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Embedded E-Bike With Energy Generating System

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ABSTRACT

Future E-Bike are the most technologically advanced answer for a better society and future gennerations. The E-Bike is a battery-powered vehicle that is both cost-effective and environmentally friendly. E-Bikes are a well-organized and ecologically responsible alternative to traditional bicycles and traditional autos, providing an environmentally friendly, enjoyable, and convenient mode of transportation. E-Bikes are powered by a battery that is connected to an electric motor. We have developeda prototype for an E-Bike with an energy-generating system. This paper describes a method for developing and executing an E-Bike on a standard bicycle by assembling different components. Our project's primary purpose is to develop a two-in-one E-Bikethat can be used as both a power-assisted bike and a traditional bicycle as needed. It also has an energy-generating system that generates electricity while pedaling the bike. It can be utilized in the exact vehicle or stored in a battery to power other devices.It also has certain embedded features for a better user experience. The project uses a GPS tracking device to track your whereabouts and allows you to register your journey on a web page.

Keywords: *Two in One Concepts (E-Bike + Cycle), Energy Generating System, Embedded Features*

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1. INTRODUCTION

The crude oil prices have increased significantly over the past few years, and there seems to be no turning back. The electric bicycle is a project that can be promote both cleaner technology and lesser dependence on oil. Our intention of implementing this project is to give a low-cost, more efficient embedded system with many features like GPS tracking, RFID security, recharging, a display screen for speed, and a GPS tracker for an excellent user experience. An electric bicycle is a form of electric vehicle based on a standard bicycle fitted with an electric motor to assist with propulsion. It is an environmentally friendly and urban mode of transportation that uses a battery as its power source. Electric bicycles became popular in the twentieth century because they were a cost-effective and easy solution to urban transportation issues and had environmental benefits. Every one of us is living in the future. Technology has enhanced our lives throughout time. Electric bicycles are now used in the majority of countries. Cycling rather than driving is always better for the environment, but the E-Bike has become the most popular form of green transportation in this decade. Consider an E-Bike in place of a regular bike or a petrol-powered scooter in place of a regular bike. An E-Bike is powered by rechargeable batteries and can go at speeds ranging from 25 to 45 kilometers an hour. As a result, it is faster than a standard cycle and will get you to your goal faster.

2. PROPOSED METHOD

The major goal of our project is to create a two-in-one E- Bike that can function as both a power-assisted bike and a standard bicycle as needed. It also includes an energy-generating mechanism that generates power while pedaling. It can be used in the vehicle itself or stored in a battery to power Other equipment. It also contains certain built-in features for a better user experience. The project tracks your whereabouts Using a GPS tracking device and allows you to log your journey on a web page. The E-Bike also has an RFID lock system for added security. We structured the process of implementing this E-Bike into three parts-

1) E-Bike with Energy Generation System.
2) Embedded Features.
3) GPS Tracking Website.

2.1 E-BIKE WITH ENERGY GENERATION SYSTEM

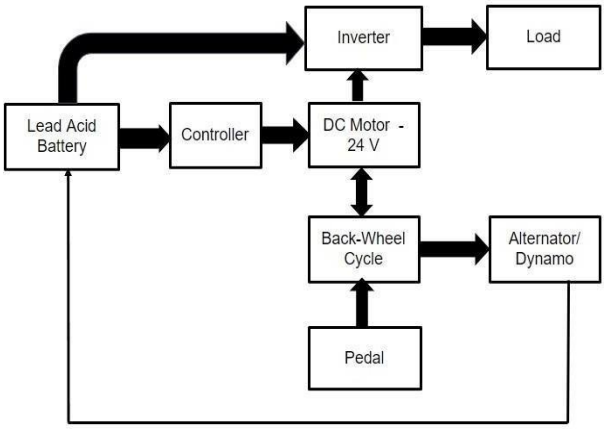

Fig.2.1. Block-Diagram of E-Bike with Energy Generating System

As illustrated in the block diagram of figure 2.1, a lead-acid battery is connected to the controller, a DC Motor controller usedto regulate or alter the speed of a DC motor. A lead-acid

