IMPACT: Journal of Research in
Engineering & Technology (IMPACT: JRET)
Vol. 2, Issue 1, Jun 2016, 23-38
© Impact Journals

HYBRID VEHICLE USING WINDMILL AND PEIZO ELECTRIC SUSPENSION

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ABSTRACT

The hybrid vehicle is combination of IC engine and electric motor. The purpose of this concept is to overcome disadvantages of IC engine and electric motor by virtue of each other. While IC engine suffers with low efficiency and high pollution at low speed conditions electric scooter fails to achieve economic speeds. We are using conventional sources of energy to recharge the power source for electric ride. Various components have been designed in order to build up a hybrid vehicle with maximum fuel efficiency. This paper briefly explains about the analysis of the various components used and how to use these components as a compact package to optimize performance. Many people have a doubt that whether an addition of windmill cause and obstruction to the flow of air by retarding the vehicle, we have proven with analysis that the windmill neither affects the drive but it helps increasing the fuel efficiency along with piezo electric suspension.

KEYWORDS: Ecoriendly, DPDT, Hybrid, Peizoelectric

INTRODUCTION

Since the invention of IC ENGINE, the automobile industry was almost completely concentrated on IC engine. Since it was the most compact and most adaptable engine from then it had wide range of applications. Inventions of other engine technologies failed to gain much attention due to overwhelming acceptance of IC engine. From the beginning of its journey the disadvantages of IC engines also gained attention. But no other type of engine was able to overcome these problems or even substitute the performance of IC engine. The engineers then concentrated on improving the IC engine to minimize its disadvantages. In its journey through centuries IC engine had changes a lot in its geometry and components. Although the basic components remained the same its material and designs changed. Many accessories where introduced. Fuels were changed. And now engines runs on command from the microprocessor. So it could give the best performance for the situation based on calculation.

However in the meantime electric vehicles gained some popularity. It became inevitable since the fossil fuel prices went up like never before. And they have their very own advantage –non-polluting ride. Even sound pollution is negligible for an electric vehicle. But in the same time they lacked in speed and torque measures. We can see electric scooters running in our speed without any sound and at a speed we can overtake by running.

Pioneers of automobile industries like BMW and electric automobile specialists TESLA motors had developed cars that run electrically with normal or higher speeds and very economic running cost. But till today TESLA motors don't have a market beyond USA and BMW, as we all know is very expensive to buy. Our topic is a hybrid two wheeler, which is economic, runs in IC engine and Electric motor & charge its battery using non-conventional energy sources including Wind mill & Piezo-electric technology.

EXSISTING TECHNOLOGY

The existing technology is very common and we see them in our daily lives. When a vehicle, which runs on IC engine, starts from rest we have to disengage the clutch and shift the transmission to first gear. As it gets initial movement and a certain speed is reached we shift it to second gear and we speeds up the vehicle. This continues up to top gear. Whenever low speed conditions are present we've to shift to the lower gear ratios. The engine condition at the initial gear ratios causes a drop in fuel efficiency. An IC engine burns comparatively more fuel in low speed conditions than in economic speed conditions. This make starting the ride, riding through difficult terrains and city riding an expensive task. Any domestic vehicle we use can provide its maximum efficiency or simply mileage at 30-50kmph but the mileage will drop when we go for city ride. The mileage is issue is more serious in case of a 2 stroke IC engine and it causes more pollution than a 4stroke engine. A 2 stroke engine is capable of developing more power than an identical 4 stroke engine. 2 stroke engines are being avoided by industry because it's low efficiency and high pollution ratings. Their usage is now restricted to small agricultural machines and low cost 2 wheelers.

