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Design, Analysis and Fabrication of Hybrid Electric Bicycle

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ABSTRACT:

As global fuel prices continue to surge, there's an urgent call to explore alternatives to conserve our natural resources. The solar bicycle emerges as a sustainable solution, utilizing solar energy to charge its battery and power its motor. With India enjoying nine months of sunny weather, the concept of a solar bicycle holds great promise in the country. Moreover, a hybrid version integrates both solar power and a pedal-driven dynamo to charge the battery, presenting a compelling alternative to traditional fuel-powered vehicles. Manufacturing solar hybrid bicycles is thus imperative in our transition towards greener transportation options.

Key Words: Mechanical,Hybrid,Solar,Hub motor,Battery.

INTRODUCTION:

The rise in urban mobility has directly contributed to worsening traffic conditions, increased fuel consumption, higher levels of automobile exhaust emissions, air pollution, and a decline in overall quality of life. Cycling, besides being a clean, economical, and equitable mode of transport for short distances, holds significant potential to address urban mobility challenges.

Urban mobility issues have become pervasive in cities worldwide, with rapid urbanization further exacerbating these challenges. As populations increasingly concentrate in urban areas, the need to address and enhance mobility becomes paramount for fostering better community quality of life and environmental sustainability.

Cycling emerges as a viable solution to urban mobility problems, particularly for short-distance trips. It offers a multitude of benefits, including reducing traffic congestion, lowering fuel consumption, mitigating vehicle emissions, improving air quality, and ultimately enhancing urban livability.

A hybrid bicycle represents an innovative approach to urban transportation, utilizing electrical energy stored in a battery to power a hub motor that propels the bicycle. Solar energy is harnessed to charge the battery, which in turn provides the necessary voltage to drive the hub motor mounted on the rear wheel, enabling the bicycle to move efficiently and sustainably.

PROBLEM STATEMENT:

Upgrading a conventional electric bicycle to a solar-powered electric bicycle presents several challenges. Firstly, the photovoltaic (PV) panels must meet specific specifications to generate power equivalent to that of a conventional electric motor. Ensuring a suitable connection between the solar cells, rechargeable battery, and DC electric motor is crucial to maximize energy efficiency for the project's success. Additionally, the electric motor must be capable of supporting the weight and size of the bicycle, as well as accommodating the size of the solar panel and the condition of the road surface.

3.1 SCOPE AND OBJECTIVE:

Utilizing a hub motor can streamline the design of the electric bicycle, offering a simpler and more integrated solution. By incorporating regenerative braking techniques, solar panels, and dynamos, energy can be harnessed from multiple sources to power the bicycle.

1.The hub motor, positioned within the wheel hub, eliminates the need for external connections and reduces complexity in the drive system. This simplification enhances reliability and efficiency while providing a smoother riding experience.

2.Regenerative braking technology enables the bicycle to recover kinetic energy during braking, converting it back into electrical energy to recharge the battery. This not only improves energy efficiency but also extends the range of the bicycle.

3.Integrating solar panels into the design allows for the continuous generation of electricity, further supplementing the battery's charge. Even in varying weather conditions, the solar panels can contribute to the overall power supply, enhancing the bicycle's sustainability.

Moreover, by optimizing the performance of the hub motor and implementing advanced motor control algorithms, the speed of the bicycle can be significantly improved. This ensures that the electric bicycle remains competitive with traditional modes of transportation while offering the added benefits of eco-friendliness and efficiency.By combining these technologies, an eco-friendly and efficient electric bicycle can be realized, offering a practical solution to urban mobility challenges while reducing environmental impact.

4. HYBRID ELECTRIC BICYCLE:

A Hybrid electric bicycle operates by utilizing electrical energy from a battery to power its hub motor, which in turn propels the bicycle forward. Solar energy is employed to charge the battery, typically through the use of two or more photovoltaic cells. These cells convert sunlight into the voltage necessary to recharge the battery, ensuring a sustainable power source for the bicycle.

1.When it comes to harnessing solar energy, there are generally two types of panels used: polycrystalline and microcrystalline. While both serve the same purpose, microcrystalline panels tend to be more efficient, boasting efficiency rates of 50-60% compared to the 15-20% efficiency of polycrystalline panels.
2.In terms of battery selection for hybrid electric bicycles, the most common options are lead acid and lithium-ion batteries. Lead acid batteries are favored for their lower cost and higher current carrying capacity, despite their shorter lifespan and heavier weight. On the other hand, lithium-ion batteries offer a lighter alternative but come with a higher price tag and a potential risk of explosion.
3.The popularity of hybrid electric bicycles has surged globally, leading to numerous projects and initiatives dedicated to their development. The motor typically used is a permanent magnet hub motor, conveniently mounted on the front wheel for optimal efficiency. Additionally, a belt and pulley mechanism are often installed on the rear side of the bicycle to drive the dynamo, further enhancing its energy efficiency and sustainability.

