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Design and Implementation of Solar Powered and Pedal Based Energy Generation E-Bicycle

Chavan Hemant, Gadade Janardan, Kapurkar Sourabh, Mane Harshad, Dr. S.D. Pawar

UG Student, Dept. of EE, Annasaheb Dange College of Engineering and Technology, Ashta, Maharashtra, India.

Assistant Professor, Dept. of EE, Annasaheb Dange College of Engineering and Technology, Ashta, Maharashtra, India

ABSTRACT: As the worldwide population is increasing day by day and there is increasing demand for the electrical and electronic products which leads to rise consumption of resources such as fossil fuels, minerals, electricity which intern generating scarcity of all this exhausting resources. Therefore electrical and electronic equipment are necessarily required to remove their dependency for power requirement on this exhausting resources thereby providing the required power fulfillment must be done through renewable resources which are abundant and available easily. For Ex. Wind and solar. In recent trend electric vehicles are launched world wide for removing the dependency of conventional vehicles or fossil fuels. Unfortunately the electric vehicles are one of the reason increasing the electricity demand. Majority of the countries are dependent on thermal power plant which uses coal for generation of electricity. Intern rising in pollution and scarcity of electricity. So, as to resolve this problem the paper proposes the design of renewable energy base solar cycle. In from the manufacturing industry a simple, reliable, eco-friendly, safety, and less costly product. Due to increasing population and leads to one of them is electrical vehicles. One type of such an electric vehicle is the solar based e-Bicycle (e-cycle). E-cycle typically incorporates a battery, which can be charged at an ordinary domestic power socket, linked to an electric motor in the bicycle transmission system. Increase in fuel price of the petrol bike along with the consideration of the environmental factors uses a bicycle over motor vehicle for short distance travelling. The rider has the power to control the output from motor i.e speed using a handlebar mounted throttle and controller. The main aim of this project is to present the idea of harnessing the various energy and use it in todays existence of human life. Now a days there are so many vehicles on the road, which consumers more fuel and its hazardous emission products.

KEYWORDS: Regenerative Braking, Boost Convertor, Solar Panel, Hall Sensor, BLDC Motor, BLDC Controller, Pedal Assistant Sensor.

I. INTRODUCTION

As worldwide population is growing day by day and there is increase in manufacturing and using of fuel powered. This vehicle requires fossil fuel to run and it a limited source of energy which will be over after some period and to cop up with this need, the revolution for the eco-friendly cycle were the most depended modes of transportation, along with this the consideration of the increases in fuel price and the environmental factors we must admit that it is far more better to use a cycle over a motor vehicle for short distance travelling. Imagine how useful would the cycle be if even the small effort applied by man for riding of rough terrain. This project is based on combination of the standard geared cycle with the electric power motor. The system is modified in such a way that the rider can make choice of which modes he prefers that he can either choose the cycle to be driven completely with the electric motor or or he can choose it to be driven manually by himself. The idea of the mounting the motors and its supports assembly onto a geared cycle was to reduce the efforts to be applied for extra little weight that the rider will have to take along with the cycle. The unit has been designed in such a way that people of any age group can depend on it. Our idea of implementation of the project was mainly biased towards providing inter college transportation. E-bicycle typically incorporates a battery, which can be charged at an ordinary solar panel and through pedals, linked to an electric motor in the Bi-cycle transmission system. The rider have a power to control the output power from motor that speed using a handlebar mounted throttle and controller. The term ‘e-bike’ is generic and includes a combination of different electrically powered two-wheelers some of which function by simply turning a throttle. This Bicycle is designed and made in very less cost as compared to original cost, so any one can afford this Bi-cycle. As we know that due to fuel powered vehicles, the emission of toxic gases is increasing day by da ,due to this 4.3 million people dead every year. The ever-increasing global demand for sustainable and eco-friendly transportation solutions has prompted the development of innovative technologies that reduce our carbon footprint. One such groundbreaking innovation is the fusion of solar power and pedal-based energy generation in electric bicycles, known as e-bicycles. This report delves into the design

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and implementation of a solar-powered and pedal-based energy generation e-bicycle, highlighting the sustainable features, technological advancements, and the practicality of this eco-friendly mode of transportation.
With the rising concerns about environmental degradation and the depletion of fossil fuels, the integration of renewable energy sources into our daily lives is a paramount challenge. Solar energy, as a clean and virtually inexhaustible source of power, has shown significant potential in various sectors. When coupled with the human-powered pedaling mechanism of a bicycle, it creates an energy-efficient and sustainable mode of transportation, promising to address not only the issues of pollution and energy conservation but also the promotion of physical fitness.

