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Power Generation from Wind Turbine on Train

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Abstract: Energy is needed to improve the finances of a country. The use of non-renewable sources of energy such as fossil fuels, coal, etc. causes a lot of environmental damage. Modern society is so dependent on the use of electrical energy that it has become an integral part of our lives. Thus there is a need to use renewable sources of energy to power our cities. Energy is needed in various forms such as heat and light. Moreover, modern advances in science and innovation havemade it possible to convert electrical energy intodesired forms and vice versa.
The objective of this project is to utilize wind energy to run several applications in the train. Its main purpose is to generate electricity from a wind turbine, store it in a battery, and then use that energy to charge an electric vehicle.
Keywords: Energy, Wind, Train, Battery, Electricity, Green Energy

I. INTRODUCTION

People in yesteryears used to work in togetherness helping each other in their everyday activities. Comparatively, today's world unlikeyesterday has become dependent fully on machines for performing their work.
The development of renewable energy is therefore a much-required need for human resource development. Making use of inexhaustible and renewable energy sources suchas wind and solar energy has been emphasized time and again as traditional energy sources are depleting.
Wind energy has been used by humans for a longtime, and the technologies associated with it are more advanced than other forms of energy. Applications using wind energy have widebenefits to the power industry and are developingmore and more rapidly.
A train travelling at high speed, in combination with wind flowing in opposite directions, results in wind energy. This wind is used kinetic mechanical energy with the use of turbines whichis further converted to electrical energy usinggenerators.
Using sustainable energy sources for movingtrains is a very creative methodology.
There may be difficulties due to the additional airresistance created by the turbines installed on topof the train roof. The speed of the airflow on the leading edge of a wind turbine when equal to or more to the speed of the train, electricity can be generated.
The device includes vertical windmills placed atop the coaches of the train, gearboxes, generators,and accumulators located inside the coach.
At the beginning of the 20th century, the concept of electricity found its way and thewindmill was converted into a wind turbinewith a rotor connected to an electrical generator.
We have designed our model such that the turbine over the coach does not hit the variousobstacles and the drag force doesn't affect theperformance of the train.

II. METHODOLOGY

A. Materials

1) DC Generator Motor- It is used to generate electricity from the rotational motion of the rotary device attached to it.It converts rotational kinetic energy into electrical energy.
2) Battery- It is used to store the electricalenergy produced by the generator.
3) Wires- It used to connect the variousdevices used to complete the circuit.
4) Fan (Rotary Structure)- It is attached tothe generator and is used to create a rotational mechanical motion from the wind.
5) Stainless Steel Frame- It creates a sturdy structure to protect the internal circuit and make the product aesthetically more appealing.
6) Air Tight Structure- It is used to protectthe circuit from water and other substances that can damage the circuit
7) Water Insulation
8) BMS- It is used to regulate the voltageinput and output into the Battery.
9) Gear Box- It is used to change the speedof the rotating shaft of the generator which is connected to the rotor.

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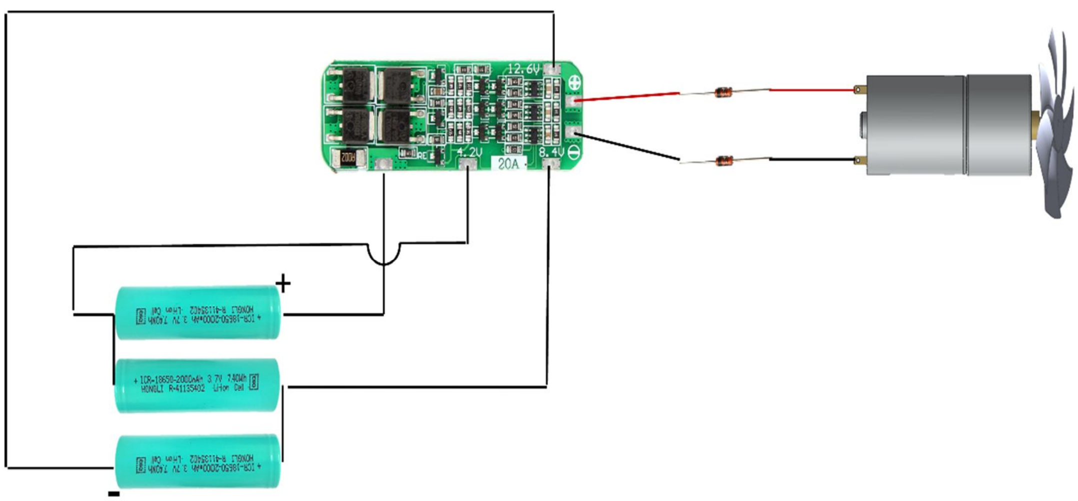
10) Hydraulic Accumulator- It is used to bring the rotor back to its original position after it folds in case of detecting an obstacle.
11) Sensor- It is used to detect obstacles so that the wind turbine can fold into the box below it beforehand.
12) Diodes-It is used to prevent reverse current from the batteries to the generator.

