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# Energy Efficient Urban Mobility Hybrid Scooter

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**ABSTRACT:** A 'hybrid electric vehicle' is a vehicle which relies not only on batteries but also on an internal combustion engine which drives a generator to provide the electricity and may also drive a wheel. It has great advantages over the previously used gasoline engine that drives the power from gasoline only. It also is a major source of air pollution. The objective is to design and fabricate a two wheeler hybrid electric vehicle powered by both battery and gasoline. The combination of both the power makes the vehicle dynamic in nature. It provides its owner with advantages in fuel economy and environmental impact over conventional automobiles. Hybrid electric vehicles combine an electric motor, battery and power system with an internal combustion engine to achieve better fuel economy and reduce toxic emissions. In HEV, the battery alone provides power for low-speed driving conditions where internal combustion engines are least efficient. In accelerating, long highways, or hill climbing the electric motor provides additional power to assist the engine. This allows a smaller, more efficient engine to be used. Besides it also utilizes the concept of regenerative braking for optimized utilization of energy. Energy dissipated during braking in HEV is used in charging battery. Thus the vehicle is best suited for the growing urban areas with high traffic. Initially the designing of the vehicle in CAD, simulations of inverter and other models are done. Equipment and their cost analysis are done. It deals with the fabrication of the vehicle. This includes assembly of IC Engine and its components. The next phase consists of implementing the electric power drive and designing the controllers. The final stage would consist of increasing the efficiency of the vehicle in economic ways.

**KEYWORDS:** Hybrid electric vehicle, Hub motor, Battery.

### I. INTRODUCTION

Around 93% of today's automobiles run on petroleum based product, which are estimated to be depleted by 2050. Moreover, current automobiles utilize only 25% of the energy released from petroleum and rest is wasted into the atmosphere. Despite recent efforts to improve fuel efficiency and reduce toxic emissions in cars, emissions have continued to increase steadily in the past two decades. For preservation of gasoline for future and increasing the efficiency of vehicle an electric vehicle can be a major breakthrough. An electric vehicle is pollution free and is efficient at low speed conditions mainly in high traffic areas. But battery charging is time consuming. Moreover, it cannot provide high power required by drives during high speed conditions or in slopes of hilly areas. Gasoline engine proves its efficiency at higher speeds in high ways and waste a lot of energy in urban areas. A hybrid vehicle solves these problems by combining the advantages of both the systems and uses both the power sources at their efficient conditions. The objective of this project aims at better utilization of fuel energy and reduces dependence on non-renewable resources using latest technology. The implementation involves development of Hybrid vehicle that uses battery as well as gasoline power for Propulsion

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## A. Energy Sources

Our project consists of both conventional and nonconventional energy sources i.e Electric energy and Gasoline these type of vehicles depends only on batteries but also on ic engines. Stored electric energy is collected from electric lines or power source that are available at our homes

## B. Engine Modelling

The work discloses a hybrid system consisting of an Electric and Internal Combustion(IC) based power drives. The front wheel is being propelled by battery and the rear wheel is powered by gasoline, i.e, it includes a single cylinder, air cooled internal combustion engine and a BLDC motor based electric power drive used for hybrid powering of the vehicle. The controller is designed to implement the switching between IC Engine and Electric motor depending on the power requirement and load conditions.

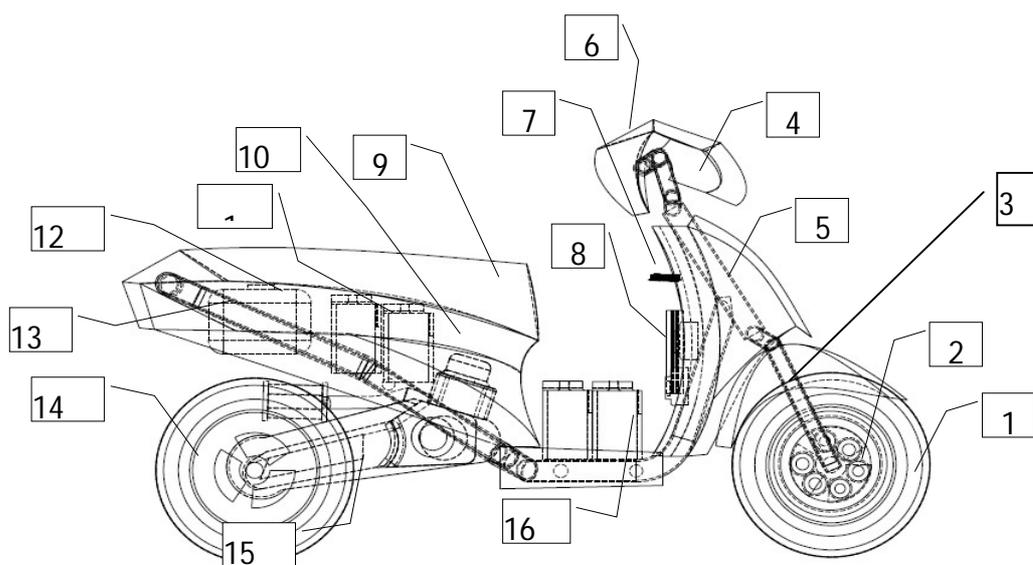


Fig. 1: Hybrid scooter parts

1) tire 2) hub motor 3) suspension 4)headlamp 5) body cover 6) display7) microcontroller 8) hub motor controller 9) seat 10) engine 11) front battery12) fuel tank 13) chassis 14) rear tire 15) transmission 16) rear battery

