International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 12 Issue: 03 | Mar 2025 www.irjet.net p-ISSN: 2395-0072

DESIGN AND IMPLEMENTATION OF A HYBRID ELECTRIC BIKE WITH DIGITAL MONITORING SYSTEM

Dr. M. Ganesh Kumari[1]

M.K. Ajith Kumar [2], K.K. Balakumar[3], V.S. Dhanushkumar[4]

[1] Assistant Professor (Sr.Gr.), Department. of Electrical and Electronics Engineering, K.L.N. College of Engineering, Tamil Nadu ,India.

[2,3,4] UG Scholar, Department of Electrical and Electronics Engineering, K.L.N. College of Engineering, Tamil Nadu ,India.

Abstract - *The rise of electric mobility has significantly impacted the transport sector by addressing environmental concerns. Electric Vehicles (EVs) introduce challenges such as charging schedules, station placement, and energy demands. To address this, we propose a solution that integrates solar power with grid power for EV charging. Solar panels help reduce grid dependency and greenhouse gas emissions. A relay prioritizes solar power when available, ensuring cost-effectiveness. A cascaded buck-boost converter and an AC-DC converter manage voltage conversion. An Arduino, integrated with a relay and sensing circuit, monitors voltage and current, optimizing power flow. This approach enhances renewable energy use, promoting sustainable electric mobility.*

Key Words: **Electric Vehicles (EVs), Digital Display, Battery Charging Schedules, Sustainability , Arduino.**

1. INTRODUCTION

The internal combustion engine (ICE) revolutionized transportation with reliability and extended range. However, ICE vehicles pose challenges like poor fuel efficiency, pollution, and rising fuel costs. Hybrid electric vehicles (HEVs) provide a sustainable solution by combining petrol and electric power, reducing emissions while improving efficiency. This project focuses on designing a hybrid bike that utilizes electric power to charge a battery, driving the motor and minimizing fuel dependency. An advanced digital display will provide real-time data on speed, battery status, fuel level, and energy consumption, enhancing performance monitoring. Addressing challenges like energy management and battery optimization, this project integrates ICE dependability with electric sustainability, contributing to cleaner and cost-effective urban transportation in India.

2. Proposed System:

The proposed Hybrid Electric Vehicle (HEV) system integrates a digital display and energy management system for efficiency and sustainability. It operates on both electric and petrol power, enabling seamless transitions to optimize energy use. A 48V, 28Ah battery powers a 48V, 250W motor, ensuring efficient electric propulsion. The energy management system regulates battery usage, preventing overcharging and deep discharging to extend battery life. A digital display provides real-time data on speed, battery voltage, and fuel level for driver awareness. Sensors monitor vehicle speed and battery status to ensure safe operation, with low-battery alerts and an automatic engine shutdown feature for protection. Testing focuses on smooth mode transitions, energy efficiency, and safety. The system reduces fuel consumption and enhances battery lifespan. Future improvements include regenerative braking for energy recovery and wireless monitoring. This project supports sustainable transportation with a cost-effective and eco-friendly hybrid vehicle solution.

Block Diagram

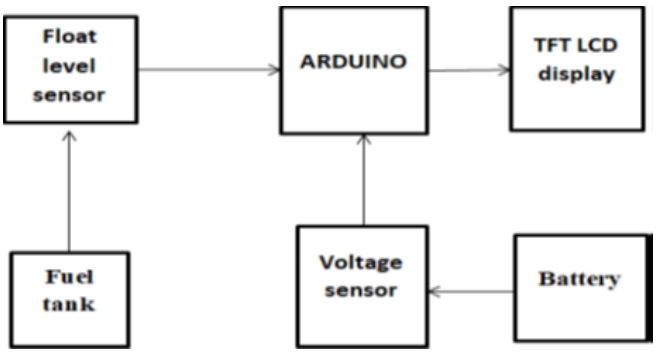

Figure 1: Block Diagram of Proposed System

Figure 1 shows that the Arduino processes data from a float level sensor to monitor fuel levels and a voltage sensor to track battery status. It then displays real-time information on a TFT LCD screen. A battery powers the system, ensuring continuous operation and providing an efficient monitoring solution for fuel and voltage levels.

3. Working Principle

The Hybrid Electric Vehicle (HEV) operates by integrating electric and petrol power to optimize energy efficiency and performance. A 48V, 28Ah battery powers a

48V, 250W motor for electric propulsion, reducing fuel consumption and emissions, while a microcontroller-based control system monitors battery voltage, vehicle speed, and throttle position to ensure smooth transitions between modes. In electric mode, the battery drives the motor, making it ideal for low-speed or short-distance travel, while the petrol engine activates when additional power is needed or the battery charge is low. The energy management system regulates battery charging and discharging, preventing overcharging and deep discharging to extend battery life. A digital display system provides real-time data on speed, battery level, and fuel status, enabling better driver control. Safety features such as low-battery alerts and automatic engine shutdown protect the system under critical conditions, while a speed monitoring system ensures stable operation. This intelligent power management strategy enhances vehicle efficiency, ensures reliability, and supports sustainable transportation, making the HEV a cost-effective and eco-friendly alternative to conventional vehicles.