II. LITERATURE SURVEY

2.1 There has been a growing interest in solar e-bikes in recent years, and a number of research papers have been published on the design and implementation of solar e-bike projects.
One paper, titled "Design and Development of Solar Hybrid Bicycle," by S. Adhisuwignj et al., describes the design and development of a solar hybrid bicycle that uses a combination of solar energy and pedal power to generate electricity. The bicycle is powered by a 250W electric motor, and the battery is charged by a 12W solar panel. The bicycle can travel up to 40 kilometres on a single charge.
Another paper, titled "Solar-powered Electric Bicycle," by G. Srinivasa Rao et al., describes the design and implementation of a solar-powered electric bicycle that uses a 50W solar panel to charge a 12V battery. The bicycle is powered by a 250W electric motor, and it can travel up to 25 kilometres on a single charge.

2.2 The Design and Performance Investigation Of Solar E-Bike Using Flexible Solar Panel By Different Battery Charging Controller Asrori Asrori, Fatkhur Rohman, Elka Faizal & Muhamad Karis

III. NECESSITY

1. **Rising fuel costs**: The cost of fuel is rising steadily, making it more and more expensive to drive a car or motorcycle. Solar-powered e-bicycles offer a low-cost and sustainable alternative to traditional transportation.
2. **Limited access to public transportation:** Many people do not have access to public transportation, or they live in areas where public transportation is unreliable or inefficient. Solar-powered e-bicycles can provide a convenient and affordable way to get around.
3. **Traffic congestion:** Traffic congestion is a major problem in many cities. Solar-powered e-bicycles can help to reduce traffic congestion and make our roads safer for everyone.

IV. FUTURE SCOPE

The future scope of solar-powered and pedal-based energy generation in the context of e-bicycles is promising. Here are some key points without plagiarism:
Sustainable Transportation: Solar-powered e-bicycles can contribute to sustainable transportation by reducing greenhouse gas emissions. Pedal-based energy generation can supplement electric power, making e-bicycles more energy-efficient and eco-friendly.

Energy Independence: Solar panels integrated into e-bicycles can help riders charge the battery during outdoor trips. This reduces the dependence on external charging infrastructure and extends the range of e-bicycles.

Efficiency: Pedal-based energy generation systems can recover energy while cycling, acting as a regenerative braking system. This enhances overall efficiency and range of e-bicycles.

Urban Mobility: E-bicycles are well-suited for urban mobility, and solar and pedal power can help alleviate the range anxiety associated with electric bikes. This makes them a viable option for commuting.

Technological Advancements: Ongoing advancements in solar panel efficiency and lightweight materials will make it more feasible to integrate solar panels into e-bicycle designs without compromising aesthetics or performance.

Consumer Demand: As awareness of environmental issues grows, there is likely to be increased consumer demand for eco-friendly transportation solutions, driving innovation in this field.

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Regulations and Incentives: Governments and municipalities may provide incentives and regulations that encourage the adoption of solar-powered and pedal-based e-bicycles, further boosting their future prospects.

Research and Development: Continued R&D efforts will be essential to optimize the integration of these technologies, improving energy capture and storage systems, as well as regenerative braking mechanisms.

Cost Reduction: As technology matures and economies of scale kick in, the cost of implementing solar and pedal-based energy generation in e-bicycles is expected to decrease, making them more accessible to a wider audience.

Collaboration and Innovation: Collaboration between the renewable energy and bicycle industries can lead to breakthroughs in design, efficiency, and overall functionality.

