International Journal of Recent Technology and Engineering (IJRTE)
ISSN: 2277-3878, Volume-8 Issue-5, January 2020

Eco-Friendly E-Bicycle

Abhijit Kumar, Awadhesh Kumar Dewangan, Vaibhav Dange, Amit Agarwal

Abstract - As the technology is upgrading itself day-by-day, it makes us dull and unhealthy. So keeping in mind the health benefits and also the cost, we have made an eco-friendly e-bicycle (EFE) for day-to-day transportation.

This EFE is a bike with a coordinated compact electric DC gear engine which can be utilized for drive by utilizing power from set of 4 battery-powered batteries. Likewise outfitted with a controller, phone charging port and extras like head light, horn and markers with the most minimal conceivable expense.

E-bikes are getting progressively well known all through the planet as an ever increasing number of individuals scan for proficient, reasonable and eco-accommodating methods of transportation. As of late e-bikes have hit the market most in China followed by Europe and USA.

Individuals around the globe are going to e-bikes as a powerful answer for their everyday transportation needs. Utilizing an e-bike for this sort of day by day travel can help set aside cash, time and furthermore be worried about the contamination and individual wellbeing.

Watchwords: Bicycle, Controller, Day-to-day transportation, Economical, Electric DC gear engine, Rechargeable batteries.

I. INTRODUCTION

An e-bike is a kind of electric vehicle dependent on a customary bike to which an electric engine has been added to help move it [1]. It might be an environmental and solid methods for transport and its wellspring of vitality is a battery. In the twentieth century, e-bikes started to assume a progressively significant job since they were a monetary and basic alternative for urban vehicle issues and had ecological favorable circumstances [2], particularly in exceptionally populated nations like China [3]. To feature this reality, it's sufficient to point that more than 31 million e-bicycles were sold in 2012 [4]. The principle preferences of an electrical bike are both financial and natural. The batteries of the e-bikes can be revived by interfacing them to a home inventory or while accelerating. What's more, a run of the mill e-bike needs 4 h to charge the battery [6] and has a scope of movement of 25 to 30 km at a speed of around 20 km/h (contingent upon rider's weight) [7].

Manuscript published on January 30, 2020.
* Correspondence Author
Abhijit Kumar*, Department of Electrical and Electronics, Dr. C.V. Raman University (C.G.)
Awadhesh Kumar Dewangan, Department of Electrical and Electronics, Dr. C.V. Raman University (C.G.)
Vaibhav Dange, Department of Electrical and Electronics, Dr. C.V. Raman University (C.G.)
Amit Agrawal, Associate Professor, Department of Electrical and Electronics, Dr. C.V. Raman University (C.G.)

This implies, with a solitary battery charge, it is sufficient to get down to business, visit companions, and profit home for a typical day, since insights show that about portion of the outings and methodology of an ordinary urban individual are completed inside a separation of 15 km from his/her home, in this manner inside the range of these e-bikes [3]. From a natural perspective, the emanations brought about by an oil vehicle in urban territories are: HC (Hydrocarbons) 3.57 g/km, CO 3.15 g/km, CO2 1.82 g/km, and NOx 2.29 g/km [8]. In this way, the e-bike, is an elective methods for transport to that of vehicle, shows that for each 100 km a normal of 8.5 L of gas is spared, and this contamination would be stayed away from. The e-bike as a substitution kind of private vehicle has prompted a substitution way to deal with portability, particularly in urban areas, both for nations with enormous populaces and for nations that are worried about the earth. The exploration on the e-bike is moderately new, however today, no one obviously knows where the endeavors are being engaged, nor what the central matters of enthusiasm of established researchers are. The principle target of this original copy is to recognize how the examination in being directed in this field and lower the expense than the present market rate.

II. HISTORY OF E-BICYCLE

Electric bikes started nearly at an identical time as customary bikes. During the 1890s, a few licenses were conceded for e-bike motors. In 1895, Ogden Bolton Jr. was allowed in the United States the patent (US Patent 552,271, 1895) for a bike battery with 6-post brush and commutator direct current (DC) center point engine mounted on the back wheel [9]. In 1897, Hosea W. Libbey in Boston imagined an e-bike (US Patent 547,441, 1895) that was controlled by a twofold electric engine. During the 1940s, e-bikes enrolled an expansion because of a lack in enormous mechanized vehicles, because of the war endeavors of the Second World War. A few licenses were conceded for models that were overshadowed by the improvement and interest in the bike business, which assumed an increasingly significant job during that war. In post-war Europe and Asia, because of the restrictions to nations like Italy and Japan to assemble and rearm their aeronautical industry, numerous architects who were committed to the advancement of motors for planes saw a specialty and devoted themselves to the bike business, and in the shadows of this improvement were e-bikes, which went somewhat disregarded however in any case profited by the new advances and developments in that industry. In any case, it was not until the principal oil emergency in 1973 that the utilization of e-bikes started to be advanced, despite the fact that they didn't have a lot of notoriety. It was in the United States where e-bikes assumed a prevalent job in urban vehicle as a spotless choice for the oil issue.

