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Zero Emission Smart Electric Bicycle

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Abstract - As urbanization and concerns about environmental sustainability continues to grow, the demand for efficient and eco-friendly transportation solutions has intensified. Electric bikes (e-bikes) have emerged as a popular alternative to conventional bicycles and motorized vehicles due to their ability to combine human pedalling with electric assistance. It investigates the integration of sensor technologies such as proximity sensors and intelligent braking mechanisms. These innovations aim to prevent accidents, mitigate risks, and enhance overall road safety for e-bike users and other road users alike. This research paper explores the integration of smart technologies into electric bikes, aiming to enhance their efficiency, safety, and overall user experience.

Key Words: Electric Bike, sustainability, Proximity sensor, transportation, eco-friendly.

1. INTRODUCTION

The increasing demand for eco-friendly and sustainable modes of transportation has spurred the development of electric bicycles, or e-bikes, which provide an efficient and convenient way to travel short distances. However, traditional e-bikes have functionality, connectivity, and user experience limitations. Smart electric bicycles aim to overcome these limitations by incorporating smart technologies, such as sensors, GPS, and connectivity, to enhance their performance and usability. This paper aims to explore the development and potential of smart electric bicycles, as well as the challenges and opportunities associated with their adoption.

2. BASIC WORKING OF ELECTRIC BIKE

An electric bicycle, also known as an e-bike, is a bicycle that is equipped with an electric motor and a battery pack. The motor and battery work together to assist the rider in pedalling and provide additional power to the bike.

Here is a step-by-step breakdown of how an electric bicycle works:

1. The rider begins to pedal the bike, as they would on a regular bicycle.
2. The motor is activated through a controller, either by the rider or automatically, depending on the type of e-bike.
3. The battery provides power to the motor, which in turn provides additional power to the pedals to assist the rider.
4. The level of assistance provided by the motor can be adjusted by the rider through the controller, which can increase or decrease the level of power assistance.
5. As the rider pedals, the motor and battery work together to provide additional power and help the rider to maintain a consistent speed, even when climbing hills or traveling over long distances.
6. The battery will eventually run out of charge, at which point the rider can continue pedalling the bike like a regular bicycle until they can recharge the battery.

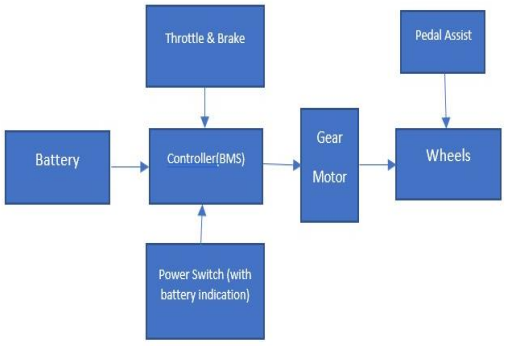

Fig -1: Block diagram

3. SPECIFICATIONS OF ELECTRIC BIKE

A. Gear Motor

1) Voltage	24V
2) Rated Speed	360rpm
3) Motor Weight	2.35kg
4) Rated Power	250 W

B. Motor Controller Specifications

1) Rated Voltage	12 V
2) Protection Class	IP 33
3) Operating Temperature	-20 to 45 °C
4) Maximum Power Dissipation	250 W

C. Battery

1) Voltage & Current	24V 20 amp
2) Charge time	5-6 hours
3) Battery type	lithium-ion
4) Capacity	12Ah (12000mAh)

4. COMPONENTS USED IN ELECTRICAL BIKE

The e-bike consists of the following components:

A) DC Motor

The motor is having rated power of 250 w capacity with a max of 360 rpm per min. DC motors are compact, lightweight, and efficient motors that are commonly used in electric bikes. They are brushless, which means that they do not have any physical contact between the moving parts, which results in a more durable and longer-lasting motor. BLDC motors are typically located in the mid-frame of the bike, and they are powered by a removable battery.

B) Controller

We have selected a 12V DC motor controller. it is a very versatile controller and in the future, we can use the same controller to work with other motors to provide high speed and high torque. The speed controller of an electric bike is an electronic circuit that not only controls the speed of an electric motor
but also serves as a dynamic brake. This controller unit uses power from the battery pack and drives it to the hub motor.
Different types of controllers are used for brushed and brushless motors. For adaptive e-bikes, a conversion kit is used and the controller is the main component of that kit.

C) Battery

A lithium-ion battery is a rechargeable battery used in many electric vehicles. Lithium-ion batteries are currently used in most electric vehicles because of their high energy per unit mass relative to other electrical energy storage systems. They also have a high power-to-weight ratio, high energy efficiency, good high-temperature performance, and low self-discharge.

