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Sustainable Transportation (Solar EV)

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Abstract: *This project aims to develop a solar-powered electric vehicle that utilizes solar energy to generate electricity for propulsion. As fossil fuel resources become increasingly scarce, solar energy presents a clean and sustainable alternative. The system uses solar panels to charge batteries via power trackers, which regulate the voltage for optimal performance. The stored energy powers a motor directly connected to the wheels, eliminating the need for traditional mechanical components like gearboxes and differentials. An auxiliary battery supports additional electrical functions. This solar plug-in electric vehicle offers low maintenance and improved driving range by enabling battery charging while in motion*

Keywords: Solar Energy, EV, ATmega328, L298, Bluetooth, Battery

I. INTRODUCTION

Global transportation systems largely rely on internal combustion engine (ICE) vehicles, which emit greenhouse gases and depend heavily on diminishing fossil fuel reserves. In contrast, electric vehicles (EVs) offer a cleaner alternative, but most still rely on electricity sourced from non-renewable grids. Solar-powered EVs address this gap by enabling on-the-go renewable charging. This project integrates solar panels, efficient energy storage, microcontroller-based control, and smart communication modules to design a functional prototype of a solar EV. This model serves as a practical demonstration of clean, sustainable transportation.

II. SYSTEM DESIGN AND IMPLEMENTATION: -

The solar EV system is composed of interconnected electrical and mechanical subsystems. The core power system includes:

1) Solar Panel (12V, 12W): Captures solar energy and converts it into electrical power.
2) Battery ($LiFePO_4$, 12.8V): Stores energy for use during cloudy weather or night-time.
3) DC-DC Buck Converter (LM2596): Regulates voltage output to protect circuits.
4) ATmega328 Microcontroller: Acts as the system brain, controlling power distribution, motor signals, and sensor data.
5) Bluetooth Module (HC-05): Enables wireless communication with a smartphone.
6) MotorDriver (L298N):Controls the speed and direction of the motors.
7) Ultrasonic Sensor (HC-SR04): Detects obstacles for safe navigation.
8) Buzzer: Provides alert signals during collision detection or alerts.

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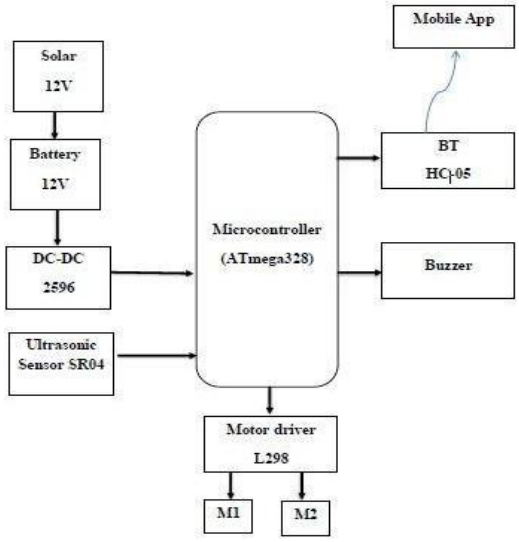

2.1 Block Diagram

III. HARDWARE COMPONENTS AND FUNCTIONALITY

1) Microcontroller (ATmega328): An 8-bit AVR microcontroller used widely in Arduino platforms. It processes sensor data, executes commands from the mobile app, and regulates outputs to the motor driver.

Fig 2:-ATMEGA 328

2) HC-05 Bluetooth Module: Offers serial communication over Bluetooth, facilitating smartphone control for forward, backward, left, and right movements of the vehicle.

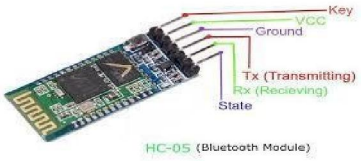

Fig 3 :- HC-05

3) LM2596 DC-DC Converter: Converts varying solar voltage to stable output, essential for reliable microcontroller and motor operation.

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Fig 4 :- LM2596 DC-DC Converter

4) Ultrasonic Sensor (HC-SR04): Measures distance to obstacles using sound waves. Useful for automated braking or alerting the user.

Fig 5:- Ultrasonic Sensor

5) L298N Motor Driver: Double H-Bridge motor driver used to control direction and speed of DC motors. Drives two hub motors attached to rear wheels.

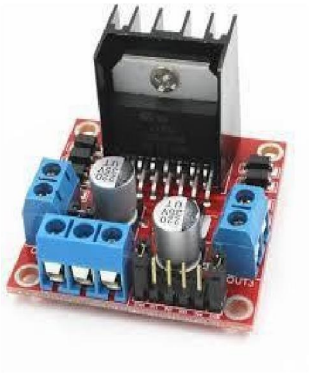

Fig 6:- L298N Motor Driver

6) 12V Battery: Stores solar energy with a long cycle life and stable performance, crucial for uninterrupted EV operation.

