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Design and Fabrication of Electric Bike

Engr. Sardar Hussain
Electrical Engineering Department
Bahria University Karachi Campus
Karachi, Pakistan

Engr. Danish Mushtaq
Electrical Engineering Department
Bahria Univer Karachi Campus Karachi, Pakistan

Abstract:- The project aims to produce a smart electric bike that can be used for pollution-free riding. This report explores the various technologies used for smart electric bikes. First the various stages connected to the hub motor were fitted to the rim using spokes. It was invented keeping in mind that the motor can withstand maximum load. Various fictional processes took place, and all the fictional components came together. The controller connects the main electrical components: the throttle and electric brake assembly and the hub motor. The throttle sends a signal to the controller and based on these signals sends the controller output to the hub motor compartment and the feature extraction is studied and discussed. Finally the final production of all the fictional components was assembled.

The main objective of this project is to provide an accurate view of the various energy sources available to mankind. In today's modern world, man's journey is very necessary to move forward in this world. To do so, their journey must be in the least possible way and moment. This paper supplies battery-powered electric bikes and motor voltage. This paper is suitable for the design and manufacture of electric bikes that use electricity as a primary source. It also highlights the design aspects of the bike. The electric power used to ride the bike provides better fuel power than a traditional vehicle, resulting in better performance and less pollution.

Keywords:- *Hub Motor , Controller , Driver , Lithium Ion Battery.*

I. INTRODUCTION (BACKGROUND)

The energy crisis is a major concern in today's world due to the rapid depletion of resources of petrol, diesel and natural gas. In addition, environmental degradation is an additional factor contributing to resource scarcity, which is dangerous information. Electric bikes powered by motors are a common mode of transportation for local travel. Future changes could be an alternative source to this by adding it to the solar panel system. The main purpose of using this e-bike is to make it user friendly, economical and relatively inexpensive. Smart E bike is the best technical application as a solution for the better world and upcoming generation. Typical parts of E-bike (Electric Motorbike) are Brushless DC Motor (Hub Motor), Throttle (Accelerator), Battery Storage (12 V), Chain Drive, Frame and other common Motorcycle The E bike is a battery(E-bikes are driven with the help of battery which is coupled with electric Motor) operated vehicle that is very economical with low maintenance cost and less pollution .

➢ *Problem Statement:*

Below middle class people are hardly to manage their monthly budget. In that situation they are unable to meet the basic requirement of daily usage of bike to overcome it There are many different ways by which we can help them to save in different sectors. Our main focus is on automobile sector where we are converting old petroleum bike to electric bike we has made basic E bike to reduces their expenses in term of fossil fuel mechanical part as well as maintenances expenses but not only that it also reduces the oil (0.7ltr in 70cc) bike.

Beyond the complexities of mechanical design(includes Frame, Battery Storage , Throttle (Accelerator), Chain Drive and other common Motorcycle) it presents very basic design challenges for DC Motor (Hub Motor), motor controllers and battery systems, engineers Motor control is a complex matter that requires experience to ensure excellent speed and torque to control over loads and speeds. The limited power available in the battery should be used as efficiently as much as possible. Larger batteries can provide greater range, whereas small batteries are lighter but they would not provide the required amount of power but for larger batteries they are greater in size and weight, using more power to move electric bikes. As such, a proper compromise between range, efficient operation and battery capacity is the first step in the design process.

Beyond the complexities of mechanical design, it presents basic design challenges for motors, motor controllers and battery systems, engineers. Motor control is a complex matter that requires experience to ensure excellent speed and torque control over loads and speeds. The limited power available in the battery should be used as efficiently as possible. Larger batteries can provide greater range, but it is larger in size and weight, using more power to move electric bikes. As such, a proper compromise between range, efficient operation and battery capacity is the first step in the design process.

