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Solar Hybrid Bike using Range Extended Electric Vehicle (Reev)

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***Abstract*— Solar energy is the source of energy in this universe so by consuming solar energy we can save our environment as well as we can fulfill our energy needs. So in this project we have tried to improve the automobile such that the vehicle can use solar energy so solve problem of ours everyday life. We have used a TVS bike of power 100 CC which will drive by solar energy for its working for this purpose we have used four batteries of 12V so that they can reserve power for its working.**

Keywords- Solar , Automobile, Hybrid, REEV,

I. INTRODUCTION

Several economic and environmental factors are contributing to increasing interest in alternative vehicle technologies. These factors include rising global demand for oil, concomitant increases in fuel prices and anthropogenic climate change.

Basics

Internal combustion engines are relatively less efficient in converting the on-board fuel energy to propulsion as most of the energy is wasted as heat. On the other hand, electric motors are efficient in converting the stored energy in driving a vehicle, and electric drive vehicles do not consume power while coasting.

II. COMPONENTS DESCRIPTION

The components used in this project are IC engine, generator, BLDC hub motor DC motor controller, sealed batteries, charging circuit, chassis, ignition switch, accelerator, wiring kit.

I C Engine

In the project, the TVS 100 is used. it will run by a 100cc, 4 stroke, single cylinder and air- cooled engine. It produces peak power of 7.5 bhp @ 8000 rpm which is more than sufficient to charge the batteries through the charging circuit. And the specifications of engine are listed below;

Type Motorcycle

Engine displacement 100 cc Engine type 4-stroke, single cylinder, air cooled Engine starting Maximum power 7.5bhp 1400 rpm Maximum torque 0.73 @1400 rpm Transmission 4-speed constant mesh Top speed 85kmph.

Brakes

Front brake Drum brakes , 110mm Rear brake Drum brakes, 100mm

Chassis and suspension

Front suspension Telescopic hydraulic fork Rear suspension Swing arm with hydraulic dampers

Dimensions

(1885x770x1060) mm Wheel lbase 1210 mm
Weight 95 kg Ground clearance 135 mm Petrol tank capacity 10.1 liters

Generator

The PMDC motor is used as a generator in this project. These types of motor are essentially simple in construction. As the magnetic field strength of a permanent magnet is fixed it cannot be controlled externally, field control of this type of dc motor cannot be possible. Thus permanent magnet dc motor is used where there is no need of speed control of motor by means of controlling its field.

Sl No.	Features	No.
1	Rated voltage(v)	110
2	Voltage range(v)	110-130
3	Rated load (mm-m)	300
4	Rated speed (rpm)	7000
5	Rated current (ma)	1050
6	Starting torque (mm-m)	540
7	Rotation cw and ccw	

Hub motor

Hub motors are an interesting development which could offer benefits such as compactness, noiseless operation and high efficiency for electric vehicles. These motors have stators fixed at the axle, with the permanent magnet rotor embedded in the wheel.

The traditional “exterior rotor” design has the hollow cylindrical rotor spinning around actuator axle. There is a “radial air gap” between the stator and rotor. The stator consists of stacked laminated steel plates with wound coils.

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Pulse width modulated current is used to supply current to the stator. Hub motors must run at relatively low speed – equal to the actual rotation of wheel if there is no final gearing stage. The benefit is about a 10%increase in efficiency due to the lack of transmission. The main reason for choosing a hub motor is that it does not require a transmission system which helps in reducing the transmission losses. Since it has no brushes to wear out the life of motor is increased. It has a greater traction control. The back emf created by BLDC motor can easily be stored in the batteries. specifications of Generator are listed below

1 Rated voltage(V) 40 DC
2 Rated power 750W
3 Controller current limit 38A
4 No load speed (rpm) 518
5 Max. torque (N-m) >50

