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ELECTRIC VEHICLE UNIFIED WITH WIND AND SOLAR POWER

Mr. Arun Kumar R[1], Mr. Dilip Gowda L[2], Mr.Deepak V[3] ,Mr. Nisarga Karnam[4] ,Mr. Raghav P S[5]

[1]Assistant Professor, Department of Mechanical Engineering, Sapthagiri College of Engineering, Bangalore, Karnataka, India

[2-5]Bachelor of Engineering (B.E Final year) Student, Department of Mechanical Engineering, Sapthagiri College of Engineering, Bangalore, Karnataka, India

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Abstract - *Due to scarcity of fossil fuel in future and its detrimental effect on the environment, an alternate energy has to be discovered. Wind Power is clean and sustainable natural resource that has yet to be fully utilized in the automotive industry. Also, the Sun is probably the most important source of renewable source of energy available today. The hybrid model system is renewable energy system, which helps conserve energy by reducing the use of fuel in vehicle.*

The need for hybrid vehicle is increasing day by day with the increasing problems of pollution. There are many hybrid vehicles which still requires fuel for its primary running functions. So, this proposed project is about complete hybridization of the vehicle using conventional energy such as solar and wind energy with a negligible use of fuel. The energy obtained from the solar panel is stored in the lithium-ion battery which is used for ignition and running purposes. The wind energy is used for the running purpose when the car is in motion. Hence, this makes complete hybridization of the vehicle with a negligible use of fuel and thereby reducing the pollution problems.

***Key Words*: Scarcity, Wind Power, Renewable Energy, Hybrid Model, Conventional energy, Pollution, Natural Resources.**

1. INTRODUCTION

When the vehicle moves, it experiences wind resistance. If stationary wind turbines are placed in front of the vehicle, it can be used to extract some power in such a way that it can recharge the battery present in the vehicle. At the same time, there are presence of solar panels on the top of the vehicle which can be used to absorb solar energy and in turn used to recharge the battery present in the vehicle.

As the battery running are beneficial for the society and more often this type of technology is fruitful for the environment. So, to overcome the energy limitation, we are going to install wind turbine with solar energy absorption. This not only reduces the Carbon emission but also environmental friendly for the society.

An electric car finds the difficulty of charging it after a few kilometers but the wind and solar powered vehicle helps to eliminate this drawback as this vehicle has the facility to be charged on board due to wind and solar energy. Here, power is generated from wind turbines and the solar panels and is directed to the battery for the charging. The battery is recharged on board and the vehicle doesn't need to be on standby for charging.

2. ENERGY DEMAND

India accounts for more than a quarter of net global primary energy demand growth between 2017-2040. 42% of this new energy demand is met through coal, meaning CO_2 emissions roughly double by 2040. Gas production grows but fails to keep pace with demand, implying a significant growth in gas imports. During the fiscal year 2018-19, the utility energy availability was 1,267.5 billion KWh, a short fall relative to requirements of 7.07 billion KWh (-0.6%). Peak load met was 175,528 MW, 1,494 MW (-0.8%) below requirements. In the 2019 Load Generation Balance report, India's Central Electricity Authority anticipated energy surplus and peak surplus to be 5.8% and 8.4%, respectively, for the 2019–20 fiscal year. Power would be made available to few states expected to face shortages from states with a surplus, through regional transmission links. From calendar year 2015 onwards, power generation in India has been less of a problem than power distribution.

2.1 Reducing Carbon-di-oxide emissions and Importance of Renewable energy

The most effective way to reduce carbon-di-oxide is to reduce fossil fuel consumption. The Intergovernmental Panel on Climate Change (IPCC) has reported to the United Nations that the Earth's climate system is undoubtedly getting warmer. The IPCC has also concluded with 95 percent certainty that much of the accelerated warming of the past 50-60 years is due to human contributions. Large percentages of this increase are due to activities by businesses, factories, and other commercial facilities. So, there have been many strategies for reducing CO_2 from energy are cross-cutting and apply to homes, businesses, industry, and transportation.

