HYBRID RENEWABLE TECHNOLOGY - HEV HYBRID CHARGING

Future with Hybrid Electric Vehicles

PROJECT TYPE: MINOR

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This chapter gives an elementary account of hybrid renewable energy systems (HRES). This type of system according to today's demand on providing new source of electricity On-pick and storage of energy as a source of such demandable energy of electricity Off-pick. Hybrid renewable energy systems (HRES) are becoming popular as stand-alone power systems for providing electricity in remote areas due to advances in renewable energy technologies and subsequent rise in prices of petro-leum products. A hybrid energy system, or hybrid power, usually consists of two or more renewable energy sources used together to provide increased system efciency as well as greater balance in energy supply [1]. A renewable energy is energy that is collected from renewable resources, which are naturally replenished on a human timescale, such as sunlight, wind, rain, tides, waves, and geothermal heat. Renewable energy often provides energy in four important areas: electricity generation, air and water heating/cooling, transportation, and rural (off-grid) energy services.

Hybrid energy systems combine two or more forms of energy generation, storage, or end-use technologies, and they can deliver a boatload of benets compared with single source systems. The option of having variety in our day-to-day life could be considered as the spice of life; therefore, why limit ourselves to just one energy source or storage option? In these cases, hybrid energy systems are an ideal solution since they can offer substantial improvements in performance and cost reduction and can be tailored to varying end-user requirements. The energy storage system (ESS) in a conventional stand-alone renewable energy power system (REPS) usually has a short lifespan mainly due to irregular output of renewable energy sources. In certain systems, the ESS is oversized to reduce the stress level and to meet the intermittent peak power demand.

Title Page

Title No. No.

