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Hybrid Powered Electric Bicycle Using Multiple Energy Storage Devices

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Abstract - The hybrid powered electric bicycle is a system that involves three different ways of charging a battery: solar power, Dynamo and 20V Ac wall charge. The power from these three modes is used to charge an electric PMDC motor running a bicycle. The hybrid powered bicycle is designed in such a way that the rider can have to modes of operating bicycle that is he can choose the bicycle to be driven completely with the electric PMDC motor or it can be driven manually by himself.

The Electric bicycle is a bike driven with the help of battery which is coupled to electric motor. The Electric bicycle which will be running on Lithium-ion battery, the power is supplied to the BLDC motor to make the rotation without pedaling. The main aim of the paper is to show the fabricated bicycle project with various multiple energy storage devices such as Battery and Solar panel, to escalate the performance of E-bicycle compared to existing E-bicycle.

The main purpose of using this E-bicycle is this is user friendly, economical and relatively cheap. Transportation is now greeted as time saving process. So, this is where electric bicycle mainly came into picture.

***Key Words*:** Hybrid powered bicycle, E-bicycle, Lithium-ion battery, electric Bicycle, battery, Solar panel.

1. INTRODUCTION

E-bike is an electric and power-assisted bike that is one of the fastest-growing technology in the bicycle industry. This bicycle uses an electric motor to help you along. So, you can ride it like a normal bicycle, but with less effort. There are two main types of E-bikes- throttle assist and pedal assist. The e-bike may be a human electrical hybrid vehicle. Basically, an associate e-bike may be a variety of electrical vehicles supported by a conventional bicycle to that an electrical motor has been adscititious to assist propel it.

It is associated with ecological and concrete suggesting that transport and its supply of energy may be a battery. Within the twentieth century, electrical bicycles began to play a crucial role as a result of they were associated with economic and easy possibility for urban transport issues and had environmental benefits, particularly in extremely inhabited countries like China to focus on this truth, it's enough to point that over thirty-one million e-bikes were oversubscribed in 2012 the most benefits of electrical bicycles square measure each economic and environmental.

The batteries of the electric bicycles are often recharged by connecting them to a plug or once monger in some gears. A “pedal-assisted” e-bike uses the motor to regulate the pedaling. The pedal-assisted motor enhances the rider's pedaling efforts. These e-bikes are called pedalless and use a sensor device to sense the speed or force of the pedals, or both.
There is also a brake activation that senses if there is a need to disable the motor.

The "power-on-demand" e-bike has a motor that is operated by the use of a throttle. This is usually mounted on the handlebars as with a motorcycle or scooter. Additionally, a typical e-bike desires 4-6 hours to charge the battery and encompasses a variety of travel of 20-25 km at a speed of concerning 30-35 km/hour (depending on riders weight) this suggests that, with one battery charge, it might to enough to travel to figure, visit friends and come home on a standard day.

since statistics show that concerning half the journeys and procedure of a standard urban person square measure applied at intervals a distance of fifteen kilometer's from his/her house, thus at intervals the reach of this bicycle.

2. LITERATURE REVIEW

The hybrid bicycle is a bicycle which is driven with a help of battery which is coupled to electric motor. The navigate research forecast that the worldwide sale of electric cycle and electric bike will reach six million annually starting from 2015 to 2022 and this will total up the rapid increment of the sales is about fifty million. driven by rising fuel price and increasing congested city streets, more consumers are starting to turn two wheeler vehicle, including electric motor cycle and e-bike. Ebike is classified sub classes of motor cycle. Nowadays, there are variety types of bicycle we will find on city streets and parks. The main part of electric bike is main frame, wheels, tires, brake system, battery and charger, motors, charge controller. This type of vehicle are easy to operate. An electric bicycle is a form of electric vehicle that is based on a standard bicycle that has been fitted with an electric motor to assist with propulsion [1]. It is an environmentally friendly and urban mode of transportation with a battery as its power source. Electric bicycles became more popular in the twentieth century as a cost-effective and simple solution to urban transportation difficulties with environmental benefits [2], particularly in densely populated nations like China [3]. To emphasise this point, the fact that over 31 million e-bikes were sold in 2012 [4] suffices.