Renewable energies are sources of clean, inexhaustible and increasingly competitive energy. They differ from fossil fuels principally in their diversity, abundance and potential for

use anywhere on the planet, but above all in that they produce neither greenhouse gases – which cause climate change – nor polluting emissions. Their costs are also falling and at a sustainable rate, whereas the general cost trend for fossil fuels is in the opposite direction in spite of their present volatility. Growth in clean energies is unstoppable, as reflected in statistics produced in 2015 by the International Energy Agency (IEA): they represented nearly half of all new electricity generation capacity installed in 2019, when they constituted the second biggest source of electricity worldwide, behind coal. According to the IEA, world electricity demand will have increased by 70% by 2040 - its share of final energy use rising from 18 to 24% during the same period – driven mainly by the emerging economies of India, China, Africa, the Middle East and South-East Asia.

3. FIELD OF INVENTION

The fixed wind powered electricity generation systems in use, till now are dependent on wind direction and the force of the wind. But, the wind is not available at all places and all time throughout the year. Therefore, there exists an immense need of a system for generating electricity from wind induced by moving vehicles which is available throughout the year at various places and with sufficient force of wind. Also, Solar Powered electric vehicle is present but there is a need to install an auxiliary fuel for fuel vehicle. Therefore, the need of inventing a hybrid renewable energy source as an auxiliary source for fuel vehicle. Therefore, this invention provides a solution to the problem for generating electricity in this manner. The proposed hybrid model grasps electricity in the form of both wind energy and solar energy.

4. OBJECTIVES

- The main objective of the present project is to provide a method and a system for generating electricity using easily available wind induced by moving vehicle and solar energy in transit or in operation.
- The other objective is to provide a solution for reducing pollution by fuel vehicle by use of freely available renewable energy source i.e Solar energy and Wind energy.
- To encourage the use of electric vehicles rather than use of fuel powered vehicles.

5. METHODOLOGY

This paper deals with how energy can be stored by a moving or in standstill vehicle which has a fuel kit using both wind and solar energy.

5.1 Construction

The Vehicle we are using is a single seater vehicle which uses both solar and wind power to charge the battery. The fan is mounted in front of the vehicle. Motor is placed below the seat with chain-sprocket to drive the vehicle. Solar panel is mounted on the top side after providing a stand for the panel support. The batteries are mounted between the steering and the seat. The solar charge controllers are placed behind in the vehicle. Both the Fan and the Solar panel recharges the batteries in the unit.

5.2 Working Procedure

When the vehicle moves, It experiences wind resistance. If stationary wind turbines are placed in front of the vehicle, It can be used to extract some power in such a way that it can recharge the battery present in the vehicle. At the same time, there are presence of solar panels on the top of the vehicle which can be used to absorb solar energy and in turn used to recharge the battery present in the vehicle. As the battery running are beneficial for the society and more often this type of technology is fruitful for the environment. So, to overcome the energy limitation, we are going to install wind turbine with solar energy absorption. This not only reduces the Carbon emission but also environmental friendly for the society.

The Diagram(Fig 1) shows how the solar power is converted into Electric power and in the diagram(Fig 2) shows how wind power is used to recharge a battery.

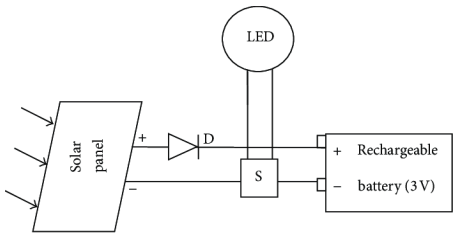


FIG.1.BLOCK DIAGRAM OF SOLAR POWER CONVERSION

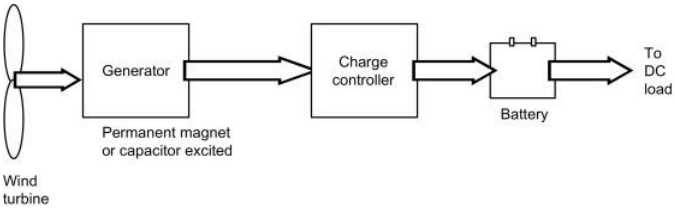


FIG.2.BLOCK DIAGRAM OF WIND POWER CONVERSION

The Diagram(Fig 3) shows how both solar and wind power are induced to charge the battery.

