International Journal of Research Publication and Reviews, Vol 5, no 4, pp 7288-7293 April 2024

**International Journal of Research Publication and Reviews**

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

# Design and Simulation of Electric Two-Wheeler.

***Jadhavjay***

Indus University student, Department of Electrical engineering, Ahmedabad, Gujarat

**ABSTRACT**

The twenty-first century requires the use of modern equipment and technology. Driving becomes more expensive as the price of gasoline and diesel fuel rises. Electric vehicles are an alternative to vehicles that use fossil fuels. Increased traffic and a shortage of parking spots will result from population development. The paper illustrate about the developing of an electric vehicle that can be simply transported anywhere. The car is powered by lithium-ion batteries, which are renewable and more efficient than typical gasoline or diesel engines. E-bikes are compact, efficient, silent, and emit zero pollutants. This is the future of urban mobility. The aim is to convert a gas-powered scooter into an electric vehicle (EV) by eliminating the engine and drivetrain and replacing it with an electric drive system. The electric drive system will include a hub motor, battery pack, electronic control module (ECM), and a display unit, while keeping the scooter's original body design and chassis.

Keywords: Modern equipment, Electric vehicles, Lithium-ion batteries, Renewable energy, Urban mobility, Foldable electric vehicle, E-bike Electric, drive system, Hub motor, Sustainable transportation

**Introduction:**

India is now one of the world's largest automotive marketplaces, with a rapidly growing middle class, shopping potential, and a stable economic structure. However, gasoline prices have increased by more than 50% in thirteen distinct increments over the last two years. Here comes the potential need for new technology in automobiles, such as electric vehicles (EV) in India. Though the initial investment is approximately 1.5 times that of a standard IC engine, time has proven that the cost of setting is now more important than the cost of the car. The purpose of this paper is to explain the technology used to manufacture an electric vehicle. The electrical vehicle is compared with the hybrid and combustion engine vehicles. It also covers the electrical vehicle's long term. In the end, people benefit from the overall effect of the electric vehicle. Electrical vehicles are regarded to be significantly cleaner than gasoline-powered steam-powered vehicles since they produce no pipe emissions that could pollute the air.

***How Does an Electric Vehicle Needed?***

Due to the rise in automobile ownership these days, more individuals will need space for parking and driving. As is well known, there is a limited amount of space available, which is contributing to traffic and the lack of necessary parking space due to the strong demand for automobiles in the current environment. India is currently the fifth most polluted nation in the world. Furthermore, the cost of gas and fuel has peaked. The use of automobiles pollutes the environment, and laws aimed at reducing vehicle pollution are becoming more onerous. Using electric cars reduces emissions and eliminates the need for additional gasoline. An e-scooter is a low-maintenance, battery-operated vehicle that is affordable. The batteries in electric vehicles are lithium-ion ones. It has a long lifespan and requires little and lengthy charging. duration of battery. Rechargeable batteries are used in electric two-wheelers to transform electrical energy into mechanical energy. It can be charged at any time or place using detachable or rechargeable batteries. An EV's battery can be readily charged with a power source. Scooters with electric versions are being developed by numerous manufacturers. Since they are inexpensive and have the capacity to carry two persons, scooters are a popular mode of transportation around the world. This is especially true in metropolitan areas where space is at a premium. The market is filled with a wide variety of goods. Companies in India like Hero, Yamaha, Revolt, and Bajaj are putting new electric scooters on the market. As a result of the new, quickly expanding market, new manufacturers are also emerging quickly. Examples of these include Vihan EV, Miracle E-bike, Ampere Electric scooters, three different models will be investigated in this project: the testing, simulation, and mathematical models. A thorough assessment of the vehicle's performance is made possible by the representation of each model as a significant phase in the development process. The mathematical model establishes the foundation and offers theoretical insights through careful design and analysis. The simulation model then makes these theories come to life, enabling virtual testing and improvement. Lastly, real-world evaluation of the testing model allows for practical validation. The initiative compares various models' output to provide insightful information on improving electric vehicles.