The vehicle at lower speed runs with electrical and at high speed it changes to gasoline by manual method shows the attachment of tire with the hub motor . There is no need for any gear reduction since the torque produced is sufficient enough to drive the vehicle. The axel of the motor is connected to the suspension . Suspension is connected to the handle which is connected to the main chassis. Accessories such as headlamp , display are included as user aid .Four batteries are placed near the fuel tank. Engine is connected to the main chassis and seat is situated above the engine

## II. METHODS OF FABRICATION

### A. Cutting

There are many ways to cut nowadays. The old standby is the saw. Others now include plasma torches, water jets, and lasers. There is a wide range of complexity and price, with some machines costing in the millions.



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## B. Folding

Some parts need to be bent. The most common method is a press brake (or brake press). It has a set of dies that pinches the metal to form a crease. This operation can only be performed in very specific cases due to the movement of the part and the possible shape of the dies. Designing for Lean manufacturing, though, can help prevent complex shapes that slow down production. Sometimes using two different types of fabrication processes or two different pieces fastened together work better than one complicated piece.

## C. Machining

This is the process of removing metal from a piece of material. It might be done on a lathe, where the material rotates against a cutting tool, or in some other cutting machine where a rotating tool is moved in a variety of ways against a stationary piece. Drills fall into this latter category. The range of motion of the cutting head is defined by the number of axes

## D. Punching

Punching is the act of a punch and a die forming a scissor effect on a piece of metal to make a hole in it. Obviously, the punch and die must be the same shape and size of the desired hole. In some cases, the main piece of material is kept, as in when holes are added for fasteners. In other cases, the piece that is removed is the desired product-this is called blanking.

## E. Welding

Welding is the act of joining two pieces of metal together. A variety of types of welding exist for use in different applications and for the range of metals used in manufacturing.

## F. Stamping

Stamping is very similar to punching, except the material is not cut. The die is shaped to make a raised portion of material rather than penetrating.

### III. FABRICATION OF VEHICLE

Mode of fabrication is that, the hub motor is fixed to the front wheel of the vehicle which gets charged by the batteries through solar panels. Controllers are placed in between the solar panels and batteries, so that current will not flow in reverse direction. Solar panels are fixed to the vehicle by welding and refit joints. However this electric vehicle depends not only on batteries but also on gasoline. Initially the vehicle starts with the gasoline and when it reaches certain speed the vehicle is switched from gasoline to electric power.

#### A. Specifications Of Vehicle

##### Dimension

Overall height	-	1060mm		
Overall length	-	1685mm		
Overall Width	-	1220 mm	Wheelbase	- 120 mm
Kerb weigh	-	79.5 kg	Fuel Tank Capacity	- 3.5 Liters

#### B. Engine

Type	-	Air Cooled		
Stroke (2/4)	-	2 Stroke		
No. of cylinders	-	Single Cylinder	Bore x stroke	- 42.6 mm x 42 mm
Displacement	-	99.9cc		

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**C. Battery**  
18ah, Voltage -12v  
Weight -20kg