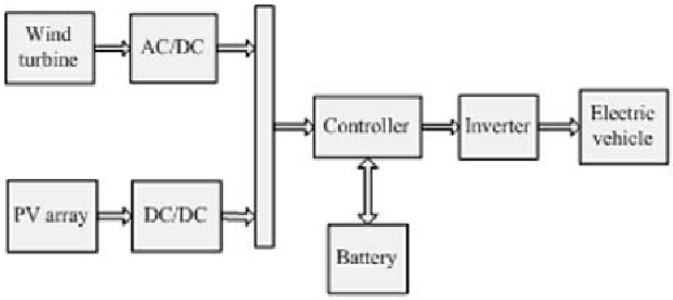


FIG.3.BLOCK DIAGRAM OF INDUCED POWER GENERATION

6. COMPONENTS USED

The following components were uses in the vehicle to provide better drivability and efficient energy to propel the vehicle.

1. Solar Panel :

A solar cell works on the principle of photo-voltaic principle, the photo-voltaic solar energy conversion is one of the most attractive non-conventional energy sources of proven reliability from the micro to the Mega watt level.

Its advantages are:

(1) Direct room temperature conversion of light to electricity through a simple solid state device.
(2) Absence of moving parts,
(3) Ability to function unattended for long periods as evidence,
(4) Modular nature in which desired currents, voltages and power levels can be achieved by mere integration,
(5) Maintenance cost is low as they are easy to operate,
(6) They do not create pollution,
(7) They have a long effective life, and
(8) They are highly reliable.

Disadvantages are:

(1) Distributed nature of solar energy,
(2) Absence of energy storage,
(3) Relatively high capital cost.

While the first disadvantage can be party overcome by concentration, the second is an inherent disadvantage overcome in PV systems by the use of conventional storage batteries. Efforts are being made world wide to reduce costs per watt through various technological innovations.

2. Battery :

In isolated systems away from the grid, batteries are used for storage of excess solar energy converted into electrical energy. The only exceptions are isolated sunshine load such as irrigation pumps or drinking water supplies for storage. In fact for small units with output less than one kilowatt. Batteries seem to be the only technically and economically available storage means. Since both the photo-voltaic system and batteries are high in capital costs. It is necessary that the overall system be optimized with respect to available energy and local demand pattern. To be economically attractive the storage of solar electricity requires a battery with a particular combination of properties:

(1) Low cost
(2) Long life
(3) High reliability
(4) High overall efficiency
(5) Low discharge
(6) Minimum maintenance
  (A) Ampere hour efficiency
  (B) Watt hour efficiency

We use lead acid battery for storing the electrical energy from the solar panel for lighting the street and so about the lead acid cells are explained below.

LEAD-ACID WET CELL:

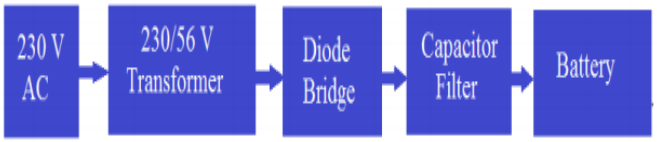
Where high values of load current are necessary, the lead-acid cell is the type most commonly used. The electrolyte is a dilute solution of sulfuric acid (H_2SO_4). In the application of battery power to start the engine in an auto mobile, for example, the load current to the starter motor is typically 200 to 400A. One cell has a nominal output of 2.1V, but lead-acid cells are often used in a series combination of three for a 6-V battery and six for a 12-V battery.

The lead acid cell type is a secondary cell or storage cell, which can be recharged. The charge and discharge cycle can be repeated many times to restore the output voltage, as long as the cell is in good physical condition. However, heat with excessive charge and discharge currents shortens the useful life to about 3 to 5 years for an automobile battery. Of the different types of secondary cells, the lead-acid type has the highest output voltage, which allows fewer cells for a specified battery voltage.

CHARGING THE LEAD-ACID BATERY:

The lead-acid battery can be charged using plug-in power and also renewable energy sources like solar energy, wind energy etc. In foreign countries they have charging

points for charging the electric vehicles. By 2030 we can also expect a large variety of electric vehicles and also charging stations. In this project we have made a charger for charging lead-acid batteries.



3. DC Generator :

A DC generator provides these three conditions to produce a DC voltage output.

