International Journal of Research Publication and Reviews, Vol (6), Issue (5), May (2025), Page – 6109-6112

WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Artificial Intelligence and IoT-Based Autonomous Hybrid Electric Vehicle with Self-Charging Infrastructure

Ms. Pooja M K*[1], Ms. Sumithra N V*,[2] Prof. Shruthy K N*[3]

B.E. Student,[1,2]*, Assistant Professor [3]

[1,2]Department of Electronics and Communication Engineering, Coorg Institute of Technology, Ponnampet-571216

A B S T R A C T:

The adoption of electric vehicles (EVs) is rapidly increasing worldwide due to their eco-friendly nature and zero carbon emissions. However, energy storage and charging infrastructure remain significant challenges that need to be addressed. This paper explores various solutions involving hybrid energy sources, plug-in hybrid electric vehicles (PHEVs), and fully electric vehicles (EVs). The integration of Internet of Things (IoT) and Artificial Intelligence (AI) in electric vehicles (EVs) enables advanced monitoring and optimization of charging systems. IoT sensors facilitate autonomous operation, self-charging, and vehicle-to-environment communication. AI's human-like decision-making capabilities enhance automation and efficiency in electric mobility. Ultimately, this synergy can contribute to the development of smarter urban infrastructure, creating a more efficient and sustainable transportation ecosystem.

I.INTRODUCTION

The integration of Artificial Intelligence (AI) and Internet of Things (IoT) technologies has revolutionized the automotive industry, particularly with the advent of Autonomous Hybrid Electric Vehicles (AHEVs). These vehicles combine electric propulsion with intelligent systems, providing a more efficient, sustainable, and autonomous transportation solution.

Key Features of AI and IoT-Enabled AHEVs

1. Autonomous Navigation: AI-powered sensors and navigation systems enable AHEVs to independently navigate complex traffic scenarios, reducing human intervention.
2. Automated Charging: IoT-enabled charging networks allow AHEVs to recharge autonomously, optimizing energy utilization and minimizing downtime.
3. Real-time Performance Monitoring: IoT sensors and AI-driven analytics facilitate continuous monitoring of vehicle status, energy consumption, and operational health.
4. Predictive Maintenance: AI algorithms predict potential mechanical issues, enabling proactive maintenance and enhancing vehicle reliability.

These features highlight the potential of AI and IoT integration in AHEVs to transform the transportation sector.

A. Self-Charging System

The concept of self-charging revolves around enabling an electric vehicle to recharge its batteries while in motion, thereby minimizing the time spent at charging stations.

DC Brushless Generators

- **Wheel-Mounted Generators:** 36V, 400W DC brushless generators are installed on both front and rear wheels, harnessing rotational energy.
- **Integration with Axle:** Generators are integrated with the vehicle's axle to maximize energy production.

Wind Turbine Generator

- **36V DC Wind Turbine:** Positioned at the front of the vehicle, this generator contributes to energy production.

Dual-Battery System

- **Simultaneous Charging and Discharging:** One battery powers the vehicle while the other is charged by the DC generators.
- **Automatic Switching:** The system switches to the fully charged battery once the active one is depleted, ensuring continuous operation.

Fig. 1 Circuit Diagram of the Self-Charging System

As the number of wheels increases the number of DC generators for each wheel system also increases and thus, we can shift from 2 battery systems to 3 battery systems.
The system can also introduce removable paddles and can also introduce solar panels and extra batteries if we need a more powerful vehicle.

Artificial Intelligence in Autonomous Driving:

Artificial Intelligence (AI) is integrated into the vehicle to enable autonomous operation, eliminating the need for human intervention. AI systems in the vehicle facilitate decision-making processes that control its movement. By utilizing various sensors, cameras, and cloud-based data, AI can gather real- time information from the environment.

The following sensors work in tandem to enable autonomous operation and assess traffic conditions:

1. **Camera:** Captures visual data for object detection, lane tracking, and traffic monitoring.
2. **Radar:** Uses radio waves to detect speed and distance of surrounding objects.
3. **Ultrasonic Sensor:** Measures proximity to objects for safe maneuvering.
4. **Lidar:** Creates high-resolution 3D maps of the environment for precise navigation.
5. **GPS:** Provides location data for route planning and navigation.
6. **801.11p:** Enables vehicle-to-everything (V2X) communication for real-time traffic updates.
7. **Wheel Encoder:** Tracks wheel rotation for accurate speed and distance measurement.
8. **Onboard Unit:** Processes sensor data and executes autonomous control commands.
9. **Maps:** Provides pre-mapped data for route planning and navigation.
10. **Motion Sensor:** Detects vehicle motion and orientation for stable control.