An electric scooter is a 2 wheeler which runs purely on an electric motor. The electric motor is powered by a battery. The battery can be recharged when the vehicle at rest. We can plug the charger to domestic ac supply and charge the battery. Once charged for 6 hours it can run 60-80 km at an average speed of 25 km per hour. This is not acceptable for the fast running world. While the electric scooter is totally ecofriendly and don't produce any pollution. It neither makes sound pollution nor air pollution. In India electric scooter under 250 watts don't even need a registration. Yet it has not achieved much acceptance due to its low speeds.

Several automobile companies have been researching in developing a hybrid vehicle and some of them had developed prototypes. Recently BMW released its own Hybrid Car commercially named i8. It has a turbocharged three-cylinder gas engine teams with two electric motors for a combined 357 hp power.

CONCEPT OF HYBRID VEHICLE

The starting stage of a vehicle can be achieved by means of an electric motor. This means the speed of the vehicle with electric motor is low, which is acceptable when a vehicle starts moving and it has not to gain speed already. The pollution is negligible sins it totally runs on electric motor. We don't have to burn any petrol either. All it takes is electricity from the battery, which should be recharged later.

When we reach a predetermined speed, at which in normal case we engage higher gear ratios in an IC engine, we can switch the ride to IC engine. Switching the ride at this stage helps us to gain more speed and avoid the fuel loss at primary gear ratios. And at economic speed conditions IC engine give better fuel efficiency and it has minimum pollution at that stage.

The battery can be charged by several methods. A readily available scooter has an inbuilt dynamo to charge its inbuilt battery. We can use this dynamo to charge our battery. But this is only a conventional method. Instead of that we can place windmill in front of the vehicle, by which we can make use of the air flow when we ride the vehicle. This wind rotates the windmill and the dynamo coupled to the windmill. With an appropriate electronic circuit we can use the electricity produced by the dynamo to charge batteries.

As a concept we can also make use of its suspension system. By placing piezo electric strips inside the suspension system we can avail more electric power. This can be used for charging the battery. It's not totally adapted in this project

COMPONENTS

The entire project is done on a 2 stroke scooter. Changes and adoptions are made to this main element. The components described in this section include

- Vehicle
- Electric
- Motor Battery
- Windmill
- Dynamo
- Piezo Electric Strips
- Accessories

Vehicle

For the fabrication of the project work we need a vehicle which runs on an IC engine.

A 2003 model Kinetic zing is the vehicle on which the project is done. It is 71.5cc 2 Stroke vehicle which delivers a Maximum Power of 4.3ps@500rpm and a Maximum Torque of 5.70nm@4500rpm. It has a top speed of 60 kmph.

This scooter has automatic transmission which makes ride easier. One aim of this project is eliminate the fuel lose at lower gear ratios. Since we have an automatic transmission scooter we don't have to worry about shifting the gear manually. But that doesn't mean automatic transmission emits loses at lower gear ratios. It only eliminates the manual gear shifting.

The transmission system is a belt drive since it is a comparatively low power vehicle. The engine is air cooled. It has electric start mechanism. In our project this mechanism enables easy ride shift between IC Engine and Electric motor. Since it has a 2 stroke engine the lubricating oil should be mixed with the petrol during refilling.

Figure 1 Kinetic Zing 2003
(Photo Taken before Fabrication)

Table 1

Kinetic Zing Specifications	
Engine Displacement	71.5 CC
Engine Type	Air cooled, 2 stroke
Number of Cylinders	1
Valves per Cylinder	0(2stroke engine)
Maximum Power	4.3 PS @5500 rpm
Maximum Torque	5.7 Nm @4000 rpm
Bore x Stroke	46.0 x 43.0 mm
Fuel Type	Petrol
Starter	Electric-Kick
TRANSMISSION	
Transmission Type	Auto
Final Drive (Rear Wheel)	Belt
WHEELS & TYRES	
Front Tire (Full Spec)	3.00 x 10 4PR
Rear Tire (Full Spec)	3.00 x 10 4PR
BRAKES	
Front Brake Type	110 mm Drum
Rear Brake Type	110 mm Drum
SUSPENSION	
Suspension Front	Leading link with coaxial Shock Absorber
Suspension Rear	Hydraulic Damper with Coaxial Spring
DIMENSIONS	
Overall Length	1740 mm
Overall Width	640 mm
Overall Height	1076 mm
Wheelbase	1235 mm
Ground Clearance	120 mm
Kerb Weight	82.0 kg
Fuel Capacity	4.0 Litres

