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DESIGN AND IMPLEMENTATION OF SMART ELECTRIC VEHICLE

Shahanawaz Shiekh[*1], Ragini Bawane[*2], Aryan Meshram[*3], Harshal Sarode[*4], Chinmay Rewasksr[*5], Ankita Bhobade[*6], Rohit Nagdeve[*7], Prathmesh Gaikwad[*8], Divyani Bawane[*9], Dr. Jagdish .G. Chaudhari[*10], Prof. Manasi Shedeme[*11]

[*1,2,3,4,5,6,7,8,9]Student, Department Of Electrical Engineering, Nagpur Institute Of Technology, Nagpur, Maharashtra, India.

[*10]Associate Professor, Department Of Electrical Engineering, Nagpur Institute Of Technology, Nagpur, Maharashtra, India.

[*11]Assistant Professor, Department Of Electrical Engineering, Nagpur Institute Of Technology, Nagpur, Maharashtra, India.

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ABSTRACT

This project presents the design and development of an intelligent electric vehicle (EV) system that integrates GPS, GSM and temperature sensors to enhance the safety, efficiency and performance of the vehicle. The system uses a brushless DC (BLDC) motor, a motor controller and a module enables real-time navigation and location tracking, while the GSM module facilities communication between the vehicle and external system. The temperature sensors monitor the vehicles temperature and prevent overheating. With features like predictive maintenance, emergency alerts, and remote diagnostics, the system is made of offer a smooth and intelligent driving experience. The initiative intends to contribute to the development of sustainable transportation solutions and promote the wider use of EVs.

Keywords: Electric Vehicles, Intelligent Transportation Systems, GPS, GSM, Temperature Sensors, Brushless (BLDC) Motor, Microcontroller, Relay Module.

I. INTRODUCTION

Air pollution and greenhouse gas emissions have significantly increased as a result of the world's growing urbanization and industrialization, mostly due to the transportation sector. The negative consequences of conventional fossil fuel-powered automobiles have grown more noticeable in many cities, since they contribute to environmental deterioration, health problems, and climate change. Electric vehicles (EVs) have become a viable and sustainable substitute for traditional cars in response to these urgent issues.

Table 1. Summary Of Literature Survey

Sr. No.	Journal	Author	Name of Paper	Survey research	Observational study	Findings
1	7th International Conference on New Frontier in Energy, Engineering and Science (NFEES). 2021.(pp.19-20).	Satyendra Singh et al.	A literature review on electric vehicles in India	The paper cites a report stating that many Indian cities are among the most polluted in the world, with the industrial sector contributing 51% and the transport sector contributing 27% to air pollution.	Electric Vehicle (EV): A vehicle that uses electric motors powered by a battery, which can be charged from an external power source. Phasor Measurement Unit (PMU): A device that measures voltage and current in real- time to	The paper "Electric Vehicles in India: A Literature Review" discusses the current state of electric vehicles (EVs) in India, highlighting the benefits and challenges associated with their adoption. According to the authors, air

					monitor and protect the power grid. NEMMP 2020: A National Electric Mobility Mission Plan government program to encourage India's use of electric automobiles.	pollution is a major issue in India, and EVs can significantly lower emissions.
2	Smart Cities **2021**, 4, 372–404	Torres-Sanz, V., Sanguesa, J. A., In 2021, Garrido, P., Martinez, F. J., and Marquez-Barja, J. M.	An overview of electric vehicles: advances and obstacles	India's air pollution problem is serious, with the transport sector accounting for 27% of the pollution. India's market for electric cars is expanding at a rate of 37.5%. India has sparse infrastructure for charging; as of 2018, there were just 650 charge stations. Customers worry about range anxiety because the longest-range electric vehicle (EV) in India can only travel less than 500 km between charges. India has found lithium reserves, which might lower the price of EV batteries.	An electric vehicle (EV) is a car that runs on batteries and electric motors. A gadget called a Phasor Measurement Unit (PMU) keeps an eye on and safeguards the electrical grid. The National Electric Mobility Mission Plan (NEMMP) 2020 is a government program designed to encourage the use of EVs. A government program to lower EV costs is called the Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME) scheme. An essential part of electric vehicles is the lithium-ion battery. Customers' worries regarding EV range and charging facilities are known as range anxiety. Infrastructure for charging: the system of EV-	In India, EVs can aid in lowering air pollution. Government programs can encourage the use of EVs. Range anxiety and inadequate charging facilities are major issues. India's lithium reserves have been discovered, which could lower EV prices.

