

Multi-Purpose Solar Electric Car: Design and Development of a Sustainable Multipurpose Electric Vehicle

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ABSTRACT

The increasing demand for sustainable transportation has created a need for electric vehicles that are energy-efficient, economical, and adaptable to multiple applications. This paper presents the design and development of a Multi-Purpose Electric Vehicle (MPEV) powered primarily by solar energy. The proposed vehicle combines electric propulsion with a solar charging system and a modular mechanical arrangement to support transportation and utility applications. The system consists of a solar photovoltaic panel, lead-acid battery, permanent-magnet DC (PMDC) motor, sprocket and chain drive, gearbox, steering mechanism, wheels, frame, and control unit. Solar energy is converted into electrical energy by the photovoltaic panel and stored in the battery, which supplies power to the DC motor. The motor transfers mechanical power to the wheels through the chain and sprocket arrangement. The design calculations presented in the project result in an estimated motor power requirement of approximately 360 W, corresponding to about 0.5 HP. The proposed vehicle offers reduced fuel consumption and emissions while providing a simple and adaptable platform for domestic, commercial, assembly, and open-field applications. The developed concept demonstrates the potential of solar-assisted electric vehicles as a sustainable alternative to conventional fuel-powered utility vehicles.

Keywords— Multi-purpose electric vehicle, solar electric vehicle, photovoltaic panel, PMDC motor, lead-acid battery, electric propulsion, chain drive, renewable energy.

INTRODUCTION

Transportation systems based on conventional petrol and diesel vehicles contribute to fuel consumption and environmental pollution. The project document identifies the increasing concern associated with greenhouse-gas emissions and the need for cleaner transportation solutions. Energy harvesting and renewable-energy technologies provide opportunities for reducing dependence on conventional fuels by converting naturally available energy into useful electrical energy. In particular, photovoltaic systems can convert solar radiation into electrical energy for storage and subsequent use in electric propulsion.

Electric vehicles provide an alternative to conventional vehicles because electrical energy can be stored in batteries and converted into mechanical power through an electric motor. The proposed MPEV extends this concept by incorporating solar energy as a charging source and by providing a multipurpose platform. The vehicle is intended to address transportation and utility requirements while reducing fuel consumption and emissions. The project also emphasizes ease of handling, modularity, energy efficiency, and suitability for rural and agricultural applications.

The proposed vehicle consists of a solar photovoltaic system, battery storage, PMDC motor, mechanical transmission, steering system, wheels, frame, and control components. During daylight, the solar panel generates electrical energy that is stored in the battery. The stored energy is subsequently supplied to the motor for vehicle propulsion. The motor is mechanically coupled to the vehicle through a sprocket and chain arrangement. This configuration provides a relatively simple and practical propulsion system for the proposed prototype.

The main contribution of this work is the integration of renewable-energy charging with a multipurpose electric vehicle platform. The proposed concept can be adapted for transportation, goods movement, assembly operations, domestic use, commercial applications, and open-field work. The document further identifies future possibilities including IoT connectivity, autonomous operation, smart diagnostics, and advanced renewable-energy integration.

LITERATURE SURVEY

Research on solar-powered and multipurpose vehicles has focused on integrating renewable energy, multifunctionality, automation, and efficient mechanical power transmission. P. V. Prasad Reddy and M. Yadi Reddy proposed a multi-purpose agricultural vehicle using solar power, in which electrical energy from a solar source was converted into mechanical energy to perform operations such as water spraying, ploughing, and seed sowing [1]. Dr. Smita Joshi, Vinit Joshi, and Shah Kalp investigated the limitations of conventional tractors and developed a solar-powered prototype capable of performing multiple agricultural operations in a single run [2]. Aditya Sharma and Dr. Puja Tripathi studied multipurpose agricultural robots for applications such as harvesting, fertilizer spraying, fruit picking, sowing, and crop monitoring, highlighting the potential of sensors and automation to reduce manual intervention [3].