DC Controller

The controller connects the power source to the motor. It controls speed, direction of rotation, and optimizes energy conversion. While batteries produce constant voltages which decrease as they are used up, some controllers require a DC to DC converter to step down this changeable voltage to the motor's expected constant operating voltage, but other controllers incorporate a DC-to-DC converter and can accept a varying voltage. Converter efficiencies are typically greater than 90%.The voltage control is achieved by "chopping" the source current - the voltage is switched on and off, with the ratio of on to off determining the average voltage. Chopping is performed by power electronic circuitry such as diodes and thrusters and silicon control rectifiers (SCR). Controllers also effect regenerative braking, by which the motor is acted as a generator to recharge the batteries. The controller for the motor is being interfaced with the motor speed regulation. The speed controlling throttle is being interfaced through the motor controller circuit. The motor used here is 48V, 250W, Ampere made hub motor. The controller for the motor is also Ampere made suitable for controlling the specified motor. The throttle is an ampere made throttle for speed regulation of the specified motor. The input to the motor is supplied by four Exide made Electra lead-acid batteries each of 12V, 26Ah through controller for testing purpose. Two independent propelling sources are being employed for obtaining total propulsion of the vehicle

1. Super low noise when starting up.
2. Speed limit/3 speed.
3. Under-voltage protection.
4. Under-current protection.
5. Cruising control.
6. Water proof.

Ignition Switch

An ignition switch is a switch in the control system of IC engine motor vehicle that activates the main electrical systems for the vehicle. It also usually switches on power to many accessories. The ignition switch usually requires a key be inserted that works a lock built into the switch mechanism. It is frequently combined with the starters witch which activates the starter motor. It may be bypassed by disconnecting the wiring to the switch and manipulating it directly. This is known as hot wiring.

In this project, TVS Chassis being used. A chassis includes the head tube that holds the front fork and allows it to pivot. Some motorcycles include the engine as a load bearing, stressed member. The rear suspension is an integral component in the design. Traditionally chassis were steel but titanium, aluminum, magnesium and carbon fiber, along with composites of these materials are now used. Because of different motorcycles varying needs of cost, complexity, weight distribution, stiffness, power output and speed, there is no single ideal frame design.

Accelerator

The accelerator mode is similar to how a motorcycle operates. When the accelerator is engaged the motor provides power and propels you and the bike forward. It allows you to kick back and enjoy a free ride. Most accelerators can be fine-tuned like a volume dial between low and full power.

Wiring Kit

The wiring kit place a major role in an electric bike. The main connecting unit is DC controller. As for the whole longer tailpipe thing (i.e. the vast majority of electricity is produced from polluting non-renewable resources) we are currently making great strides to switch to clean renewable resources for all of or power needs, also it has been proven that electric vehicles their electric power from our polluting power grid are still better for the environment due to their sheer efficiency. The looks of the electric vehicles are finally starting to look like normal vehicles and they perform with some of the best supercars in the world.

III. HYBRID BIKE

A hybrid bike is a vehicle with multiple distinct energy sources which could be separately or simultaneously operated to propel the vehicle. Many hybridization configurations such as fuel cell, gas turbine, solar, hydraulic, pneumatic, ethanol, electric and many more are proposed over the years. Among these, the hybrid electric vehicles, integrating two technically and commercially proven and well established technologies of electric motors and I.C. engine, allowing drawing upon their individual benefits have been widely accepted by the technologies and users. The most commonly adapted hybrid vehicle which combines propulsion sources of an electric motor and an I.C. engine. The power supply to the electric motor comes from onboard batteries. In a HEV, the I.C. engine cooperates with an electric motor which leads to a more optimal use of the engine. Driving in city traffic involves frequent starts and stops of the vehicle. During idling, the engine consumes more fuel without producing useful work thus contributing to higher fuel consumption, less efficiency and unnecessary emission from exhaust. The HEV solves the problem by switching to power transmission through the motor and shutting off the engine. This way no fuel will be consumed during idling with no exhaust emission. Another advantage of HEV is that when fuel tank gets empty while driving the engine, the vehicle can be driven on electric power within its maximum range.

HEV are the vehicles with more than two energy sources are present. The major challenges for HEV design are managing

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multiple energy source, highly dependent on driving cycles, battery sizing and battery management. HEVs take the advantages of electric drive to compensate the inherent weakness of ICE, namely avoiding the idling for increasing the fuel efficiency and reduce emission during starting and speeding operations, to use regenerative braking instead of mechanical braking during deceleration and down slope driving. HEV can meet customers need and has added value but cost is the major issue. These vehicles are of high cost and certain program should be supported by the specific government for marketing HEVs.