Electric Motor

The scooter provides the IC engine now we have to make the scooter hybrid. An electric motor should be provided for this purpose. Electric motor is available in form of hub motors. A hub motor is simply the front wheel of an electric scooter. In conventional wheels, inside the wheel hub we have a drum brake system or nothing. But in case of an electric scooter the front wheel hub has a motor inside it. We give power supply to this motor and it rotates so as the wheel. That’s the drive mechanism of electric scooter. When adapted to the IC engine ran scooter, the motor has to take more weight. The IC Engine vehicle is much heavier than an electric scooter. This may affect the performance of the motor. The electric motor used here is a brushless dc motor.

- Wheels : 16"x3"
- Voltage : 48 V
- Current : 7 Ampere
- Wattage: 250 watts
- Power: 0.5 HP @2800rpm

Figure 2: Hub motor (Brushless DC Motor)

Battery

The power source of the electric motor is a rechargeable automobile battery. 4 Lead acid batteries are connected in series to ensure the supply of sufficient electricity to the motor. The scooter already has a 12V Lead acid battery inbuilt. We don’t disturb that assembly. Instead assign the batteries on the central space of the scooter. The battery must be recharged with respect to its discharge. The battery used here is a maintenance free battery, which does not require frequent refilling of battery water. However if it is not used for a long time it will discharge by itself and should be recharged by means of an external battery charger. Most of the automobiles in present use a battery in order to initiate electric start mechanism and to run electric components such as lamps, fans, infotainment systems etc. All these things can be run by a 12 volt motor. But for running the hub motor of an electric scooter the 12v is not sufficient. That’s why four 12 volt batteries are used here, which supplies a total of 48 V.

Specifications of battery

- Type : Lead Acid, Dry cell
- Voltage : 12V/battery
- Number of batteries: 4
- Total Voltage: 12*4= 48 V
- Current : 7 Ampere

Figure 3: Battery (When Connected)

Wind Mill

Windmill converts the wind energy into mechanical energy. By coupling the windmill to a pump or a generator, we can make use of the mechanical energy available at the shaft of a windmill. Here a comparatively small wind mill is mounted on the front of the vehicle. The air flow at the front of the vehicle while riding can rotate the fan blades. The position of windmill and the direction of air flow affect the speed of the fan. The number of fan blades and its dimensions also takes a major role in utilizing the airflow. The fan should be mounted with an appropriate covering so that the side air flow won't disturb the rotation of the fan. The number of blades on fan should not be 4, 5 since it causes heavy vibration. No of blades should be 3 for maximum efficiency. Also its angle should be low to reduce vibration and the best optimized blade angle is 30degree.

Specifications

- Diameter of the leaf : 9 Inch
- Number of leaves : 6
- Blade Angle : 30 degree
- Blade material : Fiber

Figure 4: Wind Mill

Dynamo

Figure 5: Permanent Magnet dc Generator

Every automobile has a dynamo coupled to the engine to recharge the inbuilt battery and to power the ignition system. In this project we can use this dynamo to charge the battery. But it is not used. Instead of that a dynamo is coupled to the windmill. The mechanical energy from the wind mill is converted into electricity by means of the dynamo. The dynamo should be capable of developing electricity at a magnitude enough to charge the battery. The dynamo can't be directly connected to battery either. It requires adequate electronic circuit to connect the dynamo and the battery. The design of the dynamo should be in such a way that it can be easily coupled with the shaft of the wind mill. The dynamo is mounted on the frame and windmill is shaft is coupled to it.