➢ *Other project objectives included the following:*

- Promote E-bikes and assess interest in them as a mode of urban transportation.
- Identify appropriate sectors for e-bike use.
- Stimulate people's interest in commuting to work on E-bikes and making less use of cars use on fossil fuel.
- Promote greater use of smart E bike and helps to reduces polluting and energy- consuming modes of transportation.

➢ *Thousands of kilo meter's ridden on electric bicycles:*

During the project Smart E Bike, 369 people travelled a total of 25,205 km on the e-bikes. Of this number, 211 Quebec cyclists chalked up 24,343 km, an average of 115 km per user. The project was modified and the E-bikes were ridden in roads and on bicycle paths. A total of 158 users accumulated 862 km on rides of one hour or more.

➢ *E-bikes for Urban Transportation:*

Low pollution (51%) and low cost (41%) were also important reasons. Participants also considered it an advantage to be able to cope better with adverse travel conditions. Of all participants, 64% of him used an e-bike to commute. 65% of people who usually drive to work choose electric bikes. And 71% of traditional bike enthusiasts expressed interest in using e-bikes to commute. Clearly, many find this new technology very attractive.

➢ *Design With High Efficiency:*

From this paper it looks like they are focused on improving the efficiency of e-bikes. In general, e-bikes have a top speed in the range of 40-45 km/h. Therefore, they design aerodynamic shapes to increase the speed of e-bikes and increase the efficiency of e-bikes. Compare driveline systems for speed. In this they found his four drive train systems. Based on the application, one of four power transmission systems are used in e-bikes. As a rule, chain drives are used for power transmission. In addition to this, three types of motors are also used, such as geared hub motors, crank drive motors and direct drive motors. After completing the experimental study, it can be said that the chain drive is more efficient than belts and gears due to its specifications such as light weight, low cost, compactness, and slip resistance.

II. METHODOLOGY

➢ *Facts and Findings:*

This section describes the domain of this project, existing systems, and finally other techniques that can be used to develop this project. We focused on the systematic design and development of the project according to the requirement of minimizing the functionality of traditional projects. In other situations, they describe factors or methods that help find and gather useful information in the development of that project.

- *Domain:*

Currently, the e-bike being considered for this project uses only one battery and is powered by conventional charging. E-bikes rely solely on the energy stored in the battery to operate, unless manually propelled. This project aims to change the way batteries are charged to conserve electrical energy and generate electricity to power your bike with optimal energy.

➢ *Materials*

- *Lithium Ion Cell:*

Lithium-ion cell is a type of rechargeable- cell, they are commonly used in portable electronics or in electric cars. In the batteries, lithium ions move from the negative electrode through an electrolyte to the positive electrode during discharge, and back when charging. Li-ion batteries use an intercalated lithium compound as the material at the positive electrode and typically graphite at the negative electrode. The Li-ion cell used in our battery pack is of a nominal voltage of 3.7v and 2000mah.

- *DC Charger*

A Direct Current DC charger is use to transform Alternating Current AC to Direct Current DC .A charger simply gives a constant power or a power pulse to the battery being charge.

How to set the parameter of the charger? Voltage setting with charger, the charge voltage can be calculated in such method: Series number x 4.2Volts of a cell.

Fig 1:- Battery Bank

For example: In figure 2 we can see a charger giving output to battery of volt around 58v and 4amp of current.

Fig 2:- Controller

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- *Controller:*

Controller connects the main electrical components: the throttle and electric brake assembly and also the Hub motor. The throttle sends signal to the controller and based on these signals the controller sends output to the hub motor.

Fig 3:- Frame

- *Circuit Breaker*

A circuit breaker is an automatically operated electrical switch designed to protect an electrical circuit from damage caused by excess current from an overload or short circuit. Its basic function is to interrupt current flow after a fault is detected.