In summary, the future of solar-powered and pedal-based energy generation in e-bicycles, along with regenerative braking systems, is promising due to their potential to address environmental concerns, enhance urban mobility, and reduce the carbon footprint of transportation. Continuous innovation and investment in this field will be crucial for its long-term success.

V. SYSTEM MODEL AND ASSUMPTIONS

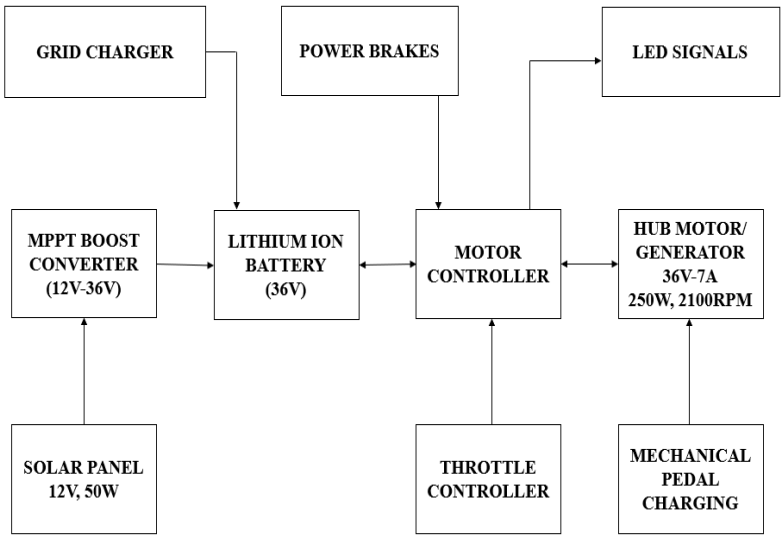

Fig (a) Block diagram

Fig(b) System Model

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ASSUMPTIONS :- Diameter of wheel(D)= 70cm=0.7 m
Radius of wheel(r)= 0.35m
Average Speed of Bicycle= 20Kmph
Total Weight(W)=100Kg

4.3.1 Motor Calculation:
Normal Reaction each tyre(N)= 50
Force(F)= 50*9.81=490.5N on each tyre
Resistance of the Motor(R)=V/I=36/7=5.14 ohm
1] Static Friction Force:
Fs=u*Fs=0.03*490.5=14.71N
2] Dynamic Friction Force:
Fd=u*F=0.004*490.5=1.96N

4.3.2 Torque Requirement:
1] For Static:
Ts=Fs*r=14.71*0.35=5.15Nm
2]For Dynamic:
Td=Fd*r=1.96*0.35=0.6867Nm
Total Torque=Ts+Td=5.15+0.6867=5.83Nm

4.3.3 Speed Calculation:
Angular Speed(W)=Velocity/Radius of wheel=20000/(0.35*3600)=15.87rad/sec

4.3.4 Power Calculations:

1]On plane ground
For static friction: Ps=Ts*W=5.15*15.87=81.78Watt
For Dynamic: Pd=Td*W=0.6867*15.87=10.90 Watt
Total Power Required=81.78*2=164 Watt

2] On Inclined Surface
Let Angle(a)=2'
Total force required is, consider static friction
F=u*mg*cos(a)+mg*sin(a)=63.65N
Power Required(Ps) =Fs*V=63.65*(20000/3600)=353.62Watt
Extra Power Required=353.62-164=189.62Watt=190 Watt
Consider Dynamic friction;
Fd= u*mg*cos(a)+mg*sin(a)=38.15N
Pd=Fd*V=38.15*(20000/3600)=211.98 Watt=212 Watt
Hence 36v, 250Watt motor required to generate torque and required speed

Charging Current should be 10% of the Ah rating of the battery
We selected 36V,250W BLDC hub motor
Hence battery should be 36V, 7Ah of rating
Charging current of adapter= Ah*(10/100) =7*(10/100) =0.7A
Hence take 0.3-3A adapter
Power = 36*3=108Watt
Charging time by adapter= (36*7)/108=2.33 Hrs