In 1982, the innovator Egon Gelhard built up a subtype of e-bikes that worked with the electrical cycle pedal rule, where the main thrust is supported by the electrical footing of the motor when accelerating. Electric bikes started to acknowledge more reputation inside the nineties. In 1992, Sinclair Research Ltd. sold the Zike, an e-bike that included nickel-cadmium batteries.

It was a transportable e-bike that gauged 11 kg with a little engine driving the back haggle batteries incorporated with its edge. Just 2000 units were sold.

Besides, at the highest point of the 1990s, the enormous bike brands ruled the market, however toward the beginning of the year 2000 the offers of e-bikes reduced drastically, just to reemerge in the year 2005 with the blast of the lithium battery. This blast toward the start of the 21st century started to thank to the decrease in the heaviness of the bike. The lightest electric bike in the market was worked by Panasonic (19.9 Kg). Before long, Honda discharged its Step Compo model, the primary electric collapsing bike to weigh 18.7 Kg. Later Panasonic embraced the Lithium-particle battery to change the market once more. Along these lines, in 2012, 854,000 e-bikes were sold in the EU27, which implies 1.7 e-bikes deals per 1000 occupants, and for the all out number of e-bikes sold methods 4.2% [4]. It is evaluated that around 21 million e-bikes were coursing in China in 2009, which is more than the all out number of vehicles in China (9.4 million cars) [11]. Truth be told, Xinri is the biggest overall producer of e-bikes [12]. From a worldwide perspective, in 2015, a little more than 40 million e-bikes were sold around the world, of which over 90% were in China, 5% in Europe, and just 0.7% in USA. From the perspective of the fundamental execution guidelines of the worldwide e-bike showcases by Motor force limit (W) and Top speed (km/h), in the USA it is 750 W and 32 km/h, in the EU it is 100-250W and 25 km/h, and in China its 25 km/h with no restriction on Motor force however the bicycle must gauge <45 kg [13, 14].

III. INSTALLED EQUIPEMENTS WITH RATINGS

These are the following instrument with specification, which is used in designing an “E-BICYCLE”, and they are:-

- **a.** DC gear motor (Model no. - MY1016Z2)
- **b.** Battery bank
- **c.** Controller
- **d.** DC Dynamo
- **e.** Battery charger
- **f.** Free wheel
- **g.** Throttle
- **h.** Accessories

a. DC gear motor (Model no. - MY1016Z2)

Rating - 24 volt, 10 amp, 240 watt

This e-bicycle is equipped with a portable DC gear motor which is used for propulsion. This DC gear motor is being powered by battery bank. This DC gear motor is mounted on the rear wheel of the bicycle.

b. Battery bank

Rating - 24 volt, 15 Ah

It is a set of 4 rechargeable battery of 12 volt, 7.5Ah each. In this, set of 2 series connected batteries are connected in parallel.

c. Controller

Rating - 24 volt, 7.5 amp, 180watt

It is just like a brain of the e-bicycle which controls power from battery bank to the different parts of the system i.e. motor, and accessories like headlight, backlight, horn and indicators and the power from charging ports to the battery.

d. DC Dynamo

Rating – 12 volt, 500 rpm

This DC Dynamo is used to generate electrical energy from the rotation of the bicycle wheel which is further used to charge the battery bank.

e. Battery Charger

Rating – 12 volt, 3 amp

Using this battery charger we can charge the battery bank installed. This charger converts the 230 volt ac supply to 24 volt DC supply to charge the batteries.

f. Free wheel

Rating - 15 step, 500 gram

It comes under the mechanical part of the system. It is placed on the shaft of the rear wheel. It transfers the torque that is being produced by the motor.

g. Throttle

It is the accelerator which is used to accelerate the vehicle as required by the rider.

h. Accessories

Different accessories are connected like headlight, backlight, horn and indicators which improves the overall look of the e-bicycle.