**D. Hub Motor**  
Voltage - 48V  
Power - 350W  
Weight - 4.6 Kgs  
Motor Diameter - 0.148m

Motor Shaft Diameter - 0.214m  
Maximum speed (rpm) - 300rpm

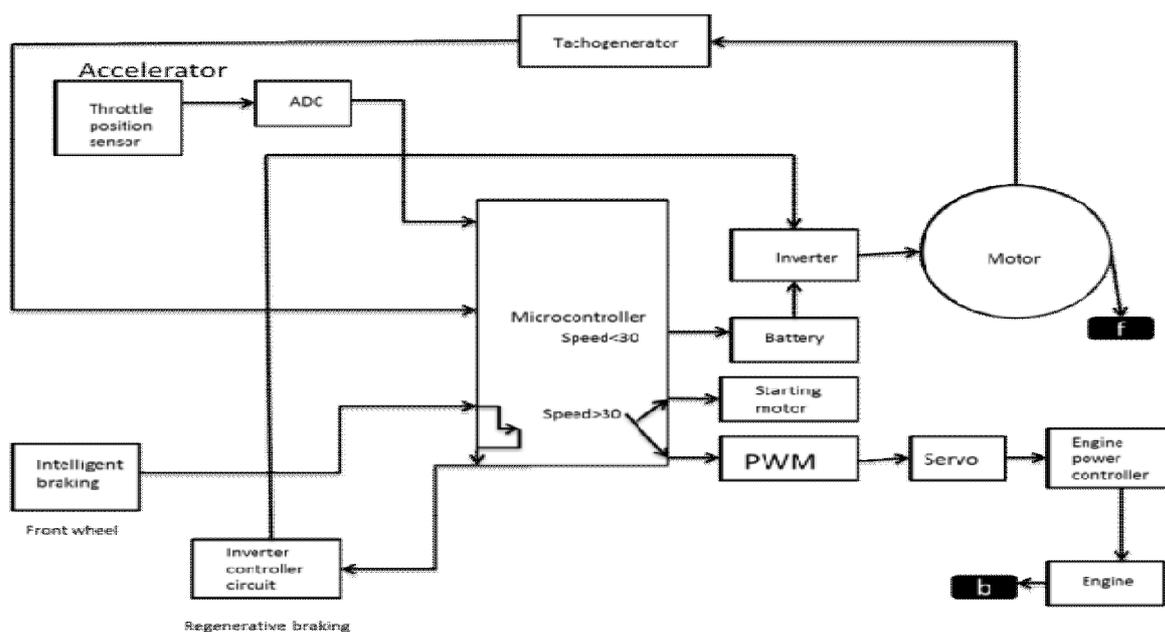


Fig. 2 : Block diagram of HEV

### A. Gasoline Engine

An engine is a device that transforms one form of energy to another and if an engine converts thermal energy to mechanical works, it is called as heat engines. A heat engine converts the stored chemical energy of the fuels to thermal energy and finally this thermal energy is converted to mechanical work. Different types of engines are available such as: Internal Combustion, External Combustion, Reciprocating, Rotary etc. Internal Combustion engine delivers higher thermal efficiency and moreover weight of these engines is quite low as compared to the power delivered by them. There are some disadvantages as well, such as the vibration generated and the limitation of fuel variety to be used. Considering all the factors, reciprocating internal combustions are the most suitable in two wheelers. Four stroke engines provide greater efficiency than two stroke engines and the emissions released into the atmosphere are less. Since the compression ratio is lower for smaller engines, spark based ignition system is preferred and gasoline is used as fuel. A 100 cc, four stroke, single cylinder, air cooled petrol engine has been used which has carbureted type fuel supply system and magneto based spark ignition system.



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## B. Hub Motor

Hub motor electromagnetic fields are supplied to the stationary windings of a motor. The outer part of the motor follows those fields that turn the wheel that is attached. In a brushed motor, energy is transferred by brushes which are in direct contact with the rotating shaft of the motor. In a brushless motor, the Energy is transferred electronically, with no physical contact between stationary and moving parts. Although the brushless motor technology is more expensive, most of them are more efficient and longer-lasting than brushed motor systems. Electric motors have greater torques at startup, making them more suitable for vehicles as they need the most torque at startup too. Their greatest torques occurs as the rotor first starts turning and this is why electric motors do not require a mode. A gear-down arrangement might be needed, but unlike in a transmission type combustion engine, shifting is not needed for electric motors.

## C. Battery

Hybrid Electric Vehicle uses battery as one of its power source for vehicle motion during at low power conditions. Batteries are devices that consist of electrochemical cells and provide electrical energy converted from stored chemical energy . Generally batteries are of two types: primary batteries that are disposable and secondary batteries that are rechargeable. Secondary batteries are preferred for vehicles as they can be rechargeable.

There are six major rechargeable batteries available today. They are as follows: lead-acid (Pb- acid), nickel-cadmium (NiCd), nickel-metal hydride (NiMH), lithium-ion (Li-ion), lithium- polymer (Li-poly), zinc-air

## D. Three Phase inverter

In a three phase voltage source inverter bridge, controlled switching with the help of IGBT is used to control voltage in normal operation, and a parallel diode is connected to make the inverter bidirectional in nature. AC voltage is obtained by switching the IGBT switches in a specific pattern to obtain bipolar square two level waveform. The bipolar square wave results in high harmonic content in the output. Use of filter makes the model costly and prohibits it from becoming bidirectional as concluded from simulation outputs.

## IV. ADVANTAGES

- Maximum output can be obtained.
- It does not cause any environmental pollution like the fossil fuels and nuclear power.
- Low power consumption.
- Conservation of energy
- Storage of energy into rechargeable battery.
- Stored energy is used for running hub motor.
- High efficiency can be achieved using inverter
- 

## V. DISADVANTAGES

- Periodic Monitoring and Maintenance is required.
- A drastic environmental change cannot be tolerated by the equipment.

## VI. RESULTS

HEV is a vehicle that uses two sources of power- gasoline and battery. For low power application battery drive is used whereas for high power application where power requirement is very high gasoline engine is used. Gasoline drive is most efficient at high speed drive. Thus HEV's both mode of operation occurs at their maximum efficiency. But in gasoline engine low speed operation is not efficient. Its high speed mode is only efficient. Therefore, it gives twice the mileage given by a normal vehicle. As this hybrid vehicle emits 50% less emission than normal vehicle it plays an



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important role for reducing pollution to certain extent without compromising with efficiency. Thus it is most efficient in urban areas mainly in high traffic where gasoline engines are least efficient as the energy from gasoline is being wasted away and creates pollution

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