Electric Vehicle – Application Of Solar Bicycle.

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Abstract— ***An electric vehicle is a vehicle that uses one or more than one electric motors or Dynamo for propulsion. An electric vehicle may be powered through a collector system by electricity from off-vehicle sources, or may be self-contained with a battery, solar panels, fuel cells , wind turbine, biofuels, or an electric generator to convert fuel to electricity. Electric vehicles include, but are not limited to, road and rail vehicles, surface and underwater vessels, electric aircraft and electric spacecraft. The Hybrid Bicycle System is a systems project that incorporates three different ways of charging a lithium-ion battery: the 220VAC wall outlet, regenerative braking, and solar power; which is used to power an electric hub motor running a bicycle. In this electric hybrid bicycle, the front wheel has a compact & light weight hub motor. It will be having regenerative charge system and solar panels, which enables substantially longer distance power assist cycling by regenerating power from pedalling energy (human energy) and solar energy and charging it in the battery.***

Keywords— Hybridscience, Solar-Bicycle, Free-Energy, Electric-vehicle, Dc current, SolarCell.

INTRODUCTION

A hybrid vehicle combines any two power (energy) sources. Possible combinations include diesel/electric, gasoline/fly wheel, and fuel cell (FC)/battery. Typically, one energy source is storage, and the other is conversion of a fuel to energy. The combination of two power sources may support two separate propulsion systems. Thus to be a True hybrid, the vehicle must have at least two modes of propulsion. For example, a truck that uses a diesel to drive a generator, which in turn drives several electrical motors for all-wheel drive, is not a hybrid . But if the truck has electrical energy storage to provide a second mode, which is electrical assists, then it is a hybrid Vehicle. These two power sources may be paired in series, meaning that the gas engine charges the batteries of an electric motor that powers the car, or in parallel, with both mechanisms driving the car directly.

The history of hybrid cars is much longer and more involved than many first imagine. It is, however, in the last ten years or so that we, as consumers, have begun to pay more attention to the hybrid vehicle as a viable alternative to ICE driven cars. Whether looking for a way to save money on spiralling gas costs or in an attempt to help reduce the negative effects on the environment we are buying hybrid cars much more frequently.

Toyota is the most prominent of all manufacturers when it comes to hybrid cars. As well as the specialist hybrid range they have produced hybrid versions of many of their existing model lines, including several Lexus (now owned and manufactured by Toyota) vehicles. They have also stated that it is their intention to release a hybrid version of every single model they release in the coming decade. As well as cars and SUVs, there are a select number of hybrid motorcycles, pickups, vans, and other road going vehicles available to the consumer and the list is continually increasing.

Since petroleum is limited and will someday run out of supply. In the arbitrary year 2037, an estimated one billion petroleum-fuelled vehicles will be on the world's roads. Gasoline will become prohibitively expensive. The world need to have solutions for the " 400 million otherwise useless cars" . So year 2037 "gasoline runs out year" means, petroleum will no longer be used for personal mobility. A market may develop for solar-powered EVs of the size of a scooter or golf cart. Since hybrid technology applies to heavy vehicles, hybrid buses and hybrid trains will be more significant.

OBJECTIVE

- Definition of hybridness
- Hybrid design philosophy
- Hybridness: parallel hybrid, series, mixed and range extender (plug-in) hybrids
- Range extender.

- Optimization and hybridness.
- Battery power and electric motor power.

PROTOTYPE DESIGN AND DEVELOPMENT

By considering the major factors for hybrids, an understanding of the various values of H is gained. The basic efficiency of the gasoline engine is low. A typical value is 25%. The efficiency of MGs is higher. Typical values are above 90%. Battery efficiency is moderate; energy is lost putting energy into the battery and again removing energy. Round trip in/out efficiency is typically 70%–80%. Because of the inefficiency, the batteries must be cooled. Overall hybrid design philosophy has three parts:

