ELECTRIC VEHICLE UNIFIED WITH WIND AND SOLAR POWER

Mr. P. Manohar[1], B. Sai Pavani Kalyani[2], B. Narmada[3], C. Pavan Kumar Reddy[4], C. Prakash[5], P. Venu[6]

[1]Assistant Professor in Department of Electrical and Electronics Engineering & SRIT
[2]Student in Department of Electrical and Electronics Engineering & SRIT
[3]Student in Department of Electrical and Electronics Engineering & SRIT
[4]Student in Department of Electrical and Electronics Engineering & SRIT
[5]Student in Department of Electrical and Electronics Engineering & SRIT
[6]Student in Department of Electrical and Electronics Engineering & SRIT

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ABSTRACT - The global energy crisis and escalating pollution from vehicle emissions pose critical challenges, compelling a shift towards electric vehicles (EVs) as an eco-friendly remedy. Despite their environmental advantages, EVs confront a hurdle in extended charging durations. To combat this, the concept of onboard charging has been explored, where EVs autonomously generate and store electricity. This paper introduces a hybrid model harmonizing solar and wind energies to propel EVs, utilizing the vehicle's battery as a storage unit for surplus energy. Integrating both renewable sources enables continuous energy production, addressing the intermittent nature of solar and wind power. The system strategically prioritizes solar charging during daylight hours and switches to wind charging at night, optimizing energy utilization. Simultaneous usage of both sources enhances overall efficiency. This hybrid system ensures a reliable, sustainable charging solution, reducing dependence on conventional grids and curbing greenhouse gas emissions. The amalgamation of renewable energies into the transportation sector aligns with the global transition towards cleaner and sustainable energy practices. In summary, this hybrid model presents a pragmatic solution to the energy crisis and vehicle emissions, contributing to a greener and more sustainable transportation landscape.

Key Words: Hybrid Vehicle, Renewable Energy, Solar power, Wind power, Remote Control, Green transportation, Arduino Uno, Motor Driver, Ultrasonic Sensor.

1. INTRODUCTION

With the alarming depletion of fossil fuels and the consequential environmental degradation, there is an urgent need for alternative energy sources. Among the promising alternatives, wind and solar energy resources have garnered significant attention. As conventional energy sources struggle to meet the escalating demands, the utilization of other energy forms becomes imperative to bridge the gap. Particularly in urban areas, vehicle emissions significantly degrade air quality, further emphasizing the necessity for renewable energy solutions. Wind energy, harnessed through wind turbines, emerges as a frontrunner in the renewable energy landscape. Wind energy conversion systems capture the kinetic energy present in wind and convert it into electrical energy. Similarly, solar photovoltaic systems have gained traction globally due to their potential to harness solar energy on a large scale. However, both solar and wind energy systems exhibit limitations, primarily in their ability to provide consistent energy output.

Solar photovoltaic systems are reliant on sunlight and may struggle to generate power during cloudy days, while wind systems face challenges due to fluctuating wind speeds throughout the year. To address the intermittent nature of renewable energy sources, energy storage systems play a crucial role. These systems store excess energy generated by wind and solar components, ensuring a continuous power supply even during periods of low energy production. While energy storage systems are essential, their high cost and bulky size pose challenges to the cost-effectiveness of renewable energy solutions. In response to these challenges, hybrid renewable energy systems have emerged as a promising solution. By combining multiple energy production methods, typically solar and wind power, hybrid systems offer several advantages. Firstly, they enhance system reliability by leveraging the complementary nature of solar and wind power production. Additionally, hybrid systems enable a reduction in the size of battery storage, as they mitigate reliance on a single energy source. This reduction in battery size contributes to cost savings and improves the overall efficiency of the system. In the context of transportation, conventional electric vehicles face limitations in charging infrastructure and range anxiety. However, wind and solar- powered vehicles offer a viable solution to these challenges by integrating onboard charging capabilities. These vehicles harness energy from wind turbines and solar panels, directing it to onboard batteries for charging. This eliminates the need for external charging stations and enables continuous charging while the vehicle is in motion.

Therefore, the transition towards renewable energy sources, particularly wind and solar power, is essential to mitigate environmental degradation and address energy security concerns. Hybrid renewable energy systems offer a versatile solution to overcome the limitations of individual energy sources, while wind and solar-powered vehicles present a sustainable alternative to conventional transportation. By embracing these technologies, we can pave the way towards a greener and more sustainable future.