Specifications

- Type : Permanent magnet dc generator
- Voltage : 12 V
- Power : 40 Watts Speed : 500 rpm

Piezo Electric Strips

Piezoelectric Effect is the ability of certain materials to generate an electric charge in response to applied mechanical stress. The suspension system of any automobile is continuously subjected to mechanical stress due to the irregularities in the terrain it's travelling and the vibrations of the vehicle itself. These stresses have being totally wasted from the beginning of automobile saga. Adaption of piezo electric technology to the suspension system is a solution for making use of this mechanical stress. For our roads the mechanical stress has higher magnitudes and they vary very frequently. By adding piezo electric technology to suspension system we can generate considerable amount of electrical energy which can be used for various purposes of a vehicle. The project adapts piezo electric strips to the rear suspension of the vehicle. By which some of the mechanical stresses can be utilized. Only a small amount of electricity is produced this way so it's not used for any purpose other than experiment. There are certain piezo electric materials available in the market. Other than that we don't have a highly efficient material. Since the researches on piezo electric materials and electricity generation using them is still at infant stage.

Table 2

Specifications	
Material	: Lead Zirconated Titanate
Voltage per strip	: 1- 1.9 V
Number of strips used	: 3
Maximum voltage	: <5.7V
Current	: 100 mA

Figure 6: Piezo Electric Suspension System in Project

Accessories

For the controlling of the components listed above some other accessories are necessary. Without these accessories the project may not function as proposed and operations can cause damage to electrical equipment. The accessories are listed below

Variable resistance accelerator Microcontroller

Variable Resistance Accelerator

This is simply a variable resistance designed to look like an accelerator. The resistance can adjust by turning the accelerator. This technology is used in electric scooter for acceleration. When the accelerator is in initial position the resistance will be maximum and there won't be any current supply into the hub motor. This remains the vehicle in rest position. When the accelerator is turned, it is just like the movement of knob of rheostat. As we turn the accelerator the resistance decreases gradually and more electricity is allowed to pass through the hub. The variable resistance used here is just a relay circuit from the micro controller because letting all the current to pass through the accelerator may cause huge current loss and will result in heating up or blowing off of the variable resistance. Since accelerator to have to be controlled by human hand we can't risk such a situation. Also the immediate drop in resistance can blow of the windings of the hub motor. It is also prevented by the microcontroller.

Figure 7: Varibale Resistance as Throatler

MICROCONTROLLER

Micro controller is that the brain of all electrical systems utilized in the electrical scooter. It's an integral most effective drive circuit. This can be a standard card utilized in the majority electrical scooters commercially. The drive circuit analyses the input from the variable resistance and inputs relating to load conditions. When analyzing the in-put information in send voltage to the motor with magnitude enough to run the motor with adequate force and speed. AN electronic speed management or ESC is AN electronic circuit with the aim to vary an electrical motor's speed, its direction and presumably additionally to act as a dynamic brake. ESCs square measure usually used on electrically steam-powered radio con-trolled models, with the range most frequently used for brushless motors basically providing AN electronically generated three-phase power low voltage supply of energy for the motor.