4.3.6 By Solar Charging
Panel rating is 12v, 60Watt
Time required by solar= (36*7)/60=4,2 Hrs

4.3.7 Speed In RPM:
N=(P*60)/(2*pi*T) =(211.98*60)/(2*pi*5.15) =347rpm=350rpm

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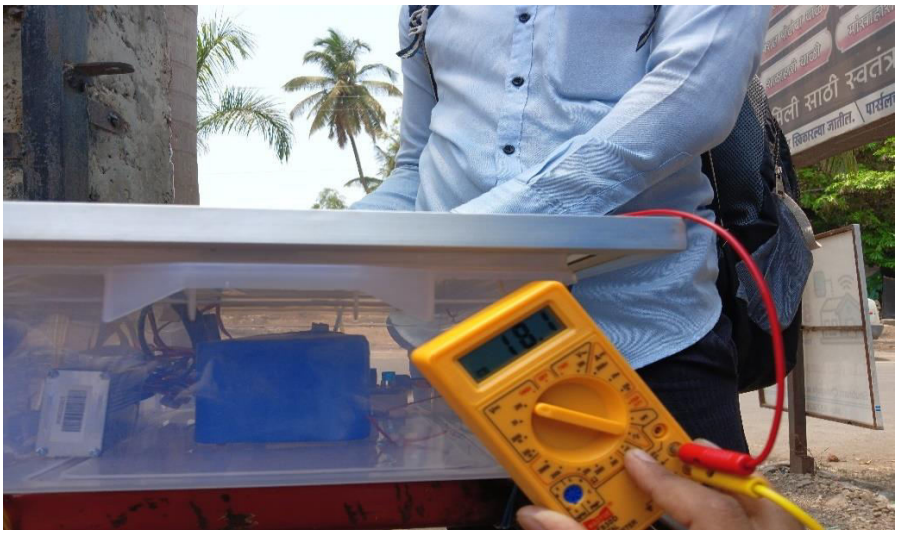
VI. RESULT AND DISCUSSION

1) When we Switch On the BMS System then BMS will shows output Voltage of Battery.



2) When it will be shows output of solar panel.

3) Then after some time the output voltage of battery will decreases & SOC will decreases From 40% to 20%

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4) When output voltage of battery will less than 44V or Zero then soc is 0% and Speaker will ON & Speaker will gives low Battery Warning

VII. CONCLUSION

The development and implementation of a solar-powered and pedal-based energy generation system, combined with a regenerative braking system in an e-bicycle, offers several significant advantages. Here's a detailed conclusion of this innovative technology:
Sustainability: This system harnesses the power of the sun through solar panels integrated into the e-bicycle's design. This renewable energy source reduces the reliance on non-renewable resources, making the e-bicycle environmentally friendly.

Efficiency: The combination of pedal power and solar energy provides continuous energy generation. Riders can pedal to generate power while the solar panels continuously charge the battery, ensuring a longer and more efficient ride.

Extended Range: The regenerative braking system is a key feature of this e-bicycle, allowing it to recover energy during braking or descending. This energy is then stored in the battery, increasing the e-bicycle's overall range and reducing the need for frequent recharging.

Reduced Energy Costs: By harnessing solar and pedal power, riders can significantly reduce their energy costs compared to traditional e-bicycles that rely solely on electrical charging.

Reliability: This system increases the reliability of the e-bicycle, as it is less dependent on grid power. Even in areas with intermittent access to electricity, the e-bicycle can still be charged and used effectively.

Zero Emissions: The integration of clean energy sources and regenerative braking significantly reduces the carbon footprint of the e-bicycle, making it an eco-friendly mode of transportation.

Health Benefits: The pedal-based energy generation encourages physical activity, promoting a healthier lifestyle for riders. It also provides an alternative for exercise and transportation.

Adaptability: This technology can be integrated into various types of e-bicycles, catering to different user needs and preferences, including urban commuting, off-road cycling, and leisure riding.

Challenges: Despite its numerous benefits, there are challenges to overcome, such as the efficiency of solar panels, the weight of the added components, and the cost of the technology. Advances in materials and technology will be crucial in addressing these challenges.