B. Design

Care has been taken to see that the blades of thefan are at a particular angle so that maximum rotation is possible.
The fan is then attached to the generator to createelectricity. This can be done in two ways- either by attaching the fan directly to the generator or by routing it through a gearbox. Routing throughthe gearbox helps to increase the Rotations per unit time of the shaft of the generator.
A wind turbine comprises a set of rotor blades that move around a central hub. The force of the wind drives these blades into action. To increasethe shaft's rotational speed, the rotor blades haveto be connected to a shaft that drives a gearbox which is connected to a generator. It converts therotational motion of the fan into electricity.
The generator is further connected to the BMS (Battery Management System). A BMS is an electronic device that manages the performance and safety of a rechargeable battery pack. It constantly monitors the voltage, temperature, and current of each battery cell. It prevents overcharging or undercharging of the battery pack, temperature, and current protection.
Diodes are attached between the generator and BMS to prevent reverse current flow from the battery to the generator. Different types of Diodes can be used for this such as Schoktty, Zener, MOSFET, Blocking diodes, Mechanical relays, etc. The most favourable diode in the current situation is the Blocking Diode. They arefavourable because they have a low voltage drop and can handle high currents.



C. Power Production

The power in the wind is proportional to:
1) the area of the windmill being swept by the wind
2) the cube of the wind speed
3) the air density - which varies with altitude.

The formula used for calculating the power in the wind is shown below:
Power = (density of air x swept area x velocity cubed)/2
$P = ½. \rho(A)(V)^3$
Where,
P is power in watts (W)
ρ is the air density in kilograms per cubic meter (kg/m3)
A is the swept rotor area in square meters (m^2) & V is the wind speed in meters per second (m/s).