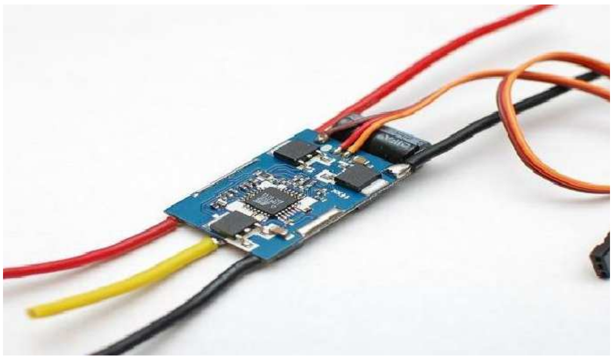

Figure 8: Inside of Electronic Speed Control

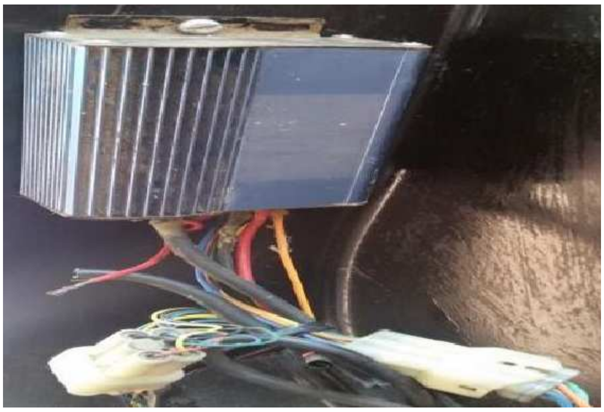

Figure 9: Electronic Speed Control in Use

BRUSHLESS DIRECT CURRENT MOTOR

A BLDC motor accomplishes commutation electronically using rotor position feedback to determine when to switch the current. Feedback usually entails an attached Hall sensor or a rotary encoder. The stator windings work in conjunction with permanent magnets on the rotor to generate a nearly uniform flux density in the air gap. This permits the stator coils to be driven by a constant DC voltage (hence the name brushless DC), which simply switches from one stator coil to the next to generate an AC voltage waveform with a trapezoidal shape

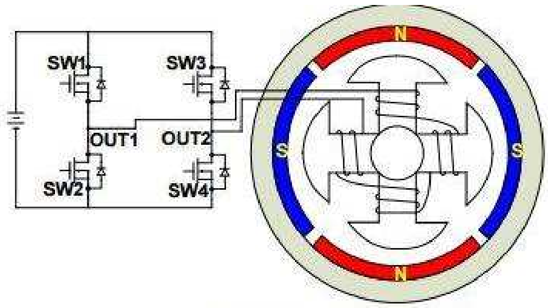

Figure 10: Brush Less DC Motor (Three-Phase BLDC Motor)

To get needed torsion and speed a three-phase BLDC motor is employed. A 3-phase BLDC motor needs three Hall sensors to find the rotor's position. Supported the physical position of the Hall sensors, there square measure 2 kinds of output: a 60° section shift and a 120° section shift. Combining these 3 Hall sensing element signals will verify the precise commutation sequence. Figure shows the commutation sequence of a three-phase BLDC motor driver circuit for gyration. 3 Hall sensors— "a," "b," and "c"—are mounted on the mechanical device at 120° intervals, whereas the 3 section windings square measure in a very star formation. For each 60° rotation, one in all the Hall sensors changes its state; it takes six steps to finish an entire electrical cycle. In synchro-nous mode, the section current switch updates each 60°. For every step, there's one motor terminal driven high, another motor terminal driven low, with the third one left floating. Individual drive controls for the high and low drivers allow high drive, low drive, and floating drive at every motor terminal.

However, one signal cycle might not correspond to an entire mechanical revolution. The amount of signal cycles to finish a mechanical rotation is decided by the amount of rotor pole pairs. Each rotor pole combine needs one signal cycle in one mechanical rotation. So, the amount of signal cycles is adequate the rotor pole pairs

