame of the bicycle through the axle flats and axle nut.
- If your bicycle geometry is such that you fall in the NO may be in the above picture, some minor modification may be required .so the quick release lip does not interfere More detailed guidance on quick release modification can be found by contacting www.ebikes.ca or your dealer.
- Check and confirm you have firmly tightened the nut on your axle so all pieces sit flat against the fork
- In case wasn't dear from the last comment Tighten the axle nuts family.

Controller

This application note describes a controller for a 350 W, 48 V Brushless DC(BLDC) motor used to power an electric bike Microcontroller unit(MCU) and associated circuitry to implement motoring control, regenerative braking, and fault protection. The source code associated with this application note is available in the under Z8 Encore! MC Applications Code Library section of the Application Sample Libraries.
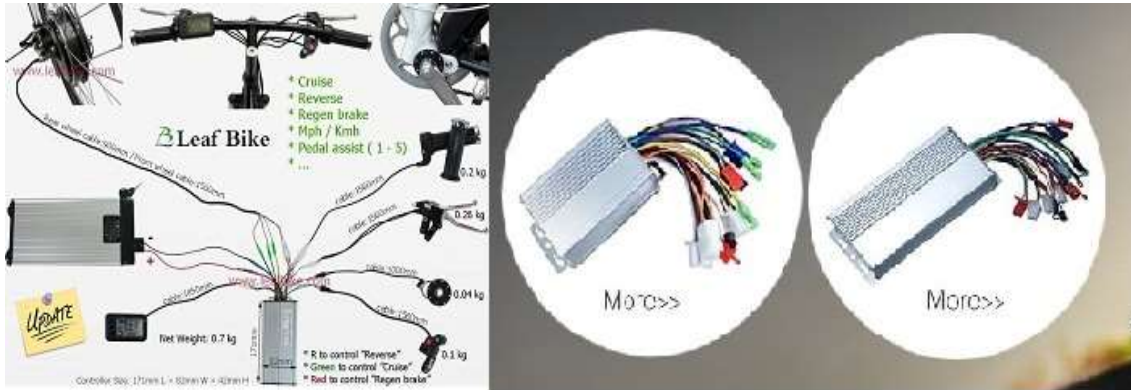

Figure-3(Controller)

Table-2

Items	Function
6 Mosfet	Power, Power Within, Manual / Automatic Curls, Dial gear / Point Thee Speed, Speeding, Anti-Theft, E-abs Brakes, Overload Protection, Anti-Speed Protection, Meter, High / Low Level Brake, Customized Functions Are Available.
9, 12, 15, 18 Mosfet	Power, Reverse, Manual / Automatic Cruse, Dial gear / Point Thee Speed, Speeding, Anti-Theft, E-abs Brakes, Overload Protection, Anti-Speed Protection, Meter, High / Low Level Brake, Customized Functions Are Available.
24 Mosfet	Reverse, Manual / Automatic Curls, High Level Brake, Dial gear Thee Speed

Features

The main features of the high-torque design include:
- Hall sensor commutation.
- Motor speed measurement.
- Potentiometer-adjustable motor speed.
- Closed-loop speed control for precise speed regulation.
- Protection logic for over-voltage, over-current, and thermal protection.

Converter

This fully isolated DC/DC converter is useful for voltage conversion to operate 12 volt electronics off 48 volt vehicle, golf carts, forklifts and telecom busses. This DC to DC converter closely regulates the output voltage over a range of input voltages.

Table-3

MODEL NO	PST-DC4812 Also known as PSTC-4812012
DC To DC CONVERTER	------------
INPUT VOLTAGE RANGE	36V DC To 70V DC
OUTPUT VOLTAGE	12 V DC(Factory setting 12.2V)
PEAK CURRENT	18A For 5 minutes
PEAK WATTAGE	216 W For 5 minutes
CONTINOUS CURRENT	12.5A
CONTINOUS OUTPUT POWER	350W