Types of Hybrid power train

Series Hybrid

This is an electric power train for which an I.C. engine acts as a generator to charge batteries and/or provide power to the electric drive motor which can be seen in. These vehicles usually have a larger battery pack and larger motors with smaller I.C. engines.

In a Series Hybrid bike (SH) the user powers a generator using the engine. This is converted into electricity and can be fed directly to the motor giving a chainless bicycle but also to charge a battery. The motor draws power from the battery and must be able to deliver the full mechanical torque required because none is available from the pedals.

Series Hybrid bikes are commercially available, because they are very simple in theory and manufacturing.

They are referred to as "Plug-In Hybrids" (or a Plug-In Electric Vehicle, PHEV) and "Range-Extended Electrics." The drive train for a series hybrid is mechanically simple, compared to other hybrids. Disadvantages to this drive train are lower efficiencies at greater trip distances and the higher cost of batteries and components, since the vehicle is all-electric. Regardless, of the three hybrid options, it is the most efficient in fuel use.

Parallel Hybrid

More mechanically complex than a series hybrid, the parallel power train is dual driven, allowing both the combustion engine and the electric motor to propel the car. Shows that the I.C. engine and motor operate in tandem. Usually the combustion engine operates as the primary means of propulsion and the electric motor acting as a backup or torque/power booster. The advantages of this are smaller batteries (less weight) and generally more efficient regenerative braking to both slow the car and capture energy while doing so. Another advantage is that it can easily be incorporated into existing vehicle models. Most hybrids on the road are of the parallel type.

In a Parallel Hybrid vehicle human and motor power are mechanically coupled at the pedal drive train or at the rear or the front wheel, e.g. using a hub motor, a roller pressing onto a tire, or a connection to a wheel using a transmission element. Human and motor torques is added together. Almost all manufactured Motorized bicycles, Mopeds are of this type.

The major disadvantage of this power train is that it adds more weight to the vehicle without necessarily shrinking the engine and other components. While the addition of the motor does increase fuel mileage by allowing the engine to operate at lower rotations per minute (thus using less fuel). These vehicles are poor highway performers, gaining most of their efficiency in city driving at lower speeds.

IV. METHODOLOGY

Range extender

The range-extended electric vehicle technology is between plug-in hybrid vehicle technology and pure electric vehicle technology. Compared with the pure electric vehicles, range-extended electric vehicle adds on-board generator system (range extender). The range-extender consists of engine, generator, and rectifying device. The engine can persistently charge the power battery, so the trip mileage is substantially increased near the conventional fuel vehicle. The range-extended electric vehicle can optimize the working condition of the engine and power battery at the same time. On the one hand the engine working area is optimized, and the engine efficiency is increased. The high efficiency area of the internal-combustion engine can be selected by the average power demand of the driving cycle, so the internal-combustion engine can work in low fuel consumption and pollution and the optimum working point can realized. On the other hand, the power battery working condition is optimized, the power battery can keep working in good condition, avoiding over charge or discharge. The utility life is increased, the braking energy can be recovered, and the energy consumption and cost is decreased. The range-extender solves the problems of the high power consumption of air condition, and other electric auxiliaries for lighting, heating, defrosting.

Power train Configuration

In a series-hybrid system, the combustion engine drives an electric generator instead of directly driving the wheels. The generator provides power for the driving electric motors by charging batteries. In short, a series-hybrid is a simple vehicle, which is driven only by electric motor traction with a generator set providing the electric power.

The Extended Range Electric Vehicle (EREV) is unique vehicle, where battery and propulsion system are sized such that the engine is never required for operation of the vehicle when energy is available from the battery. As a full-performance electric vehicle, battery, motor and power electronics must be sized for the full capability of the vehicle.