Theory of Operation :

A basic DC generator has four basic parts:

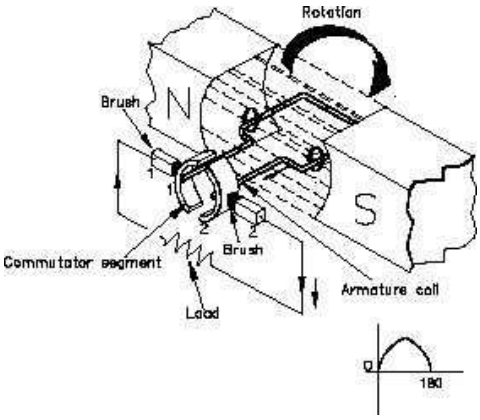
(1) A magnetic field;

(2) A single conductor, or loop;

(3) A commutator; and

(4) Brushes

The magnetic field may be supplied by either a permanent magnet or an electromagnet. For now, we will use a permanent magnet to describe a basic DC generator.



Basic Operation of a DC Generator A single conductor, shaped in the form of a loop, is positioned between the magnetic poles. As long as the loop is stationary, the magnetic field has no effect (no relative motion). If we rotate the loop, the loop cuts through the magnetic field, and an EMF (voltage) is induced into the loop.

When we have relative motion between a magnetic field and a conductor in that magnetic field, and the direction of rotation is such that the conductor cuts the lines of flux, an EMF is induced into the conductor. The magnitude of the induced EMF depends on the field strength and the rate at which the flux lines are cut.

The stronger the field or the more flux lines cut for a given period of time, the larger the induced EMF.

$E_g = KFN$

where E_g = generated voltage

K = fixed constant

F = magnetic flux strength

N = speed in RPM

The direction of the induced current flow can be determined using the "left-hand rule" for generators. This rule states that if you point the index finger of your left hand in the direction of the magnetic field (from North to South) and point the thumb in the direction of motion of the conductor, the middle finger will point in the direction of current flow.

For example, the conductor closest to the N pole is traveling upward across the field; therefore, the current flow is to the right, lower corner. Applying the left-hand rule to both sides of the loop will show that current flows in a counter-clockwise direction in the loop.

4. FRAME STAND:

This is made up of M.S. This is used as a body of the vehicle. The front and rear wheels are fitted bellow this bottom frame with the help of end bearings.

5. RACK AND PINION STEERING UNIT:-

Rack-and-pinion steering is quickly becoming the most common type of steering on cars, small trucks and SUVs. It is actually a pretty simple mechanism. A rack-and-pinion gear set is enclosed in a metal tube, with each end of the rack protruding from the tube. A rod, called a tie rod, connects to each end of the rack.

6. CONTROLLER:

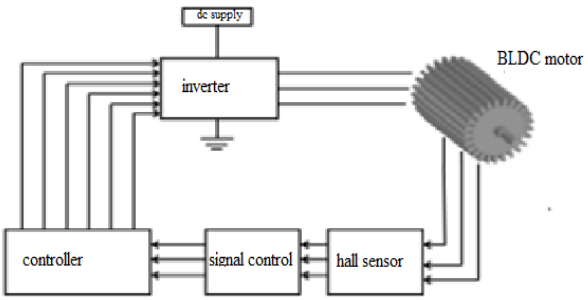
Controller is a device that serves to govern the performance of an electric motor. This may have automatic or manual means of starting and stopping the motor, selecting forward and reverse rotation, selecting and regulating or limiting the torque and protecting against overloads and faults. The given controller is of manual starting or stopping Direct on Line (DOL) type which is controlled by using throttle. This is pre-loaded with software to work for the given electric motor. This works for all functions given above.

Fig: Controller for 250W Electric Motor

BLOCK DIAGRAM OF THE CONTROL SYSTEM

The block diagram of BLDC drive system is shown in Figure 1. It consists of a three phase inverter, position sensors, signal conditioner and a digital controller. The inverter along with the position sensor arrangement is functionally analogous to the commutator of a dc motor.

The commutation of a BLDC motor is controlled electronically. The stator windings should be energized in a sequence in order to rotate the motor. Rotor position should be known in order to switch the winding in sequence. A permanent magnet brushless dc motor incorporates some means of detecting the rotor position.