S. No.	Equipment	Rating
1.	DC gear motor	24 volt,10 amp, 240 watt
2.	Batteries	24 volt,15 Ah
3.	Controller	24 volt,7.5 amp,180 watt
4.	DC Dynamo	12 volt, 500 rpm
5.	Battery charger	24 volt, 3 amp
6.	Free wheel	15 step ,500 gram
7.	Throttle	
8.	Headlight	12 volt,1 amp
9.	Backlight	4 volt, 0.5 amp

10.	Indicator	12 volt LED
11.	Horn	

IV. CONSTRUCTION

The construction of this e-bicycle is just like a simple bicycle running with a DC motor which is being powered by the battery bank.

Fig 1. Final assembly of E-bicycle

This DC gear motor is installed in the frame of bicycle with the help of clamp and screws which make it portable. A free wheel is placed to the other side (left side) of the axle on the shaft mounted on the rear wheel. This free wheel is connected with the rear wheel of DC gear motor through the chain.

Fig 2. DC gear motor

Fig 3. Portable DC gear motor

A throttle at the right side of the handle is used as accelerator for the motor. Now the energy from the battery is transfer to motor by throttle, as we increase the acceleration, the speed of the motor increases, and as the speed of the motor increases it rotates the free wheel via the chain connected which in turn produces the torque which is used in propulsion.

Fig 4. Throttle

To drive the motor electricity is required and to fulfil this requirement we are using a power source in terms of the battery bank. There are many types of battery available in the market but we are using a set of 4 rechargeable lead acid battery with 12 volts 7.5 Ah each connected first in series then in parallel to fulfil our 24 volts 15 Ah requirement. It is not the latest battery technology instead we have replaced the latest battery technology (Lithium-ion battery) with the rechargeable lead acid battery so as to lower the budget and ease of availability to common people.

Fig 5. Battery connected in first series and then parallel

Fig 6. Single Battery unit

Next in construction is the controller box, which acts as the brain of the e-bicycle. It controls all the electrical system which includes DC gear motor, charging of the battery bank, brake light, the throttle also. Throttle are connected with the controller and controller are connected with battery and motor. The controller also have output ports for head light and indicators. We have also installed additional switches for head lights, brake lights and indicators.

Fig 7. Controller

Fig 8. Additional switch

A 24 volt 3 amp adapter is used as battery charger. This battery charger converts 230 volts AC supply into 24 volts DC supply which is further fed to battery bank through the controller.

Fig 9. Battery charger

Next comes the DC dynamo. We have connected 2 DC dynamos of 2 volt, 500 rpm each which is attached on both the sides of the side rods. The wheel connected to the dynamos is further connected to the rear wheel. When the bicycle is moving, the rear wheel rotates which in turn rotates the dynamo and these dynamos will charge the batteries via the controller.

Fig 10. DC Dynamo

Fig 11. DC dynamo connected with the wheel

V. COST ESTIMATION

Equipment	Quantity	Cost per unit	Total cost
Motor	1	2800/-	2800/-
Batteries	4	375/-	1500/-
Controller	1	500/-	500/-
DC Dynamo	2	200/-	400/-
Battery charger	1	200/-	200/-
Throttle	1	250/-	250/-
Head light	1	150/-	150/-
Back light	1	20/-	20/-
Indicators	4	20/-	80/-
Horn	1	80/-	80/-
Wires	3 meter	10/-	30/-
Clamping materials			300/-
Free wheel	1	50/-	50/-

Switch	2	25/-	50/-
Carrier box	1	200/-	200/-
Labour Charge			400/-
Bicycle	1	3000/-	3000/-
Total			10,010/-

Note: - The total cost while preparing this e-bicycle is 10,010/- which is less than 50% of the total cost of the present market rate. Also it has to be considered that the total cost includes the cost of the bicycle itself but with people having the bicycle will be priced at 7,010/- with some installation charge. The cost per unit mentioned in above table of the equipments is according to the market price but if the same equipments will be manufactured then the rate shall be much lowered.

VI. TEST AND ANALYSIS

Testing of this e-bicycle is done with the battery fully charged. The results are as follows: -

- With the battery fully charged, this e-bicycle went 30 km (to be exact).
- It gained up to 25-30 km/h speed as compared to conventional bicycle which gains up to 13 km/h (maximum).
  - We tested it 2 times, first with a person weighing 70 kg and reaches a speed of 32 km/h and second with a person weighing 80 kg which acquired a speed of 25 km/h. So the analysis of this testing is crystal clear that the acceleration of the e-bicycle rely on the rider's weight.
- Also the speed went to about 15 km/h even accelerating it to its fullest when the battery drained much. This took place after the running of 28 km.
- We also tested it with the dynamos. When the dynamos are connected the distance was increased by 5 km i.e. the e-bicycle went up to 35 km with the dynamos.