Fig 4:- Breaker

- *Calculations:*

Lithium Ion Cell Rating Voltages = 3.7v
Ampere = 2.6Ah = 2600mAh

Firstly make 12 packet of 144 cells and each packet have 12 cells attached in parallel. Each of 12 packet cell are attached in series and then achieve 48v and 30 ampere

3.7v + 3.7v = 7.4v
3.7v + 3.7v = 7.4v
3.7v + 3.7v = 7.4v
3.7v + 3.7v = 7.4v
= 48v

Voltage same in parallel current same in series
2.6 × 12 = 31.2 Ampere
Battery Rating is = 48v & 30 Ampere

Battery Charging Hours Calculation:

$$T_C = AH/A$$

Tc = Time in hour
AH = Ampere hour rating of battery A = Current in Ampere

Battery charging current should be 10% of the AH battery
30Ah , 48v
30Ah × 10%
30Ah × 10/100

3 Ampere + 2 losses
5 Ampere
Tc = 30Ah/5 = 6 hours are required

III. IMPLMENTATION

➢ *Block Diagram*

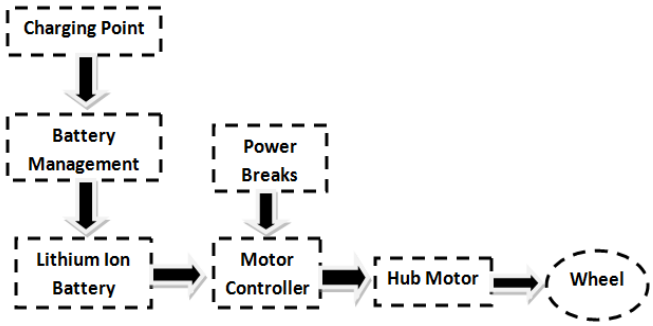

Fig 5:- Block Diagram

The above block diagram clearly describes the steps that are used from charging of battery and to and power a Hub motor to wheel.

❖ *Hardware Implementation:*

This project is basically divided into two main engineering one is electrical side (includes battery and hub motor system) and the other one is mechanical side (includes brakes and frame)

In electrical in further divided into two main parts that is Electric Battery System (Lithium Ion Cells) and the other part is Hub motor system.

❖ *Electrical Side:*

➢ *Electric Battery System:*

There are different types of rechargeable cells used such as NiMh, LiPo but most commonly used are Li-Ion since they are cells which can be relied on as, they don't deteriorate quickly, and they have good characteristics. Lithium ion cells are used in laptop and mobile batteries, they are also used in power banks and electric cars because of their characteristics. This project consists of a rechargeable battery pack which powers a light weighted motor unit over the wheel.

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The ability to deliver high surge currents while having very low energy-to-weight and energy-to-volume ratios means that the cell has a relatively high power-to-weight ratio. These features, combined with their low cost, make them attractive for automotive use to supply the high currents required by automotive starter motors. A battery uses a chemical reaction to perform the charging task and generate a voltage across its output terminals.

A charging port is connected to the rechargeable batteries through BMS which monitored battery pack charging for collecting AC current and converting such energy to electrical power that is delivered to the rechargeable batteries for recharging of a battery. If the BMS does not function properly it will pose a hazard as it can overcharge causing damage to the batteries Are chargeable battery is operable connected to DC motor for providing electrical power to drive the motor. DC charger will charge each battery to the same voltages and all the batteries in the pack will have the same values, which will help provide the output. The electric car battery system focuses on the construction of the battery pack and its connection to the BMS to make a proper battery pack that can be implemented in an EV.

Below table compare different batteries with their energy efficiency, density power density, life cycle and their self-discharging time.