The BDLC motor detects the position of the rotor using Hall sensors. Three sensors are required for position information. With three sensors, six possible commutation sequences could be obtained. In the Hall sensor technique, three Hall sensors are placed inside the motor, spaced 120 degrees apart. Each Hall sensor provides either a High or Low output based on the polarity of magnetic pole close to it. Rotor position is determined by analyzing the outputs of all three Hall sensors. Based on the output from hall sensors, the voltages to the motor's three phases are switched.

The advantage of Hall sensor-based commutation is that the control algorithm is simple and easy to understand. Hall sensor-based commutation can also be used to run the motor at very low speeds.

BLDC motor control is to have only one current at a time. Because of which current sensor is not advised to be placed on each phase of the motor; one sensor placed in the line inverter input is sufficient to control the current of each phase. Insulated systems are not required when sensor is on the ground line.

The torque and speed of motors is managed by microcontroller. A sufficient amount of processing power is required to solve the algorithms needed to generate Pulse Width Modulated (PWM) outputs for motor. By simply varying the voltage across the motor, one can control the speed of the motor.

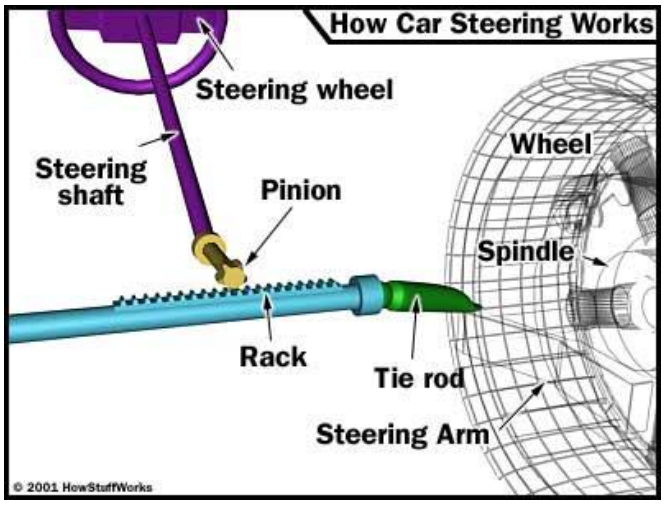
7. BRUSHLESS DC MOTOR, THROTTLE & STEERING :

We have chosen electric motor instead of IC engine in our project. But due to space constraints, we opted for electric motor. Motor which we used is reduction electric DC motor which provides required torque. Also reason behind choosing this motor is we did not want emission issues with our vehicle. Only disadvantage with this motor is increase in size of battery and decrement in RPM. Also this reduction motor comes with controller and throttle control for handle.

It is similar to DC motors with Permanent Magnets. It is called brushless because it does not have the commutator and brush arrangement. The commutation is done electronically in this motor because of this BLDC motors are maintenance free. BLDC motors have traction characteristics like high starting torque, high efficiency around 95-98%, etc. BLDC motors are suitable for high power density design approach. The BLDC motors are the most preferred motors for the electric vehicle application due to its traction characteristics.

Throttle:

Electronic Throttle control (ETC) is an automobile technology which electronically connects the accelerator pedal to the throttle, replacing mechanical linkages. ETC consists of accelerator pedal module, ETB and ECM. There are throttle positions sensor embedded in ETB which helps in determining the required throttle. The given ETB works on potentiometer.



The **pinion gear** is attached to the **steering shaft**. When you turn the steering wheel, the gear spins, moving the rack. The tie rod at each end of the rack connects to the **steering arm** on the **spindle** (see diagram above).

The rack-and-pinion gear set does two things:

- It converts the rotational motion of the steering wheel into the linear motion needed to turn the wheels.
- It provides a gear reduction, making it easier to turn the wheels.

On most cars, it takes three to four complete revolutions of the steering wheel to make the wheels turn from lock to lock (from far left to far right).

The **steering ratio** is the ratio of how far you turn the steering wheel to how far the wheels turn. For instance, if one complete revolution (360 degrees) of the steering wheel results in the wheels of the car turning 20 degrees, then the steering ratio is 360 divided by 20, or 18:1. A higher ratio means that you have to turn the steering wheel more to get the wheels to turn a given distance. However, less effort is required because of the higher gear ratio.