D) Throttle

A throttle gives the rider full control of the amount of power coming from the electric motor at any given time, regardless of how hard they are pedaling.

E) Brake with Head & Tail Lamp

An e-brake sensor is an optional device. There are two reasons to use an E-brake sensor on E-bike. One is for the safety cut-off; the motor will shut off whenever you press the brake levers.

F) Sprocket

Mechanical parts and features used as the building blocks of an E-bike. It includes the sprocket, pinion, chain, and freewheel

5. SMART FEATURES

A) GPS Tracker with Register Phone Number

Components Required:

1. NodeMCU
2. SIM800L
3. NEO-6M GPS Module
4. 18650 3.7v Rechargeable Battery

If you want to safeguard your belongings like your bike then this GPS tracker might help you with tracking your device and getting live location as well as directions to reach out there. You can install it anywhere by just adding a li-on battery. The smaller size makes it flexible and easy to hide. GPS stands for Global Positioning System. This will use the internet to get the location hence you will require an internet connection that is connected to NodeMCU interfaced with the NE0-6MV2 GPS module.

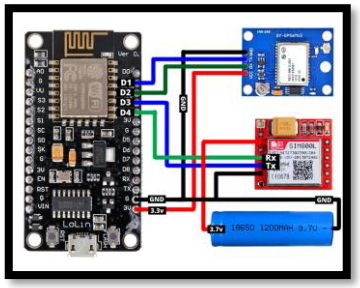

Fig -2 GPS Module

B) Location using ESP8266 using Google geolocation API keys (NO GPS MODULE REQUIRE)

you can follow the following steps:

1. Connect the ESP8266 to your Wi-Fi network.
2. Obtain the Wi-Fi Access Point (AP) information from the ESP8266. This includes the MAC address, signal strength, and SSID of all visible Wi-Fi access points.
3. Create a JSON object containing the Wi-Fi AP information and your Google Geolocation API key.
4. Send the JSON object to the Google Geolocation API endpoint via HTTP POST request.
5. Receive the location information from the Google Geolocation API in response to the POST request.

C) Speedometer

A speedometer for an electric bicycle is a device that measures and displays the current speed of the bike. It can be particularly useful for e-bike riders who want to keep track of their speed and distance traveled.

Fig -4 Speedometer

6. INTERNAL WORKING

An electronic bike is different from a regular bike. Electric bikes use a motor to help the movement of the pedals, making riding the bike less exacting. Some designs allow the bike to move forward under the power of the motor while others bear your backing to pedal. Do not confuse electric bikes with motorcycles. Let's see how it works, when you're riding a normal bike, you have to propel it using some kind of force(i.e. physically pedaling) to rotate the bus. Using a gear motor ensures the rider drives the cycle with electric pedal help depending on the will of the rider. Then, motor MY1016Z2 is used to give the propulsion. Now to control the speed of this motor then introduces the brain of the design – the regulator. The speed is controlled by the DC Motor regulator along with all electrical factors battery, motor, throttle, boscage, display, and pedal- help. the motor used for this is a 24V DC Gear motor with 360 RPM speed. To control the speed of the motor, a motor regulator(9- 60V, 20A DC) is handed. The power is handed to a motor by a 7S5P Li-ion battery pack. To cover the battery state and ensure the safety of operation, a battery-operated system(BMS) is handed.

7. NO LOAD SPEED CALCULATION

Step 1: -
Number of teeth on smaller sprocket (motor) (t1) = 9
Number of teeth on larger sprocket (bicycle) (t2) = 18
Speed on smaller sprocket(motor) (N1) = 3300 rpm
By using a reduction ratio (9.78), speed will be reduced to 338 rpm

Speed on larger sprocket (bicycle) (N2) =?