VII. DISCUSSION AND RESULT

True to form, the part of building drives the exploration, since it covers subjects like vehicle [15], improvement and assembling [16], development in materials [17], and issues identified with batteries [18].

In the event that one focus on the structure, one can see how the focal topic is electric, trailed by battery and engine. The plan is principally identified with Electrical building. On account of its lighter weight, the electric drive innovation has empowered e-bikes to be very vitality proficient. For example, most e-bikes expend around one-tenth the vitality utilization of a little electric vehicle, this implies under 2 kWh/100 km [20].

Battery group is centered around Electric battery-powered batteries. The upgrades in battery and engine innovation show that there's a pattern for e-bike plan that all the more intently takes after conventional bikes, which most likely makes them increasingly appealing to customary bike clients.

As referenced before, the usage of the electrical bike lessens CO2 outflows, and is apparently an ecological advantage. Improvement in battery innovations will improve the natural difficulties looked by pollution brought about by batteries. It ought to be noticed that CO2 outflows are multiple times not exactly a customary vehicle venturing to every part of a similar separation [20].

Mechanical building, manages contemplates related with Torque control, human force, and pendulums or frameworks steadiness. Around there, there's as yet potential for development, especially in the quest for lighter materials. This weight help would likewise permit certain sorts of e-bikes to be adjusted to the guidelines of nations whose limitations depend on the heaviness of the bike.

The best favorable circumstances gave by this methods for transport are:

a) Now-a-days people have their own bicycle which can be replaced by e-bicycle just by installing a motor which will be portable. This will also reduce the cost while designing an e-bicycle for a common man.

b) People also like those kind of products which are simple and easy to be maintained and therefore this design provides an external advantage of maintaining it in home and around.

c) Availability of materials/parts is the next in the list of advantages of this kind of design which is available in any local market. So if any kind of damage has occurred it can be replaced or repaired in no time.

d) We have replaced the lithium ion batteries (equipped in the e-bicycle available in the present market) with the rechargeable batteries (lead acid battery) which is a game changer in the total cost.

e) With these above advantages we found this prototype to be economical. This means a common man can purchase it in less than 50% of the total cost available in the present market.

f) This design can also be benefitted to the disabled people by converting their tricycle into e-tricycle with an affordable price. Also the cost of existing electric wheel chair is very costly which is not affordable by the common people, so this prototype will be a helping hand to them in the pricing sector.

g) And as the topic suggests this design also contributes in controlling the pollution level especially in countries that have high pollution concern like India.

h) Minimizes the need of parking and significantly minimizes the expenditure.

i) So after contributing in the pollution control the health of the people is also a big factor to be worried about. So the people are left with no excuse that they don't have time to exercise. It's a good opportunity for the people to exercise while riding since we work on our health system during the ride.

j) With lowering the overall cost of this kind of design, the sale increases and with the increase in the sale, it will run on the roads, this means less traffic, no air and noise pollution.

Given the advantages of the electrical bikes both from a natural and vitality reserve funds perspective, particularly in urban vehicle.

In this work we set out as a target to examine the exploration drifts about logical distributions identified with electric bikes and lower the absolute expense in making it.

S.NO.	EARLIER MODEL	OUR MODEL
1.	NO SUCH EASY WAY	EASY TO INSTALL
2.	TECHNICAL SKILL REQUIRED FOR MAINTENANCE	NO SUCH TECHNICAL SKILL REQUIRED
3.	PRODUCTS NOT AVAILABLE	PRODUCTS EASILY AVAILABLE
4.	COSTLIER	CHEAPER
5.	NEW DESIGN	ASSEMBLE IN ANY EXISTING MODEL
6.	ONLY BATTERY OPERATED	MANUAL AND BATTERY OPERATED
7.	MAX DISTANCE 30 KM	MAX DISTANCE 35 KM
8.	NO RECHARGING WHILE MOVING	RECHARGING WHILE MOVING

VIII. CONCLUSION

With the help of these research paper we are able to design an e-bicycle with much lower cost which may be the solution to our problems which we are experiencing now-a-days like traffic issues, parking and pollution from burning of fuels in vehicles. We innovate an idea to develop an e-bicycle with an affordable price which discard the orthodox mentality i.e. only pedal power can be used to move a bicycle. This paper identifies potential barriers of e-bicycle and overcomes it by using innovative ideas. This paper also presents an estimation of an e-bicycle with an affordable price to common man.