i. Front Page 1

ii. Abstract 2

iii. Table of Contents 3

iv. List of Tables and Figures 4

v. Abbreviations and Acronyms 5

Project Contents

Section 1: Introduction

1.1.Introduction to Topic 6

1.2.Need and Motivation of Topic 6

Section 2: Collected Data

2.1.Review of Collected Data 7 2.2.Conclusion Drawn 7

Section 3: Description of Issue

3.1.Problem Statement 8

3.2.Methods to Solve Issue 8

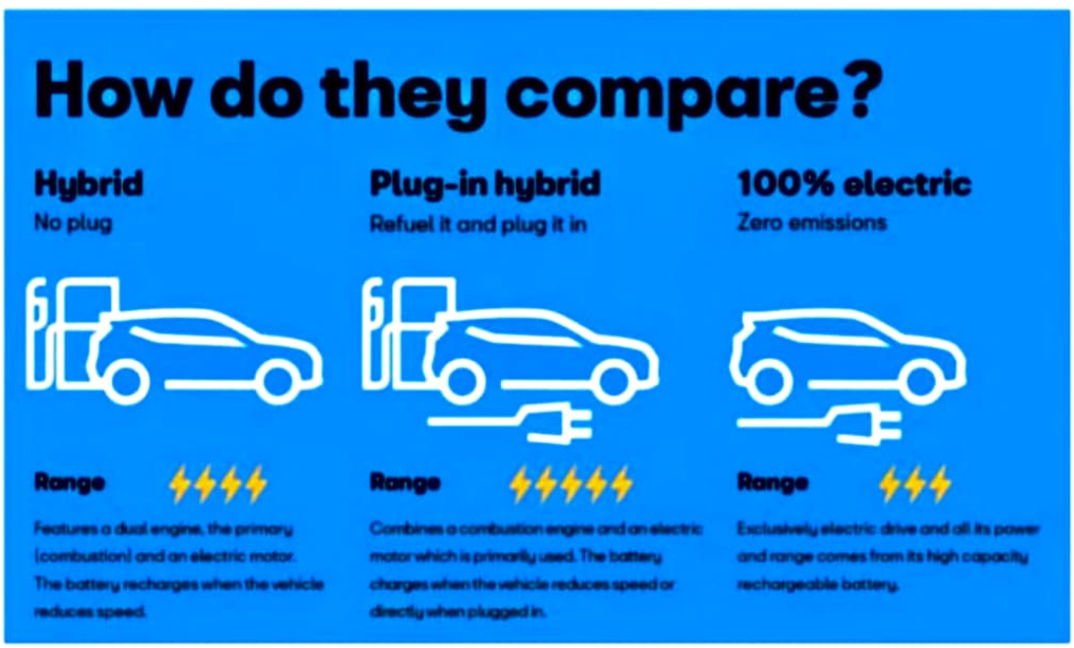
Section 4: Resolution and Conclusion

4.1.Detailed Description of each method 9 4.2.Conclusion with Justification 9

References

Appendix

	BEV	HEV	PHEV	FCEV
Traction power	Electrical motor	Electrical motor ICE	Electrical motor ICE	Electrical motor
Energy system	Battery UC	Battery ICE UC	Battery ICE UC	FC Battery UC
Energy source	Charging power station	Fuel pump Gasoline	Charging power station Fuel pump Gasoline	Hydrogen fuel
Advantage	Zero emissions Independence on fossil fuels	Less emissions Long distance covered	Less emissions Long distance covered	Zero emissions High efficiency
Disadvantage	High initial cost Battery replacement	Dependence on fossil fuels Higher cost	Dependence on fossil fuels Higher cost	Hydrogen fuel storage High cost of fuel



EV Electric vehicle

HEV Hybrid Electric Vehicle

HRES Hybrid Renewable Energy System

PHEV Plug-in Hybrid Electric Vehicle

FCEV Fuel Cell Electric Vehicle

DAS Data Acquisition System

ZEV Zero Emission Vehicle

APU Auxiliary Power Unit

EMS Energy Management System

BPEV Battery Powered Electric Vehicle

ICE Internal Combustion Engine

SOC State Of Charge

ICEV Internal Combustion Electric Vehicle

Introduction:

The conventional vehicle widely operates using an internal combustion engine (ICE) because of its well-engineered and performance, consumes fossil fuels (i.e., diesel and petrol) and releases gases such as hydrocarbons, nitrogen oxides, carbon monoxides, etc. The transportation sector is one of the leading contributors to the greenhouse gas (GHG) emissions as shown in Fig. 1. As per the report of the United States Environmental Protection Agency (EPA) CO2 is the primary GHG emitted through human activity. Human activities have affected the carbon cycle by adding more CO2 to the atmosphere and depleting the natural sink of CO2 gas like forest and soils which remove/store or fix the CO2 level in the atmosphere (EPA, 2020). The rise in fossil fuel price, environmental pollution and the limited lifetime of fossil fuels has led the automobile manufacturers to look for an alternative to fossil fuel such as natural gas, hydrogen and biofuel for the propulsion of the vehicle. Among the various developed technologies, the electric vehicles (EVs) have gained tremendous attention as an alternative technology and are becoming a part of the modern transportation system. The average efficiency of ICE is 25%, which means that only 25% of the fuel is converted into useful energy and the rest of the 75% fuel is wasted through heat and friction losses, on the other hand, EV has an average efficiency of 80% but it has limitations in terms of total mileage and refuelling time as compared to ICE vehicle.

Need and motivation for renewable energy in hybrid electric vehicle:

Electric and hybrid vehicles can have significant emissions benefits over convention vehicles. All-electric vehicles produce zero tailpipe emissions, and PHEVs produce tailpipe emissions when operating in all-electric mode. HEV emissions benefits vary by vehicle model and type of hybrid power system.

Fuel Economy

Electric vehicles can reduce fuel costs dramatically because of the high efficiency of electric-drive components. Because all-electric vehicles and PHEVs rely in whole or part on electric power, their fuel economy is measured differently than that of conventional vehicles. Miles per gallon of gasoline equivalent (MPGe) and kilowatt-hours (kWh) per 100 miles are common metrics. Depending on how they are driven, today's light-duty all-electric vehicles (or PHEVs in electric mode) can exceed 130 MPGe and can drive 100 miles consuming only 25–40 kW