***Concept of Electric Vehicle***

Significant trends in the electric vehicle (EV) market today are influencing the direction of transportation toward sustainability. Thanks to developments in battery technology, EVs can now go farther and charge more quickly, which alleviates range anxiety and improves user convenience. Furthermore, incorporating renewable energy sources into the infrastructure for charging devices shows a dedication to cutting carbon emissions and encouraging the use of clean energy. Furthermore, linked car technologies and the rise of autonomous driving capabilities are improving safety, changing the driving experience, and opening the door to more intelligent and effective transportation systems.

The goal of switching from a gasoline-powered car to an electric one is to promote pollution-free mobility and environmental sustainability by lowering hazardous emissions. The paper gives detail information about the electric vehicle and how it helps to minimizes air and noise pollution by switching from conventional gasoline-powered cars to electric alternatives, enhancing both public health and air quality overall. This adjustment is in line with international initiatives to mitigate climate change and lessen our reliance on fossil fuels. By means of this endeavour, our goal is to make a positive impact on the environment and promote a more sustainable and eco-friendly transportation system for both the current and upcoming generations.

**Design Methodology:**

The design process for an electric vehicle includes a variety of factors, including mechanical components and electrical systems. Nonetheless, a crucial component that is sometimes disregarded but essential to the vehicle's operation and security is the wiring harness. The wiring harness facilitates the transfer of electricity and electrical impulses between different components of the car, acting as its nervous system. A key factor in guaranteeing the smooth operation and dependability of the electric two-wheeler is its design and integration.

## WORKING PRINCIPLE:

An electric two-wheeler's development and modelling process involves many different elements, from electrical systems to mechanical parts. Nonetheless, a crucial component that is sometimes disregarded but essential to the car's operation and security is the wiring harness. The wiring harness facilitates the transfer of electricity and electrical impulses between different components of the car, acting as its nervous system. A key factor in guaranteeing the smooth operation and reliability of the electric two-wheeler is its design and integration.

• The E-Moped operates on the idea that a DC motor can transform electrical energy into mechanical energy.

• The motor is installed in the back wheel's hub.

• A controller is in place to ensure that the motor is run at the correct speed.

• A throttle is used to manage speed; when the throttle is engaged, the controller feeds the motor with an equivalent +/- amount of electric energy, causing the car to go forward on its own.

• A rechargeable lithium-Ion battery pack serves as the energy storage device.

An electric two-wheeler's development and modelling process involves many different elements, from electrical systems to mechanical parts. Nonetheless, a crucial component that is sometimes disregarded but essential to the car's operation and security is the wiring harness. The wiring harness facilitates the transfer of electricity and electrical impulses between different components of the car, acting as its nervous system. A key factor in guaranteeing the smooth operation and reliability of the electric two-wheeler is its design and integration.