1) Operate electric motor first (less emissions/less fuel consumed).
2) Add gasoline engine only when needed.
3) Operate gas engine at the best rpm and throttle setting, that is, operate on minimum fuel consumption line in engine map.
4) **Regenerative Braking-** For small values of H , which implies small generator, the Motor/Generator (M/G) set cannot absorb the kinetic energy of the vehicles forward motion in a rapid stop. Although modest regenerative braking is possible and is used at low H , regenerative braking can only be fully exploited when H is about 40%.
5) **Motor Assist** -Vehicle launch is part of motor assist, but applies to very low speed. Motor assist covers a broader range of speed and vehicle operations such as hill climbing and driving in snow. More power and a larger electric motor are required. Hybridness, H , of 50% yields enough power from the electrical motor to overcome the power deficiencies of the downsized engine.
6) **Electric-Only Propulsion –** Electric-only propulsion means the gasoline engine is shut down and does not consume fuel. Electric-only operation improves mpg. To achieve performance goals, the motor must have adequate power. At H = 50%, the traction motor is as large as the engine. Alone, the traction motor yields the desired performance. Another reason that electric-only operation is desirable is the fact that emissions are zero or near zero. Stringent emission requirements may be met by electric-only operation. However, cool-down of the catalyst during idle-off is a problem to be solved.
7) **Kilometre per litter gain** – As hybridness increases, up to about 50%, mpg (1 mile per gallon = 0.425143707 kilometres per litter) also increases. This is a result of a balance between power required and power available. The increase in mpg possible by plug-in is not shown. Plug-in requires energy from charging stations.
8) **MILD OR MICRO HYBRID FEATURES –** As a result of being a mild hybrid, certain features follow. The M/G may be belt or chain driven. Alternatively, the M/G may be part of the flywheel. The M/G serves as the starter/alternator combined. Mild hybrids have limited regenerative braking. The battery and installed M/G may be large enough to provide low speed motor assist or to provide low speed launch assist. For the rare case of a diesel/hybrid, the M/G in M-mode can provide cold start of the diesel. For a mild hybrid, other possible design features include fuel cutoff at deceleration, idle shutoff, and torque converter lockup where applicable.
9) **PLUG-IN HYBRID** – The plug-in hybrid can be viewed as an EV but with a small engine to extend range. Features of a plug-in hybrid include a large, heavy, expensive battery. The comparison with a full hybrid is a battery of a few 45.36 kg instead of the typical 45.36 kg in a full hybrid. Additional equipment is needed to connect to external "wall plug" electrical source for recharging. Since batteries are high voltage, the voltage of the charging source must be even higher. Inductive rechargers prevent exposure to high voltage. The plug-in will likely have small gasoline engine driven generator for on-board charging; this engine separates the plug-in hybrid from the EV. For people willing to undertake the recharging chore, the plug-in offers fantastic mpg. To gain the benefits, the range of hybridness for a plug-in is 50% < H < 100% with H likely to be closer to 100%.

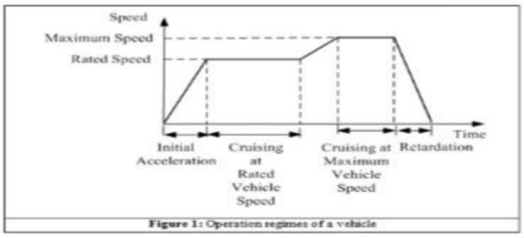


Figure 1: Operation regimes of a vehicle

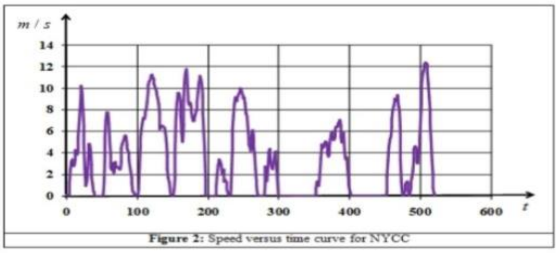


Figure 2: Speed versus time curve for NYCC

Mass of vehicle [Kg]	5300
Coefficient of rolling resistance	0.01
Gravitation acceleration constant [m/sec^2]	9.81
Air density [kg/m^3]	1.3
Aerodynamic drag coefficient of vehicle	0.5
Frontal area of vehicle (m^2)	5.65
Road angle [degrees]	0
Radius of the wheel [m]	0.21

Table 1: Parameters of the test vehicle.

Average speed	3.63 [m/s]	Maximum deceleration	2.6 [m/s²]
Maximum speed	12.4 [m/s]	Maximum power	85 [kW]
Maximum acceleration	2.7 [m/s²]	Maximum braking power	89 [kW]

Table 2: Parameters of NYCC

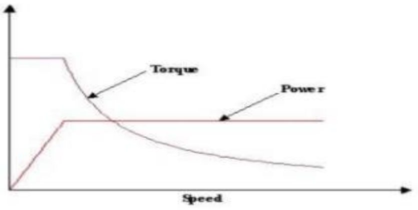


Figure 3: Ideal performance characteristics for a traction motor.