This comprehensive sensor suite enables the autonomous vehicle to perceive its environment, make informed decisions, and operate safely and efficiently.

Solar Charging System:

Solar energy supplements the vehicle's power supply, enhancing its efficiency and sustainability. Key aspects include:
1**. Solar Panel:** Directly connected to the battery, the solar panel charges it, providing power to the vehicle.
2. **Continuous Charging:** The battery is charged through multiple sources, including solar energy, while the vehicle is in operation.
This integration of solar energy reduces dependence on external power sources and contributes to a more environmentally friendly transportation solution.

Fig: Solar Setup

Simulation Methodology:

In the proposed system, the Arduino UNO microcontroller is used to manage the vehicle's operations, interfacing with the L293D Motor Control circuit. The motors M1, M2, M3, and M4 are connected to the output pins of the L293D Motor Control circuit and are controlled by the Arduino. The vehicle will not function unless the Arduino is properly linked to the control system. Additionally, the motors are arranged in an H-bridge configuration, allowing the vehicle to drive the motors in both forward and backward directions.

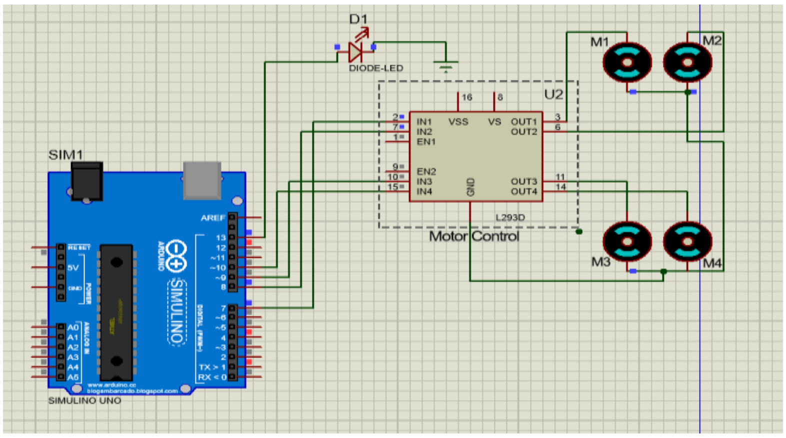

Fig. III Simulation of Vehicle

Results and discussion:

Table I Results of Plugin Charge of Battery

Battery Discharge(V)	Battery Voltage(V)	Time
12.3	6	0:00
11.35	8	0:20
10.37	11.3	0:40
10.33	11.7	1:00

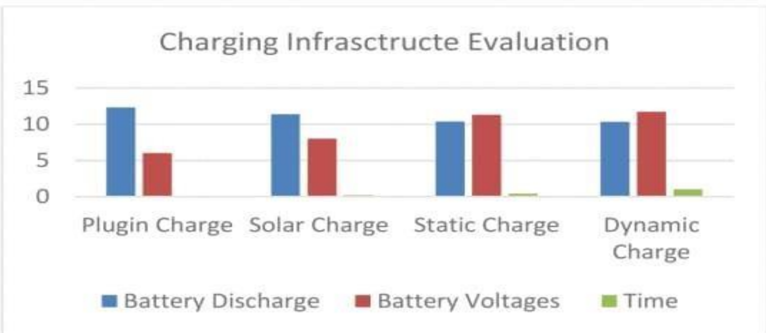

Fig. Graph of Results

CONCLUSION

The increasing demand for Hybrid Electric Vehicles (HEVs) reflects a global shift toward sustainable and environmentally conscious transportation. The integration of autonomous driving technologies further elevates the capabilities of HEVs, making them smarter and more adaptable to modern mobility needs. This trend is largely fueled by the ongoing depletion of fossil fuels and growing concerns over air quality and environmental sustainability.

Autonomous HEVs present a cleaner and more cost-effective alternative to conventional vehicles, offering intelligent features and enhanced performance while significantly lowering dependence on non-renewable energy sources. Their role is especially significant in the vision of smart cities, where interconnected IoT systems optimize traffic flow and vehicle operations.

