

# Design and Fabrication of Self-Charging Electric Vehicle

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**ABSTRACT:** Today's Automobile world is influenced by the invent of modern electric cars. Generally these types of cars are driven by a battery powered electric motor. But these batteries can be charged only during the static condition and the process is more time consuming. So there is a need to create a sustainable means of energy source for these cars. This project aims at developing a self-charging electric vehicle which generates the electric power required to drive the vehicle during the running condition by the means of two auxiliary power sources. One power source is dynamo, which is directly coupled to the driving motor. Other one is a horizontal windmill placed in the front of the car. These two power sources are managed by the means of a current regulator for charging the battery simultaneously.

**KEYWORDS:** Battery; Dynamo; Motor; Horizontal Windmill; Electric car.

## I. INTRODUCTION

There are so many types of car that came to influence in this existing world. Their operating systems are based on the fossil fuel systems. At present, the fossil fuel can exceed only for a certain period and it also becomes costlier, scares and creates environmental issues. Due to these constraints, alternate fuels and other source of energy such as solar, wind, etc., bringing the automobile industry to the next level. Hybrid vehicles are becoming more now-a-days. Their performances are more than the existing conventional vehicles. Also the electric vehicles are developing rapidly. These electric cars have both pros and cons. The main advantage is that it does not require gas, doesn't cause emissions and also more cost effective. Its disadvantages are that longer recharge time, battery replacement, recharge points are less. Due to these problems in this vehicle, we have made an attempt to design and fabricate a self charging electric vehicle. Generally the electric motor driven vehicles draw power from a battery and will run based on the charging capacity of the battery. It have to be charged at the time only when vehicle is in stationary condition. To break through, we have designed our vehicle which will generate power by itself while the vehicle is in running condition and the battery is getting charged simultaneously. This is done by coupling a dynamo with motor which generate current when the vehicle is in running condition and will be stored in the battery. In addition to this, horizontal windmill setup is also introduced in the front of the car, to increase the charging capacity of the battery.

Usually a vehicle consists of four wheels and it will be powered by an internal engine. Automobiles are used to transport from one location to another. Automobiles generally use gasoline to fuel the internal engine, but technological advances have led to the design of cars that run on electricity and even water.

## II. LITERATURE SURVEY

(1) **Kusekar S.K., Bandgar P.M, Andhale P.S, Adlinge G.H, Gaikawad V.V, Dhekale S.P. (2015)** has conducted an experiment in Design and development of electrical car to illustrate an implementation of electric vehicle technology on a small scale. Here we observed how to design an electric car with less cost and have studied about various components that is required to design an electric car. It shows that electrical battery operated vehicle is more suitable than other vehicle because the cost of the electricity is low and also maintenance cost is less. Also we got an

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idea about how to calculate the torque required to move the vehicle. In this study we understand the basic principles of chassis designing, steering system, caster, camber, drift, acceleration, top speed and performance tuning of the vehicle.

(2.) **K.Vignesh, P.Sakthi, A.Pugazhenth, V.Karthikeyan, C.Vinothkumar (2015)** performed an experiment in the Design and fabrication of Free Energy Bicycle which would produce a cheaper and effective result than the existing system. In this, they have fitted a dynamo in the bicycle which is in contact with the rear wheel. The motor is also connected with a rear wheel via main shaft to transmit power to the wheel and other end of dynamo is connected with the two terminals of the battery for the recharging purpose. It is working on the principle that when the wheel rotates, dynamo is functioning and from this the battery is charged by means of battery. The connections from the battery is given to the motor in such a way that when the motor energies through the current, the stator field coil get magnetized and induces the rotor shaft to rotate in the counter clockwise direction.

(3.) **Awash Tekle (2014)** performed an experiment on the topic Renewable Energy Use for Continuous electric vehicles Battery charging capacity in mobile. This paper presents and studies on renewable energy use, by integrating solar and wind energy for continuous electric vehicle battery charging capacity in mobility. Here, the power for electric vehicle is generated from solar cells and wind turbine and it is fed to the battery for charging the inverter. This is fed to the electric motor for rotational power development to the differential shaft. Here we mainly observed the charging and discharging rate of the battery and we came to know that it fully depends on the battery design. In this paper we studied about how to calculate the power generated by the wind turbine and the blade tip ratio for the various speeds.