Step 2: -
Using speed ratio formulae,
N1t1 = N2t2
N2 = 169 rpm

Step 3: -
Diameter of wheel =650mm
Circumference of wheel =3.14*650
=2041mm

Step 4: -
Speed of vehicle = speed of wheel X circumference of wheel
=169 X 2041
=344418075 mm/min
=344.41 m/min
=20665 m/hr
=20.66 Km/hr

8. REQUIRED POWER TO DRIVE BICYCLE

Step (1)
the Total load act on a bicycle is as follows
the Normal weight of a person =is 65 kg
=65*9.81
=637.65N
Weight of bicycle = 5 kg
= 5*9.81
= 49N
N Other Miscellaneous load =5 Kg
=5*9.81
= 49.05 N
The total load = (637.65+49+49.04)
= 735.65N

Step (2)
To find the reaction on each wheel, The above total load is divided equally on both wheel
Force (Ffw) =Force(Frw)
=735./2
=367.8N

Where reactions on the rear and front wheels are as follows
Rfw=Rrw
=0.2*340.5
=73.56 N

Step (3)
To find torque on each wheel
Total torque=Tfw+Trw
To find Torque on the Front Wheel
T1 = Rfw*(D÷2)
=68.1*[(65*10-2)/2]
=22.1325Nm

T1=T2=22.1325Nm
Total torque on wheel=44.265 Nm

Step (4)
To find power on motor = 391.69 watt

9. RESULTS

Following is an image of a ready model of our smart electric cycle.

Fig -5 E-bike Integrated with controller and sensors

10. ADVANTAGES

1. They're Green Technology, which is Zero Pollution, and zero CO2 Emigration.

2. Further provident than gasoline-powered motorcars and motorized bikes

3. Using E-Bikes keeps you fit and well.

4. It can still work manually if the battery dies.

5. Up to 25 kilometers per hour of backing.

6. High Performing Electric bike pedaling can run up to 60 kilometers on a single charge of the battery.

7. It's easy to detect the bike when it gets crashed.

8. It's simple to climb the Hills and Mountains.

9. They're swish, clean, and healthy enjoyment.

10. It's available at low to high costs depending upon its capacity, performance, etc.

11. You may convert your Standard Bike into an Electrics Bicycle by using a tackle and it's indeed a do-it-yourself event in many twinkles, which saves you, plutocrat, on a new bone.

12. It allows the rider to travel further range or climb pitches when further abidance training is necessary.

11. OPERATIONS

1. They're used for traveling sufficient distances.

2. They're the unborn mode of transport and can indeed replace other pollution-causing mobility systems like Petrol bikes and Diesel machine buses.

3. Electric Bikes are better for aged people due to their lower pedal force operations.

4. They're used in large diligence and manufacturers to travel across assiduity areas.

5. They can be used as a mode of transport for small merchandisers to carry their business particulars without any trouble and at an affordable price.

12. CONCLUSION

Electric vehicles are the future of our world with the added consumption of non-renewable coffers similar to petroleum, and diesel which leads us to step our way towards renewable sources similar to solar hydroelectric power and battery. These bikes are environmentally friendly, needs lower conservation, and can be also assembled into small element. There are indispensable ways by which we can save energy. One similar way is the electric bike; it's also a new way of transport that provides us with an easy way of transport to give for any age. It's a cheap source of transport and affordable to anyone. The motor used in this bike has high effectiveness and the battery bank has lower weight with high speed.

13. ACKNOWLEDGEMENT

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14. REFERENCES

1. S. Matey, A. Prabhu, “Design and Fabrication of Electric Bike” International Journal of Mechanical Engineering and Technology- Vol. 8 Issue 3- March 2017.
2. C.D. Ajudiya,M. M. trivedi, “Design and Development of EBike –A Review” Iconic Research and Engineering journalsVol.1 Issue 5- Nov 2017 .
3. J. Dill, G. Rose, “Electric bikes and Transportation policy insights from early adopters” SAGE Journals-Vol.2, Issue-1, 2012.
4. E. Fishman, C. Cherry, “E-bikes in the mainstreamReviewing a Decade of Research"- Vol 36 Issue 1, 2016.
5. S. Washington, N. Haworth, “Bike shares impact on car evidence from the United States, Great Britain, and Australia"- Vol. 31, PP. 13-20, 2014.
6. C. C. Chan “The state of the art of electric and hybrid vehicles “Proceeding to IEEE, Vol. 90 Issue 2, PP. 247-275, 2017.
7. K.J. Astros, R.E. Klein, “Bicycle dynamics and control - Adapted bicycles for education and research” IEEE control system magazine, Vol. 25 Issue 4, pp.26-47, 2017
8. GoPedelec: ‘GoPedelec handbook’. Technical report, Go Pedelec Project Consortium, 2012

9. Al-Ali, A.R., Zualkernan, I., Aloul, F.: 'A mobile GPRS-sensors array for air pollution monitoring, IEEE Sensors J., 2010, 10, pp. 1666–1671
10. Behrendt, F.: 'Sharing cycle rides on smartphones and city streets: towards understanding the intersection of mobile media and electrically-assisted cycling'. ECREA (European Communications Conf.), Istanbul, 2012