In conclusion, the integration of solar power, pedal-based energy generation, and a regenerative braking system in e-bicycles represents an innovative and sustainable solution for future transportation. It promotes eco-friendliness, reduces costs, and enhances the overall riding experience, making it a promising technology for a more sustainable and energy-efficient future.

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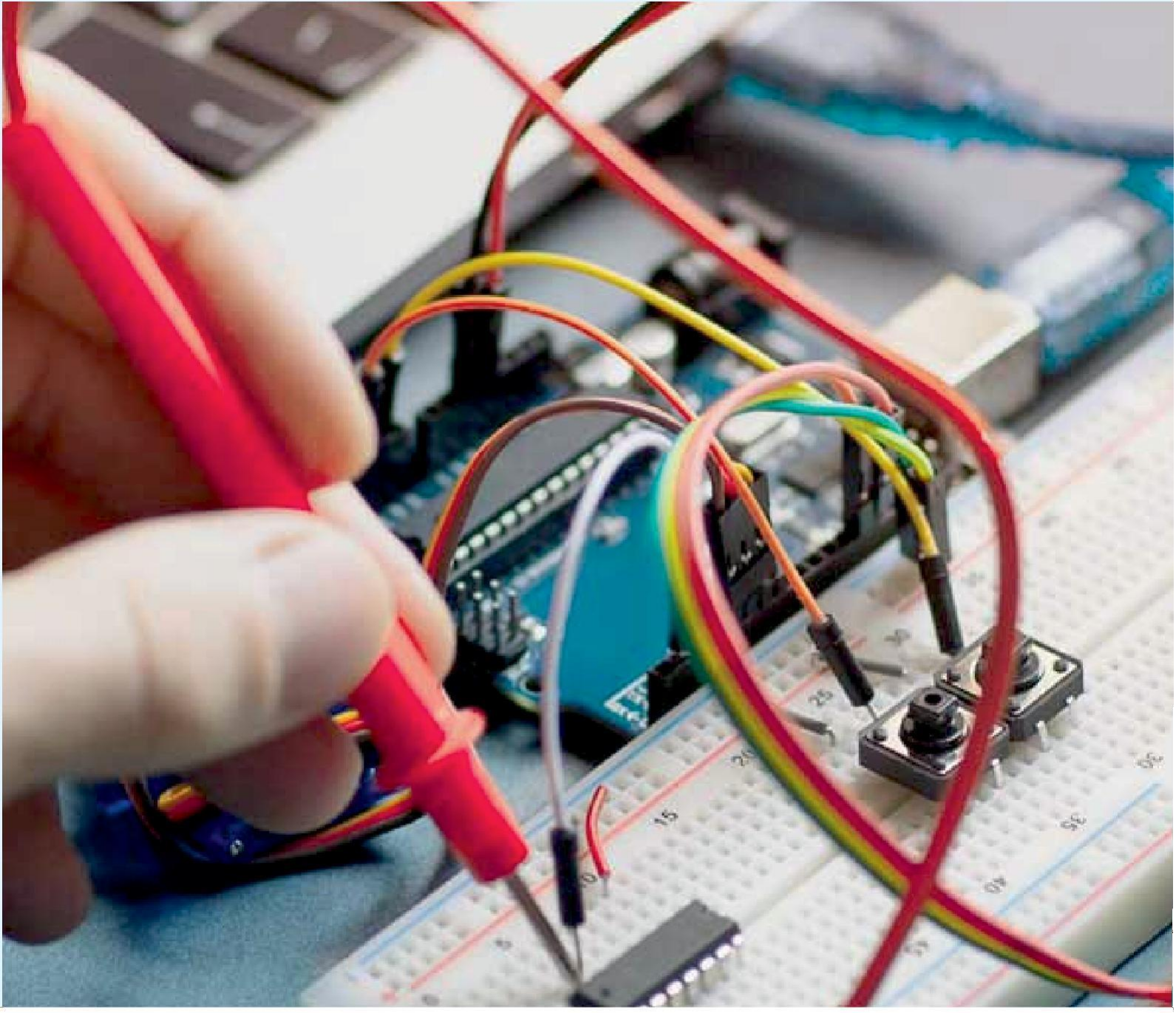

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