The proposed design merges autonomous navigation with self-charging technology, addressing major challenges related to energy efficiency and human reliance. Benefits include reduced operational costs, decreased reliance on oil imports, and real-time system monitoring. Although similar solutions are limited in the current market, the introduction of such a vehicle could offer a strong competitive edge, appealing to consumers seeking fuel-free, time-saving, and intelligent transport options.

REFERENCES

[1] Terken, J., & Pfleging, B. Toward shared control between automated vehicles and users. Automotive Innovation, 3(1), 53-61. 2020.

[2] Van Arem, B., Van Driel, C. J., & Visser, R. (2006). The impact of cooperative adaptive cruise control on traffic-flow characteristics. IEEE Transactions on intelligent transportation systems, 7(4), 429-436.

[3] Abatan O.A, Adewale A.O, Alabi A.A, Constant Electricity Generation From Self-Charging Inverter, IJETAE ISSN 2250-2459, ISO 9001:2008 Certified Journal, Volume 3, Issue 12, December 2013.

[4] B. Gao, K. Cai, T. Qu, Y. Hu, and H. Chen, "Personalized adaptive cruise control based on online driving style recognition technology and model predictive control," IEEE transactions on vehicular technology, vol. 69, no. 11, pp. 12 482–12 496, 2020.

[5] A. Emadi, Y. J. Lee, and K. Rajashekara, "Power electronics and motor drives in electric, hybrid electric, and plug-in hybrid electric vehicles," IEEE Trans. Ind. Electron, vol. 55, no. 6, pp. 2237–2245, June 2008.

[6] C. Chan, "The state of the art of electric, hybrid, and fuel cell vehicles," Proc. IEEE, vol. 95, no. 4, pp. 704–718, Apr. 2007.

[7] A. Amin et al., "A Review of Optimal Charging Strategy for Electric Vehicles under Dynamic Pricing Schemes in the Distribution Charging Network," 2020.

[8] M. Networks, A. Mohammad, F. Ahmad, M. S. Alam, and Y. Rafat, "IoT Enabled Monitoring of an Optimized Electric Vehicle ' s Battery System," no. October 2017, 2018, DOI: 10.1007/s11036-017-0957-z.

[9] V. Suhas, S. Calastawad, M. Phaneesh, and S. Swaraj, "PERFORMANCE OF A BATTERY ELECTRIC VEHICLE WITH SELF CHARGING CAPACITY FOR ITS PROPULSION," pp. 2313– 2321, 2015.

[10] Plamen Petrov, Mathematical Model for Control of an Autonomous Vehicle Convoy, WSEAS TRANSACTIONS on SYSTEMS and CONTROL; ISSN: 1991-8763: Issue 9, Volume 3, September 2008

[11] Y. Liu, Z. Wang, K. Han, Z. Shou, P. Tiwari, and J. Hansen, "Vision cloud data fusion for adas: A lane change prediction case study," IEEE Transactions on Intelligent Vehicles, pp. 1–1, 2021

[12] P. I. Krogh and C. E. Thorpe, "Integrated Path Planning and Dynamic Steering Control for Autonomous Vehicles," pp. 1664–1669.

[13] S. Urooj, F. Alrowais, Y. Teekaraman, and H. Manoharan, "IoT Based Electric Vehicle Application Using Boosting Algorithm for Smart Cities," 2021.

[14] R. V. I. S, "AN INTRODUCTION OF AUTONOMOUS VEHICLES AND A BRIEF SURVEY," vol. 7, no. 13, pp. 196–202, 2020.

[15] J. A. Afonso and R. A. Sousa, "IoT System for Anytime / Anywhere Monitoring and Control of Vehicles Parameters," 2020.

[16] R. Ravi, U. Surendra, N. Shreya, and R. Ravi, "EasyChair Preprint Comparative Analysis of Various Techniques of IoT in Electric Vehicle Comparative analysis of various techniques of IoT in Electric vehicle," 2020.

[17] C. Hodge, B. O. Neill, and K. Coney, "EFFECTIVENESS OF ELECTRIC VEHICLE POLICIES AND IMPLICATIONS FOR PAKISTAN," no.

July 2020.

[18] C. C. Chan, "The State of the Art of Electric and Hybrid Vehicles," vol. 90, no. 2, 2002.