The primary benefits of riding an electric bicycle are both financial and environmental. The entire cost per kilometre cycled with an electric bicycle (including electricity, purchase, and maintenance) is less than 0.7 cents, compared to $0.031/km for a gasoline scooter [5], or $0.62/km for a car. The electric bicycles' batteries may be recharged by plugging them in or pedalling in certain gears. A typical electric bicycle also takes 6–8 hours to charge the battery [6] and has a range of 35 to 50 kilometres at a speed of roughly 20 kilometres per hour (depending on rider weight) [7]. This means that a single battery charge would be sufficient to get to work, visit friends, and return home on a typical day, as statistics show that about half of a typical urban person's trips and procedures occur within a 15-kilometer radius of his or her home, and thus within the range of these bicycles [3].

From an environmental standpoint, gasoline car consumption in metropolitan areas emits 3.57 g/km of HC (hydrocarbons), 3.15 g/km of CO, 1.82 g/km of CO2, and 2.29 g/km of NOx [8]. As a result, the electric bicycle, as an alternative mode of transportation to the car, saves an average of 8.5 litres of fuel every 100 kilometres, avoiding pollution. The electric bicycle, as a new mode of private transportation, has opened a new era of mobility, particularly in cities, which is beneficial to both countries with big populations and those concerned about the environment. Although electric bicycle research is very young, no one understands where the efforts are currently focused or what the scientific community's primary topics of interest are. The goal of this paper is to determine how electric bicycle research is progressing around the world, and in particular, around which scientific fields it is centred.

Finally, the major trends in this sector may be discovered. Electric bicycles were introduced practically simultaneously with traditional bicycles. Several patents for electric bicycle motors were issued in the 1890s. Ogden Bolton was given a patent (US Patent 552,271, 1895) in the United States in 1895 for a bicycle battery with six brush poles, a DC collector, and a hub motor installed on the back wheel [9].

Hosea W. Libbey of Boston designed an electric bicycle with a double electric motor in 1897 (US Patent 547,441, 1895). In the 1990s, the Giant Lafree ebikes (electric-assist bicycles) brand used the same design. [10] Heinzmann, a German firm, began mass-producing electric motors for bicycles in 1920. Their first motor was a tandem setup. It continued on to develop motors that included German mail distribution bicycles later on In the 1930s, Minneapolis-based Lejay Manufacturing files patents for the GoBike, an electric bicycle powered by a Ford T generator attached to the rear wheel.

Electric bicycles grew in popularity in the 1940s as a result of a shortage of large motorised vehicles as a result of WWII war operations. Several patents for prototypes were granted, but they were overshadowed by the growth and investment in the motorcycle sector, which played a larger role throughout the war.

Many engineers who were dedicated to the development of engines for aeroplanes saw a niche and dedicated themselves to the motorcycle industry in postwar Europe and Asia, due to prohibitions on countries like Italy and

Japan from building and rebuilding their aeronautical industries, and in the shadows of this development were electric bicycles.which went a bit gnored but nonetheless benefited from the new technologies and innovations in that industry. However, it wasn't until the first oil crisis in 1973 that electric bicycles were marketed, despite their lack of appeal at the time. Electric bicycles played a dominant position in urban transportation in the United States as a clean solution to the oil dilemma.

This initial mass-market model, which had a solid steel frame and was difficult to move, was a little rough and hefty compared to contemporary variants. However, when contrasted to the massive and powerful engines of the 1970s, it proved to be extremely adaptable and cost-effective

As a result, simply increasing engine power may not result in a greater acceptance of electric bicycle-style transportation.

3. PROPOSED SYSTEM

Electric bicycle is a vehicle that is called as e bike. It is a bicycle which assist by the electric motor to set the vehicle in motion. The bicycle uses electric dc motor which is receiving power supply from rechargeable batteries. With the help of batteries, the power supply is given to the motor, the bicycle can travel up to 15 to 20 mph, but this range depends on the batteries and the motor power limit which each of the components has their own specifications and limitation.