P2.1. Review of Collected Data
Back-up System from 1993:
The data acquisition system used in 1993 was an energy meter fiom Cruising Equipment that measured voltage, current, and time, and then integrated the power over time to calculate the net
energy (kwh) used fiom the main battery pack.*.' A serial port could print out the voltage and current every second, but it required a laptop to record data for the duration of the event. Because 30 laptop computers were not available, no temporal data were collected during the 1993 competition. This system was already installed in three-fourths of the vehicles and was kept in the vehicles for the 1994 Challenge as a back-up energy meter.
1994 Data Acquisition System:
The primary DAS used in the 1994 HEV Challenge was called the Autologger, designed by Instrumental ~olutions.~ A competitive procurement process was used to evaluate and select the
DAS for the 1994 HEV Challenge.
The Autologger had the following features:
1. Four analog channels measured: two currents and two voltages.
2. Optical isolation from high voltage on all four analog channels.
3. Measurement of distance and velocity.
4. Monitoring of auxiliary power unit (APU) odoff activity.
5. 128K of on-board memory to store 1 -second averages of all channels sampled, resulting in 6 hours of continuous second-by-second data storage.
6. High sampling rate of 2500 Hz.
Difficulties encountered with new DAS
A number of problems were encountered with both the new DAS hardware and the way the students installed and wired the DASs in their vehicles that prevented complete data from being
collected from all of the schools. First, not all of the schools had their hardware wired correctly, with one common problem being the APU odoff activity channel. Second, the DASs were often mounted in electrically and magnetically "noisy" locations under the hood, which might have been solved prior to the competition if the students had more time for their own testing. Finally, the on-board software occasionally got corrupted on ignition "key-on," causing some data to be lost by altering the program memory.

All temporal data results presented here will be based only on the data that has been determined to be reasonable, which comprises data from 19 schools. One major advantage of the new DAS is that it allows this type of determination to be made by plotting the second-by-second voltages, currents, speeds, and APU activity, making clear which schools had noise problems or
incomplete data. Prior to the 1994 HEV Challenge, all HEV and electric vehicle (EV) competition energy data were "black box" data making it difficult to determine its reasonableness.

ISSUE 3.1. Problem Statement

Energy Management in Hybrid Electric Vehicle

3.2. Methods to Solve the Is

One of the HEV and PHEV specific control problems is energy management. HEV have both an IC engine and electric motor and two or three sources of energy (oil in the tank, and an electric charge in the battery or in the ultracapacitor). One advantage of the HEV is the possibility of combining these sources and drives to obtain the best resultant efficiency. This requires however sophisticated energy management. There are six possible different operation modes in both series and parallel HEV:

1. The battery alone mode: the engine is off; the vehicle is powered by the battery only.
2. The engine alone mode: powered by the ICE/G (the engine and the generator)
3. Combined mode: both the ICE/G set and the battery provide power for the traction motor.
4. Power split mode: the ICE/G power split to drive the vehicle and charge the battery.
5. Stationary charging mode 6. Regenerative braking mode.

The control problem is how to distribute power between different sources and different drives to obtain maximal efficiency.

4.1. Conclusion with Justification

Environmental concern, for instance, air pollution and global warming put an adverse effect on human beings and their livelihood. Energy crises are becoming an emerging problem due to the limited stock of conventional resources and an increase in prices. Due to all these reasons, developing countries are focusing mainly on EV implementation and replacing the ICEV into HEV for combating the ever-growing pollution. HEV makes an appearance in today's vehicular industry due to low emission, less fuel intake, low-level clangour, and low operating expenses. This paper presents an overview of EV with a focus on possible energy storage and generation sources and EVs types. The energy storage device is the main problem in the development of all types of EVs. In the recent years, lots of research has been done to promise better energy and power densities. But not any of the energy storage devices alone has a set of combinations of features: high energy and power densities, low manufacturing cost, and long life cycle. So the concept of a combination of energy sources (hybrid energy sources) has emerged to obtain better performance with help of EMS to control over the optimal power flow level between the energy source, converters and the other parts in the EVs. With the improvement in Li-ion and NiMH battery technology, EVs systems like HEV and PHEV can achieve the target.

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