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R&D ON ELECTRIC BIKE

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Abstract - *Sustainable and personal mobility solutions for our world environment have traditionally revolved around the utilization of bicycles or provision of pedestrian facilities. An electric bicycles offers a cleaner various travel short –to-moderate distance instead of fossil fueled automotive. From conventional automobile for transport we experience problems like traffic congestion, parking difficulties and pollution from fossil fueled vehicles. It appears that only pedal power has not been sufficient to supplant the usage of petrol and diesel automotive to date, and therefore it is necessary to investigate both the reason behind continuous use of environment unfriendly transport and consider potential solutions. This paper represents the results from a year-long study into electric bicycle effectively. This paper identifies potential barriers of electric bicycle. Overcomes it by using innovative "redemption springer forks" in front suspension with electric motor for assistance.*

***Key Words*: BLDC Motor, Controller, lithium-ion battery.**

1. INTRODUCTION

A significant contemporary phenomenon that may have a profound impact on mobility patterns is the emergence of the electrically assisted pedal cycle or what is more commonly known as the 'e-bike' .The electric vehicles industry is continuously evolving. One type of such electric vehicle is the electric bicycle (e-bike). E-bikes typically incorporate a battery, which can be charged at an ordinary domestic power socket, linked to an electric motor in the bicycle transmission system. The rider have the power to controls the output power from motor i.e speed using a handlebar mounted computer display panel and controller. The term 'e-bike' is generic and includes a combination of different electrically powered two-wheelers some of which function by simply turning a throttle. Electric bicycles, like other electric vehicles, use a BLDC motor (Brushless Direct Current Motor). This paper presents a way of designing and implementing an electronic module for an e-Bike. The paper shows how a low power can be utilize to drive such a motor and also manage other useful functions on an e-Bike. E- Bike make use these BLDC motors as the propulsion method. Due to the fact that BLDC motors do not have brushes, they present some advantages over the DC brushed motors, from which we remember:

(1) Longer life span,
(2) Lower EMI (Electromagnetic interference) radiation,
(3) Noiseless operation,
(4) Grater torque to motor size ratio

From experiences, we know that even at current high oil prices, fossil fuelled vehicle are more favoured over bicycles, despite of them being the cheaper alternative. Thus, there are some barriers which may exist to the usage of bicycle .The premise of this paper is to overcome many of these barriers by technological means at minimal cost to create a usable transport for public use.

1.1 PROBLEM DEFINITION

In the modern days, the primary concern of government is to find out a way by which we can minimize consumption of fossil fuel and promote the use of electric vechile in our daily life.

However, there are certain barriers while adopting these latest technology in our daily life.

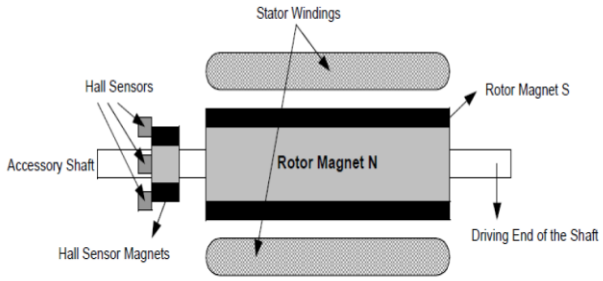
2.1 Instrument with Specification

These are the following instrument with specification, which is used in designing an "ELECTRIC BIKE", and they are

a) Motor
b) Battery
c) PIC Controller

a) Motor

Brushless DC (BLDC) motors are synchronous motors consisting of armature windings on the stator permanent and magnets on the rotor. The stator of a BLDC motor consists of stacked steel laminations with windings placed in the slots and these stator winding can be arranged in two patterns i.e. a star pattern or delta pattern. The major difference between the two patterns is that the star pattern gives high torque at low RPM and the delta pattern gives low torque at low RPM. There are many advantages of BLDC motor such as better speed versus torque characteristics, high dynamic response, high efficiency, long operating life, noiseless operation, higher speed ranges.