Type	Energy Efficiency (%)	Energy Density (Wh/Kg)	Power Density (W/Kg)	Cycle Life (Cycles)	Se Disch
Lead acid	70-80	20-35	25	200-2000	Lo
Ni-Cd	60-90	40-60	140-180	500-2000	Lo
NI-MH	50-80	60-80	220	3000	Hig
Li-ion	70-85	100-200	360	>2000	Medi
Li-polymer	70	200	250-1000	>1200	Medi

Table 1:- Batteries Comparison

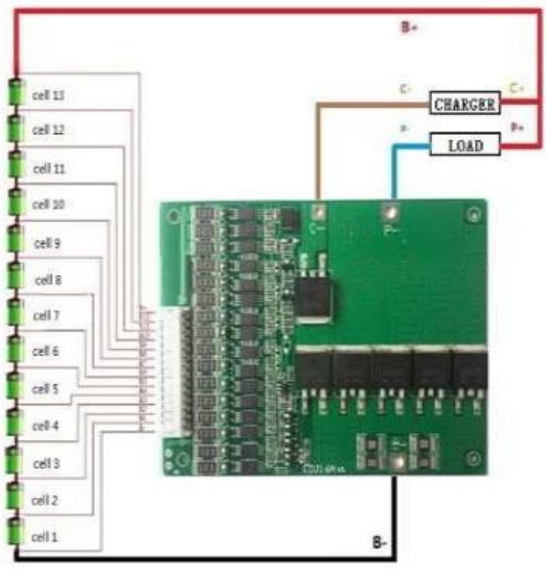

Fig 6:- Circuit

In above table, we discuss about the life, energy and power of all types batteries. We conclude that the Li-ion battery is the best for bike because it has more efficiency and more life from other batteries.

➢ *BMS (Battery Management System):*

As its name suggest it is a component used to control the battery over charge and over discharge along with short circuit protection and temperature monitoring. BMS are commonly used in an energy storage unit as it can affect the real time performance of an energy storing bank, industries which deal with battery banks use BMS so they can monitor the conditions and maintain the robustness of their operations.

Fig 7:- (B.M.S)

❖ *Mechanical Side:*

➢ *Hub motor system:*

In this project Rechargeable battery is used with long life for charging DC electric hub motor used. An electric motor converts electrical energy into mechanical energy. Most electric motors operate through the interaction of magnetic fields and current- carrying conductors to generate force. In brushless motor, as there is no physical contact from any parts of the motor inside, therefore there is virtually no wear and tear possibilities, making the motor's durability limitless. These motors have more sophisticated controllers,

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and it makes it possible for using three different windings, and power is supplied individual windings according to the position they are in the movement. When the motor passes one winding, the controller passes the power to another winding, making the movement to continue without stopping. A brushed DC motor is an internally commutated Electric motor designed to be run from a direct current power source these types of motors are quite popular nowadays.

The electricity generated by the power which is stored in the battery, enabling a rider to operate to hybrid mode anytime and control the speed of the bicycle using the accelerator.

Fig 8:- Hub Motor

Fig 9:- Thumb Throttle

➢ *Brakes :*

A new side-pull "Vies brake" of the type used on any decent modern bike can be bolted directly onto the old brake mounting post. A normal bike is light and top heavy, so the front brake can be used as the main brake, but as any heavy bike rider knows, on a heavier bike the front brake does 90% of his job.

➢ *Thumb Throttle:*

This smart e-bike thumb throttle is easy to use and perfect for those who want to keep their original handlebar grips. Thumb throttles are typically used on bikes with a rotary gear change system.

"Thumb throttle" refers to the method of controlling the speed of an engine or motor. The thumb throttle is located on the right side of the handlebar and is a small lever on the underside of the handlebar that is operated by depressing it with your thumb. Push your thumb in to speed up (faster) the engine. Retracting the thumb (or releasing the throttle to let the spring back in) slows the motor down.

➢ *Chain set:*

It is the more common type of chain drive which is used for transmission of mechanical power to long lasting & better way of rotatory motion from one gear to another it is derived by a tooth head wheel called a sprocket it is simple, reliable and efficient.

IV. RESULTS AND DISCUSSIONS

- An e-bike that can reach 40-50 km/h in power mode (depending on the weight of people sitting on it).
- A high-performance, ergonomic product that is, most importantly, lighter and provide good acceleration.
- Useful accessories providing greater safety in urban environments.

