Development of a Testing Bench for Three-Wheeled Electric Vehicle Harnessing System

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Abstract— This paper presents the development of an EV harnessing testing bench for a Three-wheeler. A test bench is used for the study and testing of the harnessing of EVs. The work is done in two phases. In the first phase understand the flow of electric vehicles with their circuit diagram and block diagram. In the second phase visualization and implementation of the whole equipment on a bench with proper segregation of LV and HV is done with the help of a block diagram. The test bench includes the measurement of electrical parameters and checking the continuity with the help of a testing bulb. The test bench demonstrates the positive effect of testing to improve the reliability and efficiency of EVs.

Index Terms- Three-wheeler Harnessing, Circuit diagram, Testing bench, Converter.

I. INTRODUCTION

The advent of electric vehicles (EVs) has marked a transformative shift in the automotive industry towards sustainable and eco-friendly transportation solutions. Among the various types of electric vehicles, Three-Wheeler EVs have gained prominence for their versatility and efficiency in urban mobility. As the demand for such vehicles continues to rise, ensuring their robust performance and safety becomes imperative. The Three-Wheeler EV Harnessing Test Bench serves as a fundamental component in the development, evaluation, and optimization of electric propulsion systems, particularly focusing on the intricacies of the vehicle's powertrain Through systematic testing and analysis, this test bench facilitates the refinement of electric vehicle performance, contributing to the advancement of sustainable and environmentally conscious urban transportation. The insights gained from this testing endeavor are instrumental in enhancing the reliability, safety, and overall functionality of Three-Wheeler EVs, thus accelerating their integration into modern urban mobility [1]

II. HARNESSING EXPERIMENTAL SETUP

I. Developing a testing bench for the three-wheeled electric vehicle harnessing system is crucial to ensure the smooth functioning of the vehicle. The connection starts on the Battery side. [1]. Meanwhile checking the specifications and servicing electric three-wheelers to ensure they operate without any glitches [2]. In terms of quality testing, every circuit in the manually produced wire harness must be tested due to the high likelihood of errors during the process [3]. A standard checking the all connection work properly we can simultaneously test up to all connections between points in just three seconds, providing measurement data for each connection [4]. Test benches are developed for types of vehicles, including three wheelers and perform a variety of tests such as odometer/speedometer tests, maximum speed, acceleration/deceleration, coast-down, brake testing, and more [5].

II. Besides, a comprehensive dimensional and visual inspection process of EV connectors can upgrade the wire harness inspection process and prevent serious issues from arising [6]. Furthermore, research analyses and checking also continuity test on the bench there will the positive side and battery side and another where we can check whether the current reaching the equipment and the flow of supply is continuous to help test the efficiency of the test-bench increases [7]. components and systems. Develop and optimize control strategies for EV components and systems. Harnessing EV test benches can help reduce the time and cost of developing and testing new EV components and systems. It can also help to improve the performance and reliability of EVs.

III. Wiring harness assembly is typically a manual process with ergonomic challenges. With the rapid electrification of vehicles and transportation systems, the demand for wiring harnesses is expected to increase rapidly, further exacerbating the challenges for assembly operators. Automating this assembly process is a top priority for production engineers. The rapid development of industrial technology has increased opportunities for human-robot collaboration and simplified the automation of wiring harness process tasks. However, for human-involved automation applications to be successful, tasks must be efficiently and securely distributed between humans and technology. Unfortunately, given the capabilities of new automation technologies such as collaborative robots, current assembly system design methodologies may be outdated and inadequate. This paper presents a design and specification methodology and focuses on collaborative assembly operations in complex production systems [2]

Fig. 2 shows the actual image of the Block diagram setup.

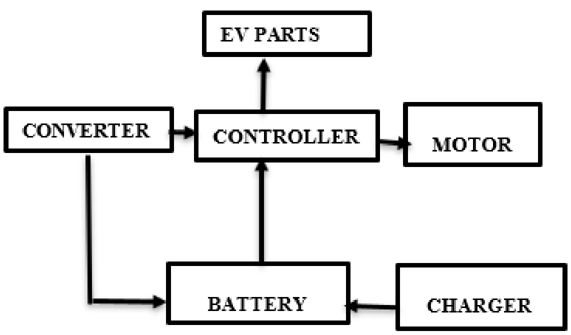

Fig 1. Block diagram for Test bench

III. COMPONENTS

There are some major components are used in the Testing bench as follows below

Controller, Battery, Converter, Hub Motor, Brakes, connecting wires, Display, Headlight, Indicator, Throttle, MCB, etc.

This component works Below

1. Controller:

The EV controller is responsible for regulating the speed and torque of the electric motor based on inputs from the driver. It acts as the intermediary between the vehicle's electronic systems and the motor.

2. Battery:

The battery is the energy storage unit, typically utilizing lithium-ion technology. It stores electrical energy that is then converted into kinetic energy to propel the vehicle.

I.