(4.) **Patel Vijaykumar, R.L.Patel (2012)** conducted an experiment on the topic Structural Analysis of Automotive Chassis frame Design Modification for Weight Reduction for the work performed towards the optimization of the automotive chassis with constraints of maximum shear stress, equivalent stress and deflection of chassis under maximum load. Here we observed that how the chassis serve as a frame work for supporting the body and different parts of the automobiles. Here we analysed how to design a chassis, its load withstanding capability and the calculations required for the chassis frame. This paper also gives idea about, how to modify the design for the required weight of vehicle.

(5.) **S.M.Ferdous, Walid Bin Khaled, Benozir Ahmed, Sayedus Salehin, Eniyat Ghani (2011)** conducted an experiment on Electric vehicle which is based on the concept of charging the batteries of an electric vehicle when it is in motion. In general the energy storage capacity of the battery used in electric vehicle is very low compare to the conventional fuels used in modern automobiles. Hence they have found out a method to recharge the battery using renewable resource. This can be achieved by using the wind energy which is caused by the relative motion between the vehicle and the wind surrounding it. In this paper, we have study about the use of Renewable energy i.e. wind energy to generate electricity and to charge the battery by using the developed power. Here we referred how to calculate the energy produced by the wind using wind turbine, here we also get an idea about the aerodynamic analysis of the structure of vehicle along with the flow pattern.

### III.PROBLEM IDENTIFICATION

In a current scenario, the fossil fuels are depleting rapidly due to the over usage of conventional vehicles. Generally conventional vehicles use petrol and diesel as a main fuel. It causes heavy damage to our environment by emitting the harmful gases such as HC (hydrocarbon), CO (carbon monoxide), and Nox emissions which leads to ozone depletion and global warming. Also more number of alternative fuels such alcohol (methyl alcohol and ethyl alcohol), biogas, bio-diesel, natural gas and vegetable such as peanut oil, linseed oil, rapeseed oil, sunflower oil, etc can be used in order to replace the existing fossil fuel. But a proper cause and effects has not yet identified.

Here the electric vehicle plays a vital role to boom the automobile to the next generation. The most of the electric vehicle uses battery as a major source of power. But main problem we identified is that the battery should be charged for a long period of time in a static condition only. It leads to consume more conventional power and so it increase the cost of the electricity used. And also recharging fuel stations are not sufficient as the process of recharging consumes more time. As the battery is continuously used to run the vehicle, deep discharge of battery is frequently occurring. So that the life cycle of battery is decreased. Due to this the replace cost of battery is high.

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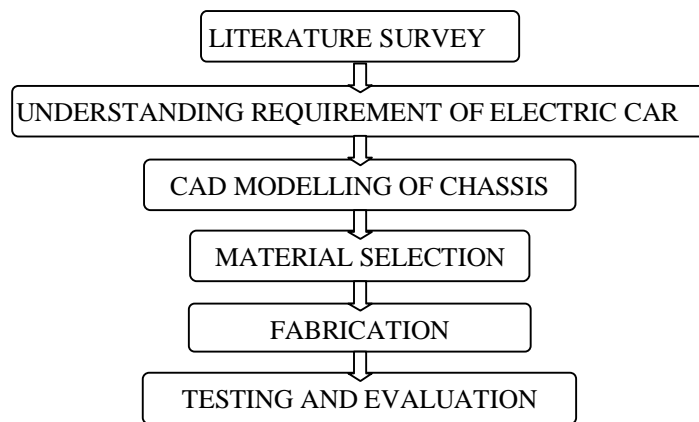
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## IV. METHODOLOGY

The design and the fabrication work of self-charging electric vehicle starts with the collection of data regarding the need for a self-charge to be operated while car is in running condition. The flow chat depicts the actual plan of action carried out in order to design and fabricate the car from the development stage. After literature survey, brainstorming session was conducted to decide on possible features to be incorporated in the electric car.



## V. CAD MODELLING

Design process was carried out using Solidworks software and the model was developed and it is presented. The design of components started from scrap defining dimensions for each and every component. A number of models were developed before actually confirming the final design. Due to several reasons such as material wastage, cost effectiveness, time involved in fabrication, difficulties in manufacturing a number of design changes were made and obtained as final model as shown in the figure 1 and 2.