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battery with a capacity of 24 volts and seven amps will deliver DC powerto the controller, which will then be given to a 24-volt dc motor. The 24V, 350-watt dc motor is mounted to the back wheel of the cycle through a timing chain and will power the E-Bike. As we can see, the lead-acid battery is also connected to the inverter. The inverter will convert DC energy to AC energy. At the output of the inverter, we can utilize AC loads and usethe energy for different applications, particularly in rural regions where energy is needed. The inverter is linked to the DC motor 24V, 350 watts, so that the AC energy from the inverter can be generated when pedaling the cycle since we used a DC motor that can generate DC energy. We can also see that the alternator/dynamo is mounted to the cycle's back wheel. When we pedal the cycle, the alternator/dynamo generates DC energy, transferred to the lead-acid battery.Using this concept of energy generation, we can also charge the lead-acid battery with an alternator/dynamo.

2.2 EMBEDDED FEATURES

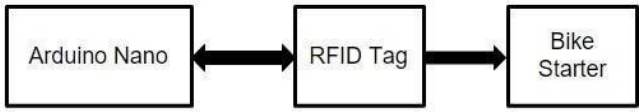

Fig.2.2. Block-Diagram of RFID-Security System

We have provided an RFID key for E-Bike security. Generally, there is only an ignition lock switch, and the thief can easily hack it. Figure 2.2 depicts how the RFID circuit's components are connected. In this case, we utilized an Arduino Nano with an RFID module and two RFID tags to lock and unlock the bicycle.

2.3 GPS TRACKING WEBSITE

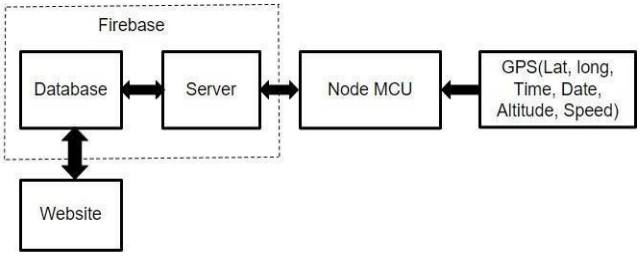

Fig.2.3. Block-Diagram of GPS Tracking WebsiteSystem

As shown in the figure 2.3, for GPS tracking we have fixed Neo 6m sensor on our bike to get information on the current latitude, longitude, time, altitude, and it also shows the speed of E-Bike in Km/hr. Now using the node MCU (ESP8266) board we send the data obtained from the sensor to Google firebase (which acts as a remote database) and also display that data on the OLED display which is fixed on the bicycle too. Node MCU board has a unique User ID pre-coded in it. So that when we store data from Node MCU to firebase we can get separate folders for each user. Also, we have made a website that allows users to track their route or get the current position of their bicycle. For the website, we have used React JS library. Now when the user logs into our site, we check the user Id of the user with the user Id stored in our firebase and if it matches then firebase returns data of that particular user. Once we get the data in react we convert it into a JSON format and then create a map onto it using leaflet.js.

3. IMPLEMENTATION

3.1 BATTERY

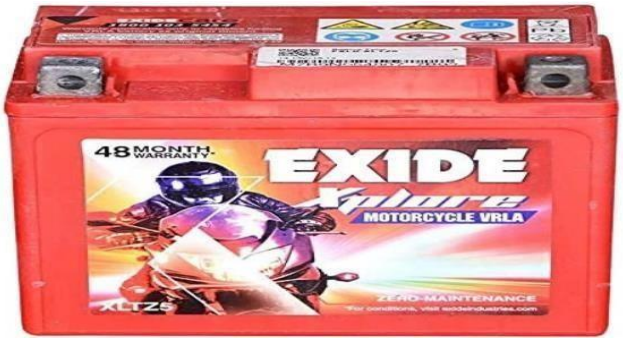

Fig.3.1.Battery used for E-Bike

The Battery is the main source of electrical energy in E-bikes. A lead-acid battery is a kind of rechargeable battery as shown in fig.3.1. It is the first type of rechargeable battery ever invented. Depending on the manufacturing process, sealed lead-acid batteries can have a design life ranging from 3-5 years to 12+ years. Temperature is one of many factors that affect the battery's service life. We're using two 12V, 7 AMPS Lead-acid batteries connected in series. So total we are using 24V, 7Amps battery.