Shaikh Ajaharuddin G. and Prof. P. G. Tathe proposed a multipurpose vehicle capable of performing multiple operations within a single assembly, with emphasis on adaptable dimensions and precision-based agricultural applications [4]. David D. Wilson and John H. Lumkes developed and tested agricultural attachments including a maize grinder, two-row planter, and three-point-hitch caddy, demonstrating the usefulness of a practical multifunctional platform [5]. Prof. P. V. Bute, Shailesh Deshmukh, and Vishal Deshmukh proposed an automated farming mechanism using RF communication for wireless control of agricultural operations [6]. The literature indicates that solar-energy integration, multi functionality, automation, wireless communication, and adaptable mechanical systems are important approaches for developing sustainable multipurpose vehicles. These studies provide the basis for the proposed solar-powered multipurpose electric car, which combines renewable-energy charging with battery-powered electric propulsion and a versatile vehicle structure.

PROBLEM STATEMENT

Traditional vehicles contribute to environmental pollution and are generally designed for specific transportation requirements. The project identifies a need for a sustainable and adaptable vehicle capable of serving multiple purposes without excessive cost. Limited charging infrastructure, battery-related concerns, fuel dependence, and the variable requirements of users create a need for an alternative multipurpose transportation platform.

OBJECTIVES

The principal objectives of the proposed system are:

1. To develop a solar-powered multipurpose electric vehicle capable of providing sustainable transportation and utility functions while reducing dependence on conventional fuels.
2. To integrate an efficient electric propulsion and modular mechanical system using a battery, PMDC motor, chain drive, and adaptable vehicle structure for transportation and field-oriented applications.
- 3.

PROPOSED SYSTEM

The proposed system is a solar-assisted electric vehicle in which photovoltaic energy is used to charge the battery and the stored electrical energy is subsequently used to drive the vehicle. The proposed architecture includes the solar panel, battery, motor, motor control arrangement, mechanical transmission, steering mechanism, and vehicle frame. The solar panel converts sunlight into DC electrical energy, which is supplied to the battery through the charging arrangement. The battery then provides the required electrical power to the PMDC motor.

The mechanical propulsion arrangement uses a motor-connected sprocket, chain drive, shaft, and wheels. The motor converts electrical energy into mechanical energy, while the chain and sprocket arrangement transfers the rotational motion to the vehicle wheels. The frame supports the solar panel, motor, battery, and other mechanical components. A steering unit enables directional control, while the control system manages the electrical and propulsion components.