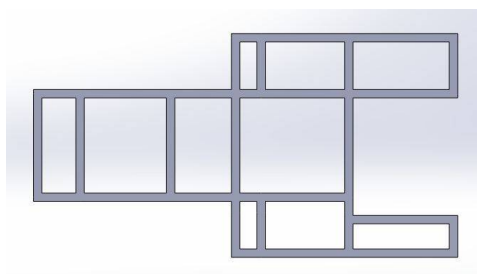


Figure 1 Isometric View

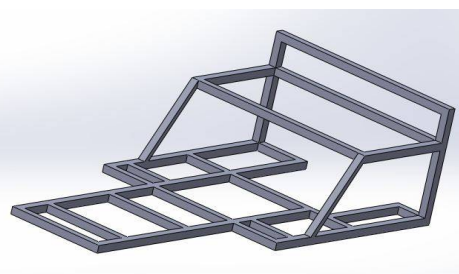


Figure 2 Top View

### A. STRESS ANALYSIS OF THE CHASSIS

With the help of ANSYS software, the schematic diagram of the chassis were drawn and analysed by applying various forces as shown in the figure 3,4,5,6. The load is applied on the particular area based on the real time application and their results are noted down.

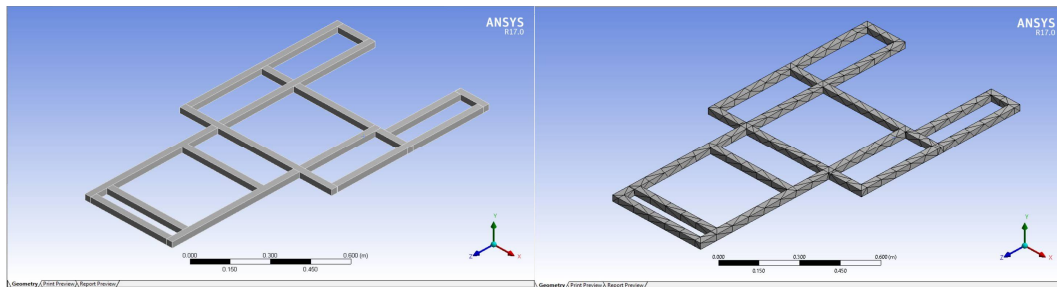


Figure 3 Chassis Design

Figure 4 Meshing Of Chassis

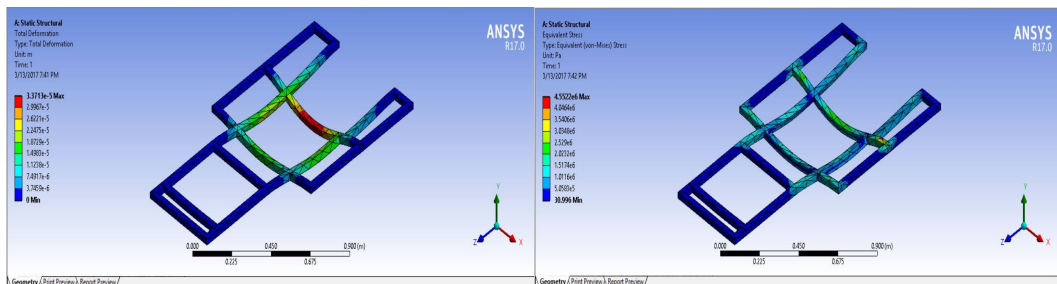


Figure 5 Total Deformation

Figure 6 Equivalent Stress

## VI. WORKING

A battery with capacity of 12V, 75Ah is connected with 12V, 65amps (at full load capacity) DC series motor through MCB (Mini circuit breaker) using 16 square mm single core copper wire, so as to withstand the load. This motor setup is connected to the crank shaft by the help of 26mm v-belt and pulley drive. Other end of this shaft is coupled with dynamo which generates 12V, 65amps.

Initially the DC series motor draws power from the battery for starting at idle speed. Once motor reaches the particular speed, the gearbox will activated based on the centrifugal force and transfer the power to the rear wheel, so as to enable the vehicle to move. Also the dynamo starts to produce current due to the rotation and it is directly coupled to the battery for charging purpose simultaneously.

In addition to that, the horizontal windmill setup is placed in the front of the vehicle. When the vehicle starts to move, based on the wind direction and pressure, the wind blade starts to rotate, which in turn starts to produce current. This is also connected with battery for charging purpose in the running condition itself.