MINIMUM OUTPUT FOR RATED VOLTAGE REGULATION	0A
NO-LOAD OVERHEAD	<100ma
LINE REGULATION	+1% to -1%
LOAD REGULATION	+5% to -5% at terminal block
EFICIENCY	80% TYPICAL
TOPOLOGY	TRANSFORMER ISOLATED FORWARD CONVERTER TOPOLOGY
SWICHMODE FREQUENCY	67 Khz
ISOLATION	INPUT To OUTPUT: 1500VAC FOR 1 Second. INPUT TO FRAME GROUND: 1500 VAC FOR 1 Second
INPUT CONNECTION	SCREW TERMINAL BLOCK
OUTPUT CONNECTION	SCREW TERMINAL BLOCK
TEMPARATURE	0 to 65 ^{0}C
WEIGHT	0.9 Kg, 2 POUNDS

Installation Instructions
- Install in an area free from rain, dust, or salt spray where re is air can flow past the unit for cooling.
- The input terminals are labelled Gr on the three terminal connector. Connect the input making sure of the polarity The"G terminal is the frame ground is fully isolated from the input and output terminals and can be connected to the frame of the vehicle if desired or left unconnected.
- There are 3 sets of plus output terminals and 4 sets of minus output terminals They are marked They are all in parallel the full current can be drawn from a single pair or multiple pains The multiple connectors are for your convenience if there is more than one appliance to be connected.
- The extra terminal marked C is optional and rarely used It is a plus terminal that is diode isolated from the other terminals This is used for a battery backup function the output voltage is adjusted so that 13 8 appears at the volts terminal it will charge a battery .Then if a load is connected to the battery will act as a battery backup for power supply with an unregulated battery backup only the equipment attached to the terminal, not the other plus terminals.
- Voltage is set for 12 volts at the factory. To adjust the voltage remove the top cover and turn the trim pot VR1.VR1 is near the transformer and the output torpid the output voltage range is approximately 11 V to 13.9 V.
- Bent Cover. The top cover is bent over the top of a capacitor leaving a 2 mm gap between the cover and the sides of the converter. This is a feature of this first build and not a sign of miss assembly

Advantages
- Inexpensive high current Dc/Dc converter stabilizes voltage for equipment designed for automotive applications that require 12 to 13.8 volts.
- The DU4812 DC/DC Converter can be used to provide regulated 12VDC from 48 volt golf carts, forklifts, and telecom busses.
- High efficiency Dc/Dc converter >85%

Battery
Here four dry cell batteries of 12volt/20AMP are used. The batteries are connected parallel for taking 48v supply for the Hub motor. The batteries are placed in the battery box which is attached to the chassis. The connection of the batteries in series and parallel are given below:
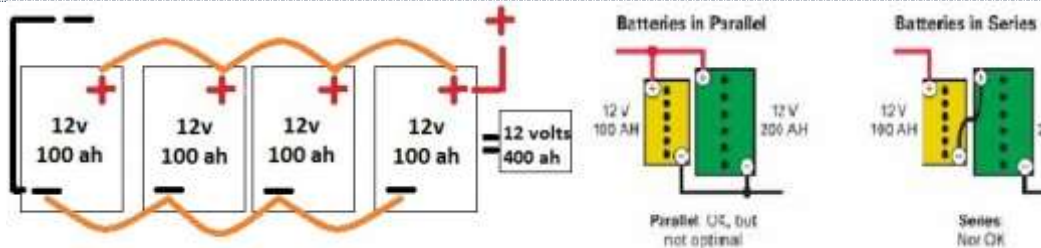
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Figure-4(Series And Parralel Connection)

Charging the Battery and LED Battery Life Indicator

a) The battery can be charged anytime, regardless of whether the battery is run down completely or not, when the battery is fully run down, it will automatically shut off the LED and display will not light up.

1. b). to charge the battery, ensure the battery switch is in the on position before connecting the charger and turning the charger on. If the battery requires charge, the orange LED will turn on and the internal fan will spin. Once charge is complete the LED light will turn green and the fan will shut off. A flat battery will take on the order of 5 hours to fully charge.

b) If the charger is turned on when the battery switch is off. Or's not connected to the battery, the charger light will turn green, falsely indicating a full charge. Once green, a charger must be turned off and on to reset. Since the make battery is charging in the "on" position, we suggest to sure your throttle switch is turned off or your battery disconnected from the system so that your bike doesn't take off on you while you are charging.

c) When the battery is connected to your rig and turned the niddle of the meter will be at "F" point. When the battery is low then the niddle will be at point "E". The charger of the 48v battery will indicate red light when the battery is charging otherwise green light will glow when the battery is fully charged.