In this Fig.1 shows a transverse section of a BLDC motor. The rotor has alternate N and S permanent magnet s. The Hall sensors are embedded into the stationary part of the motor. Here hall sensors are connected with hall sensor magnet to detect the position of the rotor. In BLDC motors, the phase windings are distributed in trapezoidal fashion in order to generate the trapezoidal waveform. The commutation technique generally used is trapezoidal commutation where only two phases will be conducting at any given point of time.

Typically, BLDC motors have three phase windings that are wound in star or delta fashion and need a three-phase inverter bridge for the electronic commutation. The brushless motors are generally controlled using a three-phase power semiconductor bridge. The motor requires a rotor position sensor for starting and for providing proper commutation sequence to turn on the power devices in the inverter bridge.

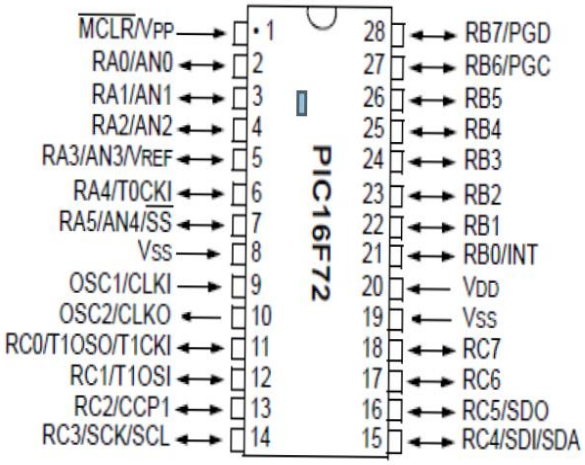
b) Battery

E-bikes use rechargeable batteries, electric motors and some form of control. Battery systems in use include sealed lead-acid (SLA), nickel-cadmium (NiCad), nickel-metal hydride (NiMH) or lithium-ion polymer (Li-ion). Batteries vary according to the voltage, total charge capacity (amp hours), weight, the number of charging cycles before performance degrades, and ability to handle over-voltage charging conditions. The energy costs of operating e-bikes are small, but there can be considerable battery replacement costs. The lifespan of a battery pack varies depending upon the type of usage. Shallow discharge/recharge cycles will help extend the overall battery life. The range is a key consideration with e-bikes, and it is affected by factors such as motor efficiency, battery capacity, efficiency of the driving electronics, aerodynamics, hills and weight of the bike and rider. Some manufacturers, such as the Canadian BionX or American E+ (manufactured by Electric Motion Systems), have the option of using regenerative braking, the motor acts as a generator to slow the bike down prior to the brake pads engaging. This is useful for extending the range and the life of brake pads and wheel rims. There are also experiments using fuel cells. E.g. the PHB. Some experiments have also been undertaken with super capacitors to supplement or replace batteries for cars and some SUVs. E-bikes developed in Switzerland in the late 1980s for the Tour de Sol solar vehicle race came with solar charging stations but these were later fixed on roofs and connected so as to feed into the electric mains. The bicycles were then charged from the mains, as is common today. While mainly bigger companies in past, many small to medium produced e-bike batteries companies have started using innovative new methods for creating batteries that are more durable.

c) PIC Controller

Here we use PIC16F72 controller to control the electric bicycle system. In this electric bicycle system, some components are installed such as brushless dc motor; PIC controller and battery are required to the controller for controlling the different component of electric bicycle system. There are different functions of this controller such as under voltage protection, over current protection, control power supply, also to drive and control the Brushless dc motor. There are different signal was transmitted to pin of PIC controller to drive and control brushless dc motor, such as current detection signal, motor speed control signal, capacity detection system. In this PIC16F72 controller has 28 pins, 22 I/O pins that are user configurable on a pin-to-pin basis. There are 35 number of instructions in this PIC controller. The operating frequency is 20 MHz Also in this controller there are three I/O port are use such as PORTA, PORTB and PORTC and three Timers are use Timer0, Timer1 and Timer2. In this pin diagram RA1, RA4 and RA5 pin there are transmitted speed control, helping signal, current detection signal. The current detection signal use here because, if any heavy current situation electric bicycle is running at heavy load the current is increasing in the motor. Then it will be damages winding of motor and component of motor. Here required current detection signal for controlling the current. Also, there are under voltage protection is required because of avoiding the low voltage supply, which is effect on electric bicycle running normally, then controller should be provide capacity checking. The voltage consists with resistance then it transmitted to PIC controller. If voltage supply signal transmitted to PIC controller then checking supply voltage. The pins RB2 to RB7 are used for signal for driving motor.

