3E-Smart Bicycle: A Review Paper

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Abstract— The rapidly increasing prices of petroleum and diesel have made the role of alternative energy sources for vehicles more significant. Furthermore, the emission of poisonous gases from different types of vehicles has become highly detrimental to the health of the living beings. For this reason, it is the right time to look for more eco-friendly fuel sources. Solar power is a renewable energy source in that the sunlight we use today does not leave less for tomorrow; the sun will continue to shine for billions of years. So this is our very first and simple approach or step to design and prepare a self-charging electric bicycle consisting of solar panel to utilize the solar energy which is available free of cost to charge the batteries, the BLDC motor to convert the electrical energy into mechanical energy. To convert and store the mechanical energy into electrical energy, we have employed dynamos.

Key words: Solar Bicycle, Cycle, Economic, Effortless, Eco-Friendly, Solar Operated, Self-Charging

I. INTRODUCTION

The 3E in the title stands for Effortless, Economical, and Efficient bicycle. The 3E- Smart Bicycle consists of a energy storing device-Battery, a device which converts Electrical energy to mechanical energy or rotational energy-Motor, a device which again converts the rotational energy into electrical energy-dynamo, a device which utilizes the natural source and converts it in electrical energy for self-charging of the bicycle-solar panels, a device which controls and directs the energy flow through different components by using controller. Solar bikes use rechargeable batteries which are of lighter varieties can travel up to 25 to 32km/h (16 to 20 mph), depending on the laws of the country in which they are sold. The more high-powered varieties can often do more than 45 km/h (28 mph).

The problems which we are trying to solve are:

1) Vehicular emissions.
2) Health problems.
3) Fitness problems.
4) Traffic congestions.
5) Dependency on fossil fuels.
6) Self-Chargeable.

II. RESEARCH PAPER REVIEW

In 2001, Per Roger Johansen et. All, made use of an axial flux permanent magnet in-wheel direct drive in an electric bicycle with Batteries of 2 X 12 V, Switch 2XT0-220 MOSFETs and BLDC motor. The distance travelled by the bicycle was 44 km with a speed of 25 km/hr.[1]

In 2002, Luciano Cardinali et. All, used 300 W fuel cell generator on an electric bicycle, the incorporated battery of 25V, 9Ah and two Dc/dc converters of 150V. They concluded that at 50 -100% load the efficiency was 31% and the mean speed was 18 km/hr.[2]

In 2004 J. J. Hwanga et. All, used Stacked fuel cells of (48X0.7V) 303W, Motor(V/A) of 24/9.5, 4 Cooling fans of 7.2W and, Microcontroller of 24 W. They concluded that at Distance to fuel ratio is 1.35 km g−1 H2, Power is 200W and, Efficiency of 35%.[3]

In 2007 Vanessa Paladini et. All, used Batteries of 48 V, Super capacitor of 48V. They concluded that its Power density is 30% lower compared to ICE and, Specific energy Consumption is 40% lower.[4]

In 2010, Yogesh Jadhav et. All, made use of an 2 Batteries of 24V 190Ah, Solar module of 140Wp(Watt Peak), Connecting Cables of Motor connection:-25Sq.m, Charge controller unit of 1Sq.mm, Charge controller to battery unit is 2Sq.mm and, Motor High torque DC motor 1Hp=746W. They concluded that unit is with 30-35% efficiency, Suitable to Low speed and, After 17% charge remaining cycle stops.[5]

In 2012, Ajit B. Bachhe et. All, made use of BLDC motor power 250W, Solar panel of (170V, 20W), 2 Lead acid battery – 12V, 35Ah. They concluded that unit Maximum Speed - 25-30 kmph, Initial Cost Rs. 16470/- and, Operating cost around Rs. 0.45/km.[6]

In 2012, R. Kandiban et. All, made use of BLDC Motor, Adaptive Fuzzy PID controller, software package MATLAB/SIMULINK. They concluded that, the experimental results verify that a Adaptive Fuzzy PID controller has better control performance than the both Fuzzy PID controller and conventional PID controller.[7]

In 2013, M. Reddi Sankar et. All, used Solar capacity : 20 watt,Battery capacity: 220-240v, Accelerator & motor controller: 24v 10amp, BLDC hub motor: 300 rpm, torque 12Nm, power rating 250W, 2 Seal lead acid battery 12V by that he solve It can travel max distance of 35-40km, Its operating cost is around Rs.0.70/km & its initial unit cost is 6500Rs/- approx., load carrying capacity : 75-100kgs, Speed 25-30kmph.[8]

In 2013, Minas Roukas et. All, They have used Brushless DC Motor, Electro-Hydraulic Disc Brake system, Lead acid battery(2)- 12V 12.5 Ah, BLDC motor power-350W they have conclude that 12-18% efficiency, maximum speed- 30km/hr, working hours- 3hr, charging time – 4.5 hr.[9]

In 2014, Rahul Sindhwani et. All, used Speed of cycle, Aerodynamic structure from this structure He get Aerodynamics in total (65%) :- wheel - 7-11%, fork- 6-9%, frame- 4-9%, other- 2-4%. Maximum speed – 40 km/hr, Maximum range – 70-75 km, 45-50% efficiency.[10]

In 2014, Vivek V Kumar et. All, Utilization of PMDC motor to generate power, (Mechanical Energy - Torsional Energy - Electricity), PMDC motor utilizes 12V & 14A from the battery, But it was noticed that with increase in the effective speed the current drops to 1.077 A.[11]

In 2015, Ivan Evtimov et. All, They have used different components BLDC motor power – 250W, Solar panel – 17V, 20W, Lead acid battery(2) – 12V, 35Ah also

they conclude that 24-30% efficiency, It can run also in hilly areas, charging time – 3hr, maximum speed – 25 km/hr.[12]