ACKNOWLEDGEMENT

Our sincere appreciation & gratitude goes to Mr. Amit Agarwal who has always inspired us and for his advice, assistance and invaluable guidance in the preparation of this project. We are also grateful to our university Dr. C.V. Raman University (C.G.).

REFERENCES

1. MacArthur, J.; Dill, J.; Person, M. Electric bicycles in North America: Results of a web review. Transp. Res. Rec. J. Transp. Res. Board 2014, 123–130.
2. Pucher, J.; Peng, Z.R.; Mittal, N.; Zhu, Y.; Korattyswaroopam, N. Urban vehicle patterns and arrangements in China and India: Impacts of quick financial procedure. Transp. Fire up. 2007, 27, 379–410.
3. Cherry, C.; Cervero, R. Use qualities and mode decision conduct of electrical bicycle clients in China. Transp. Strategy 2007, 14, 247–257.
4. Fishman, E.; Cherry, C. E-bicycles inside the Mainstream: Reviewing a time of research. Transp. Fire up. 2016, 36, 72–91.
5. Weinert, J.; Ma, C.; Yang, X.; Cherry, C. Electric bikes in China: Effect on movement conduct, mode move, and client security observations during a medium-sized city. Transp. Res. Rec. J. Transp. Res. Board 2007, 62–68.
6. Hatwar, N.; Bisen, A.; Dodke, H.; Junghare, A.; Khanapurkar, M. Configuration approach for electric bicycles utilizing battery and super capacitor for execution improvement. In Proceedings of the sixteenth International IEEE Conference on Intelligent Transportation Systems-(ITSC), The Hague, The Netherlands, 6–9 October 2013; pp. 1959–1964.
7. Thomas, D.; Klonari, V.; Vallée, F.; Ioakimidis, C.S. Execution of an e-bicycle sharing framework: The impact on low voltage arrange utilizing PV and brilliant charging stations. In Proceedings of the International Conference on Renewable Energy Research and Applications (ICRERA), Palermo, Italy, 22–25 November 2015; pp. 572–577.
8. Joumard, R.; Jost, P.; Hickman, J.; Hassel, D. Hot mentor discharges demonstrating as a component of immediate speed and increasing speed. Sci. All out Environ. 1995, 169, 167–174.
9. Peine, A.; van Cooten, V.; Neven, L. Restoring configuration: Bikes, batteries, and more established adopters inside the dispersion of e-bicycls. Sci. Technol. Murmur. Qualities 2017, 42, 429–459.
10. The Statistics Portal. Accessible on the web: www.statista.com.
11. Ramzy, A. On the Streets of China, Electric Bikes Are Swarming. Time Magazine. 14 June 2009. Accessible on the web: http://new.electricbikehub.co.nz/wp-content/transfers/2014/05/On_the_Streets_of_ China_TIME.pdf.
12. Mitra, S., Mitra, J. C., Kashyap, R., and Awasthi, A. (2019). "No Energy" how's life (A general response). Worldwide Journal of Innovative Technology and Exploring Engineering, 8(12). https://doi.org/10.35940/ijitee.L3535.1081219
13. Ruan, Y.; Hang, C.C.; Wang, Y.M. Government's job in troublesome development and industry rise: The instance of the electrical bicycle in China. Technovation 2014, 34, 785–796.
14. EU. Reed Business Information. EU Regulations for E-Bikes, Pedelecs and Speed Pedelecs; Bike Europe: Brussels, Belgium, 2014.
15. Macarthur, J.; Kobel, N. Guidelines of E-Bikes in North America; NITC-RR-564; National Institute for Transportation and Comunities Sponsored by the U.S. Division of Transportation: Portland, OR, USA, 2014.
16. Marinaro, G.; Xu, Z.; Chen, Z.; Li, C.; Mao, Y.; Vacca, A. The Purdue tracer: A vitality effective human-fueled water powered bike with adaptable activity and programming helps. Energies 2018, 11, 305.
17. Shao, X.Y.;Wang, Z.H.; Li, P.G.; Feng, C.X.J. Incorporating information handling and unpleasant set for client bunch based disclosure of item arrangement rules. Int. J. Goad. Res. 2006, 44, 2789–2811.
18. Rose, G. E-bicycles and solid transportation: Emerging issues and uncertain inquiries. Transportation 2012, 39, 81–96.
19. Ji, S.; Cherry, C.R.; Han, L.D.; Jordan, D.A. Electric bicycle sharing: Simulation of client request and framework accessibility. J. Clean. Nudge. 2014, 85, 250–257.
20. Gao, B.; Zhang, W.; Tang, Y.; Hu, M.; Zhu, M.; Zhan, H. Game-theoretic vitality the board for private clients with dischargeable module electric vehicles. Energies 2014, 7, 7499–7518.
21. Ji, S.; Cherry, C.R.J.; Bechle, M.; Wu, Y.; Marshall, J.D. Electric vehicles in China: Emissions and wellbeing impacts. Environ. Sci. Technol. 2012, 46, 2018–2024.
22. Weinert, J.; Ma, C.; Cherry, C. The progress to electric bicycles in China: History and key purposes behind quick trip. Transportation 2007, 34, 301–318.
23. Lee, A.; Molin, E.; Maat, K.; Sierzchula, W. Electric bike use and mode decision inside the Netherlands. Transp. Res. Rec. J. Transp. Res. Board 2015, 1–7.
24. Fishman, E. Bikeshare: An audit of ongoing writing. Transp. Fire up. 2016, 36, 92–113.
25. Munkácsy, A.; Monzón, A. Potential client profiles of imaginative bicycle sharing frameworks: The instance of BiciMAD (Madrid, Spain). Asian Transp. Stud. 2017, 4, 621–638.
26. Dill, J. Bicycling for transportation and wellbeing: The job of foundation. J. General Health Policy 2009, 30, S95–S110.
27. Nocerino, R.; Colorni, A.; Lia, F.; Luè, A. E-bicycles and E-bikes for keen coordinations: Environmental and monetary maintainability in star E-bicycle Italian pilots. Transp. Res. Procedia 2016, 14, 2362–2371.
28. Bai, L.; Liu, P.; Chen, Y.; Zhang, X.;Wang,W. Relative investigation of the security impacts of electrical bicycles at signalized crossing points. Transp. Res. Part D Transp. Environ. 2013, 20, 48–54.
29. Schepers, P.; Twisk, D.; Fishman, E.; Fyhri, A.; Jensen, A. The Dutch street to a significant level of cycling security. Saf. Sci. 2017, 92, 264–273.