BLOCK DIAGRAM

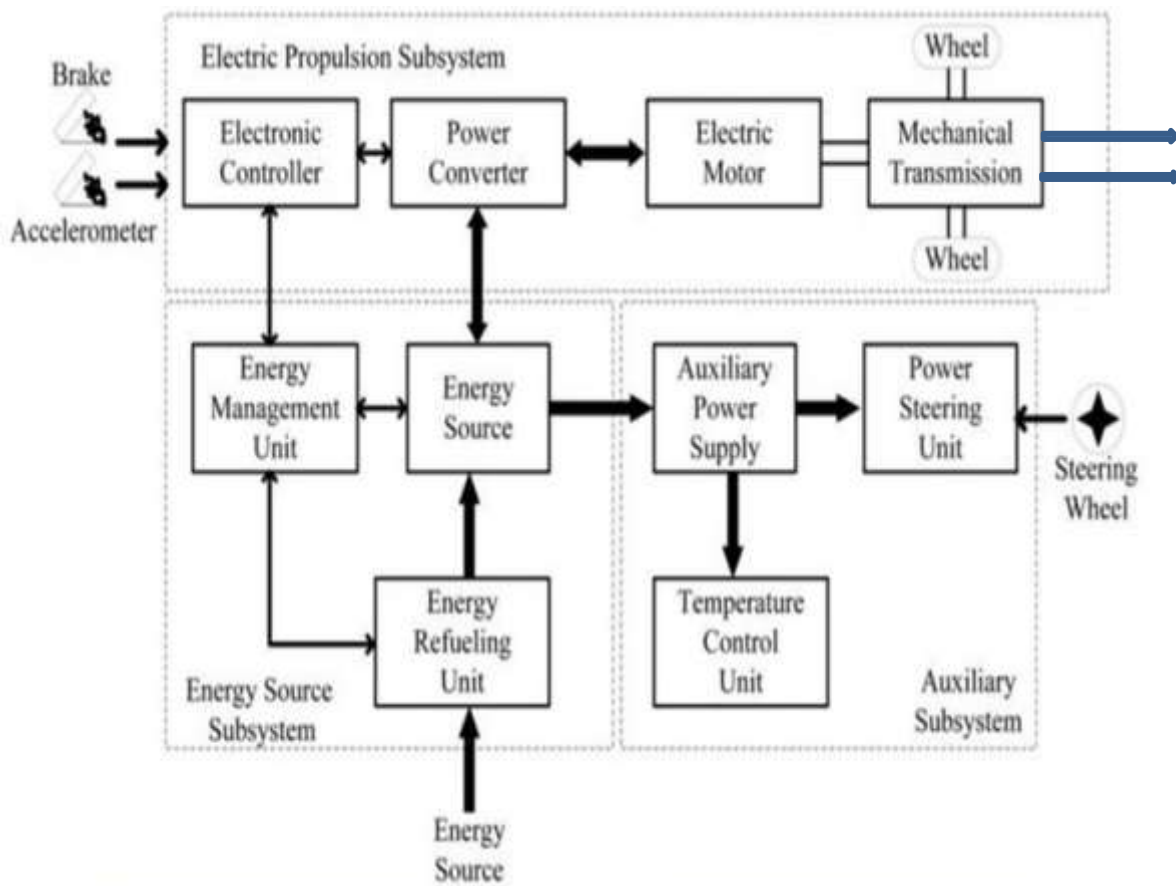


Fig 1 Block Diagram

METHODOLOGY

The methodology of the proposed MPEV consists of solar-energy harvesting, energy storage, electric propulsion, mechanical power transmission, and vehicle control. Solar photovoltaic panels mounted on the vehicle capture solar radiation and generate DC electrical power. The generated power is stored in the battery for later use. The project proposes MPPT-based charging as an energy-management option for improving solar-energy utilization, while a Battery Management System can monitor battery voltage, temperature, and state of charge.

During vehicle operation, electrical energy from the battery is supplied to the PMDC motor. The motor develops mechanical torque and transfers the power through the sprocket and chain drive to the shaft and wheels. The driver controls the vehicle using the steering and control mechanisms.

The proposed energy-management approach can also combine solar charging with grid charging as a backup source. Sensors and monitoring systems can be incorporated to observe battery status, solar input, and motor performance.

The vehicle structure is designed using a frame capable of supporting the electrical and mechanical components. The project uses a lead-acid battery arrangement, PMDC motor, chain drive, sprockets, wheels, steering unit, shaft, bearings, and connecting wires. The hardware setup is intended to provide a detachable and replaceable solar-panel and battery arrangement, allowing the system to be charged when required.

RESULTS AND DISCUSSION

The developed concept demonstrates the integration of solar energy generation, battery storage, and electric propulsion into a multipurpose vehicle. The solar panel provides a renewable source for charging the battery, while the stored energy is used to operate the PMDC motor. The motor-driven chain and sprocket system provides mechanical power transmission to the wheels. This arrangement reduces the requirement for conventional fuel and avoids direct tailpipe emissions during electric operation.

The design calculations indicate a motor power requirement of approximately 360 W, leading to the selection of a 0.5 HP PMDC motor. The proposed hardware arrangement includes four lead-acid batteries, one PMDC motor, two sprockets, two chains, four bearings, a steering unit, shaft, frame, and associated wiring and fasteners.

The principal advantages identified in the project are reduced fuel consumption, reduced emissions, reduced dependence on fossil fuels, use of solar energy, and the ability to store solar-generated energy while the vehicle is stationary. However, the system has limitations including relatively high initial cost, the requirement for a larger solar-panel area for higher power generation, and the variable nature of solar energy.



Fig 2 Hardware Setup

CONCLUSION

This paper presented the design and development concept of a Multi-Purpose Solar Electric Car integrating photovoltaic energy generation, battery storage, and electric propulsion. The proposed system uses a solar panel to generate electrical energy, a lead-acid battery to store the energy, and a PMDC motor to convert electrical energy into mechanical power. A sprocket and chain transmission transfers the motor output to the vehicle wheels. The project calculations indicate an approximate motor requirement of 360 W or 0.5 HP.

The proposed vehicle provides a sustainable alternative to conventional fuel-powered utility vehicles by reducing fuel dependence and direct emissions during electric operation. Its multipurpose structure allows applications in domestic, commercial, assembly, and open-field environments. Although solar intermittency, panel size, and initial cost remain limitations, integration of improved batteries, IoT monitoring, autonomous control, and advanced energy-management systems can enhance the future performance and applicability of the proposed MPEV.

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