IJTRET "Voice of Innovative Minds"
International Journal of Trendy Research in Engineering and Technology
Volume 8 Proceedings of NCCDS-24
ISSN NO 2582-0958

DESIGN AND DEVELOPMENT OF HYBRID POWER SYSTEM OF TWO-WHEELER

Harshitha H S [1], Ananya Jois [1], B V Manasa [1], Inchara K S[1], Smt.Bharathi. R[2]
[1]UG Student, Dept. of Electronics and Communication, GSSSIETW, Mysuru, India.
[2]Assistant Professor, Dept. Of Electronics and Communication, GSSSIETW, Mysuru, India.
bharathi@gsss.edu.in

Abstract

The integration of Electric vechicles that are hybrids (HEVs)) into automotive engineering marks a significant advancement, combining electric motors and internal combustion engines to enhance fuel efficiency and reduce emissions. Managing power distribution between these sources, particularly during low battery levels, presents challenges. In this paper, we propose a novel control system utilizing an ESP32 microcontroller as the central unit. This system seamlessly switches between electric and fuel propulsion modes based on preset thresholds, optimizing vehicle efficiency and ensuring continuous operation. Real- time monitoring and visual feedback mechanisms enhance user experience and reliability. Our research aims to overcome existing hurdles in hybrid vehicle technology, promoting widespread adoption and contributing to a more sustainable automotive future. Additionally, we detail our specific contributions in developing and implementing this control system within the context of hybrid two-wheelers.

Keywords —Hybrid Electric Vehicles (HEVs), ESP32 microcontroller, Power distribution, Fuel efficiency, Real-time monitoring, Energy efficiency, User-friendly interface, Sustainable transportation

I. INTRODUCTION

In contemporary automotive engineering, the progress of hybrid vehicles [1, 6, 8, 12] represents a significant innovation, blending two distinct power sources to propel vehicles efficiently and sustainably. These cars combine electric motors with internal combustion engines. [4, 14] offering enhanced fuel efficiency, reduced emissions, and a versatile driving experience. Hybrid configurations vary, including diesel/electric, petrol/electric, and fuel/battery setups. One defining feature of hybrid vehicles is their ability to operate in multiple propulsion modes, seamlessly transitioning between an internal combustion engine, and electric motor based on driving conditions for optimal performance and efficiency [3, 7]. Series hybrids utilize the internal combustion engine primarily as a generator, while parallel hybrids integrate both power sources directly into the vehicle's transmission. Different driving circumstances, such stop-and-go traffic or interstate travel, are catered to by the distinct advantages that each configuration offers. As the automotive industry progresses, hybrid vehicles represent a strategic convergence of electric and traditional propulsion [2, 5, 11] technologies, providing consumers with environmentally conscious options without compromising practicality. This paper explores the intricacies of hybrid vehicle technology, its benefits, and its role as a pivotal step towards more sustainable and efficient transportation solutions.

II. LITERATURE SURVEY

[1] Hassan Moghbelli, et al proposed a solution to mitigate gasoline emissions involves integrating Compressed Natural Gas (CNG) into propulsion systems. This entails establishing a strong CNG infrastructure, advancing propulsion technologies, transitioning vehicle fleets, promoting public awareness, and securing regulatory support. Through these efforts, the solution aims to substantially decrease greenhouse gas emissions, bolster energy independence, spur economic growth, and enhance public health, fostering a cleaner and more sustainable transportation future.[2] Barai Santhosh Santram, et al suggested a fix for combat the depletion of traditional fuels and mitigate global warming, a practical solution involves integrating separate gas-kits into vehicles. These kits deliver a metered mixture of gas and air directly into the engine cylinder through the carburetor, offering a sustainable energy source. By adopting this technology, we address the environmental impact of conventional fuels, reduce carbon footprint, and contribute to a healthier, more environmentally friendly world.[3] Aman Sharma, proposed that developing a dual-fuel bike with LPG presents challenges, including the absence of retrofit kits for existing bikes and the need for custom components due to size constraints. Integrating an LPG cylinder and gas kit requires careful consideration of limited space and weight issues, potentially necessitating