30. Padilla, F.M.; Gallardo, M.; Manzano-Agugliaro, F. Worldwide patterns in nitrate filtering research inside the 1960–2017 period. Sci. Absolute Environ. 2018, 643, 400–413.
31. Bauman, A.E.; Rissel, C.; Garrard, J.; Ker, I.; Speidel, R.; Fishman, E. Cycling: Getting AustraliaMoving: Barriers, Facilitators and Interventions to Get More Australians Physically Active through Cycling; 31st Australasian Transport Research Forum, Ed.; Cycling Promotion Fund: Melbourne, Australia, 2008; pp. 593–601. Accessible on the web: http://atrf.info/papers/2008/2008_Bauman_Rissel_Garrard_Ker_Speidel_Fishman.pdf.
32. Haustein, S.; Møller, M. Age and frame of mind: Changes in cycling examples of different e-bicycle client sections. Int. J. Support. Transp. 2016, 10, 836–846.
33. Lopez, A.J.; Astegiano, P.; Gautama, S.; Ochoa, D.; Tampère, C.M.; Beckx, C. Revealing e-bicycle potential for driving excursions from GPS follows. ISPRS Int. J. Geo-Inf. 2017, 6, 190.

AUTHORS PROFILE

Abhijit Kumar, M.Tech. Scholar (Power system engineering), Department of Electrical and Electronics, Dr. C.V. Raman University (C.G.)
Email ID: - kumar.abhijitog@gmail.com

Awadhesh Kumar Dewangan, M.Tech. Scholar (Power system engineering), Department of Electrical and Electronics, Dr. C.V. Raman University (C.G.)
Email ID: - awadheshdew@gmail.com

Vaibhav Dange, B.E. 3rd year student, Department of Electrical and Electronics, Dr. C.V. Raman University (C.G.)
Email ID: - vaibhavdange256@gmail.com

Amit Agrawal, Associate Professor, Department of Electrical and Electronics, Dr. C.V. Raman University (C.G.) Publications: - More than 17 research papers are published in different international and national journals. Achievement: - Awarded for the excellence in research under the category HEI Professor by “Auropath Global Awards 2019”.
Email ID: - amitagrawal_bit@rediffmail.com