					supporting charging stations and locations	
3	**Transportation** Research Part D: Transport and Environment 2.3 (1997): 157-175.	Letendre, Steven E., Willett, and Kempton .	Electric utilities are considering using electric vehicles as a new source of power.	Air pollution in India is a significant concern Electric vehicle market in India is growing. Limited charging infrastructure in India. Range anxiety is a concern among consumers. Lithium reserves discovered in India.	Phasor Measurement Device for Electric Vehicles (EV) (PMU) The Faster Manufacturing and Adoption of Hybrid and Electric Vehicles (FAME) initiative is part of the 2020 National Electric Mobility Mission Plan (NEMMP). Lithium-ion batteries, charging infrastructure, and range anxiety	EVs can reduce air pollution in India. Government initiatives can promote EV adoption. Limited charging infrastructure and range anxiety are concerns. Lithium reserves in India can reduce EV costs.
4	Journal of Energy Storage 56 (2022): 106048.	Ibrahim, Faran, and Razi Dincer	An analysis of Canada's present situation, obstacles, prospects, and potential paths for implementing sustainable electric vehicle infrastructure.	Summary statistics of the device's performance metrics, such as accuracy and distance measurement range.	Accuracy: 91% (improved from 78% in the existing device) Distance measurement range: 1m to 1.5m	This study explores the potential applications and challenges of face recognition technology (FRT). While FRT has gained significant attention due to its accuracy and non-intrusive nature, a common issue in face databases is the limited availability of sample images per individual. This limitation can significantly impact the performance of traditional FRT algorithms. The study highlights the need for further research to address this challenge and improve the robustness of FRT
5	Energies,	Contò, C.,	E-bike motor	User satisfaction:	Rider behavior:	Combining survey

	16(1), pp.160.	& Bianchi, N. (2022).	drive: An overview of settings and features.	Conduct a survey to measure the satisfaction level of e-bike users, including their opinions on the bike's performance, comfort, and overall experience. Usage patterns: Investigate how e-bikes are used, including the frequency of use, distance traveled, and purpose of use (e.g., commuting, recreation)	Observe e-bike riders in different environments (e.g., urban, rural, or mixed) to understand their behavior, such as speed, braking, and turning patterns. Infrastructure usage: Observe how e-bikes interact with existing infrastructure, such as bike lanes, roads, and intersections, to identify potential safety issues or areas for improvement.	and observational data: Use survey data to identify patterns and trends in e- bike usage, and then use observational data to validate or refute these findings. Using observational data to inform survey design: Use observational data to identify key variables or themes that can inform the design of a survey, such as identifying common rider behaviors or safety concerns.
6	IEEE Transactions on Power Electronics, vol. 25, no. 10, pp. 2564-2572, Oct. 2010.	D. Cvoric, J. B. Ferreira, S. W. H. d. Haan, and Z. Yuan	A FACTS Device: Distribute d PowerFlow Controller (DPFC)	The creation of a novel flexible AC is the main goal of the study. Device known as the Distributed Power-Flow Controller (DPFC) is part of the Transmission System (FACTS). The DPFC inherits the control capabilities of the Unified Power-Flow Controller (UPFC) from its ancestor. The common DC is eliminated by the DPFC. link between the series and shunt converters, and instead exchanges active power via the transmission line at the third	A cutting-edge FACTS device that can control all system parameters, such as bus voltage, transmission angle, and line impedance, is the Distributed Power-Flow Controller (DPFC). Controller for Unified Power Flow (UPFC) It is a powerful Facts gadget that operates on all system settings at once. D-FACTS, or distributed facts The idea is to employ several small single-phase converters rather than a single large converter in order to lower costs and increase reliability.	This observational study and survey research will shed important knowledge on the advantages, difficulties, and potential areas for development of DPFCs in power transmission networks. The results will eventually help the power industry and consumers by advancing the creation of more dependable and efficient power transmission systems.