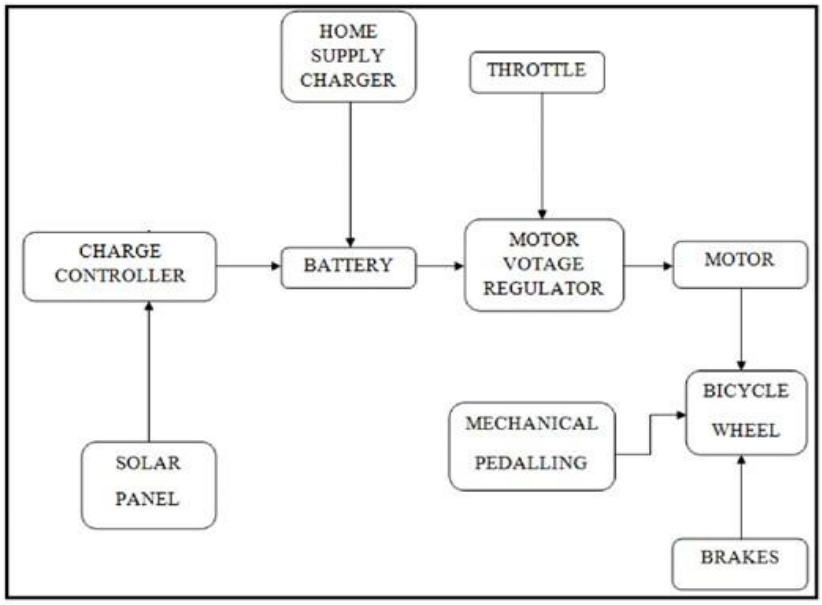
4.1 COMPONENTS REQUIRED:

- Hub motor
- Solar panel
- lithium ion battery
- Motor voltage controller
- Accelerator
- Bicycle
- Charge controller

4.2 BLOCK DIAGRAM:

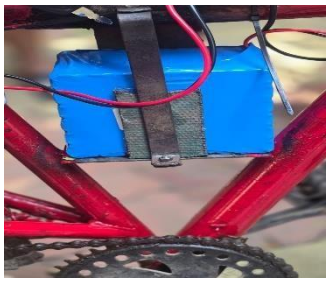
The block diagram depicts an electric bicycle driven by a DC motor installed on the middle shaft of the bicycle frame and powered by a battery. A solar panel is mounted on the carriage, generating 12V power when exposed to sunlight, with its terminals connected to a charge controller.

During idle periods in the daytime, the solar panel charges the battery. However, due to variations in sunlight intensity and fluctuations in wheel speed, the output voltage from both the solar panel and the dynamo (connected to the wheel) exhibits varying characteristics. To address this, the charge controller regulates the voltage to a constant 12 volts, ensuring optimal charging of the battery.



The power flow operates in parallel with the power delivered by the rider through pedaling. Consequently, the rider has the option to engage the motor completely, relying solely on electric power, or to pedal as in a conventional bicycle. This flexibility allows the rider to adjust the level of assistance provided by the motor based on personal preference or riding conditions.

A. **BATTERY:** 24 volt battery for staring of generating energy or a electric source. It is also use to give a power supply to the motor so it will run bicycle.It gives a 24 volt -25 Ah power . It is a lithium ion battery and its weight about 2kg. This type of battery can be rechargeable.



B. **SOLAR PANEL:** We are using a polycrystalline type of solar panel. Solar panel is of 50 watt & 12V & it weight is about 1kg. High modules conversion efficiency 50W solar panel and its efficiency is 80%. It require use space so that if will produce energy faster as compare to other.

C. **ACCELERATOR:** It is use to control the speed of bicycle. It produce beams of a charged particle that can be used for a variety of purpose. Basically it will help to control the speed in traffic.

D. **MOTOR:** It will convert the electric power into mechanical or rotational movement. The motor we use is of 250W and 25V. Its rpm is 3300. The weight of the motor is about is 2.5kg to 3kg.

E. **MOTOR SPEED CONTROLLER:** It will initially start the power supply to the bicycle. It is of 24V (rated voltage DC) & 250W (rated power), Throttle is of 1-4. This is a brushed controller type and its weight is 200g.