The electric bicycle is not restricted or bend to the motorist vehicle law even though it is powered by motor, it still considered as bicycle which is the identity of Electric bicycle. It is a bicycle which is assist by the electric motor the bicycle is still fixed on it. The electric bicycle is free from pollution, this is because it using electric source, rather than gasoline. It will not cause pollution to environment, and it will be more similar to a motorcycle.

Hence, the using of dc motor that power supply from the batteries is used on the electric bicycle. The electric bicycle is still used pedal to for pedaling, it just adding the motor, batteries, electronic components and throttle for speed. This add up is for assist the rider in certain condition which is when pedaling away up the high slope, more power is needed, so the motor can assist the rider by provide pedaling power to the rider during pedaling up the high slope.

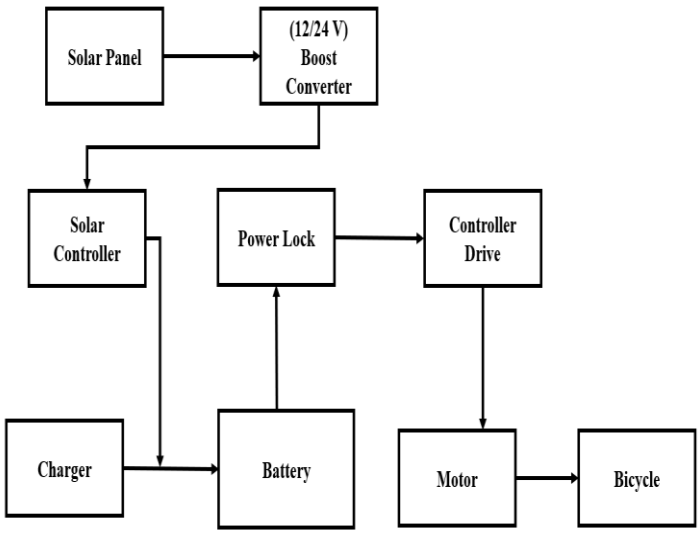

Fig-1: Overview of the Proposed Sytem

3.1 CONFIGURATION OF AN ELECTRIC BICYCLE SYSTEM

Basic Configuration of an Electric Bicycle System An electric bicycle drive's fundamental configuration comprises of a controller that regulates the power flow from the battery to the electric motor.

This power flow works in tandem with the power produced by the rider through the bike's pedals. The rider of an E-bike has the option of totally relying on the motor or pedalling while using the engine (use as a conventional bicycle).

4. STARTING SYSTEM PRINCIPLE OF OPERATION

4.1 BATTERY :

Fig-2: Battery

It is a source of energy, obtained by the conversion of chemical energy from the chemical reaction into electrical energy. There are various types of batteries like Lead-Acid batteries, Lithium-Ion Battery, etc.

Sealed Maintenance Free Battery is a type of lead acid rechargeable battery. They are widely used in large portable electrical devices Batteries are used for storage of electrical energy.

Since the batteries are high in Capital cost it is necessary that overall system be optimized to be economically attractive, the storage Batteries with particular combination of properties:

- Fast and Efficient Charging.
- Very Little Wasted Energy.
- Long Life, Improved Safety, High Reliability, High Efficiency.

It demands for a battery with longer running hours. Among all the existing rechargeable battery systems, the lead acid cell technology is the most efficient and practical choice for the desired application.