## VII. DESIGN CALCULATION

### A. CALCULATION OF ROLLING RESISTANCE

Rolling Resistance = Gross Vehicle Weight \* Crr

Here,

Gross Vehicle Weight is 170 kg = 1667.7N

Co-efficient of Rolling Resistance is 0.015 (Concrete-Fair)

$$RR = 1667.7 * 0.015$$

$$RR = 25.0155 \text{ N}$$

### B. CALCULATION OF GRADE RESISTANCE

Grade Resistance = Gross Vehicle Weight \* sin $\theta$

Grade or inclination angle  $\theta = 0^\circ$  [Since the surface is Flat]

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$$GR = 1667.7 * \sin(0^\circ)$$

$$GR = 0 \text{ N}$$

### C. CALCULATION OF ACCELERATION FORCE

$$FA = m * a$$

m = Gross Vehicle Weight / g

Here,

FA = Acceleration Force

m = Mass of the vehicle

g = Acceleration due to gravity (9.81m/sec<sup>2</sup>)

a = Required acceleration

$$m = 1667.7 / 9.81$$

$$m = 170 \text{ kg}$$

a = final velocity – initial velocity / time

Final velocity = 20kmph = 5.56m/s

Initial velocity = 0m/s

Time = 30sec

$$a = 5.56 - 0 / 60$$

$$a = 0.0926 \text{ m/s}^2$$

$$FA = 170 * 0.0926$$

$$FA = 15.742 \text{ N}$$

### D. CALCULATION OF TOTAL TRACTIVE EFFORT

TTE = Rolling Resistance + Grade Resistance + Acceleration Force

$$TTE = 25.0155 + 0 + 15.742$$

$$TTE = 40.7575 \text{ N}$$

### E. CALCULATION OF TORQUE REQUIRED ON THE DRIVE WHEEL

Torque = Rf \* TTE \* r (wheel)

Rf = Friction factor = 0.7

r (wheel) = Radius of the drive wheel = 0.21m

$$\text{Torque} = 0.7 * 40.7575 * 0.21$$

$$\text{Torque} = 5.99 \text{ Nm}$$

### F. CALCULATION OF BATTERY LIFE CYCLE

Rating at C20

Life cycle of battery = 200 \* charge current / time

Here,

Charge current = 65amps

Standard test at normal condition = 200 cycles

Time = 20mins

$$\text{Life cycle of battery} = 200 * 65 / 20$$

$$\text{Life cycle of battery} = 650 \text{ cycles}$$

### G. CALCULATION OF WIND BLADES

Diameter of the wind blade = 48cm = 0.480m

1) At **15kmph** = 4.166m/s,

i) To calculate power in the wind,

$$P = (1/2) * \rho * A * V_i^3$$

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Here,

$P$  = power in wind (Watt)  
 $\rho$  = Air density (1.23 Kg/m<sup>3</sup>)  
 $A$  = Area of blade ( $\pi/4 * D^2$ ) (m<sup>2</sup>)  
 $V_i$  = Air velocity (m/s)

$$P = (1/2) * 1.23 * (\pi/4) (0.48^2) * (4.166^3)$$

$$P = 8.051w$$

ii) To calculate the power developed

$$P = V * I$$

Here,

$V$  = voltage = 6.9v  
 $I$  = current in amps = 0.13amps

$$P = 6.9 * 0.13$$

$$P = 0.897w$$

iii) To calculate efficiency

Efficiency = (Power developed by the windmill / power in the wind) \* 100  
Efficiency = (0.897 / 8.051) \* 100 = 11.4%

2) At **20kmph** = 5.55m/s,

i) To calculate power in the wind,

$$P = (1/2) * \rho * A * V_i^3$$

$$P = (1/2) * 1.23 * (\pi/4) (0.48^2) * (5.55^3)$$

$$P = 19.08w$$

ii) To calculate the power developed

$$P = V * I$$

Here,

$V$  = voltage = 8.7v  
 $I$  = current in amps = 0.34amps

$$P = 8.7 * 0.34$$

$$P = 2.958w$$

iii) To calculate efficiency

Efficiency = (Power developed by the windmill / power in the wind) \* 100  
Efficiency = (2.958 / 19.08) \* 100 = 15.5%

3) At **25kmph** = 6.944m/s,

i) To calculate power in the wind,

$$P = (1/2) * \rho * A * V_i^3$$

$$P = (1/2) * 1.23 * (\pi/4) (0.48^2) * (6.944^3)$$

$$P = 37.26w$$

ii) To calculate the power developed

$$P = V * I$$

Here,

$V$  = voltage = 10.4v  
 $I$  = current in amps = 0.63amps

$$P = 10.4 * 0.63$$

$$P = 6.552w$$

iii) To calculate efficiency

Efficiency = (Power developed by the windmill / power in the wind) \* 100  
Efficiency = (6.552 / 37.26) \* 100 = 17.58%