2. Literature Survey

[1]. In October 2011, Adejumobi et al. introduced the concept of Hybrid Solar and Wind Power as a vital solution for powering Information Communication Technology (ICT) infrastructure and rural communities. With the depletion of conventional energy sources, there's a pressing need to transition towards renewable energy sources for electricity generation. Integrating solar and wind energy systems offers a sustainable solution that minimizes environmental impact while ensuring uninterrupted power supply.

[2]. In a study published in Jan-Feb 2012, Kavita Sharma et al. addressed the challenges of designing a Hybrid Power Generation System using Wind and Photovoltaic Solar Energy, particularly focusing on Fuzzy controller for maximum power point tracking (MPPT) in varying environmental conditions. Traditional MPPT techniques often struggle to adapt to changing conditions, resulting in inefficient power generation. To overcome this, the Adaptive Neural Fuzzy Interference System (ANFIS) algorithm was proposed to achieve rapid and accurate MPPT, maximizing output power while minimizing system oscillations and tracking time.

[3]. In a study by Li, Y., Zhong, J., Chen, J., Liu, H., & Zhang, C. (2020), titled "Development and Application of Solar Energy Vehicles," the authors explored the development and application of solar energy vehicles (SEVs). The paper discusses the importance of SEVs in reducing greenhouse gas emissions and mitigating climate change. It highlights the challenges faced in the development of SEVs, such as limited energy conversion efficiency and high manufacturing costs, and proposes solutions to overcome these challenges. The study also presents various applications of SEVs in different sectors, including transportation, agriculture, and military. Additionally, it provides insights into future research directions and opportunities for the advancement of SEV technology.

2. Energy Demand

India's pivotal role in global energy demand growth from 2017 to 2040 sees coal as a significant contributor, leading to CO2 emissions doubling by 2040. Challenges in utility energy availability and peak load met during fiscal year 2018-19 underscore the importance of balancing supply and demand through regional transmission links. While energy surplus is projected for 2019–20, distribution challenges persist, emphasizing the need for efficient distribution mechanisms to ensure energy security amidst India's evolving energy landscape.

3. Reducing Carbon-di-oxide emissions and Importance of Renewable Energy

Reducing carbon dioxide emissions is imperative in combating climate change, with the most effective approach being the reduction of fossil fuel consumption. The Intergovernmental Panel on Climate Change (IPCC) underscores the human contribution to accelerated warming, primarily driven by industrial activities. Strategies for CO2 reduction span across residential, commercial, industrial, and transportation sectors. Renewable energies emerge as crucial solutions, offering clean, inexhaustible, and competitive energy sources. Unlike fossil fuels, renewables produce no greenhouse gases or polluting emissions. Their increasing affordability and global potential make them a pivotal player in the transition to sustainable energy. The International Energy Agency (IEA) reports that renewables accounted for nearly half of all new electricity generation capacity installed in 2019, emphasizing their growing importance globally. With world electricity demand projected to surge by 70% by 2040, renewables are poised to play a significant role in meeting future energy needs, particularly in emerging economies like India, China, and Africa.

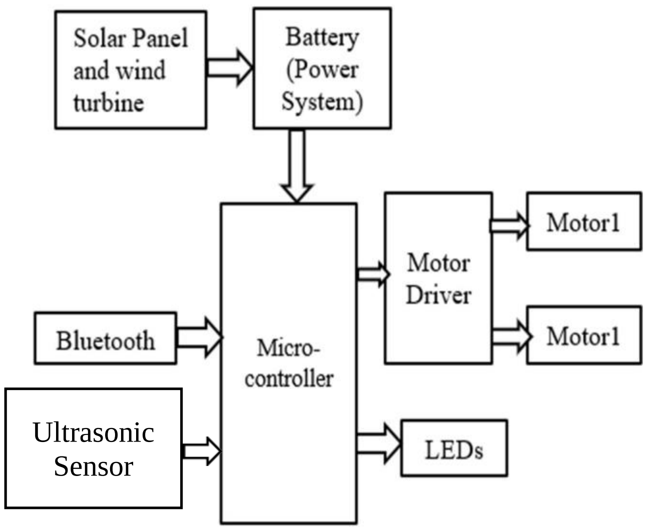
4. Objectives

- To promote the adoption of Electric Vehicles over traditional fuel-powered vehicles.
- To Reduce pollution from fuel vehicles by utilizing freely available renewable energy sources such as solar and wind energy.
- To create a system capable of generating electricity from wind and solar energy while vehicles are in motion.