F. **CYCLE:** It is the base component of the project. All the other component are mounted on the cycle.

4.3 DESIGN CALCULATION FOR MOTOR SELECTION:

Distance across of the bike wheel D = 0.66m Span r = 0.33m
Speed required s = 30km/hr Bike weight Wb= 20kg
Weight of the rider (Roughly) Wr = 70 kg Add up to weight Wt = 90 kg Power calculation:
Normal response on each tire Wn = Wt/2 = 45 kg
Force F = Wn * g = 45* 9.81 =441.45 N

1. Considering inactive grinding: inactive grinding coefficient u = 0.03
   Fs = u * F = 0.03 * 441.45 = 13.24 N Torque Ts = Fs * r = 13.24 * 0.33 = 4.37 Nm 2. Considering energetic friction: static grinding coefficient u = 0.004 Fd = u * F = 0.004 * 441.45 = 1.765N
   Torque Td= Fd* r = 1.765 * 0.33 = 0.5827 Nm 1. Precise Speed: w = velocity/radius = 30,000/ (0.33*3600) = 25.25 rad/sec Power Requirements: 1. On plane Ground for inactive condition Ps = Ts*w = 4.37 * 25.25 = 110.34 W for energetic condition Pd = Td * w = 14.71 W overall
   power necessity = 110.34 * 2 = 220.68W
2. On slanted surface let point of slant a = 2’ total force required is

a] considering inactive friction
F = u * m*g * cos (a) + m*g sin (a) =57.28 N
therefore, control required = F*V = 477.33 W additional control required = 477.33 – 220.68 = 246 W b] considering energetic friction
F = u * m*g * cos (a) + m*g sin (a)= 34.34 N
Power P = F*V = 230 W
By considering the over calculations we require 250W center motor By considering the above calculation we require 250W hub motor.

4.4 CALULATION OF CHARGING TIME:

Charging connector selection:
Charging current ought to be 10% of the rating of the battery. Therefore,
Charging current of connector = battery * (10/100) = 1.5 A
Due to a few misfortunes, we may take 1.5- 3.5 Amperes for battery charging reason instep of 1.5 Amp. We select 24V 3A charging adapter.
Calculation of charging time of battery:
Charging time of battery by connector = Battery / charging current. Charging time for 15Ah battery = 15 Ok/ 3 A = 5 Hrs.
It is for perfect cases…
Practically, it has been famous that 40% losses occur in case of battery charging. At that point 15*(40/100) =6Ah. In this manner, 15+6 = 21Ah (15Ah + losses) Now, charging time of battery = 21 /3A = 7 Hrs.
Selection of sun powered panel:
we utilize board of 50 W ,12V each having measurement 350mm* 550 mm associated in arrangement to give 24V output.
Charging time of battery when charged by sun oriented panels:
Charging time of battery by connector = Battery / charging current. Charging time = 15 / 2.5 A= 6 Hrs.

The calculation gives the required rating of the gadgets that are to be utilized in the venture. These evaluated components are collected in a appropriate way to create our venture. The results of all these are analyzed and talked about in the another chapter.