				harmonic frequency.		
7	International Journal of Electro Compu-tational World & Knowledge Interface, 4(3). pp. (35- 48).	Varshney, A., Mishra, B., Dwivedi, A., & Singh, R. (2016).	Smart Bike Helmet and Accident Preventio n System.	Data on blind people's requirements, preferences, and experiences with current assistive technologies could be gathered through a survey.	T-tests, ANOVA, and regression analysis could be used to compare the effectiveness of different assistive technologies and to identify factors that. influence navigation performance.	Sound waves are used to measure distance through a process called echolocation. The distance can be computed by timing how long it takes a sound wave to reach an object and return.
8	2015 International Conference on Renewable Energy Research and Applications (ICRERA). IEEE, 2015.	Thomas, Dimitrios, etal.	Implement-ation of an e-bike sharing system: The effect on low voltage network using ev and smart charging stations.	Online survey: Design a questionnaire to collect data from power system operators and engineers who have experience with DPFCs. Sampling: Identify a sample of 150-250 participants from various power transmission and distribution companies.	Case study: Select three power transmission systems they have implemented DPFCs and obtain permission to conduct an observational study. Data collection: Collect data on the DPFCs' performance using various methods, such as: SCADA system data Field measurements (e.g., voltage, current, power flow) Interviews with system operators and engineers	This survey research and observational study will provide valuable insights into the impact of DPFCs on power system reliability and efficiency, highlighting their benefits, challenges, and areas for improvement. The results will eventually help the power industry and consumers by advancing the creation of more dependable and efficient power transmission systems.
9	In Proceedings of the LACCEI International Multi-Conference for Engineering, Education and Technology (pp. 24-26).	Meetoo, C., Sharma, C., and Bahadoorsin, S. (2019).	Implementation of electric vehicle guidelines	Online survey: Create a survey to get information from both e-bike users and non-users. Sampling: Identify a sample of 200- 300 participants from various cities with e-bike sharing systems.	Case study: Select three cities with e-bike sharing systems and obtain permission to conduct an observational study. Data collection: Collect data on the e- bike sharing systems' performance using various methods,	This survey research and observational study will provide valuable insights into the impact of e-bike sharing systems on urban mobility and sustainability, highlighting their benefits, challenges,

					such as: GPS tracking data Sensor data (e.g. speed, distance, energy consumption) Interviews with e-bike users and non-users.	and areas for improvement. The findings will contribute to the development of more efficient and sustainable urban transportation systems, ultimately benefiting cities and their residents.
10	Energy Procedia 68 (2015): pp446454.	Abdul, Sunarto, and Kaleg Hapid and Kurnia, M. Redho.	Conversion to electric vehicles depending on cost, speed, and distance requirements.	Online survey: Design a questionnaire to collect data from EV owners and non-owners. Sampling: Identify a sample of 250-350 participants from various cities with EV charging infrastructure.	Case study: Select three Cities with EV charging infrastructure and obtain permission to conduct an observational study. Data collection: Collect data on the charging infrastructure's performance using various methods, such as: Charging station usage data EV owner surveys.	This survey research and observational study will provide valuable insights into the impact of EV charging infrastructure on EV adoption and usage, highlighting its benefits, challenges, and areas for improvement. The results will eventually aid in the broad adoption of EVs by assisting in the creation of more effective and efficient EV charging infrastructure.

II. METHODOLOGY

Based on the information provided in the project document, the research methodology for this project on Electric vehicles (EVs) are as follows:

1. Study of basic concepts of DC-DC converters.
2. Finding problems from conventional systems by surveying literature.
3. Design and study of electronic devices.
4. Analysis of the proposed topology.
5. Study of control strategies.
6. Comparative analysis of proposed petrol vehicle and electric vehicle

Electric Motor: A hub motor or mid-drive motor is integrated into the bike. The motor is designed to assist the rider with pedalling, typically up to a certain speed (often around 28 mph or 45 km/h, depending on local regulations).

- **Hub Motor**: Located in the wheel, providing direct propulsion.

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Battery Technology: High-capacity lithium-ion or lithium-polymer batteries are used for lightweight, long-lasting power storage. The battery is integrated into the frame or mounted on the rear rack for better weight distribution and balance.

- **Battery Management System (BMS)**: Ensures safe charging, regulates temperature, and monitors the state of charge.

Safety Features: Integrated lighting systems (headlights, taillights, brake lights), horn, and reflective decals improve visibility at night or in low-light conditions.

Charging Infrastructure: The bike's battery can be charged via standard charging ports or through wireless charging solutions, though most still rely on plug-in chargers.

- **Charging Time**: Depending on the battery size, charging can take between 3 to 6 hours for a full charge.

Connectivity (Bluetooth, Wi-Fi): Enables connection to smartphones and other devices for enhanced user control. Riders can adjust settings, check stats, or even track the bike's location in case of theft.