5. Operation of the Proposed System

The wind and solar-powered car is designed for high efficiency and minimal maintenance, utilizing a unique charging and discharging system. The block diagram illustrates the functionality of the proposed system. As the vehicle operates, the motor draws power from the onboard battery. When the battery requires recharging, power is generated from wind turbines and solar modules, directing energy to recharge the battery while the vehicle remains in operation. This eliminates the need for the vehicle to be stationary for charging, enhancing its usability and efficiency.

The energy generated from the wind turbine is demonstrated using LEDs in the project, simulating the actual charging process. However, in practice, this energy aligns with the battery voltage ratings, facilitating efficient charging. Additionally, a Bluetooth module HC-05 is incorporated for remote operation, controlled via a Bluetooth controller application. The controller receives data signals from the Bluetooth module and translates them into corresponding outputs, enabling remote control functionality. To drive the vehicle's motors, a Driver IC L293D is utilized, receiving signals from the controller and providing appropriate voltage to the motor terminals. This allows for precise control of motor direction and speed. For forward movement, both motors receive 12V signals, while reverse movement requires the motors to receive 0V signals. Turning maneuvers are achieved by selectively stopping one motor while allowing the other to operate in the desired direction.



Block Diagram of the proposed System

Overall, the system efficiently harnesses renewable energy sources to power the vehicle, while enabling wireless remote control for enhanced usability and maneuverability.

Additionally, the vehicle is equipped with obstacle detection, which senses objects within a 30cm range and automatically stops the vehicle to ensure safety during operation.

6. Components used

I. Solar Panel

The electric vehicle prototype integrates a 70 x 70 sq.mm solar panel to absorb light, powering an LED indicator. When light falls on the panel, the LED illuminates, indicating the presence of sunlight and energy generation. This solar-powered LED system enhances the vehicle's visibility and signals the utilization of renewable energy. This integration enhances sustainability and reduces reliance on traditional power sources. Overall, the combination of solar and wind power technologies represents a significant advancement in eco-friendly transportation solutions.

Fig 1: Solar Panel

II. Battery

The electric vehicle prototype is powered by a 12V battery, serving as the primary energy source. Integrated with wind and solar power systems, it optimizes renewable energy to supplement and recharge the battery efficiently. Notably, the vehicle features onboard charging and discharging capabilities, enabling continuous power management while in operation. This innovative design ensures that the vehicle can both charge and discharge its battery while running, enhancing efficiency and usability

Fig2: Battery

III. DC Motor

In this project, a 12V DC motor is utilized to drive the electric vehicle, enabling movement in forward, backward, left, and right directions.

This motor serves as the primary propulsion system, providing versatility and maneuverability to the vehicle. With its reliable performance and precise control, the 12V DC motor ensures smooth navigation and operation of the prototype.

Fig3: DC Motor

IV. Bluetooth Module

The HC-05 Bluetooth module facilitates wireless communication in master or slave configurations, featuring six pins for various functions. These include Key/EN for mode selection, VCC for power, GND for ground, TXD and RXD for serial data transmission, and State for connection status indication. Operating at 3.3V, it can be powered by either 3.3V or 5V sources. The module is equipped with a red LED that indicates connection status; initially, it blinks periodically, but when connected to a Bluetooth device, the blinking slows to every two seconds. Pairing with smartphones requires a Bluetooth terminal app, and configuration is possible through command mode using AT commands, with a default baud rate of 38400bps.

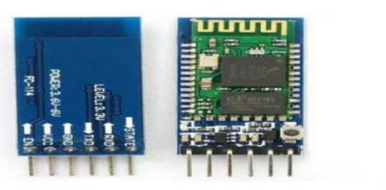


Fig4: Bluetooth Module

V. Motor Driver (L293D)

The L293D is a 16-pin IC motor driver circuit capable of controlling two DC motors simultaneously. It utilizes the H-bridge concept, allowing voltage to flow in either direction for motor rotation. Each L293D chip contains two H-bridge circuits, enabling independent control of two motors. Input pins regulate motor rotation based on logic signals, with high (LOGIC 1) and low (LOGIC 0) states determining motor direction.

Working of L293D:

The L293D has four input pins: pins 2 and 7 on the left, and pins 15 and 10 on the right. Inputs on the left side control the motor connected to the left output pins, while inputs on the right side control the motor on the right. To rotate a motor, apply Logic 0 or Logic 1 to the corresponding input pins.

