RETROFITTING OF IC ENGINE BIKE INTO GEARED ELECTRIC BIKE

S.Haribabu[1] Assistant Professor, G.V.Nagamani[2] , V.Harshavardhan[3], K.Venkatarathnam[4], V.Raviteja[5], P.Kotesh[6], M.Balaji[7]
, Department of Mechanical Engineering, Nellore, AP
UG Students, Narayana Engineering College, Nellore, AP

Abstract: The End-of-life of ICE bikes undergoes regular service and cost of bike parts are also high to buy and make it repair, so it ended as scrap, in order to that to buy an EV's which possess sustainable transportation is overpriced. So, the transition of ICE bike to EV is a best idea for a cost-effective Electric Bike. And there are no EV bikes with gear system to feel an easy ride on hilly areas.The Aim of this project is to utilize the End-of-life ICE bikes and to retrofit that ICE bike into a Geared Electric bike instead of buying new electric vehicles.Retrofitting is a mechanical operation and this process involves in removal of ICE-related systems such as the engine, fuel system, and exhaust, except gearbox and chain drive, the integration of electric drive including an BLDC motor, Brushless Controller, Battery pack, Power electronics. Attaching Gear box to electric bike can transfer more torque when need and for verifying the efficiency at various speeds and loads.

Keywords: ICE Bike, BLDC Motor, Brushless Controller, Battery, Gear box, Retrofitting…

I. INTRODUCTION

The transition from ICE vehicles to EVs represents a critical juncture in searching for a sustainable transportation solution. The first electric vehicle was developed in the 1830s by Scottish inventor Robert Anderson, who created a crude electric carriage powered by non-rechargeable primary cells. At present in the world, electric vehicles (EVs) are at the forefront of the automotive industries innovation and transformation with advancements in battery technology, EVs have gained significant traction globally and have a good demand in market and cost of EVs are risen.A well performing ICE bike price is high and maintenance, repair and running costs are also increased. Even though EVs also overpriced, the running and maintenance costs are less compared to ICE bike, due to this the demand of an EV is high. And the life span of ICE bikes was about 10 to 15 years, and later it needs more services and it exhausts more emission gases which impact the environment and leads to climatic and health issues.The primary motivation for retrofitting is to reduce the carbon footprint of older vehicles. As the world shifts toward cleaner energy sources, retrofitting provides a sustainable way to extend the life of existing vehicles while minimizing their environmental impact.Retrofitting allows us to repurpose and upgrade vehicles that were originally designed with ICE technology. By transforming them into EVs, we contribute to cleaner air quality and reduced greenhouse gas emissions.

II. FUNCTIONAL OVERVIEW

Collected literature reviews, journals and patents, studied in detail and summarized the data and set the project overview.Evaluating the bike's frame, structure and determining the compatibility to retrofit.

Selecting the right Electric Motor kit.Designing the bike according to the retrofitting plan.Installed the electric drivetrain(components) and connecting them.Giving the correct electric wiring connectionsaccording to the circuit connections.Securely attached the battery and mounting it safely.Checking efficiency tests and recorded itChecking safety considerations and going through modifications if any need.

- **Key Functional Features:**
- Powertrain Replacement: In retrofitting, the gasoline or diesel engine is replaced with an electric powertrain. This includes components like batteries, electric motors, and associated control systems12.
- Economic and Environmental Benefits:
    - Cost-Effective: Retrofitting can be more affordable than purchasing a new EV.
    - Reduced Emissions: Retrofitted EVs contribute to lower greenhouse gas emissions.
    - Extended Vehicle Life: Retrofitting allows older vehicles to continue serving without scrapping them3.
- Policy Recommendations:
    - Policymakers can promote EV retrofitting by incentivizing it through supportive policies.
    - Encouraging research and development in retrofitting technologies can accelerate adoption
- Gear box:
    - Gear box for speed control of vehicle like ICE vehicle and it give more control on vehicle. It gives you the feeling of driving ICE bike.
    - It allows you to experience multiple constant speeds compared to normal EV bikes and more torque also.

III. DESIGN

Design Details of this Project

1. Control System:

- **BLDC motor controller:**A Brushless DC (BLDC) motor controller is an electronic device that regulates the operation of a BLDC motor. Unlike traditional brushed DC motors, BLDC motors do not use brushes to transmit electrical power to the rotating motor shaft. Instead, they employ a set of permanent magnets on the rotor and fixed coils (stator windings) to generate motion. These controllers can detect the rotor's position either through sensors (such as Hall-effect sensors) orsensorlessly.

- **Converter:**A DC-to-DC converter is an electronic circuit or electromechanical device that transforms a direct current (DC) input voltage into a different DC output voltage. we are converting 48V to 12V for auxiliary purpose.

2. User Interface:

- **LCD Display:** The LCD screen is used to display real-time information to the user. This includes operational status, battery level, and error messages. The LCD is connected to the controller, which sends the necessary data to be displayed.

3. Mechanical Design:

- **Power train modification:** The powertrain is modified by replacing motor, controller and other electronic devices in the place of ICE components.
- **Customized Battery box:**we don't have space to put battery on front side of vehicle so we are attaching separatebattery box is for holding the battery safely and securely with vehicle and the size of box is based on size of battery.