4.5 CAD MODEL:

4.6 ANALYSIS OF BICYCLE FRAME:

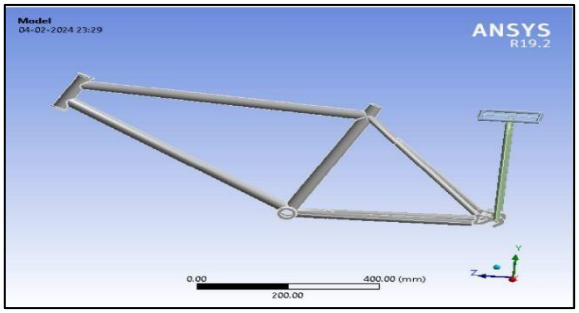


Fig - Base Model

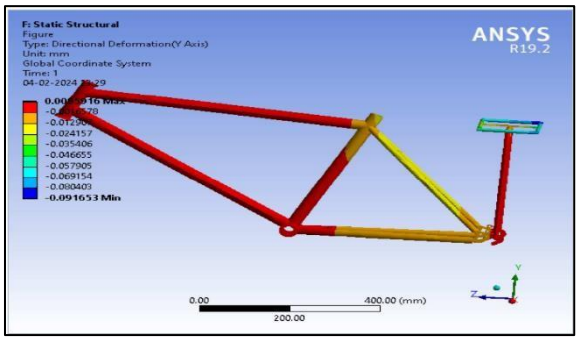


Fig - Deformation

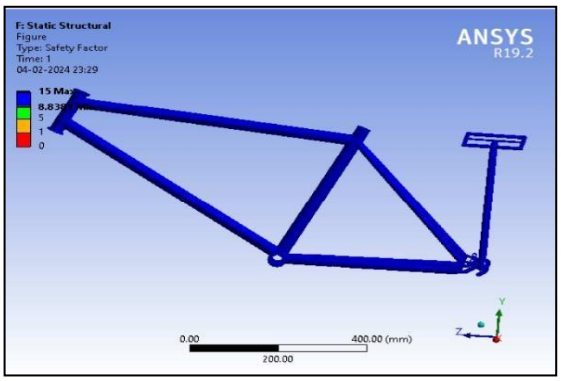


Fig-Factor of safety

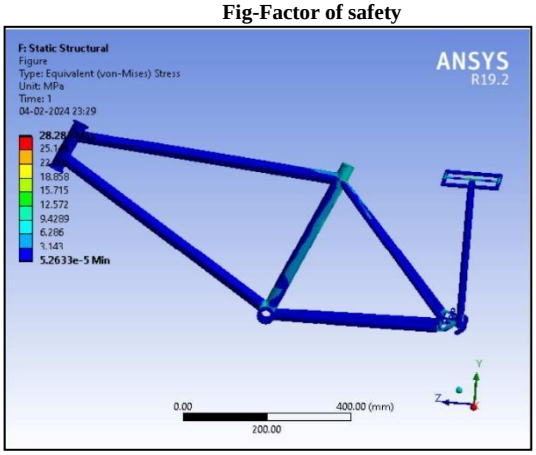


Fig- Equivalent stress

ADVANTAGES:

1. Solar energy, harnessed through solar cells, stands out as one of the most utilized, eco-friendly, and sustainable power sources available.
2. It produces no harmful emissions or reliance on traditional fuels, thus mitigating the risk of global warming. Solar cells operate independently, ensuring constant charging and reducing the time needed for charging via a high AC voltage charger.
3. Moreover, they boast a lengthy lifespan of at least 20 years and demand minimal upkeep, translating to lower maintenance costs. Normal pedaling remains an option even when not in power assist mode, offering versatility.
4. The detachable battery facilitates convenient indoor charging. With a user-friendly thumb throttle, operation is simplified and reduces hand strain.
5. Continuous charging by solar panels ensures uninterrupted usage. Additionally, the unit cost is remarkably economical.

DISADVANTAGES:

1. The cost of the motor, battery, and solar panel escalates as consumers demand higher energy output.
2. Sunlight availability varies, particularly at night, and may not be uniformly distributed in all locations.
3. Neither solar cells nor dynamos consistently supply the required power levels, rendering them unsuitable as primary charging sources.

CONCLUSION:

The venture carried out by an inspiring assignment in the field of car division. It is exceptionally valuable for having the two wheelers, since require not to spend the parcel of cash for the fuel. This venture will decrease the fetched included in the concern.Project has been planned to perform the whole prerequisite errand at the most limited time accessible. Due to this contamination can be controlled. Sun based helped bike is adjustment of existing bike and driven by sun powered vitality. It is appropriate for both city and nation streets, that are made of cement, black-top, or mud. This bike is cheaper, less complex in development & can be widely utilized for brief separate voyaging particularly by school children, college understudies, office goers, villagers, postmen etc.It is exceptionally much appropriate for youthful, matured, cripple individuals and caters the require of financially destitute lesson of society. It can be worked all through the year free of taken a toll.

8.FUTURE SCOPE:

The current project focuses on a hybrid-powered electric bicycle that utilizes solar energy as one of its energy sources. Looking ahead, wind energy could also be harnessed by incorporating a wind turbine at suitable locations. Further modifications could adapt the hybrid bicycle for use by individuals with physical disabilities. Additionally, there's potential to digitize bicycles by integrating indicators, advanced sensors, digital displays, and navigation systems. Implementing a gear variation system could enhance torque and provide better speed control.

REFERENCE:

[1]. David Clay, “Solar powered electric bicycle”, Semantic Scholar-2001.
[2]. Mitesh M Trivedi, Manish K Budhvani, Kuldeep M Sapovadiya, Darshan H P ansuriya, Chirag D Ajudiya,
“Design and development of e-bike –A review” Iconic research and Engineering Journals, November 2017, ISSN:2456-8880.
[3]. ‘Sunikshita Katoch et al.,’, “Design and Implementation of smart electric bike” - International Journal on Innovative Technology and Exploring Engineering-2019.ISSN:2278-3075 April 2019.
[4].‘Nitipong Somchaiwong and Wirot Ponglangka’, “Regenerative Power Control for Electric Bicycle”.

'SICE-ICASE International Joint Conference 2006'.

[5]. Veronique Lamy," ELECTRIC BIKE 2000 PROJECT", Centre for Electric Vehicle Experimentation in Quebec (CEVEQ), April 2001.

[6].Ajit B. Bachche, N. S. Hanamapure, "Design and Development of Solar Assisted Bicycle", International Journal of Engineering and Innovative Technology (IJEIT) Volume 2, Issue 6, December 2012.

[7].Muhsin Abdur-Rahman, Bo Hu, Erik Cheever, Fred Orthlieb, Grant Smith," Design and Implementation of a Hybrid Electric Bike", Engineering 90 Senior Design Project, May 05, 2005.