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Fig5: L293D

For example, to rotate a motor connected to pins 3 and 6 clockwise, set pin 2 to Logic 1 and pin 7 to Logic 0. Conversely, for anticlockwise rotation, set pin 2 to Logic 0 and pin 7 to Logic 1. When both input pins are set to the same logic level, the motor remains idle.

VI. Ultrasonic Sensor

Ultrasonic sensors utilize sound waves to detect objects and measure distance without physical contact. They emit high-frequency sound pulses and measure the time taken for the echo to return, calculating the distance based on the speed of sound.

An ultrasonic sensor is incorporated into the vehicle to detect obstacles, ensuring it halts before reaching within 30 cm of the object. Upon obstacle removal, manual operation is required to initiate vehicle movement again.

Fig6: Ultrasonic Sensor

VII. LEDs

LEDs serve as indicators for solar and wind energy presence: when sunlight is available, LEDs associated with the solar panel illuminate; when wind energy is detected, LEDs linked to the wind source light up. If both solar and wind energy are accessible simultaneously, both corresponding LEDs illuminate, providing a visual indication of their availability.

Fig7: LEDs

VIII. Arduino Uno

The Arduino Uno ATmega328P serves as the brain of our project, facilitating communication and control between different parts. It regulates power distribution from the battery to all components. Additionally, it processes data from sensors, such as the ultrasonic sensor for obstacle detection, ensuring safe operation. The Arduino Uno also interfaces with the motor driver to control the vehicle's movement based on inputs received. Moreover, it coordinates the charging and discharging of the battery using energy from the solar panel and wind propeller, optimizing energy efficiency.

Fig8: Arduino Uno

IX. Wind turbine

In our project of an Electric vehicle unified with wind and solar power, we've incorporated a compact wind turbine capable of generating 3 to 5 volts of electricity. This energy is efficiently stored in the vehicle's battery, ensuring continuous power availability. Additionally, we've installed LEDs that illuminate as the vehicle's wheel rotates, demonstrating the utilization of renewable energy sources for efficient operation.

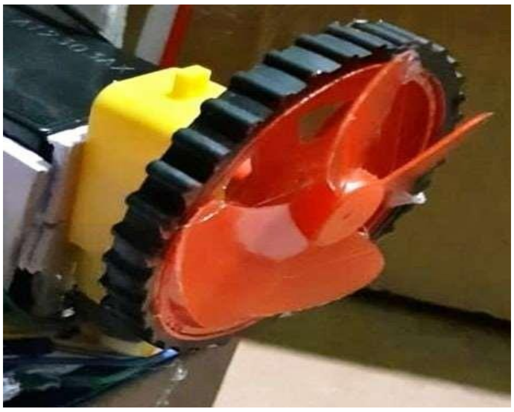


Fig9: Wind turbine

X. Power supply board

The power supply board in our project serves the purpose of distributing power efficiently to various components of the electric vehicle system. It ensures that each component receives the required voltage and current for proper operation, facilitating seamless functionality of the vehicle's electrical and electronic systems. Additionally, the power supply board helps in managing and regulating the power flow from the battery, solar panel, and wind turbine to maintain optimal performance of the vehicle's propulsion and auxiliary systems.