custom fabrication. Addressing safety, regulatory, and certification requirements adds complexity. However, successful implementation could yield environmental benefits and provide riders with expanded fuel options. [4] Akash Anil Vaidya, et al proposed that Traditional internal combustion engine bikes are not just costly, but also environmentally damaging, necessitating frequent maintenance. The solution lies in the replacement of IC engines with electric motors, offering a cleaner and more cost-effective alternative. Electric bikes eliminate the need for fuel, reduce emissions, and require less maintenance, contributing to a sustainable and efficient transportation future.[5] A.Rakesh Kumar, et al proposed ,India faces a substantial challenge in aligning with global development trends to transition the transition of the transportation sector from ICE to electric vehicles (EVs). The key techniques involved in this shift primarily revolve around battery swapping and power conversions. Putting these tactics into practice not only addresses the effects on the environment but also accelerates the adoption of EVs by providing efficient and convenient solutions for charging and power management, contributing significantly to The development of sustainable transportation practices on a global scale.[6] Ibrahim Shanono, et al proposed a solution HEVs encounter challenges like engine power limitations, electrocution risks from high-voltage batteries, high initial and maintenance costs, and low market adoption. Methodology: This study examines the hybrid electric vehicle (HEV) in parallel architecture, emphasizing simultaneous power delivery by the internal combustion engine and electric motor for efficiency and size benefits.[7] Tuan Nguyen Thanh, et al proposed a solution Focusing on finding new energy sources to replace traditional fuel and to select equipment, design and manufacture a system to supply bi-fuels. Techniques employed are emission analysis, optimization of mixer design for efficient combustion and fuel delivery.[8] Kalagotla Chenchireddy, et al proposed that, Early electric vehicles faced limited range due to battery constraints. Hybrid power systems combine electric and internal combustion engines to extend the range for longer trips. Vehicle starts with electric motor to avoid idling an internal combustion engine kick in as needed, and a generator operates during coasting and braking.

III. OBJECTIVES

1. Design an auto control system which switches from battery system to petrol system and vice versa.
2. Monitoring the battery level
3. Monitoring fuel meters.
4. Cruice control
5. Automatic speed controlling and breaking.

IV. METHODOLOGY

The proposed hybrid system incorporates an ESP32 microcontroller as its central control unit, overseeing the operation of peripheral components and managing battery status through a voltage sensor. This arrangement enables efficient management of power distribution between electric and petrol modes. When the battery level exceeds 20%, the ESP32 directs the motor wheel, ensuring seamless propulsion. Conversely, if the battery level drops below 20%, control switches to a fuel pump via a relay module, maintaining continuous vehicle operation. Real-time instructions and status updates are prominently displayed on an LCD screen, offering users immediate feedback on the system's operation.

In addition to the core control mechanism, the system integrates ultrasonic sensors to enhance functionality. Sensor-1 is dedicated to monitoring fuel levels by emitting high-frequency sound waves and analyzing their reflections to accurately gauge fuel levels in tanks or containers. Meanwhile, sensor-2 is essential to the automatic braking system by detecting obstacles or objects in the vehicle's path. By emitting ultrasonic waves and analyzing their reflections, the sensor can trigger automatic braking if a collision is imminent, significantly enhancing safety and accident prevention.

Furthermore, the integration of these components ensures a robust and user-friendly interface. In instances where the battery level falls below the predefined threshold, the voltage sensor triggers the ESP32 to switch control to the fuel pump, facilitating continuous motion through the vehicle's engine. All instructions and status updates are continuously displayed on the LCD screen, providing users with comprehensive feedback on the system's operation. This holistic approach to hybrid system design not only optimizes energy efficiency but also enhances safety and reliability, transforming it into a compelling solution for sustainable and efficient

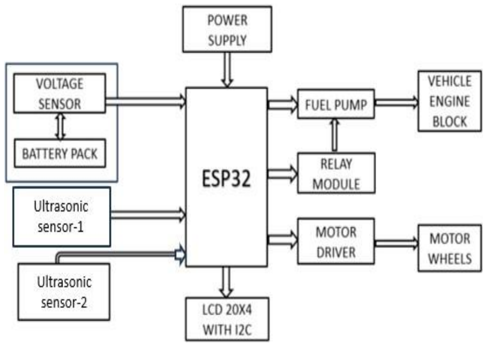

Fig. 1 Block diagram of Hybrid Power system of two-wheeler

FLOW DIAGRAM

Once the process starts all the sensors (Ultrasonic and voltage sensor) and the modules (Relay module) are initialized, Then the condition arises which states that the proportion of the battery is less than or equal to 20% this condition has to perform in two scenarios, this is explained in the below figure 2,