4. Motor and Power Supply:

- **Motors:**Brushless DC motors (BLDC) have been a much-focused area for numerous motor manufacturers as these motors are increasingly the preferred choice in many applications, especially in the field of motor control technology. BLDC motors are superior to brushed DC motors in many ways, such as ability to operate at high speeds, high efficiency, and better heat dissipation.
- **Power Supply:** The wheelchair is powered by a rechargeable battery, ensuring reliable and consistent power for extended use. The power supply system includes voltage regulation components to maintain stable operation of the electronic circuits and motors. We are using Lithium-ion (Li-ion) batteries are the most popular choice for EVs due to their high power-to-weight ratio, energy density, and good high-temperature performance.

5. Safety and Reliability:

- **Electrical Safety Testing:** Ensures electrical components meet safety standards (insulation, shock protection, overcurrent).
- **Electromagnetic Compatibility Testing:** Checks for interference and susceptibility to external electromagnetic fields.
- **Mechanical Safety Testing:** Assesses structural integrity, crashworthiness, and occupant protection.
- **Performance Testing:** Evaluates range, acceleration, and top speed.

IV.WORKING

Detailed Working of the Retrofitting of ICE bike into geared electric bike Project

1. Removal of ICE Components:
    - The retrofitting process begins by removing the original petrol or diesel engine, fuel tank, and associated components from the vehicle.This step involves disconnecting the exhaust system, fuel lines, and other ICE-specific parts.
2. Installation of Electric Components:

    The heart of the retrofit is the installation of electric components:

    - Electric Motor: Replaces the original engine. BLDC (Brushless DC) motors are commonly used due to their efficiency, compact size, and reliability.

- Battery Pack: Provides power to the motor. Lithium-ion batteries are prevalent for their energy density and rechargeability.
- Controller (Inverter): Manages motor operation by converting DC power from the battery to AC power for the motor.
- Wiring and Electronics: Connects all components, ensuring seamless communication.
- Cooling System: Maintains optimal operating temperature for the motor and battery.

Proper placement and secure mounting of these components are essential.

3. Motor Operation:
   - When the driver accelerates, the controller sends pulses of current to the motor windings.
   - The motor's rotor interacts with the stator's magnetic field, generating rotational motion.The motor torque drives the vehicle's wheels, propelling it forward.
   - During regenerative braking, the motor acts as a generator, converting kinetic energy back into electrical energy and charging the battery.
4. Safety Considerations:

   Retrofitting must adhere to safety standards:
   - Electrical Safety: Insulation, grounding, and protection against short circuits.
   - Crashworthiness: Structural integrity and occupant safety.
   - Fire Safety: Proper battery enclosure and thermal management.

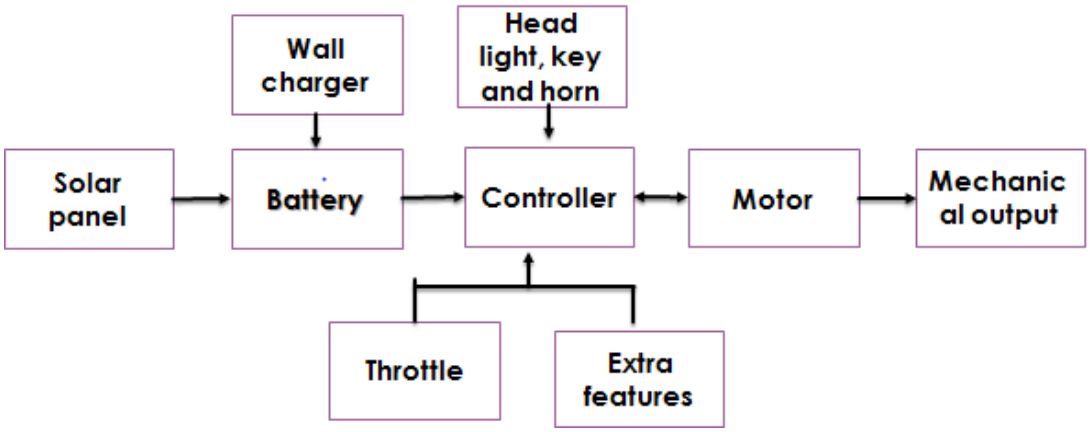

Fig: Electric bike working

IV. CONCLUSION

In conclusion, retrofitting an internal combustion engine (ICE) vehicle into an electric vehicle (EV) involves removing the original engine and installing an electric motor, battery, and controller. While it offers benefits like zero emissions and lower maintenance costs, safety, testing, and legal compliance are critical. Retrofitting allows existing vehicles to embrace eco-friendly mobility while preserving their unique characteristics.VI. REFERENCES

[1] S. Vasanthseelan,"Conversion of IC Engine vehicle to Electric vehicle"- International Research Journal of Engineering and Technology (IRJET), Volume: 06 Issue: 03- March 2019.
[2] Rohan Sarode, "Electric Vehicle (Construction and Working principle)"- International Research Journal of Engineering and Technology (IRJET), Volume: 07 Issue: 10- October 2020.
[3] Amit Soni, "A Case Study on Electric Vehicle Conversion from an Internal Combustion Engine" - LNEE, volume 862, pp 17–23- June 14 2022.
[4] Mothe Deepak, "Analysis of Critical Issues in Retrofitting of IC Vehicles to Electric Vehicle: A Technical Review" - Proceeding to IEEE, PP. 137-140, doi:10.1109/AGEC57922.2023- November 28 2023.
[5] Fabian Hoeft, "Internal Combustion Engine to Electric Vehicle Retrofitting"- Transportation Research Interdisciplinary Perspectives 100330 (ELSEVIER)- September 2021.
[6] S. Matey, A. Prabhu, "Design and Fabrication of Electric Bike" International Journal of Mechanical Engineering and Technology- Vol. 8 Issue 3- March 2017.