In 2016, Mayur Parmar, et. All, Solar panel- 40W, Lead acid battery(2)- 12V 12.5 Ah, BLDC motor power-350W by that they get effective solution Maximum speed 25 km/hr,Battery can charge by electrical supply and solar supply both, 20-25% efficiency.[13]

In 2016, Kartik S Mishra et. All, BLDC motor – 24V, 250W, Solar Panel – 12V, 25W, Lead acid Battery(2) – 12V, 7.5Ah by that Maximum Speed – 15 kmph, Efficiency – 50-60%, Power – 175 W, Charging time: By using Adapter – 2hrs, By using Solar Panel – 3.6hrs.[14]

In 2016, Mohmmad Reza Maghami et. All, they used The amount of power loss due to soiling on solar panel so by this Thus they proposed to clean the PV module from dust accumulation on daily basis to reduce the power loss.[15]

In 2017, Shubham U. Tayde et. All, They have used different methods like Utilization of dynamo, PMDC motor, flywheel, housing, multi-crank freewheel, sprockets, lead acid battery, chain drive, gear mechanism and they conclude that this bicycle simplified riding with minimal effort on flat as well as gradients due to its design. In order to avoid extra effort for cycling, electrical assistance has been provided to the cycle that will ease the user to ride the unit with help of motor.[16]

In 2017, S. T. Wankhede et. All, They have different components the amount of power loss due to soiling on solar panel and they got Electric bicycles with may be addressed by custom-designed drives that are most efficient over a given operating cycle. Aldo we take PIC16F72 controller & this controller has function of over-current protection. Experiment turned out controller has better dynamic characteristics & run steadily.[17]

In 2017, Kunjan Shinde et. All, worked on electric bike as it is a modification of the existing cycle by using electric energy & solar energy if solar panels are provided, that would sum up to increase in energy production. With the increasing consumption of natural resources of petrol, diesel it is necessary to shift our way towards alternate resources like the electric bike & others because it is necessary to identify new way of transport. The operating cost per/km is very less & with the help of solar panel it can lessen up more.[18]

In 2018, Boopathi S et. All, They have made use of various parts Lithium ion batteries with lower weight but have higher cost and they have chances of explosion and and they concluded that it could last 6-8 hours/charge by using EB supply, range of 10–40 miles, speeds of up to 20+mph, Maximum speed of 25 Km/hr, They cannot weigh more than 40 Kg.[19]

In 2018, Akshay S. Dhabekar et. All, They have experiment different components and finally conclude more efficient technology Utilization of mechanical energy to electrical energy of wheels to charge the battery. Use components like BLDC hub motor, dynamo, controller, lithium acid battery, speedometer, brakes & throttle by this they have get different concludetion so this bicycle also gives safety driving for human because of its limited speed, Low cost effective.[20]

III. Conclusions

BLDC motors are most efficient & powerful among the alternators & dynamos, Battery capacity directly affects the range of the e-bike, The sprocket & chain drive used in the e-bike system should be same or like the sprocket & chain drive of the cycle to be used, Soiling on solar panel reduces its efficiency, BLDC motors can charge the batteries if the polarity is reversed. The efficiency of the system depends on the quality of the material used in the system.

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References

[1] Per Roger Johansen et all, "The use of an axial flux permanent magnet in-wheel direct drive in an electric bicycle", Volume 22, January–March 2001.
[2] Luciano Cardinali et all, "Design and realization of a 300 W fuel cell generator on an electric bicycle", Volume 106, 1 April 2002.
[3] J. J. Hwanga et all, "Development of fuel-cell-powered electric bicycle", Volume 133, 4 June 2004.
[4] Vanessa Paladini et all, "Energy Conversion and Management", Volume 48, November 2007.
[5] Yogesh Sunil Wamborikar et all, "Solar Powered Vehicle" Volume 2, October 20-22, 2010.
[6] Ajit B. Bachche et all, "Design and Development of Solar Assisted Bicycle", Volume 2, December 2012.
[7] R. Kandiban et all, "Design of Fuzzy PID controller for Brushless DC motor", Volume 2, June 2012.
[8] M. Reddi Sankar et all, "Design and Development of Solar Assisted Bicycle Design and Development of Solar Assisted Bicycle" Volume 3, March 2013.
[9] Minas Roukas et all, "Development of the Control System for an Electric Vehicle", Volume 22, October 2013.
[10] Rahul Sindhwani et all, "Design of Electric Bike with Higher Efficiency", Volume 2, March 2014.
[11] Vivek V Kumar et all, "Design And Implementation Of Electric Assisted Bicycle With Self Charging Mechanism.", Volume 2, 16th - 18th July -2014.
[12] Ivan Evtimov et all, "Transport problems", Volume 10, March 2015.
[13] Mayur Parmar et all, "Solar Powered E-Bike.", Volume 11, August 2010.
[14] Kartik S Mishra et all, "Design and Development of Solar Hybrid Bicycle", Volume 12, March 2016.
[15] Mohammed Reza Maghami et all, "Power loss due to soiling on solar panel: A review", Volume 2, Jan2016.
[16] Shubham U. Tayde et all, "Modification of solar hybrid tricycle for divyang people by using electronics system", Volume 4, Jan -2017.
[17] S. T. Wankhede et all, "MULTI CHARGING ELECTRIC BICYCLE", Volume 3, March-April 2017.

[18] Kunjan Shinde et all, "Literature Review on Electric Bike", Volume 7, Nov 2016 - April 2017.
[19] Boopathi et all, "Design and Fabrication of Low Cost Electric Bicycle", Volume 05, Mar-2018.
[20] Akshay S. Dhabekar et all, "Design And Fabrication Of Selfcharging Bicycle" Volume 2, January 2018.