1. When the condition is true i.e., battery percentage is less than 20% the control system is switched to the engine system with the help of relay module later then the fuel tank is picturized where the motor is ignited and fuel is pumped moving on further the fuel tank capacity is measured. Again, a condition arises which states that the capacity of the fuel is less than or equal to 20%. If the condition is satisfied it is notified on the LCD for refill or else the loop continues. Then the movement of the vehicle is determined by the energy driven from the motor driver that moves the vehicle and the process comes to an end.
2. If the condition is not satisfied i.e., the battery percentage is not below the threshold value there will be a direct connection to the motor driver that in return gives the moment to the wheel that determine the movement as the output and then process is at rest.

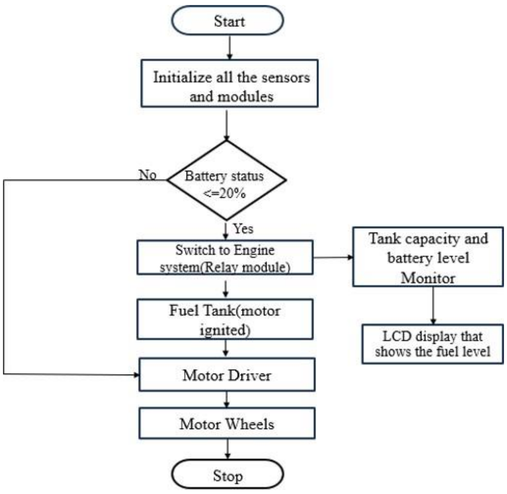

Fig.2: Flow diagram of Hybrid Power system of two-wheeler

V. RESULTS

Regulated power supply is constantly given to both ESP32 and the battery pack (voltage sensor and battery).

Voltage sensor keep on monitoring the status within the battery and keeps instructing the ESP32 about the battery level. Whenever the battery level sensed by voltage sensor is above 20%, instruction is sent to ESP32 regarding the same, thus ESP32 drives the motor driver which in turn drives the motor wheel and keeps the vehicle moving.

Now when Battery level status is below 20%, that is sensed by the voltage sensor and the instruction is sent to ESP32, then Relay module is used to switch the control from motor drive to that of Fuel Pump, this fuel pump is connected to the vehicle engine, thus flowing of fuel to vehicle engine keeps the vehicle in motion.

All the instructions will be continuously displayed on LCD.

Thus, serving the purpose successfully.

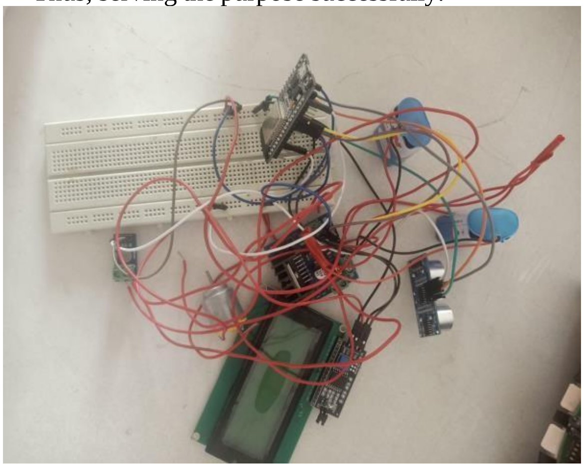

Fig3 Hardware model of Hybrid Power system of two-wheeler

VI. CONCLUSION

In conclusion, the proposed integration of an ESP32 microcontroller into a hybrid two-wheeler system, featuring electric power as the primary mode and petrol as a backup, offers a promising solution for efficient and adaptable transportation. By leveraging intelligent control logic facilitated by the ESP32, the system optimizes energy usage and seamlessly transitions between electric and petrol modes, ensuring a balanced and reliable riding experience. This integration anticipates enhanced energy efficiency, particularly for short-distance urban commuting, while providing a safety net for extended journeys through the petrol backup system. Real-time monitoring features provided by the ESP32 contribute to a user-friendly interface, enhancing rider awareness and convenience. Overall, the expected outcome is a technologically advanced, sustainable, and versatile two-wheeler transportation solution that meets the diverse needs of riders, promising an efficient and reliable commute in both urban and long-distance settings.