Figure 2: Digital Display

Figure 2 shows that the digital display in the Hybrid Electric Vehicle (HEV) provides real-time information to the rider, including speed, fuel level, and battery status, enhancing user experience and enabling informed decision-making during operation.

Figure 3: Lead Acid Battery

Figure 3 shows that the lead-acid battery is a reliable and cost-effective power source. We are using a 48V, 28Ah battery to ensure a stable power supply for our vehicle.

Figure 4: Hardware Implementation

Figure 4 shows that the hardware implementation of the complete project kit.

4. Result and Discussion

Testing the Hybrid Electric Vehicle (HEV) in urban, suburban, and highway environments demonstrated a significant improvement in fuel efficiency, particularly in city driving, where the electric mode was predominantly active. Compared to conventional internal combustion engine (ICE) vehicles, fuel consumption was reduced by approximately 25-30% in urban settings, lowering emissions and reducing environmental impact. On highways, the petrol engine recharged the battery, extending the vehicle's range without external charging. The digital display system provided real-time feedback on speed, battery charge, fuel level, and energy consumption, helping drivers optimize performance. The battery management system and regenerative braking played crucial roles in maintaining battery health and recovering kinetic energy during deceleration, enhancing efficiency in stop-and-go traffic. These outcomes highlight hybrid vehicles as a practical solution for urban mobility, offering a balance between efficiency and sustainability. Future improvements could focus on optimizing battery technology and expanding infrastructure for broader hybrid adoption.

Table 1: Result Statistics

S.No	Mode	Price(Rs)	Distance(Km)
1	Petrol	101/-	60
2	Battery	8.30/-	40
3	Hybrid mode	112.2/-	100

The result statistics are shows in Table 1. The table presents a cost comparison of different operational modes for a hybrid two-wheeler, highlighting the price per mode and the corresponding travel distance.

5. Conclusion

The Hybrid Electric Vehicle (HEV) efficiently integrates gasoline and battery power to optimize performance based on driving conditions. It operates on battery power during low-speed city driving, reducing emissions, while the gasoline engine activates during high-power demands for efficiency. This dual-mode operation enhances fuel economy, achieving twice the mileage of conventional vehicles while cutting emissions by 50%. HEVs are particularly beneficial in urban areas, minimizing pollution and fuel wastage, making them a sustainable solution for modern transportation.

6. Mapping of Sustainable Development Goals

1.SDG 7: Affordable and Clean Energy

The project promotes the use of hybrid technology, combining electric and petrol power to enhance energy efficiency and reduce dependence on fossil fuels. By improving the energy utilization in vehicles, it contributes to making energy systems more sustainable and accessible.

2.SDG 9: Industry, Innovation, and Infrastructure

The project embodies innovation in automotive technology, showcasing how advancements in hybrid systems can lead to more sustainable industry practices. It encourages investment in sustainable infrastructure that supports green transportation solutions.

3.SDG 11: Sustainable Cities and Communities

The development of hybrid vehicles supports the creation of sustainable urban transportation solutions, helping to reduce traffic congestion and air pollution. This contributes to building resilient infrastructure and fostering inclusive and sustainable urbanization.

4.SDG 13: Climate Action

By reducing greenhouse gas emissions through the integration of electric power in vehicles, the project addresses climate change challenges. It promotes cleaner technologies and practices that contribute to global climate action efforts.

7. Acknowledgement:

We thank our mentors and advisors for their guidance, and our institution for providing the necessary resources. Our peers and colleagues also played a key role through their collaboration and support. We appreciate the contributions of industry experts and research references that helped shape our project. Lastly, we are grateful to our families and friends for their constant encouragement and motivation.

8. References:

[1] Sharada Prasad N and Dr. K R Nataraj, "Design and development of hybrid electric two-wheeler with solar charging methodology" in International Journal of Scientific & Engineering Research, Volume 5, Issue 11, November 2014.

[2] Yasmeen Malik and Vikas Kumar, "A Review on Hybrid Electric Vehicle" in International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, Vol. 6, Issue9, September 2017.

[3] Pappuri Hazarathaiah ,Y.Ashok Kumar Reddy , P.Vijaya Bhaskara Reddy and M.Sreenivasulu, "Design and Fabrication of Hybrid Electric Bike" in International Journal of Applied Engineering Research, Volume 14, Number 4 (2019), pp. 930-935

[4] N.Boopalan, Marlon Jones Louis ,A.K.Nachimuthu,"Design and Fabircation of Hybrid Two Wheeler" in International Journal of Research and Innovation in Engineering Technology,Volume 01, Issue: 01, Pages 8 – 12, April-2020.

[5] Kamatchi Kannan V, Ponmurugan P and Chitra K,"Design and Development of Hybrid Two-Wheeler" in International Journal of Scientific & Technology Research, Volume 9, Issue 01, January2020

[6] Balasubramani N, Hari Prasath S, Jagadeesh Kumar A, Karna Prakash S, and Karun Prasath D, "Fabrication and Performance Analysis of Hybrid Two Wheeler" in International Research Journal of Engineering and Technology, Volume: 05, Issue:03, Mar-2018.