4.2 Solar Panel

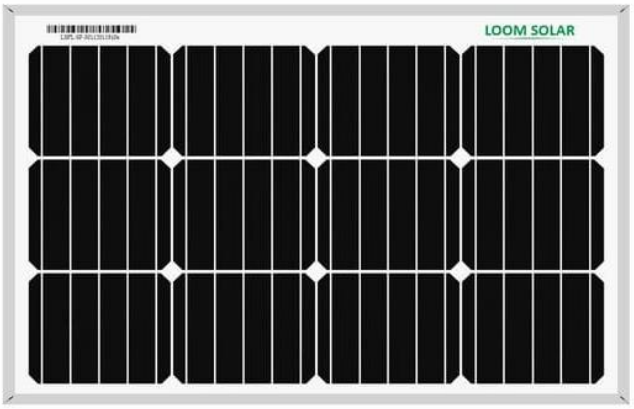

Fig-3: Solar Panel

It is responsible to collect solar radiations and transform it into electrical energy. It is an array of several solar cells. Solar cells convert the energy of sunlight directly into electricity through the use of the photovoltaic effect.
The photovoltaic effect involves the creation of a voltage into an electro-magnetic radiation.

4.3 BLDC Motor

Fig-4: BLDC Motor

A brushless DC motor (known as BLDC) is a permanent magnet synchronous electric motor. It is driven by direct current (DC) electricity and it accomplishes electronically controlled commutation system instead of a mechanically commutation system.
Where, Commutation is the process of producing rotational torque in the motor by changing phase currents through it at appropriate times. BLDC motors are also referred as trapezoidal permanent magnet motors.

4.4 Controller

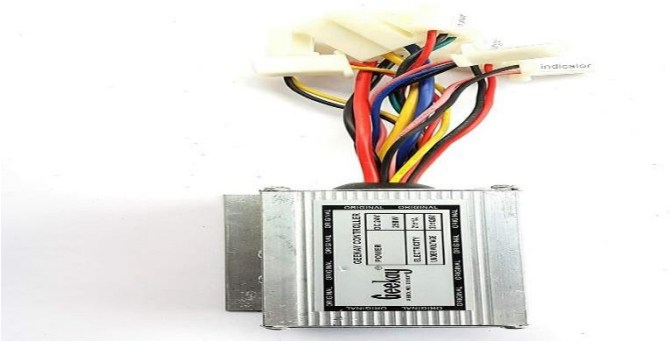

Fig-5: Controller

An important device for the control of parameters such as voltage, speed etc. It decides the speed of the bicycle as per the accelerator position. This controller monitors the throttle setting.

There are two distinct types of controllers designed to match either a brushed motor or brushless motor. Controllers for brushless motors: brushless motors typically have Hall sensor commutation for speed measurement. The controllers generally provide potentiometer-adjustable motor speed, closed-loop speed control for precise speed regulation, protection logic for over-voltage, over-current and thermal protection.

The controller uses pulse width modulation to regulate the power to the motor.

5. FUTURE SCOPE

In today's market, lithium-ion batteries are expensive and hazardous, in the future due to improvements in technology the cost and safety could help in utilizing it for E-Bike.

Self-recharging is not efficient and reliable in today's technology which can be improved in the future. Regenerative braking is still used only on high-end cars and bikes in the near future this technology can be used on all forms of automobiles and E-Bikes.

Range extender by utilizing self-recharging and regenerative braking which could help to increase the range of hybrid and electric vehicles. The Controller we are using is a pre-programmed circuit board which cannot be modified but in future it can be changed by utilizing a programmable ECU.

6. CONCLUSIONS

Solar-powered Bicycle is a modified bicycle that is powered by electricity. It is suitable for both city and country roads made of cement, asphalt, or mud. This bicycle is less expensive, has a simpler design, and can be used for short-distance travel by schoolchildren, college students, office workers, villagers, postmen, and others. The most important feature of this bicycle is that it does not use valuable fossil fuels, saving you a lot of money on gas.

It is eco-friendly and pollution-free because it emits no emissions. Furthermore, it is noiseless and can be recharged with an AC adapter in an emergency. The whole unit was controlled by a control unit. The estimated range of an E-bike is 15Km, with a speed of 20-25 kmph. As it is having two modes of drive electric and manual pedalling it will significantly improve the rider's health than motorbikes and reduces rider fatigue from a traditional bicycle.
E-bikes are claimed to have a significantly lower environmental impact than conventional automobiles and are generally seen as eco-friendly.

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