A. Advantages

1. Energy Efficiency
2. Adaptability
3. Realtime Monitoring
4. Versatile Mobility
5. Reduced Environmental Impact
6. Improved power efficiency
7. High performance

B. Limitations

1. Technical Vulnerabilities
2. Complexity and Costs
3. Increased Weight

C. Future Scope

Potential advancements in hybrid two-wheeler technology include improvements in battery efficiency, exploration of alternative fuel sources, and development of advanced control algorithms for seamless mode transitions. These innovations aim to enhance vehicle performance, reduce environmental impact, and offer more sustainable urban commuting options.

ACKNOWLEDGMENT

We offer our sincere phrases of thanks to Smt. Vanaja B Pandit, Honorary Secretary, Dr. Shivakumar M, Principal and Dr. Rajendra R Patil, Professor and Head, Dept. of ECE and also Smt.Bharathi.R, Assistant Professor, Dept. of ECE, GSSSIETW, Mysuru for her guidance, motivation and support. We would also like to thank all the staff of ECE department for their support.

REFERENCES

1. Hassan Moghbelli, et al proposed "Conversion of Gasoline Vehicles to CNG Hybrid vehicles (CNG-Electric vehicles)": 05 August 2013.Research Journal of Applied Sciences, Engineering and Technology.
2. Barai Santhosh Santram, et al proposed "Dual Fuel Bike (LPG cum Petrol)": April 2015-September 2015.International journal of recent research in civil and mechanical engineering.
3. Aman Sharma, proposed "Dual fuel system used in bike": November 2017. International journal of science and research (IJSR).
4. Akash Anil Vaidya, et al proposed "Conversion of IC engine Bike into Electric Motor bike": April 2019. Journal of emerging technologies and innovative research (JETIR).
5. A.Rakesh Kumar, et al proposed "Electric Vehicles for India :Overview and challenges": 02 April 2019. IEEE India Info.
6. Ibrahim Shanono, et al proposed "Hybrid Electric Vehicles: A Mini-Overview": 26 February 2021. Journal of modern manufacturing systems and technology (JMMST).
7. Tuan Nguyen Thanh, et al proposed "A Study of CNG Fuel system uses mixer for Engine of the Suzuki Viva Motorcycle": 01 January 2022. International Journal of Mechanical Engineering and Robotics Research.
8. Kalagotla Chenchireddy, et al proposed "Hybrid electric vehicles and battery electric vehicles": 02 December 2022.Teegala Krishna Reddy Engineering College Hyderabad, Telangana, India
9. Dipanjan Mazumdar, Surajit Das, N Pramila Rao, A.Sivakumar, S.Jabez Dhinagar, Development of 48 V Starting Systems for a Two Wheeler Parallel Hybrid,2013.
10. Ruthvik P. Sankar, Sagar N, Sarthak J, Shubham P. Toraskar,Yashvanth Kumar "Design and Development of Smart Hybrid TwoWheeler" International Journal of Innovative Research in Science,Engineering and Technology Vol. 6, Issue 6, June 2017.
11. Vijay B, Shanmughasundaram R "Control Strategy for Parallel Hybrid
12. N.Boopalan, Marlon Jones Louis 2, A.K.Nachimuthu "DESIGN ANDFABIRCATION OF HYBRID TWO WHEELER" InternationalJournal of Research and Innovation in Engineering Technology Volume: 01 Issue: 01.
13. Harish N, Amar Thakur, Alwin George, Mahmadali Babu Sab Nadel "Hybrid Two-Wheeler" International Journal of Latest EngineeringResearch and Applications Volume – 03, Issue – 05, May 2018, PP – 45-47
14. Mr. Aniket Badgujar, Prof. S. S. Surve, Mr. Yadnesh Keny, Mr. Gaurang Kadam "Hybrid Two Wheel Drive Motorcycle with Range Extender" International Journal for Scientific Research &Development| Vol. 4, Issue 03, 2016.