3.2 DC MOTOR

Fig.3.2. DC motor used in the E-Bike

For our E-bike, we used a 24V, 2750 RPM, 350 Watt DC motor as shown in fig.3.2. This motor weighs 1.9kg in total. This motor has an 11-tooth, 25 chain sprocket as well as a 4-bolt mounting bracket on the bottom. Because this is a DC motor, it can rotate in either the clockwise or counterclockwise direction by just switching the battery polarity to the motor, and it can be speed regulated.

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3.3 CONTROLLER

Fig.3.3. E-Bike Controller

To control the speed of the DC motor, the controller is used in combination with the throttling unit. The controller is the main device of the E-Bike shown in fig.3.3. We have used a 24V 500W DC motor controller which provides functions such as controlling the speed of the bike, battery charging unit, brake light, power lock. This motor brush controller for Electric bicycles scooters is compatible with the MY1016 500W DC motor. The controllers modulate the amount of power flowing to the motor, which uses your input to transfer the desired amount of current from the battery into the motor.

3.4 THROTTLE

Fig.3.4. Throttle used for E-Bike

We have used throttle to control the speed of the DC motor, the throttle is used in combination with the dc motor controller for speed control, we have 3 wires in throttle red wire which is used as power +5v, black wire is ground and green wire is the signal wire to vary the speed all these wired are connected to dc motor controller. We have used the normal E-bike twist throttle it features linear control over E-Bikemotor and lets you change the speed of the E-bike according to your requirement. It obtains a direct connection with the E-Bike Controller Circuitry through the wire attached to it.

4. DESIGN DETAILS

We have successfully developed and implemented the concept of a two-in-one E-Bike in fig 4.1, in which we can ride the electric cycle with the help of a dc motor but, in the event ofa failure or a problem, such as a battery discharge, we can returnto conventional cycling with pedaling. We utilized a Dc Motor of 24v, 350 watts, a pulsar chain, also known as a timing chain, 32 teeth sprocket of Timing chain obtained from a bike engine, aDc Motor controller of 500 watts, throttle, and a Lead-acid Battery of 24v,7amps (connected in series).

Fig.4.1. Two in one bicycle implementation

We adopted the chain drive concept, the Dc motor sprocket of 11 teeth connected to the freewheel (32 teeth sprocket) at the back bike tire with the assistance of a chain (Timing chain). We bought a normal cycle's freewheel and welded a timing chain sprocket (32 teeth) to the normal cycle's freewheel on top, exactlyin the centre. Then we fixed these two freewheels with the help ofa Chuck Nut, one freewheel (normal cycle one) for the cycling chain and the second freewheels, which were welded with a timing chain sprocket for the E-bike chain drive, as shown in figure 4.2, figure 4.3.

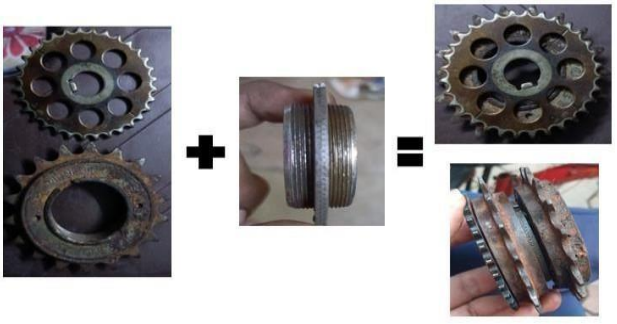

Fig.4.2. Welding of 2 freewheels using check nut for two in one concept

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Fig.4.3. Welded part fitted on the E-Bike

5. EMBEDDED FEATURES

5.1 RFID SECURITY SYSTEM

RFID embedded feature, we mounted this small box shown in figure 5.1.1, to the front of the bicycle and connected it to our controller as a switch to start our E-Bike.As a result, we can secure our E-Bike using this method. When we turn on the switch on the box, the RFID system isactivated, and the green led lights indicate that the system isactive. The red light glows, and the green led flashes when the RFID tag is identified. As a result, the relay output is triggered, and the RFID system will function as a key for bike security.