Here RB2, RB3 and RB4 are connecting with higher-level signal of Phase A, B and C. In addition, RB4, RB5, RB7 are also connecting with lower level signal of Phase A, B and C. The A/D is allowed a conversion of the analog input signal to the 8-bit digital number. Here pins AR0-AR4 support for analog to digital conversion. If the signal transmitted to pins of PIC controller then after analog to digital conversion the brushless dc motor driven through this signal.



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2.2 CONSTRUCTION

(FIG.2.2.1 DEFINES DESIG OF AN ELECTRIC BIKE)

It contains following component shows in fig 2.2.1

i. REDEMPTION SPRINGER FORK: - We are representing an old-school front suspension system, which are used in “CUSTOM MOTORCYCLE”. The springer fork is an early type of leading link fork. A springer fork does not have the suspension built into the fork tubes, but instead has it mounted externally, where it may be integrated into the triple clamp. This style of fork may be found on antique motorcycles or choppers, and is available today on Harley-Davidson's Softail Springer.
While it may have redesign to reduce its weight and complexity of that assembly .Instead of using traditionally springer forks we have replace its fork by U shaped forks and plate are mounted on both forks. We also not used triple clamp instead of that we mounted the plate on u shaped fork directly. A short leading link holds the wheel and the forward leg, which actuates the springs.

ii. FRONT AND REAR WHEEL: - It is a main component of an automobile. There are many types of wheel are available in the market with high specs. However, we are using 36 spokes 24-inches tubeless wheel on both front and rear for better performance.

iii. BRAKE: - Brake is the most important because by the help it, we can stop the vehicle. There are many types of brakes are present in the market but we are using the most suitable brake with our requirement which is DISC BRAKE. A disc brake consists of a metal disc, or "rotor", attached to the wheel hub that rotates with the wheel. Calipers are attached to the frame or fork along with pads that squeeze the rotors for braking. As the pads drag against the rotor, the wheel - and thus the bicycle - is slowed as kinetic energy (motion) is transformed into thermal energy (heat). Disc brakes may be actuated mechanically by cable, or hydraulically.

iv. THROTTLE: - Throttle is the main component by which we can control the power delivered to the wheel with the help of a motor and engage and disengage the motor to the wheel as well. There are many types of throttle available in the market but we are using racing type throttle by which we can control the speed of motor

v. PIC CONTROLLER: - It is a controller box, which acts as a brain of the e-bike. It controls all the electrical system as well as BLDC motor and the throttle also. Throttle are connected with the PIC controller and controller are connected with battery and motor.

vi. BATTERY: - To, drive the motor electricity is required and to fulfill this requirement we are using a power source in term of the battery. There are many types of battery are available in the market but we are using rechargeable LI-ION battery with 48 volts to fulfill our requirement. IT is a latest battery which are in u shape are easily detachable so that it can be charge. It is a compact battery which we are using in our “ ”

vii. FRAME: - It is a backbone of every automobile. The entire component is mounted in it. We are using an

aluminum-based frame with more rigidity and for better space management.

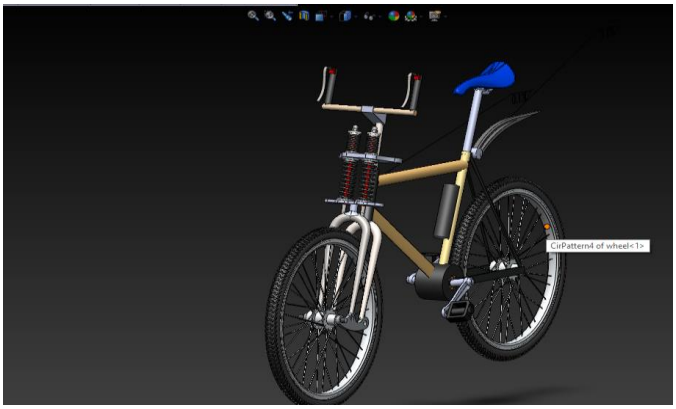
viii. PEDAL: - It is a component, which is connected on both side and with the front sprocket, and front sprocket are connected with chain and chain are connected with rear sprocket and doing pedaling, we can drive the rear wheel.

ix. BLDC MOTOR: - To provide a drive to rear wheel without the necessity of human power, we need an alternative such as a motor. Therefore, we are using 32 volts, 250-watts brushless motor with pedal assist technology that can fulfill our requirement.