HARDWARE REQUIRED

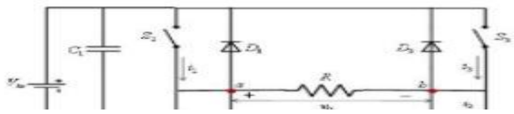
Components	Specifications	Quantity
Solar panels	74 w , 15 A Solar panel	3
Battery	Lead acid battery	2
Hub motor rotor	-	1
Hub motor stator	-	1
Accelerometer	-	1
Voltage regulator	-	1

Table 3 List of components used in the experimental work

Drive	Dual powered (Motor & pedal driven)
Weight	40 kg.
Riders weight	80 kg.
Load capacity	120 kg.
Size	140*540*1040 mm

Max. Power (w)	20
Charging current	2
Open circuit voltage	21.6
Max. Power voltage	17
Short circuit current	1.36
Power measured at standard condition	1000 w/m2 at 25 °c
Lifespan	25 yr.
Size	500*338*35 mm

Table 5 Specifications of Solar panel



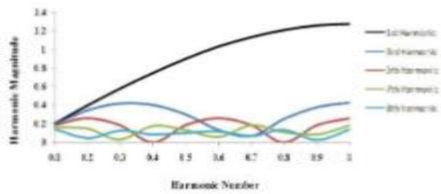


Figure 5: Harmonic content for

Pulse Number	Starting angle α [°]	Pulse Width δ [°]
1	12.98	4.04
2	39.30	11.40
3	66.73	16.54
4	96.00	17.90
5	127.90	14.20
6	162.26	5.48

Table 6 : The starting angle and pulse width.

for Sine PWM with 6 pulses per half cycle.

BLOCK / CIRCUIT DIAGRAM AND PROGRAMMING

Single Pulse Width Modulation -In this modulation only one pulse per half cycle exists and the width of the pulse is varied to control the inverter output voltage. The generation of the gating signals and the output voltage of single phase full-bridge inverters are shown in Figure 3 . The gating signals are generated by comparing a rectangular reference signal of amplitude Ar with a triangular carrier wave of amplitude Ac. The frequency of the reference signal determines the fundamental frequency of the output voltage . The ratio of Ar to Ac is the control variable and defined as the amplitude modulation index .

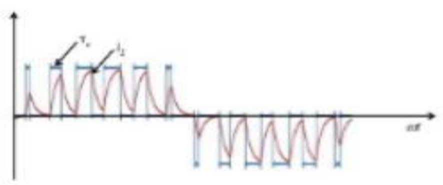


Figure 7: Voltage and Current waveforms for Sinusoidal PWM with 6 pulses per half cycle.

RESULT

Parameters	Solar Assisted Bicycle	Moped	Ordinary Bicycle
Max. Speed limit (km/h)	25 - 30	45 – 50	10 - 15
Drivers pedaling requirements	No	No	Yes
Initial cost	16470	35000	3000
Operating cost for 0- 40 km traveling	Nil	45	Nil
Weight	40 kg.	80 kg.	15 kg.
Max. Traveling distance at a stretch in km	35 - 40	150	15 - 20
Fuel used per 100 km	Nil	2 lit.	Nil
Charging (oil filling) time	6 – 7 hr. For 74 w , 15 A Solar panel and 16 – 18 hr. For 20 w , 02 A Solar pane.	Not Applicable	Not Applicable
Types of energy used	Solar	Petrol	Muscle power
Driving noise (dB)	Noiseless	60 – 70	Noiseless
Drivers license required	No	Yes	No
Helmet required	No	Yes	No
Age limit	No	Yes , over 18 yr.	No
Engine size	Not Applicable	100 – 125 cc	Not Applicable

CONCLUSION

Solar assisted bicycle is modification of existing bicycle and driven by solar energy. It is suitable for both city and country roads, that are made of cement, asphalt, or mud. This bicycle is cheaper, simpler in construction & can be widely used for short distance travelling especially by school children, college students, office goers, villagers, postmen etc. It is very much suitable for young, aged, handicap people and caters the need of economically poor class of society. It can be operated throughout the year free of cost. The most important feature of this bicycle is that it does not consume valuable fossil fuels thereby saving crores of foreign currencies. It is ecofriendly & pollution free, as it does not have any emissions. Moreover it is noiseless and can be recharged with the AC adapter in case of emergency and cloudy weather. The operating cost per kilometre is minimal, around Rs.0.70/km. It can be driven by manual pedalling in case of any problem with the solar system. It has fewer components, can be easily mounted or dismounted, thus needs less maintenance

This project is a way of using the outgoing power. The concept of the project is providing ease to the rider while riding a bicycle and also to conserve energy by all possible means. When the solar electric bicycle is kept under sunlight then the solar rays charge the battery through the solar panel. The battery powers an electric motor in the motor of wheel. It also lowers the resistance in pedaling to make it easier to go up hills. When there is no sunlight, the bicycle can be charged by mains electricity. The hybrid bicycle approach is different. It works in normal day as well as in cloudy day. We have designed an electric hybrid bike with a minimal amount of additional weight, an integrated control system, based on the decision-making of the rider and microcontroller, and that is capable of greater efficiency than typical hybrid bikes through its use of regenerative motor control and various other feedback control mechanism.

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