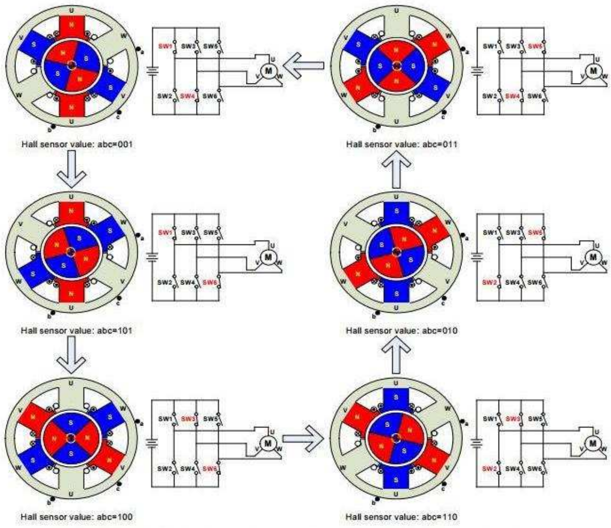

Figure 11: Three-Phase BLDC Motor Commutation Sequence

Figure shows the temporal arrangement diagrams where the section windings—U, V, and W—are either energized or floated supported the Hall device signals a, b, and c. this may be AN example of Hall device signal having a 120° section shift with relation to each other, where the motor rotates counter-clockwise. Producing a Hall signal with a 60° section shift or rotating the motor right-handed desires a novel temporal arrangement sequence.

To vary the rotation speed, use pulse breadth modulation signals on the switches at a so much higher frequency than the motor rotation frequency. Generally, the PWM frequency need to be a at least of 10 times on prime of the maximum motor rotation frequency. Another advantage of PWM is that if the DC bus voltage is far on prime of the motor-rated voltage, therefore limiting the duty cycle of PWM to satisfy the motor rated voltage controls the motor.

DC GENERATOR

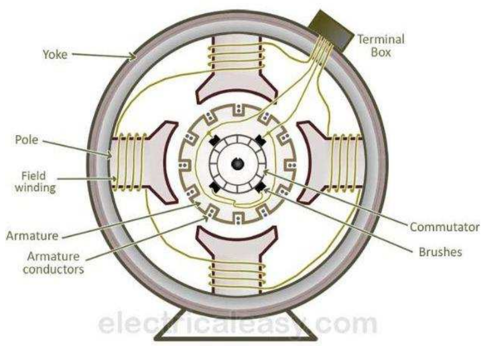

Figure 12: Construction of a DC Generator

According to Faraday's laws of magnetism induction, whenever a conductor is placed in a very variable magnetic field (OR a conductor is touched in a very magnetic field), Associate in Nursing electrical phenomenon (electromotive force) gets iatrogenic within the conductor. The magnitude of iatrogenic electrical phenomenon will be calculated from the electrical phenomenon equation of dc generator. If the conductor is supplied with the closed path, the iatrogenic current can flow into inside the trail. in a very DC generator, field coils turn out Associate in Nursing magnetism field and therefore the coil conductors area unit turned into the sector. Thus, Associate in Nursing electromagnetically iatrogenic electrical phenomenon is generated within the coil con-doctors. The direction of iatrogenic current is given by Fleming's right rule.

The direction of induced current changes whenever the direction of motion of the conductor changes. Let's consider Associate in nursing coil rotating dextrorotatory and a conductor at the left is moving upward. once the coil completes a 0.5 rotation, the direction of motion of that exact conductor are reversed to downward. Hence, the direction of current in each coil conductor are alternating. If you explore the on top of figure, you may shrewdness the direction of the iatrogenic current is alternating in Associate in Nursing coil conductor. However with a split ring commutator, connections of the coil conductors additionally get reversed once the present reversal happens. and thus, we tend to get unifacial current at the terminals.

FABRICATION

The front fork of the scooter was alternated to accommodate the hub motor.

The original front wheel was removed and in that place hub wheel is mounted.

The batteries are connected in series and placed on a frame in the central compartment

The Microcontroller unit is screwed to the body of the scooter.

The windmill, dc generator and its frame is bolted on the front of the scooter

An auxiliary handle for accommodating variable resistance accelerator is welded to the frame of the scooter. The accelerator was mounted on it.

Connections between motor, generator, accelerator and micro controller are wired.

An additional frame is welded aside the suspension system to accommodate the piezo electric strips.

WORKING OF PROJECT

The scooter starts moving when the variable resistance accelerator (electric throttle) is turned by means of hub motor.