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D. Characterization

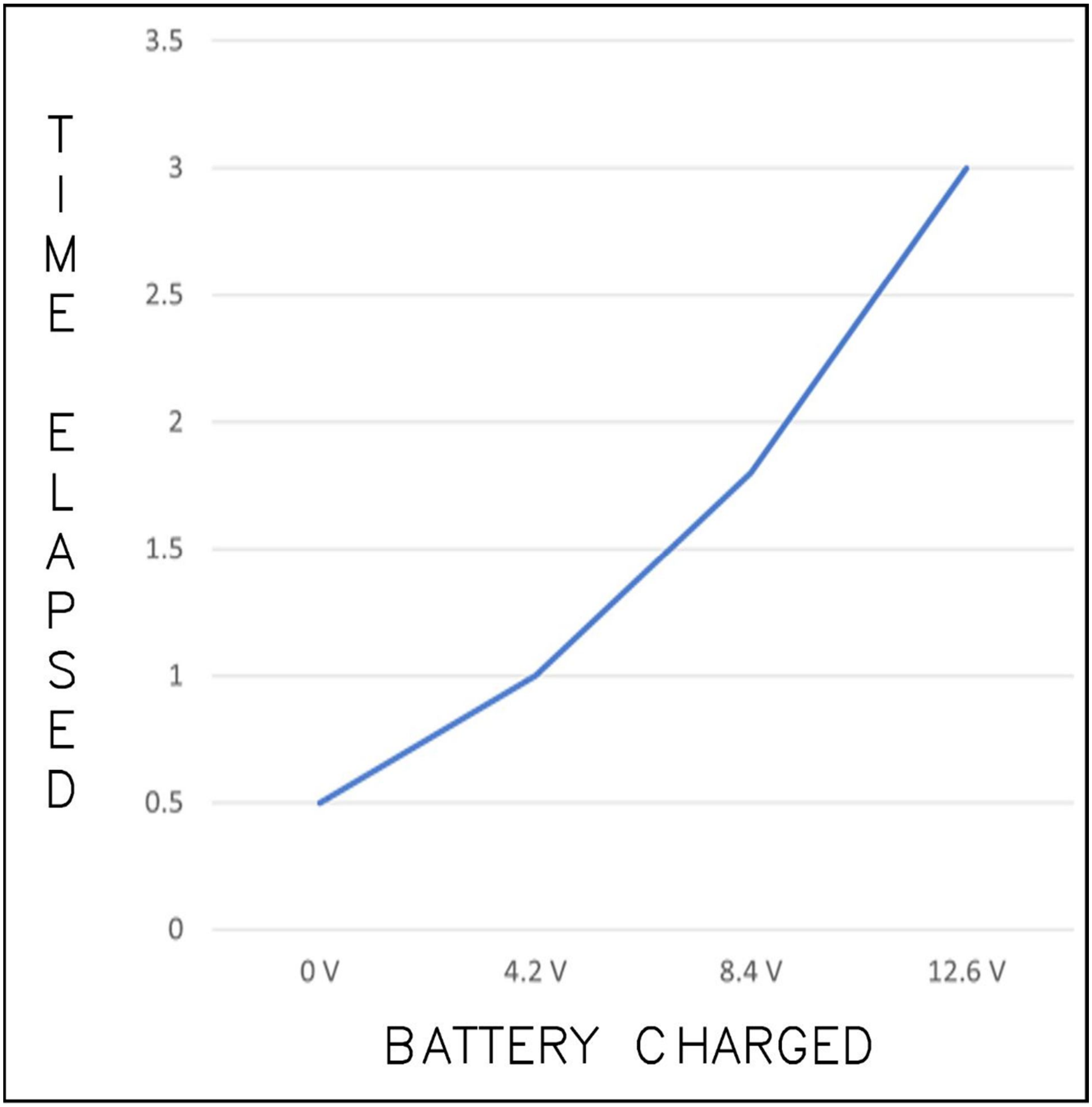
The whole model is to be placed on a hollow place on the roof of the train. Sensors can be placed on the coaches which will enable them to sense obstacles on the way. When an obstacle is encountered, the outer frame retracts into a box placed within the coach. A hydraulic system is fixed which will bring the outer frame to its original position after the obstacle has passed.

Every coach has two turbine generators on its roof. The battery will be placed in the last coach of the train. The electrical energy generated willbe passed on from each coach to the last coach and will be stored in the batteries there. Once thestorage capacity of the batteries is to the maximum, further electrical energy can be used to run the various electrical appliances of the train. On reaching its final destination the fully charged batteries will be replaced with empty ones so that they can be used for storage on the train's onward/return journey. The charged batteries can be put into use in various ways suchas the charging of electric vehicles.

III. RESULTS AND DISCUSSION

The whole model is very compact and appealingto the eyes. It makes optimum use of the available space such that all segments of the system, reducing the need for lengthy wiring.

The wagon length of 24 meters and the separation between each unit is adequate to keepup the favoured air speed in each unit.



IV. CONCLUSION

This will go a long way in conserving non-renewable sources of energy to a large extent. This makes the production of electrical energy more efficient and cost-effective. This will prove to be beneficial in our country, especially with the Indian Railways. Reduction in carbon emissions and saving non-renewable fuel sourcesare a few of the good aspects this technology helps with.

V. ACKNOWLEDGEMENTS OR NOTES

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