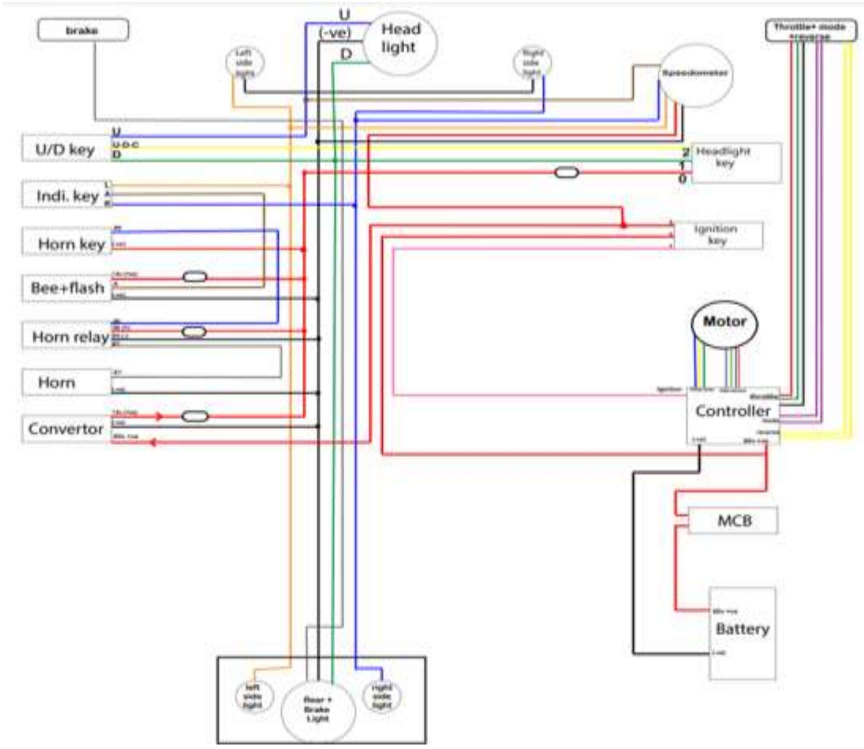


**Fig no 1: Schematics of wiring harness.**

***Vehicle Dynamic Simulation Using Software:***

For a long time, simulation software has played a vital part in the automotive industry; nowadays, it is one of the most important development tools, and nearly no development range does not employ simulation software. This project greatly contributes to reduced development time and cost. In this paper, the simulation capabilities and usage OF AVL CRUISE M software is done, which is a product of one of the world's largest propulsion system development firms. In addition to the automotive industry, the program is used by numerous research teams and information institutes. In this chapter, the project briefly highlights the software's possibilities based on their research.

***Powertrain Layout***

The structure of the model is produced by properly connecting the previously described pieces. When manufacturing a vehicle, in addition to the wheels, brakes, engine, and bodywork, it is critical to describe the driving cycle, track specifications, and environmental conditions. The notion of environment includes air temperature, pressure, and composition. The track can be created in 3D space with varied frictional conditions, such as using Car Sim. This enables us to test stability control systems under slippery road conditions. The simulation software can work with a variety of other programs. With these enhancements, the project model now provides more simulation possibilities.

Figure 2.3.1 depicts the powertrain arrangement produced using the AVL Cruise M software. Each block represents a separate component or subsystem of the electric motorcycle's powertrain and is linked together to indicate the flow of energy, control signals, or data. The red lines normally represent high-power electrical connections, but the blue lines may represent communication or control signals. The arrows represent the direction of the passage of electricity or signals. The overall structure provides a concise but complete perspective of how power is routed throughout the vehicle, how the rider interacts with the motorcycle, and how the battery and electrical systems are maintained. It's an effective tool for engineers to examine and optimize the motorcycle's power and efficiency.