Accelerator

The accelerator is used for increasing or decreasing the speed of the motor. The function o the accelerator is controlled by the controller. The supply is given to the all parts of the E-Bike by switching ON. When switch is ON the supply comes into the accelerator also. As we rotate the handle of the accelerator then supply is given to the hub motor for running.

Figure-5

Charger

The charger is used for charging the battery. The 48v charger is used for charging the battery. There some characteristics of charger are given below:-

Figure 6(Charger)

Characteristics of Charger
1. Reduce the dehydration of the battery the hydration of the KELEN charger is only 1/3-1/2 compared the normal charger the special
2. Remove the sulphuration effectively pattern car KELEN positive and negative pulse charge protect the battery effectively when it is charging and Makes the battery throughout to maintain the good
3. Equalizing charge control the unbalance of the time batteries effectively, and control the vicious circle of battery which is backward.

Functions
1. The temperature compensation along with temperature change the charger can change the charge voltage automatically and thoroughly settle that the battery charges incompletely in winter and overcharging in summer.
2. Guards against overcharging we take the advanced Multiple protection control circuit to cease the overcharging problem for the batteries.
3. Low voltage protection guards against charging for the bad and old or not matching battery
4. Overheat protection ensure the charger is safe under high temperature environment (note the charger is not allowed working for a long time under high temperature condition).
5. Misconnection protect guards against damage charger when misconnecting accidentally.
6. Short circuit protection guards against damage the charger while the circuit is short circuit.
7. Capacity shower the LED light will bright one buy one when is charging to show the capacity of m batteries.
8. The function of waterproof the crust is used the design of waterproof to protect the charger when it is working.

III.   SILENT FEATURES OF DESIGN THE PROJECT
What kind of changing we have done in our project is given below:-

For making the project E-Bike we have done the mostly change into the chassis of the petrol bike.

The chassis of the bike is designed as required for the E-Bike.

The changes which takes place into the chassis is given below:-
1. Engine-In the E-Bike there is no use of engine because it depends upon only electricity So in the place of the petrol engine we use "Hub Motor" The hub motor is placed in the rear wheel of the E-Bike. Its size is very small like a fan motor. Due to having centre position in the rear wheel it has high moment of inertia which helps in the smooth running.
2. Petrol Tank:- In the E-Bike there is no requirement of the petrol tank because it runs with the help of electricity So we replace the battery box by the petrol tank For giving the 48V supply to the Hub Motor we use four set of batteries Each battery have 12v/20Amp.
3. Gear Box: - Gear box plays an important role in controlling of the In the place of gear box we used accelerator and controller The accelerator is used for increase decreasing the speed of the motor The controls the hole of the function of the E-Bike

IV.   CONCLUSION

Today's oil prices are high and so are consumption rates Research and development that needs to be done to curb consumption. The deficiency and the rate of the oil is the major problem of this generation. To overcome from this problem we have to try best in ourselves in making a E-BIKE. The E BIKE runs with the help of electricity or 48V DC supply. There is no use of oil like petrol etc. So a person travels on this bike without doing air and sound pollution. So this bike will provide the better environment to the new generation. In a Yo-BIKE there is much to describe because in a Yo BIKE, after the completion of 4 to 6 hours charging it travels only 20 to 25 kilometres But E-Bike takes only three hours for complete charging the battery The full Charge battery travels 45 to 50 Km when only one person is riding it gives the same average when two or three persons are riding on it. The converter and controller are doing their work properly. Light, indicator and horn etc are also giving the good performance. The working of the E.BIKE is quite good The hub motor is running smoothly and giving the better performance .After the complete charging of the battery the E-BIKE is the average of 45 to 50Km/h this is better than another Yo-bike overall the result of the E-Bike is good.

V.   REFERENCES

[1] Web Sites http://www.national.com Homepage of National Semiconductors
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