4) At **30kmph** = 8.333m/s,

i) To calculate power in the wind,

$$P = (1/2) * \rho * A * V_i^3$$



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$$P = (1/2) * 1.23 * (\pi/4) (0.48^2) * (8.333^3)$$

$$P = 64.4w$$

ii) To calculate the power developed

$$P = V * I$$

Here,

$$V = \text{voltage} = 12.2v$$

$$I = \text{current in amps} = 0.95\text{amps}$$

$$P = 12.2 * 0.95$$

$$P = 11.59w$$

iii) To calculate efficiency

$$\text{Efficiency} = (\text{Power developed by the windmill} / \text{power in the wind}) * 100$$

$$\text{Efficiency} = (11.59 / 64.4) * 100 = 17.99\%$$

5) At **35kmph** = 9.722m/s,

i) To calculate power in the wind,

$$P = (1/2) * \rho * A * V_i^3$$

$$P = (1/2) * 1.23 * (\pi/4) (0.48^2) * (9.722^3)$$

$$P = 102.27w$$

ii) To calculate the power developed

$$P = V * I$$

Here,

$$V = \text{voltage} = 13.1v$$

$$I = \text{current in amps} = 1.6\text{amps}$$

$$P = 13.1 * 1.6$$

$$P = 20.96w$$

iii) To calculate efficiency

$$\text{Efficiency} = (\text{Power developed by the windmill} / \text{power in the wind}) * 100$$

$$\text{Efficiency} = (20.96 / 102.27) * 100 = 20.49\%$$

## VIII. FINAL ASSEMBLY

Thus the vehicle has been fabricated and various components were painted. Then the assembled vehicle was road tested under the normal load condition. The result is given in below heading (Table 1). The photographic view of the vehicle is shown in the figure 7 and 8 as side and front view.



Figure 7 Final Assembly (Side View)



Figure 8 Final Assembly (Front View)

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## A. ADVANTAGES

1. The main scope of this project is to enhance the electric vehicle by recharging the battery automatically when the vehicle is in moving condition.
2. As the battery charges simultaneously, the deep discharge of battery gets avoided. Hence it increases the battery life cycle.
3. This method can be adopted in current electric vehicle to increase its efficiency.
4. This vehicle consumes no fuel and so it is more Eco friendly.
5. Zero Emission.
6. Reduction in time and electric power for recharging the battery.

## B. APPLICATIONS

1. This project suits well applicable in golf cart vehicle.
2. Mainly it can be used in small scale industry for transportation.
3. It can also be used as an On-road vehicle.

## IX. RESULTS

Table 1 Result of wind mill

SL.NO	VELOCITY (Km/hr)	POWER IN WIND (Watt)	POWER DEVELOPED (Watt)	EFFICIENCY (%)
1	15	8.051	0.897	11.14
2	20	19.08	2.958	15.5
3	25	37.26	6.552	17.58
4	30	64.4	11.59	17.99
5	35	102.27	20.96	20.49

## A. ON ROAD TESTING

Total weight of the car = 170kg (Including single person load = 80kg)

### 1. TESTING ONLY WITH MOTOR

Initial level of the battery = 12.7V  
After 15 minutes of on road testing,  
Final level of the battery = 11.9V

### 2. TESTING WITH DYNAMO AND WINDMILL SETUP

Initial level of the battery = 12.2V  
After 15 minutes of on road testing,  
Final level of the battery = 11.8V

## X. CONCLUSION AND FUTURE SCOPE OF THE PROJECT

Thus the self-charging electric car was fabricated. This car is very feasible for day-to-day travel similar to motorbike. The car is much comfortable which supports the driver for easy riding. It is very less weight compared to a small car and provides better safety than a two-wheeler. This project provides flexibility in operation and noiseless operation. The scope of this project lies in fully determining and understanding the functioning of car. This project gives solution to the old problems, where the most common problem arising from existing electric car is the recharging system. The conventional system leads to consume more conventional power and time. Hence our project reduces the problem called recharging time and makes our car the most economical one.



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We can further develop more features in this car. This car was fabricated for the purpose of self charging the battery when the vehicle is in moving condition. This vehicle uses a Lead acid battery which needs replacement after some period. Instead of using Lead acid battery, we can switch over to Lithium-ion batteries which provides more life cycles and they are much reliable. We can use high rated DC motor to drive the high loads as possible. New inventions of lighter but stronger materials like carbon fibers, High strength polymers can help in reducing the overall weight of the car and thus smaller sized high efficiency motors can be used. In future, we can add solar panels to this car to make it more economical. We can encrypt the idea of multipurpose vehicle similar to existing, so that we can develop the electric car to the next level.

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