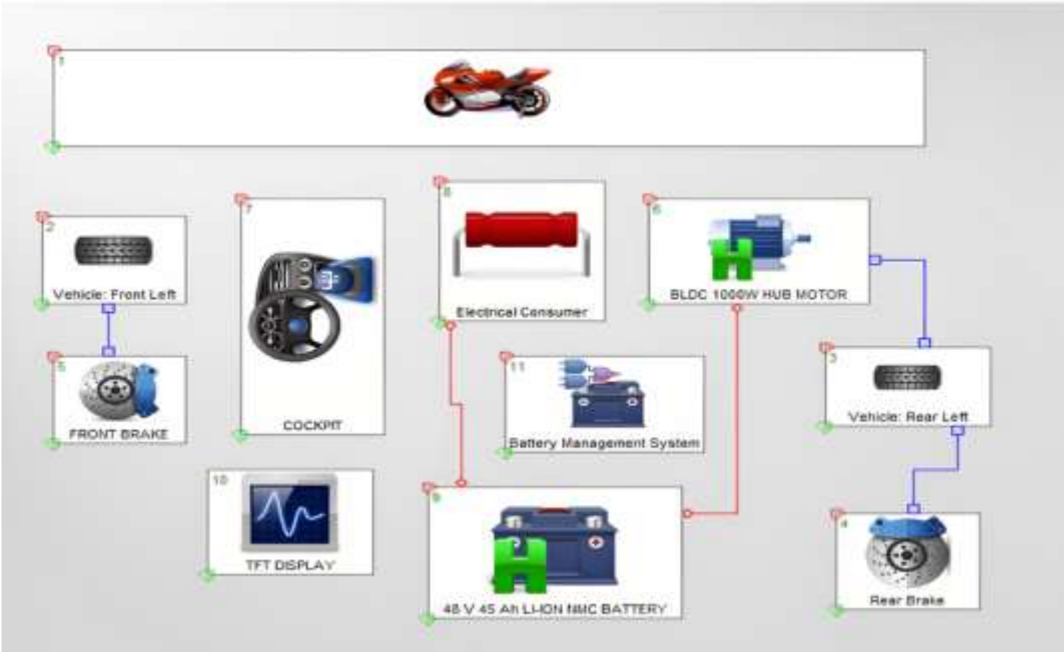


**Fig no 2: Powertrain layout**

***Vehicle performance Evaluation:***

The comparison of three unique study analysis models, each employing a different methodology (mathematical modelling, simulation, and physical testing), provides essential insights into vehicle performance and behaviour across numerous operating parameters. Several essential characteristics are central to this research, including continuous speed range, accelerated range, gradient range, actual range, power for normal condition, power on slope, power on acceleration, total tractive effort, effort on slope, and effort during acceleration.

First, the mathematical model provides a theoretical foundation for predicting vehicle performance using mathematical equations and principles. It employs mathematical formulae to determine the Continuous Speed Range, Accelerated Range, and Gradient Range, so providing useful theoretical insights into the vehicle's capabilities under various operational scenarios. While mathematical models are cost-effective and efficient for analysis, they may lack the precision and real-world accuracy that empirical data provides.

Simulation models, on the other hand, use computer simulations to recreate real-world settings and evaluate vehicle performance. Simulation software may give extremely precise forecasts of Continuous Speed Range, Accelerated Range, and Gradient Range based on pertinent parameters and variables, providing a more comprehensive understanding of the vehicle's behaviour under varied situations. Simulation models excel in providing deep insights into complex systems, enabling iterative testing and refinement without the use of real prototypes.

Finally, physical testing entails the actual deployment of electric two-wheelers in real-world situations to monitor and validate performance indicators, as shown in table. Controlled experiments and field tests allow researchers to physically examine and quantify the vehicle's Continuous Speed Range, Accelerated Range, and Gradient Range, providing actual data for comparison with theoretical projections. Physical testing provides the highest level of precision and reliability, but it can be time-consuming and resource costly.

| Metric | Testing Model | Mathematical Model | Simulation Model |
| --- | --- | --- | --- |
| Continuous Speed Range (km) | 135.549 | 217.508 | 135.549 |
| Accelerated Range (km) | 52.726 | 41.212 | 52.726 |
| Gradient Range (km) | 29.382 | 19.202 | 29.382 |
| Actual Range (km) | 97.751 | 142.548 | 97.751 |
| Power for Normal Condition (W) | 309.340 | 309.340 | 309.340 |
| Power on Slope (W) | 3540.877 | 3540.877 | 3540.877 |
| Power on Acceleration (W) | 1632.643 | 1632.643 | 1632.643 |
| Total Tractive Effort (Nm) | 9.610 | 10.774 | 10.774 |
| Effort on Slope (Nm) | 88.669 | 96.778 | 96.778 |
| Effort During Acceleration (Nm) | 24.706 | 16.453 | 16.453 |