- **Mobile App**: A custom app is developed to allow users to interact with their bike, track rides, lock/unlock the bike, and receive diagnostic information (battery status, motor health, etc.).
- **GPS & Mapping**: Real-time location tracking, navigation, and route optimization.

Research Design:

- Based on the information provided in the project document, the research design for this project on.

Comparative Study:

- The project aims to compare petrol vehicles with electric vehicles, which suggests a comparative study design.
- Experimental Design: The project involves designing and analyzing a proposed electric vehicle system, which suggests an experimental design.

Descriptive Study:

- The project also involves studying the basic concepts of DC-DC converters, electronic devices, and control strategies, which suggests a descriptive study design.

The block diagram below internal circuit of smart electric vehicle with all the necessary components shown in Below of fig 1.

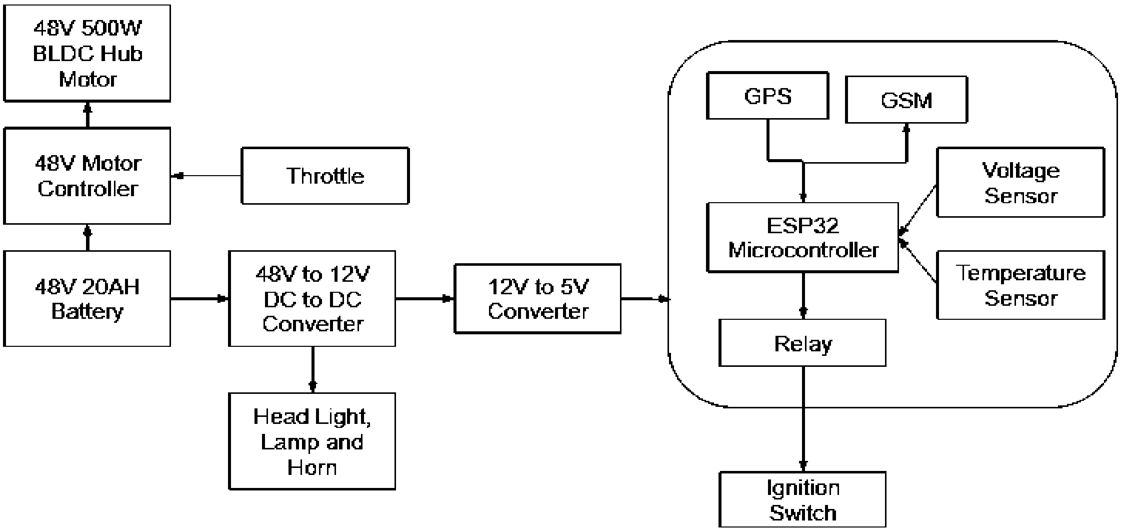

Fig 1: Block Diagram of EV

III. RESULTS & DISCUSION

- **Energy Efficiency and Cost Savings:** The vehicle will result in a more energy-efficient transportation solution compared to traditional internal combustion engine (ICE) vehicles, leading to reduced energy consumption and lower operational costs for the user.

- **Improved Safety:** By integrating advanced sensors, cameras, and AI algorithms, the vehicle can prevent accidents, monitor driver behavior, and provide real-time hazard detection, significantly improving road safety.
- **Enhanced User Experience:** The inclusion of a smart interface and autonomous features will improve the overall driving experience, making it more convenient, enjoyable, and less stressful. Features like predictive route planning and real-time traffic updates can also reduce travel time and enhance efficiency.
- **Economic Impact:** The success of this project could help create jobs in the electric vehicle and smart technology sectors and further advance the adoption of EVs in the global automotive market.
- **Future Innovations:** The project could pave the way for future innovations in intelligent mobility solutions.

IV. CONCLUSION

As a result, the optimum option for EV conversion depends on how performance requirements are chosen. The maximum speed should be specified before the battery capacity if the conversion is based on distance. In contrast, distance is not given priority when conversion is done based on speed. Distance, speed, and maximum efficiency should be combined when funding is a limitation.

This project aims to develop an intelligent electric vehicle system that combines these technologies to create a smart, efficient, and eco-friendly mode of transportation. The conversion of conventional gasoline-powered vehicles into electric vehicles, the installation of real-time monitoring systems, and the enhancement of vehicle performance are among the main goals that the project will accomplish through a thorough requirement analysis and system architecture design.

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