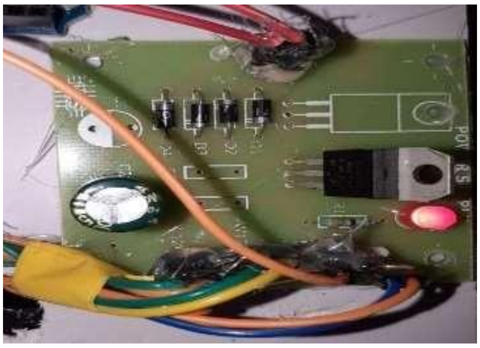


Fig10: Power supply board

7. Software Requirements

I. Arduino IDE

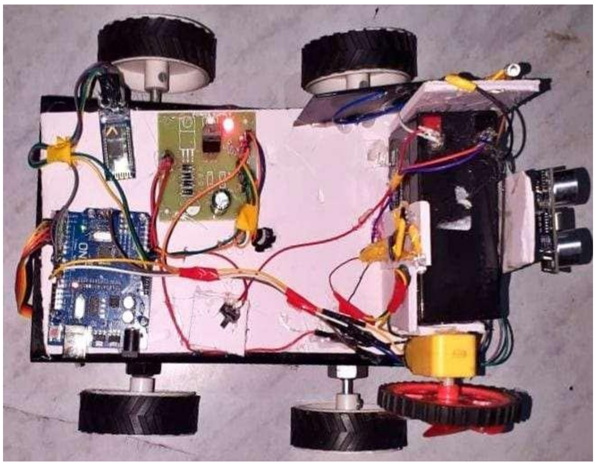
In the electric vehicle project, Arduino IDE is employed alongside the Arduino Bluecontrol application to facilitate wireless control. By inputting commands such as "l" for left, "r" for right, "f" for forward, "b" for backward, and "s" for stop, users can remotely maneuver the vehicle. This integration enhances the project's maneuverability and control, allowing for precise navigation. Leveraging Bluetooth technology, Arduino Bluecontrol enables seamless communication between the Arduino board and a smartphone, offering intuitive control options. The user-friendly interface of Arduino Bluecontrol simplifies the operation process, making it accessible to users of all levels. Overall, the integration of Arduino IDE and Bluecontrol enhances the electric vehicle project's control capabilities, enabling versatile and convenient operation.

The data from these sensors is transmitted to the driver's phone via Bluetooth, which then sends notifications to the nearest healthcare facility and the driver's relatives through text messages.

7. Result

During the comprehensive evaluation of the vehicle's performance, several key observations were made. Firstly, the vehicle exhibited a commendable responsiveness to Bluetooth commands, showcasing its ability to efficiently interpret and execute movement instructions sent wirelessly. This responsiveness underscores the effectiveness of the vehicle's control system, which seamlessly translates user inputs into corresponding actions, facilitating smooth operation and maneuverability. Furthermore, the vehicle's obstacle detection capabilities proved to be robust and reliable. Equipped with ultrasonic sensors, the vehicle demonstrated its capacity to detect obstacles in its path and respond promptly to mitigate potential collisions. Specifically, when an obstacle was detected within a proximity of 30cm, the vehicle initiated an automatic halt, effectively preventing any potential accidents or damage. This feature enhances the safety and security of the vehicle, making it suitable for various real-world applications where obstacle avoidance is paramount.

Moreover, the vehicle's performance was evaluated in terms of its operational range within a Bluetooth communication environment. It was observed that the vehicle maintained consistent and stable communication with the Bluetooth controller within a range of up to 15 meters. This extensive range provides users with ample flexibility and freedom to control the vehicle from a considerable distance, enhancing the overall user experience and usability of the system.



Prototype of the Equipment

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Bluetooth commands

Conclusion

The project successfully demonstrates the viability of an electric vehicle powered by a combination of solar and wind energy. The utilization of renewable sources presents a compelling alternative to traditional fuel-powered vehicles. The synchronization between the electric motor and Bluetooth module enhances the charging cycle efficiency of batteries. Through this innovative design, charging Lead acid batteries becomes feasible using a solar charging scheme and wind turbine. The durability and convenience for consumers are improved, showcasing the potential for widespread adoption in three-wheeler and four-wheeler vehicles. This research underscores the significance of harnessing renewable energy for sustainable transportation, offering higher efficiency than individual solar and wind systems. The working condition of the model affirms the successful capture of solar and wind energy, highlighting the substantial potential for energy production through these environmentally friendly sources. Overall, the project signifies a positive step toward greener and more eco-friendly electric vehicles.

References

[1]. In a ponder by Li, Y., Zhong, J., Chen, J., Liu, H., & Zhang, C. (2020), titled "Improvement and Application of Sun based Vitality Vehicles," the creators investigated the improvement and application of sun powered vitality vehicles (SEVs).

[2]. “Solar Fueled Electric car” by S. Nagaraju distributed in April 2023.

[3]. “A Ponder on Campus -Neighborly Sun powered Fueled Electric Vehicle” by Gangesh Shukla, Karmit Raval distributed in Feb 2019.

[4]. In October 2011, Adejumobi et presented the concept of Half-breed Sun oriented and Wind Control as a imperative arrangement for fueling Data Communication Innovation (ICT) foundation and provincial communities.

[5]. Chen, L., Huang, Y., and Wu, Z. (2020). "Plan and Sending of Wind-Solar Half breed Control Frameworks for Electric Vehicle Charging Offices: Case Considers and Usage Bits of knowledge." Worldwide Diary of Economical Vitality, 15(3), 320-335.

[6]. 4. Kumar, S., Sharma, N., and Singh, R. (2021). "Exploring the Integration of Renewable Vitality into Electric Vehicle Charging Framework: An In-depth Survey." Vitality and Environment Diary, 12(1), 150-165.