***Table 1: comparison table***

## Results

The paper provides thorough insights into its performance across a variety of metrics. Graphs demonstrating acceleration, elasticity, braking, and climbing performance reveal important insights. Acceleration tests reveal the vehicle's capacity to accelerate quickly, whilst elasticity testing demonstrate its ability to maintain a stable speed under different loads. Braking performance assessments show that stopping distances are efficient, which ensures safety. Climbing tests demonstrate the vehicle's ability to traverse inclines. Combined with tables showing precise metrics, these findings highlight the electric two-wheeler's sturdy design and exceptional performance, confirming its suitability for urban travel while emphasizing its safety and efficiency.

## Conclusion

This paper demonstrates how to effectively integrate an electric drive into a previously engine-driven vehicle. It demonstrates the goods that are already on the market as well as how to convert the car yourself. The paper fully shows the components to be utilized, as well as the manufacturing and assembly steps to be taken. The results reveal the E - Moped specs. It is an environmentally friendly method of transportation. It is gearless, making it simple to drive. It emits no direct pollutants and has a very small carbon impact. The charging fee is quite low in comparison to the cost of petrol, making it a very cost-effective option.

An Electric Vehicle is an interesting proposal in the automotive industry. It is a completely environmentally friendly vehicle because it runs on electricity. The vehicle includes a lithium-ion battery, a hub motor, and a variety of other characteristics. As a result, it is lightweight and easy to use, allowing it to be taken and stored anywhere. Furthermore, when using a removable battery, only the battery needs to be transported to the charging point; the entire cycle is not required. Overall, this is the greatest car for modern life and urban mobility.

**References:**

List all the material used from various sources for making this project proposal.

Research Papers:

1. Suyant Dharwarkar et al. “Laufband Zyklus”; International Journal of Advance Research, Ideas and Innovations in Technology, ISSN: 2454-132X, (Volume 5, Issue
2. Ionuț Daniel Smărăndescu, Petre-Marian Nicolae “About Electric Scooter Mobility. Aspects Regarding the Designing of a Brushless DC Motor for an Electric Scooter”; International Journal of Engineering
3. Advanced Technology (IJEAT), ISSN: 2249 – 8958, Volume-5, Issue-4.
4. Prof. Firoz khan et al. “Design and Development of Light Weight Multi-Utility Electric Scooter using Hub Motor Transmission”; International Journal of Engineering Research & Technology (IJERT), ISSN: 2278-0181, Vol. 5 Issue 07.
5. Suyant Dharwarkar, Abdulhasnain Akodiyawala “E - Zyklus”; International Journal of Advance Research, Ideas and Innovations in Technology, ISSN: 2454-132X, (Volume 6, Issue 4)
6. J.D.K. Bishop et al. “Investigating the technical, economic and environmental performance of electric vehicles in the real-world: A case study using electric scooters”; Journal of Power Sources 196 (2011) 10094– 10104.

7. Ji-Young Lee et al. “In-wheel Motor Design for an Electric Scooter”; J Electr Eng Technol.2017; 12(6): 2307- 2316.
8. Prof. Mahesh S. Khande et al. “Design and Development of Electric scooter”; © 2020, IRJET | Impact Factor value:
9. 7.529 | ISO 9001:2008 Certified Journal | Page 359.
10. Kunal D Topiwala et al. “Design and Fabrication of Electric Motorcycle”; International Journal of Engineering Research & Technology (IJERT), ISSN: 2278-0181 IJERTV9IS040294, Published by: www.ijert.org, Vol. 9 Issue 04, April-2020.
11. https://m.indiamart.com/proddetail/honda-dio- 5024933955.html
12. https://aggarwalev.com/product/hub-motor-kit-for- scooter-48v-1000w/
13. https://www.order2india.com/products/48v-2-5a-20ah-lithium-lifepo4-battery-charger-for-e-bike-scooter- electric-