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Fig 7 :- Battery

7) Solar Panel (12V):- A solar cell is a key device that converts light energy into electrical energy in photovoltaic energy conversion

Fig 8:- Solar Panel

8) Buzzer :- A buzzer is an electronic device that emits sound when it is powered. It is commonly used in various applications for audio signaling, such as alarms, timers, notifications, or alerts. Buzzers are typically categorized into two types: active buzzers and passive buzzers

Fig 9 :- Buzzer

IV. CIRCUIT DIAGRAM AND OPERATION

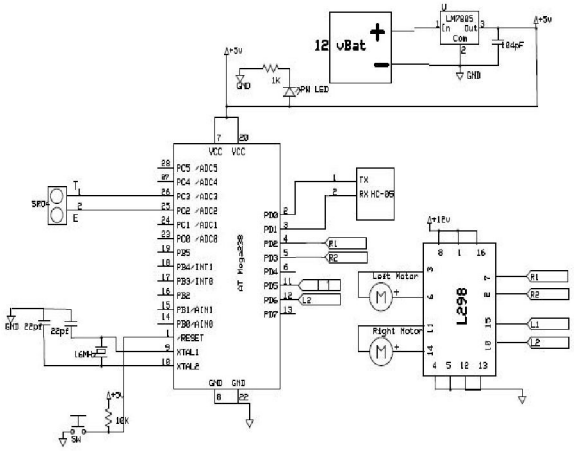

Fig 10:- Circuit Diagram

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The solar panel is mounted on the vehicle chassis and directly wired to the battery through the LM2596 voltage regulator. The regulated power feeds the microcontroller and the motor driver. The microcontroller reads user commands sent via Bluetooth and responds accordingly. The motors are powered based on the signals provided, and the ultrasonic sensor provides obstacle feedback to avoid collisions. The system also includes a buzzer to alert the user of potential hazards or operational statuses.

V. EXPERIMENTAL SETUP

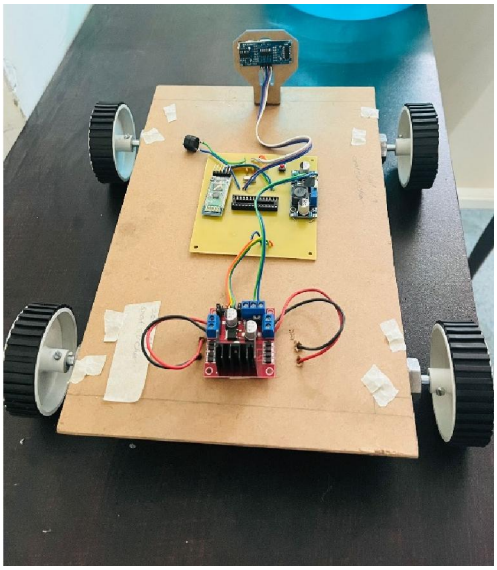

Fig.11. Experimental Setup

VI. CONCLUSION

The developed solar-powered electric vehicle prototype demonstrates a viable solution to reduce dependence on fossil fuels and support environmental sustainability. By integrating renewable energy harvesting, efficient energy conversion, smart control, and minimal mechanical components, the system achieves cost-effectiveness, low maintenance, and user-friendly operation. Applications of this model extend to educational institutes, industrial zones, and recreational parks, promoting awareness and adoption of clean transport technologies.

VII. MERITS AND DEMERITS-

Merits

It's a solar robot automobile that you can operate wirelessly.
Both reconnaissance and surveillance are possible with the robot.
It is extremely inexpensive and widely accessible.
The robot's diminutive size makes it suitable for use as a spy.
A design that is both simple and cost-effective.

Demerits:-

While operating on battery vehicle will not run at Sames peed as it drive with the fuel powered system. Also the time required to charge the battery by solar and wind energy will be little more

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VIII. APPLICATIONS

Scientific Use: The majority of the probes to the other planets in our solar system have been remote control vehicles.
Military and Law Enforcement Use: Remote-controlled vehicles are used by many police department bomb squads to defuse or detonate explosives.
Search and Rescue: This can be a great asset to save the lives of both people along with soldiers in case of terrorist attacks.
Forest Conservation.
Used in aviation and space flight.

IX. PROPOSED SYSTEM

The main objective of this project is to generate power using solar energy to run electric vehicles.
In this project, the system has been designed and installed to generate power using solar
It helps conserve energy by reducing the use of fuel in vehicles.

X. RESULT

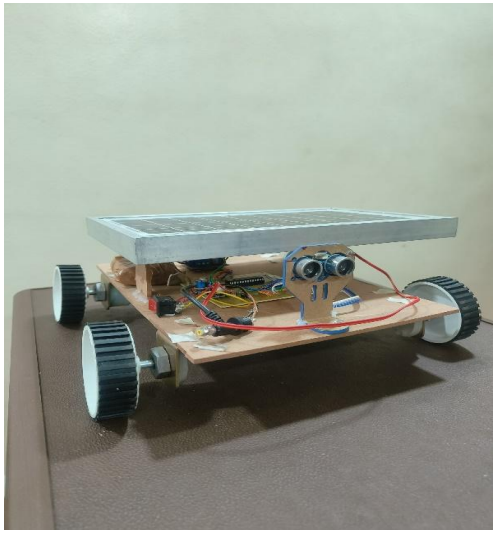

Fig.12.Final Result

XI. FUTURE SCOPE

For automatic obstacle detection and avoidance, IR sensors can be employed. The robot can be password-protected in the project so that the right password must be entered to run it. Receiving alarm condition notifications while the user is at work from their home would be fantastic.

XII. ACKNOWLEDGMENT

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