When a desirable speed is achieved hub motor is switched off and using ignition switch vehicle is started.

The windmill rotates due to the air flow and dynamo rotates. The current from the dynamo is passed to micro controller. The micro controller then charges the battery

As the vehicle travels through irregular terrains the stress developed in the suspension causes piezo electric strip to produce electricity.

ANALYSIS

Table 2: Variable Resistance Accelerator

Throttle Angle (Degree)	Signal Voltage (V)
0	0
10	0.45
20	0.9
30	1.44
40	1.9
50	2.37
60	2.84
70	3.31
80	3.78
84	4.24
90	4.538
100	5

Equation of Electricity Generation in Piezo Electric Material

The quantity of the electric charge (Q) is constant depending on the composition. The piezoelectric element is sandwiched between a constant mass (m) and a base. From Newton's Second Law, the relationship between the acceleration (α) applied to the accelerometers sensor, and force (F) applied to the piezoelectric element can be expressed. Therefore, since (d) and (m) are constant, the generated electric charge (Q) is linearly proportional to the acceleration (α)

- Q= d× F
- F= m×α
- Q= d× m

Equation of torque in hub motor Power P = V * I, Where

V=voltage (volts)

I= current (amp)

P = T x w, Where:

T = Torque (Nm)

w = Rotational velocity (rad/sec)

Torque T= P/w

Windmill power generation:

Wind energy is the kinetic energy of air in motion, also called wind. Total wind energy flowing through an imaginary surface with area A during the time t is:

$$E = \frac{1}{2}mv^2 = \frac{1}{2}(Avt\rho)v^2 = \frac{1}{2}At\rho v^3,$$

Where ρ is the density of air; v is the wind speed; Avt is the volume of air passing through A (which is considered perpendicular to the direction of the wind); Avtρ is therefore the mass m passing through "A". Note that ½ ρv2 is the kinetic energy of the moving air per unit volume.

Power is energy per unit time, so the wind power incident on A (e.g. equal to the rotor area of a wind turbine is:

$$P = \frac{E}{t} = \frac{1}{2} A\rho v^3.$$

Wind power in an open air stream is thus proportional to the third power of the wind speed; the available power increases eightfold when the wind speed doubles. Wind turbines for grid electricity therefore need to be especially efficient at greater wind speeds

ON ROAD CALCULATIONS

The vehicle speed was recorded using speedometer. Voltage and current at different positions of speed was analyzed using voltmeter and ammeter. Also the respective wind velocity at different speeds was analyzed using anemometer.

Table 3: Windmill Testing

SR. No	Vehicle Speed (km/hr)	Wind Velocity (m/s)	Voltage (V)	Current (A)	Power (W) (P=V*I)
1	20	5.2	11.5	2.3	26.45
2	25	6.3	11.8	3.1	36.58
3	30	8.2	12.1	4.2	50.82
4	35	9.1	12.2	5.5	67.10
5	40	10.9	12.3	6.6	80.52
6	45	11.7	12.3	7.2	88.56
7	50	12.4	12.3	7.5	92.25

MILEAGE VARIATION

Procedure of Testing

1st stage: The vehicle was driven till the complete fuel and power from battery was utilized. So there is no more charge in battery and no more fuel in tank

2nd stage: The vehicle is then filled with 1 litre of petrol-oil mixture, now it can be driven till the maximum distance, till the fuel finishes. Here it will run up to a distance of 35 km, which was the mileage of given vehicle. During this time the windmill rotates and battery gets charged.

3rd stage: Now the actual working of our hybrid vehicle starts. Then it was filled with 1 litre of fuel and mileage results were analyzed.