An E-REV does not need to start the engine for speed or power demands and therefore does not need to be on when battery energy is available. The engine is used only when the battery charge is low and to charge the battery in such cases. Unlike an internal combustion engine, electric motors are highly efficient with exceptionally high power-to weight ratios providing adequate torque when running over a wide speed range. Internal combustion engines run most efficiently when turning at a constant speed. An engine turning a generator can be designed to run at maximum efficiency at constant speed.

Conventional mechanical transmissions add weight, bulk and sap power from the engine with automatic shifting being complex. Unlike conventional transmission mechanism, electric motors are matched to the vehicle with a simple

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constant-ratio gearbox hence multiple-speed transmission can be eliminated.

Methodology of Hybrid Vehicle

The following steps were adopted to proceed with the concept of range extension in an electric vehicle.

Step 1: Mounting an IC engine (Petrol run, 5000rpm, and TVS 100 engine) on the chassis of the bike making suitable adjustments.

Step 2: Flywheel of IC engine is modified and attached with a pulley and is connected to a PMDC Motor (110V, 15 amps @5000 RPM) mounted in line with engine using belt drive and connections are made to the batteries through a charging circuit.

Step 3: When the charge indicator shows charge is less, IC engine will be turned ON mechanically and PMDC Motor will produce electricity to maintain the battery level until finding a plug in source.

Step 4: Testing the scooter for improved range.

Step 5: Procurement of electric scooter, IC engine and PMDC motor in working condition.

Step 6:

1. Flywheel of IC engine is connected to a PMDC Motor (110V, 15 amps @5000 RPM) through a belt drive and the whole setup is mounted on the floorboard of the electric scooter with suitable clamping.
2. The power developed at the flywheel was coupled to the PMDC Motor (110V, 15 amps at 5000 RPM) through the V – Belt drive and a rated power output of 900 W (110V, 15amps).
3. The connections were given to the batteries through a charging circuit which helps in developing the required current levels.
4. Here there is a need to charge 4 x 12V series connected batteries which require 1.2 x 48 which is equal to 57.6V and hence we made use of 60V PMDC Motor. And this is because of voltage drop on application of load

Stage7:

1. When the charge level comes down to a moderate level, then it is indicated by the charge dial. Then, the engine is switched on mechanically.
2. The power developed from the engine generates electricity through the PMDC motor and charges the batteries through the Charging Circuit.
3. Our charging circuit charges the batteries at 10Amps.

V. ANALYSIS OF THE RECORDED DATA

As the primary need for this work is to record the data, the method of recording the speed is done through dynamometer provided in the vehicle. The test vehicle is driven in stock condition through the given test route of Advancer city. The total distance covered in this trip is 3 Km. the time taken for covering this distance is 272 seconds under moderate traffic condition. The initial need for this work is to measure and record the vehicle speed. The measurement of speed is divided into two groups.

1. Using the equipment provided in the vehicle like speedometer.
2. Usage of some additional equipment like GPS system.

The traffic condition varies with respect to different parts of the city. In classifying the traffic conditions the parameters used to be the average speed and percentage of idle each of the trip. The four traffic conditions based on the above criteria are as follows

VI. CONCLUSION

The power train efficiency of the range-extended electric vehicle is compared indifferent driving cycles, energy management strategies, and range-extended control methods the range-extender uses thermostat control method, the system efficiency is the maximum. The energy efficiency can reach 33%, the comprehensive efficiency of and rectifier can reach above 90%.The influence of the CD-CS and Blended strategy on the economy is compared indifferent driving cycles and daily trip mileage is 130 km. Different driving cycles and control strategies have influence on the economy of the range-extended electric vehicle. The hybrid bike can be powered by dual source such as gasoline and electricity. Compared to ordinary bikes this hybrid bike is more efficient and economic. This hybrid bike will be a new innovation in automotive era, it is more eco-friendly because it cause less pollution. The hybrid bike is a better solution for hiking fuel cost day to day.

VII. FUTURE SCOPE

1. An engine less than 100 cc can be used.
2. Compact battery can be used along with 36 V hub motor which requires only 3batteries.
3. Chain pulley can placed on the bike.
4. Efficiency can be increased

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PROJECT: SOLAR HYBRID BIKE USING RANGE EXTENDED ELECTRIC VEHICLE (REEV)