Fig 10:- Battery Bank

➢ *Battery Pack Results:*

After the upgrade with a wheel hub permanent magnet motor in the back wheel, a lead-acid battery pack, a suiting motor controller and a modified handle bar, of the electrified bike was created. The above shown battery pack designed as a prototype, and then we checked whether our lithium ion battery pack is obtaining the desired output which is required 48 V. By the given result we have successfully achieved our required output voltage and by providing such voltages we can easily obtained our desired speed from the motor and it also handles the load.

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The electric bike, as described is equipped with a 48 V battery pack, an electric back wheel hub motor and a motor controller. The battery pack and converter are new and latter possesses additional features, in comparison to the replaced device. The main improvement often the old controller is the ability to handle regenerative braking, which can be activated by slightly pushing the brake handle. At the present time, regulation of the electric braking force is not possible.

For testing purpose that our battery pack is fully efficient and working properly we have attached other DC equipment to see our that our lithium Ion battery efficiently operate it.

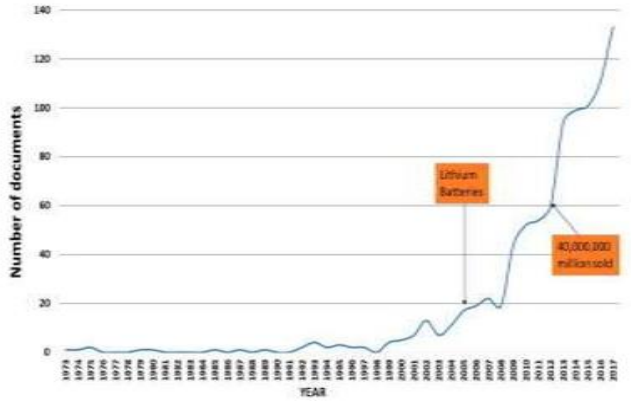

Fig 11:- Comparison Graph

➢ *Discussion:*

Our project ‘’Smart E bike’’ as the name applies is a prototype of an actual motorbike but it has attached with the battery pack ,motor controller and Hub motor unlike as the simple motorcycle which has engine to run the bike. Our project has all the basic components that is used in a motorcycle like frame, handle throttle and breaks but we had tried to convert mechanical side of the bike to electrical side by removing its engine by battery and motor to run over it. The battery pack regardless of its output has all the components that are used to in other electrical vehicles battery pack, a lot of this depends upon the total amount required to build a large scale battery pack.

Our project main object is to remove usages of fossil fuel/oil and to make an alternate way to use renewable energy. Our main focus is to get enough output power to run 48 v hub motor but if we get proper and enlarge recourses we can make more efficient battery pack which can provide more power to hub motor resulting increasing in speed, by making this battery pack we have learned that lithium ion battery pack is way more valuable and efficient as some huge brands around the world use the same mechanism as we had done on a small scale those brand includes Tesla Honda Yamaha and etc.

The total weight of the bike 82 kg, rider and measurement equipment was 171, 162, 142 kg respectively. 03 test runs were carried out at different speed levels and the speed was held constant by regulating the throttle. At the top of the roads, the power was cut in the same place at every run and the bike was ridden back down.

When the current reached zero, bike and rider were assumed to be on top of the road and hence a new run was beginning. Afterwards, each run was split into 3 parts; Zero, positive- and negative current. Parts with zero current were ignored, because the bike was at standstill or in no-load operation. The data with positive and negative current was averaged in their respective parts. This resulted in two averaged power measurements per run; regenerative and normal operation.

Electric Bike	Engine Bike
• No fossil fuel/oil is required. • Environment is friendly and pollution free. • Main components are: **Battery Pack** **Controller** **Hub Motor** • Approximate zero emission as well as smooth ride and no noise. • Maximum speed is 50-60 km/h. • Distance covered in single charge is almost up to 60 km. • Cost of full charge is Rs: 50	• Fossil fuel/oil is required. • It creates pollution. • Main components are: **Engine** **Fuel** • It makes noise and as well as pollute the environment. • Maximum speed is 70-80 km/h. • Distance covered full fuel tank is 8*45 = 360 km. • Cost of one liter petrol is RS:235 now a day.