It was started and run with electric motor to a maximum of 25km/h, after that ic engine was used for running. Now run the vehicle to the maximum distance using ic engine mode and electric mode, until the vehicle stops. The new distance we get is the mileage of our hybrid vehicle

Table 4: Test Results from IC Engine

Maximum Speed	50 kmph
Avg Speed	38.5 kmph
Mileage	35 km

Table 5: Test Results from Hybrid Vehicle

Maximum Speed	40Kmph
Average Speed	30kmph
Per Litre Mileage	42-43 kmph

TEST RESULTS FROM HYBRID VEHICLE

This hybrid system is the combination of wind and piezo energy. The system is designed for wind turbines having the capacity of 35 watt and one piezo electric suspension system of 3w. After conducting the tests about 38 watts of energy is generated using this system. The wind turbine starts generating the designed power at a speed of 20 km/hr up to 50km/hr when the wind velocity was about the 12 m/s to 14 m/s this the rated speed and power. After this the power remains constant. Hybrid energy systems can offer efficient solutions to customers that individual technologies cannot match. This system can address limitations in terms of fuel flexibility, efficiency, reliability, emissions and economics. This system will helpful to reduce fuel consumption by assisting renewable energy source. It may also reduce the harmful effects on environment. About 90 watt is the additional power available so it will increase efficiency of engine. The hybrid vehicle ultimately gave 42.5 km/ltr mileage, which is 25% increment of actual mileage

FUTRE SCOPE

The vehicle can also be run as multi drive vehicle by running parallel both the electric and ic engine modes. During this time the vehicle doesn’t have stability due to torque variation from two modes are different. This problem can be solved by using a torque synchronizer which connects both electric and ic engine shafts and provide a single torque. Also a DPDT switch can be used with battery of electric motor, which can be used as regenerative braking. When the it accelerates current lows in one direction and when brake is engaged the DPDT switch works and hub motor wheel reverse its direction, during this time if slightly current is varied wheel can be stopped without friction plates or discs. Costlier piezo-electric materials available in markets can be used for more power generation.

CONCLUSIONS

The project is completed successfully and the hybrid vehicle featuring the synergistic combination of IC engine and electric motor is successfully developed. The project also features non-conventional battery charging methods including wind energy and piezo electric technology. The experiments done on the project clearly illustrates its eco-friendliness and fuel saving capability. Further modifications can be done on the concept with more investment of money and technology. The position of the windmill can be designed to suit the aero dynamic shape of the vehicle. Also exception of lead bases materials as piezo electric strips can be done. The adaption of concept to more advanced motor vehicles such with 4-stroke engine and other efficiency improving technologies may lead to further fuel saving and cutting down pollution. The project here was adapted on a 2stroke vehicle to clearly mention the pollution problem of those engines and how it can be resolved by introducing the hybrid technology. Adapting hybrid technology to any kind of IC engine and any kind of IC engine powered vehicle can produce higher efficiency and low polluting vehicles.

REFERENCES

1. Habib al jed and Andre MIEZE „A electric vehicle model and a driving cycle for mail delivery use EIGSI France
2. C. C. Chan and K. T. Chau, “Modern electric vehicle technology” Oxford university press, New York,2001.
3. Behnam Ganji, Abbas Z. Kouzani, and H.M. Trinh, Driving cycle analysis of the performance of hybrid electric vehilcles, Deakin university, Australia.
4. M. Montazeri-Gh and M. Naghizadeh, „Development of car drive cycle for emission and fuel economy, Iran university of science and technology, Iran.
5. Openshaw Taylor, „Utilization of electric energy, orient longman pvt. Ltd. 2003.
6. Sanghpriya H. Kamble a, Tom V. Mathew b,*, G.K. Sharma, Development of real world driving cycle: case study Pune, India.
7. Yimin Gao and Mehrdad Ehsani, „Hybrid electric vehicle:overview and state of the art, IEEE 2005, June 20- 23, CROATIA.
8. Lei Wang, Yong Zhang, Chengliang Yin, Minming Zhang, Design and simulation for a series-paralled hybrid electric city bus, IEEE 2009.