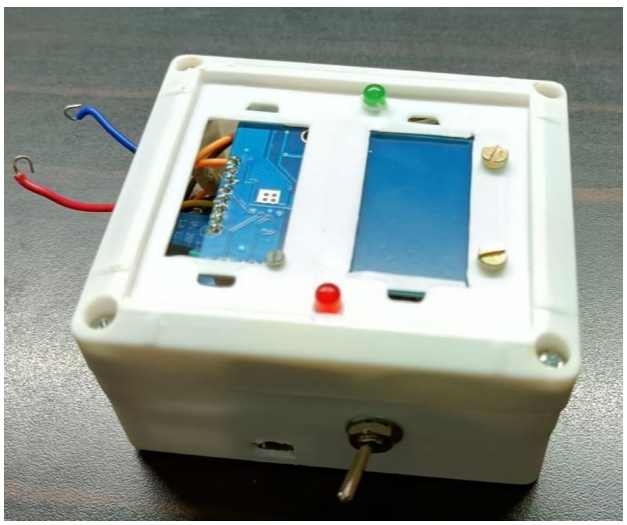

Fig.5.1.1. RFID security system

In fig 5.1.2 RFID tags are a tracking system that uses smart barcodes to identify items. RFID is short for “Radio Frequency Identification,” and as such RFID tags utilize radio frequency technology. These radio waves transmit data from the tag to a reader, transmitting the information to an RFID computer program.

Fig.5.1.2. RFID Tags

5.2 GPS TRACKING SYSTEM

GPS tracking tracking feature, we constructed the circuit in a compact box, as shown in figure 5.2.1. We mounted this littlebox to the front of the bicycle and connected it with the website for real-time tracking of the user's whereabouts. So, using this technique, we can maintain track of where the bikeis at any time.

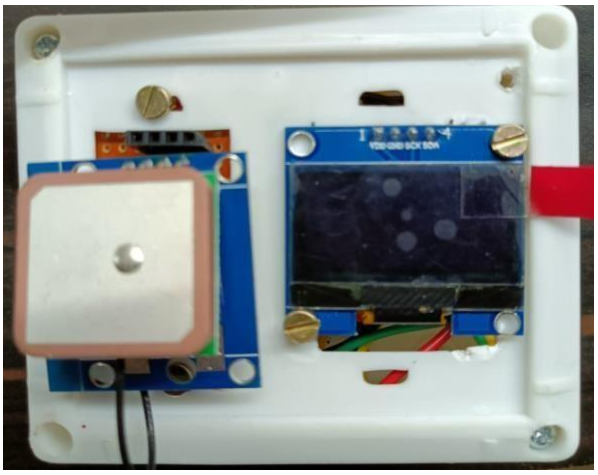

Fig.5.2.1. GPS tracking system

The data collected by this GPS tracking device is sent to the firebase realtime database. Once the data is recorded in the database, it is shown on our website in .a map. We used a react Firebase library that detects changes in the data and updatesthe website accordingly. As shown in figure 5.2.2, a user may access his data on this website using his user id and monitor his whereabouts at any moment. It is also a safety measure since if the E-Bike is stolen, then user may track its location using this website.

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Fig.5.2.2. Sign-in page for user

When user logs into our site, we check the user Id ofthe user with the user Id stored in our firebase and if it matches then firebase returns data of that particular user. Once we get the data in react we convert it into a JSON format and then create a map onto it using leaflet.js. Also, this website also allows users to view their location from their starting position to their current position, shown in figure 5.2.3.