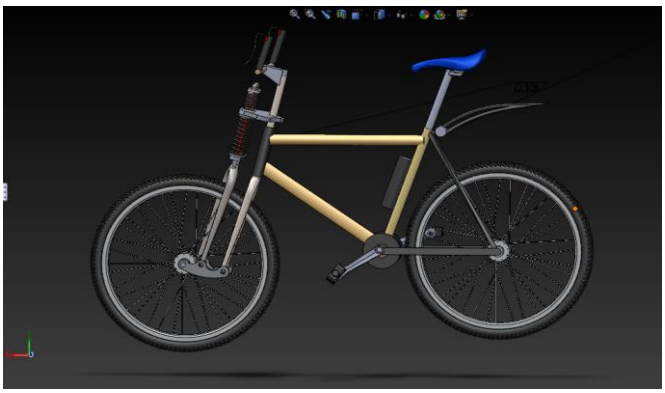
x. SEAT: - It is mounted on top of the frame with a comfortable cushion, so that rider sit comfortably.

xi. REAR SUSPENSION: - It is mounted on the single sided swing arm and frame of the e-bike. Here we are using coil-spring type suspension for providing riding comfort to the rider and safety to the frame.

xii. HANDLEBAR: - It is used to control the vehicle and give direction as well. Therefore, we are an aggressive style handlebar for better grip and control to the rider.



(FIG2.2.2 SHOWS FRONT PHASE)



(FIG. 2.2.3 SHOWS SIDE VIEW)

(FIG. 2.2.4 SHOWS SIDE VIEW)

(FIG. 2.2.5 SHOWS BACK PHASE)

2.3 WORKING OF POWER ASSIST SYSTEM

Power assist system is a combination of "POWER ON DEMAND" and "PEDAL ASSIST".

POWER ON DEMAND:-

Some e-bikes have an electric motor that operates on a power-on-demand basis only. In this case, the electric motor is engaged and operated manually using a throttle, which is usually on the handgrip just like the ones on a motorbike or scooter. These sorts of e-bikes often, but not always, have more powerful motors than pedelecs do .With power-on-demand only e-bikes the rider can:

- Ride by pedal power alone, i.e. fully human-powered.
- Ride by electric motor alone by operating the throttle manually.
- Ride using both together at the same time.

PEDAL ASSIST ONLY:-

E-bikes with pedal-assist only: either pedelecs (legally classed as bicycles) or S-Pedelecs (often legally classed as mopeds)

Pedelecs: have pedal-assist only, motor assists only up to a decent but not excessive speed (usually 25 km/h), motor power up to 250 watts, often legally classed as bicycles

S-Pedelecs: have pedal-assist only, motor power can be greater than 250 watts, can attain a higher speed (e.g., 45 km/h) before motor stops assisting, legally classed as a moped or motorcycle (not a bicycle).

But in Power assist system we are using both the system in which rider have the power to engage the motor with the help of "POWER ON DEMAND" system and on the other side when the rider needs the power to reach its goal the motor will automatically help to reach at certain speed without using the throttle and it is done with the help of "PEDAL ASSIST" system and this system are used in now a days. These type of system have a default PIC controller which control the demand and electric output.

3. CONCLUSIONS

With the help of these research paper we are able to design an e-bike which may be the solution to our problems which we are experience now a days like traffic congestion, parking difficulties and pollution from fossil fueled vehicles.

We innovate an idea to develop an e-bike which discard the orthodox mentality i.e only pedal power can be used to move an bi-cycle. This paper presents the results from a year-long study into electric bicycle effectively. This paper identifies potential barriers of electric bicycle. Overcomes it by using innovative "redemption springer forks" in front suspension with electric motor for assistance.

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