Table 2:- Comparison b/w Electric & Engine Bike

In above table, we discuss about the compression between Electric bike and Engine bike and from this compression we conclude that the Electric bike is efficient from Engine bike because it’s not produce any pollution and also consume less charges.

V. CONCLUSION AND RECOMMENDATIONS

➢ *Conclusion*

The conclusion of this project and the whole summary of the project is based on a lot of things that took part in this project including working , implementations, circuit description, and components description the methods we used and what problems we faced all these things took part and these are the part of this project . As from now onwards soon the conventional cars and bikes will be vanished, the era of electric cars and electric bikes will come and we’ll gradually see that the electric vehicles will rule the world. After some years the sale and purchase of petrol and diesel vehicles, cars, trucks, busses will be stopped and as a result in the coming few years the hype of electric vehicles will be increased people therefore the oil and gasoline will face a sudden fall down and worst fall down and people can get pollution free environment.

“**PURCHASE ELECTRIC BIKE AND SAVE OUR MOTHER EARTH IT IS YOU**
Who can stop pollution and start Revolution”

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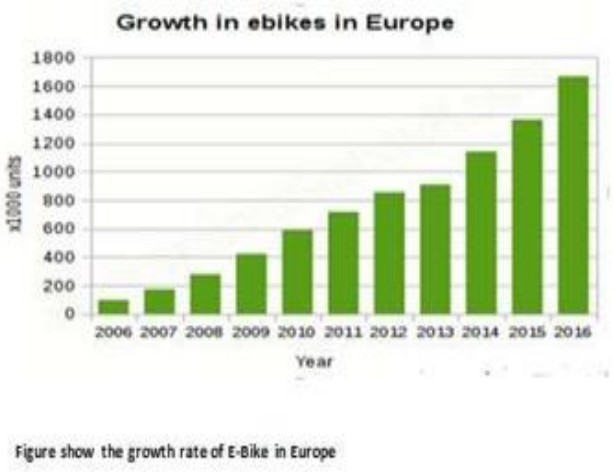

Graph 1:- Demand of E-bike

In graph 1, we discuss that the demand of Electric bike is increased day by day. In European countries most of the peoples use these bikes now days.

➢ *Future Work:*

After some years the sale and purchase of petrol and diesel vehicles, cars, trucks, busses will be stopped and as a result in the coming few years the hype of electric vehicles will be increased people will get away from conventional cars therefore the oil and gasoline will face a sudden fall down and worst fall down.

We can use solar system as well as to charge during driving, first we can charge the solar panel and then connect it with cars battery so that it can charge during driving the electric vehicle. Beside we are using the alternators with the tires so that the tires will move in such a way that it can charges the battery during driving. And electric vehicles provide pollution free environment electric vehicles are very useful way to reduce the pollution. So it's a good thing if you're getting a lot of benefits so why not toavail. We also install the bi0-metric system for the protection of vehicle from thieves. Also make the wireless charging station.

With the help of car companies, along with a new range of electric bikes, e- bikes are beginning to become another real option for moving the world away from the gas pump and toward a more sustainable future.

➢ *Conclusion:*

The first step of taking any initiative that could bring revolutionary changes in the society is always tough and could not succeed or sustain without the support of the administrative involvement form the governing authorities, hence it is of high importance that the state should play

It's part when an initiative this much revolutionary for the transformation of transportation sector of an already suffering oil importing economy is taken so that later such studies could be implemented for the betterment of the society and uplifting the suffering transport sector of the country.

It concludes that Electric bike/Smart electric bike is more efficient and reliable as compare to engine/fuel bikes. It's not much more expensive. Within few years almost every country will use these bikes and cars.

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