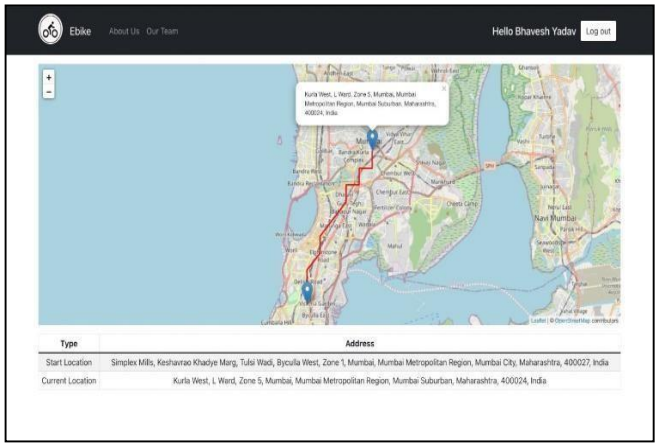

Fig.5.2.3. Website for GPS tracking

We have stored data in the key value format. The dataincludes speed, position, and time which is obtained from the sensor, shown in figure 5.2.4.

Fig.5.2.4. Database received for user's location

6. CONCLUSION

This paper discusses a system designed to meet the needs of those who want an efficient, secure, and cost-effective form of transportation. The E-Bike is designed in three parts: a two-in-one E-Bike, an Energy generation system, and a GPS tracking website; these parts are integrated with a standard bicycle to build our system.

REFERENCES

[1] N. Hatwar, A. Bisen, H. Dodke, A. Junghare and M. Khanapurkar, "Design approach for electric bikes using battery and super capacitor for performance improvement," 16th International IEEE Conference on Intelligent Transportation Systems (ITSC 2013), 2013, pp. 1959-1964, doi: 10.1109/ITSC.2013.6728516.

[2] H. A. Abdallah Dafallah, "Design and implementationof an accurate real time GPS tracking system," The Third International Conference on e-Technologies and Networks for Development (ICeND2014), 2014, pp. 183-188, doi: 10.1109/ICeND.2014.6991376.

[3] Y. Taniguchi, K. Nishii and H. Hisamatsu, "Evaluation of a Bicycle-Mounted Ultrasonic Distance Sensor for Monitoring Road Surface Condition," 2015 7th International Conference on Computational Intelligence, Communication Systems and Networks, 2015, pp. 31-34, doi: 10.1109/CICSyN.2015.16.

[4] Chris Kiefer, Frauke Behrendt, "Smart E-Bike monitoring system: real-time open source and openhardware GPS assistance and sensor data for electrically-assisted bicycles" 12th IET Intelligent Transport Systems 2015.

[5] Z. Garofalaki, D.Kallergis, G.Katasikogiannis, I.Ellinas and C.Douligeris, "Transport services within the IOT ecosystem using localization parameters," 2016 IEEE International Symposium on signal Processing and Information Technology (ISSPIT), 2016, pp. 87-92, doi:10.1109/ISSPIT.2016.7886014.

[6] M.K. Jadhav, S. A. Jadhav, A. A. Kate and S. G. Gholap, "Design and Analysis of Hub Dynamo for Electric Vehicle," 2018 International Conference On Advances in Communication and Computing Technology (ICACCT), 2018, pp. 262-264, doi: 10.1109/ICACCT.2018.8529619.

[7] Ranjan Kumar, Munna Kumar, Pradyumn Sah, Mustaim Alam "Design and Fabrication of Electric Bicycle" 2018 International Journal of Innovative Technology and Exploring Enginerring ISSN: 2278-0181.

[8] H. M. Al-Kadhim and H. S. Al-Raweshidy,"Energy Efficient and Reliable Transport of Data in Cloud-Based IOT," in IEEE Acess, vol 7, pp. 64641-64650, 2019, doi: 10.1109/ACCESS. 2019.291.2917387

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