Generally, lighter, sportier cars have lower steering ratios than larger cars and trucks. The lower ratio gives the steering a quicker response -- you don't have to turn the steering wheel as much to get the wheels to turn a given distance -- which is a desirable trait in sports cars. These smaller cars are light enough that even with the lower ratio, the effort required to turn the steering wheel is not excessive.

7. DESCRIPTION OF COMPONENTS AND CALCULATION

1. SOLAR PANEL:

Specifications:

Array Size : 12 x 6

Output Voltage : 12V (Normal Condition)

Output Voltage : 19V (peak Hours)

Type : D.C Voltage

Material : Silicon

2. BATTERY:

Specification for single battery:

Material : Lead-Acid Battery

Output Voltage : 48 V

Output Power : 40 Ampere-Hour

3. BRUSHLESS DC MOTOR:

TORQUE AND POWER REQUIREMENT

Torque, T = Fc x r

Where,

Fc - Circumferential force

Motor shaft is connected to the sprocket

∴Fc - Centrifugal tension in the sprocket

$Tc = m \times v^2$

V - Velocity of the chain

Where,

m - Mass of the chain per unit length

m = Area x length x density

= b x t x l x ρ

Where,

b = Breadth of the chain

= 0.015 m

t = Thickness = 0.007 m

l = Length = 1 m

ρ = Mass density = 1140 kg/m^3

So,

m = 0.1197 kg/m

Now,

v = (3.14 x d x n) / 60

= (3.14 x 0.2286 x 3000) / 60

= 35.90 m/sec

Tc = m x v^2

= 0.1197 x $(35.9)^2$

= 154.27 N

Fc = Tc

Now torque = Fc x radius of sprocket in the motor

= 154.27 x 0.1143

= 17.633 N-m

POWER RATING OF THE MOTOR:

Torque at motor sprocket = 17.633 N-m

Torque at the reduction gear = 5.289 N-m

Power of the motor= Torque x (2 x 3.14 x N) / 60 = (5.289 x 2 x 3.14 x 650) / 60 = 360 Watts

= 360/735.5

= 0.49 H.P ≈ 0.5 H.P

Specifications:

Material : Aluminium

Input Voltage : 12-90 Voltage

Type : Permanent Magnet D.C

Horse Power : 1/2 H.P

Ampere : 7 Ampere

Rated R.P.M : 1800 R.P.M

Duty : Continuous

8. PROPOSED HYBRID MODEL

The diagram(Fig 6) shows the final proposed model of our model.

9. ADVANTAGES

- This concept of hybrid model is useful as it has two power sources for the vehicle. The drive is induced both by solar and wind power to charge the battery
- It helps to reduce the use of fuel which is more profitable for the future. Also, it will help in reducing pollution as there is less consumption of fuel
- Zero carbon emission
- The battery recharges both by solar and wind energies. So, the battery recharges efficiency of battery is increased by a small rate

10. DISADVANTAGES

- Only can be used in city
- Limited vehicle speed
- Limited distance covered.
- If the primary battery is dead, then we have to recharge battery for start-up of the vehicle in case of night time.

11. CONCLUSION

After making the final completion project, it is found that the project is in working condition. It is found that the model captured solar energy through solar panel and wind energy through fan induced in it. There is huge potential for producing energy through renewable sources. This paper gives a clear idea that vehicle is powered with the help of solar energy and wind energy and is more green to the environment than fuel powered vehicles.

ACKNOWLEDGEMENT

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BIOGRAPHIES

Arun Kumar R, Assistant Professor, Dept. of Mechanical Engineering, Sapthagiri College of Engineering, Bangalore, Karnataka, India

Dilip Gowda L, B.E Final year Student, Dept. of Mechanical Engineering, Sapthagiri College of Engineering, Bangalore, Karnataka, India

Deepak V, B.E Final year Student, Dept. of Mechanical Engineering, Sapthagiri College of Engineering, Bangalore, Karnataka, India

Nisarga Karnam, B.E Final year Student, Dept. of Mechanical Engineering, Sapthagiri College of Engineering, Bangalore, Karnataka, India

Raghav P S, B.E Final year Student, Dept. of Mechanical Engineering, Sapthagiri College of Engineering, Bangalore, Karnataka, India