II. Converter:

Converts DC power from the battery to AC power required by the motor, and vice versa during regenerative braking.

4. Hub Motor:

Wheel hub motor drive is the most advanced electric vehicle driving technology, which installs two, four, or more motors in the wheel, direct driving wheels, commonly known as electric wheels, which is especially suitable for pure electric vehicles. Wheel hub motor drive is the most advanced electric vehicle driving technology, which installs two, four, or more motors in the wheel, direct driving wheels, commonly known as electric wheels, which is especially suitable for pure electric vehicles.

5. Break:

A brake is a mechanical device that inhibits motion by absorbing energy from a moving system. It is used for slowing or stopping a moving vehicle, wheel, or axle, or to prevent its motion, most often accomplished using friction.

6. Connecting Wire

Wires and cables connect various components, ensuring the transmission of signals and power throughout the vehicle.

7. Display

The display provides information to the driver, including speed, battery level, and other relevant data.

8. Headlight

The headlight illuminates the road for visibility during low-light conditions.

9. Indicator:

Indicators or turn signals signal the intended direction of the vehicle to other road users.

10. Throttle:

The throttle controls the acceleration of the vehicle by adjusting the power supplied to the motor.

11. MCB:

Acts as a safety device, protecting the electrical system from overcurrent and short circuits.

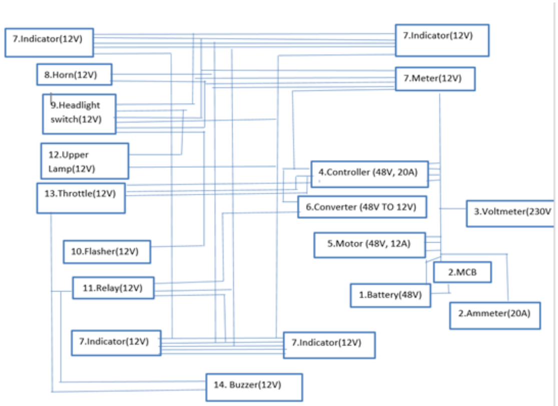

Fig 2. Circuit diagram for Harnessing setup

III. PRINCIPLE AND WORKING

The experiment setup is modeled by using the Block Diagram model as shown in Fig. 3

i. To enable the efficient and precise assessment of the vehicle's harnessing system, a testing bench for three-wheeled electric vehicles (EVs) must be developed with careful consideration of several parameters. This testing bench's main objective is to evaluate the electrical harnessing system's performance, efficiency, dependability, and testing in a three-wheeled EV. A control unit, power supply, measuring tools, safety systems, and a mock three-wheeler EV electrical system are some of the main parts of the testing bench. The bench is set up for both dynamic and static testing, enabling the measurement of voltage, current, and resistance while simulating real-world circumstances including turning, acceleration, and deceleration. [5]

ii. The process of creating and putting in an electric vehicle (EV) harness that safely, dependable, and effectively links all of the electrical parts is known as "EV harnessing." Since it is in charge of sending signals and power between the various parts of the EV, the EV harness is an essential component. EV harnesses can increase an EV's efficiency by lowering the energy lost in the wiring system. This may result in higher

iii. Important parts and sensors incorporated into the testing bench include temperature sensors to track temperature variations, voltage, and current sensors to measure electrical parameters at various system points, and load simulators to simulate the electrical load of various components. To capture and analyze different parameters during testing, data logging requires a strong data-gathering system. The ability to monitor in real-time offers instant feedback. Safety elements like overload protection and emergency stop mechanisms are put in place to safeguard the system from harm caused by an excessive load or voltage. [7]

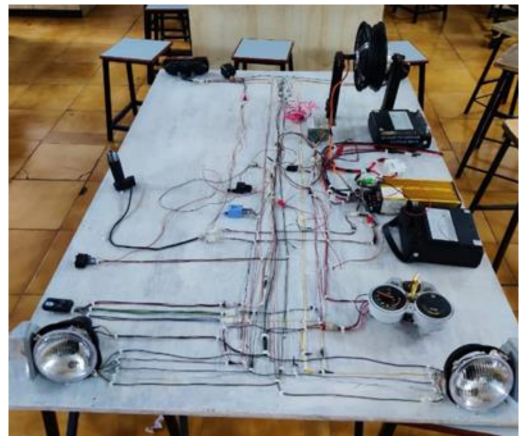

Fig3.Circuit Diagram

IV. RESULT

Table 1 presents the result of the experimental setup for the different conditions with the help of a circuit diagram to get the Reading of voltage, current, and power.

No Load Condition: The electrical system is not subjected to any external load in this scenario. The voltage reading represents the potential difference across the system, which remains stable as no current is drawn. The current reading should ideally be minimal, indicating negligible current flow.

At Full Load Condition: The electrical system operates under maximum stress at full load, drawing the highest current to meet the demand. The voltage reading remains consistent with the system's nominal voltage, indicating the maintained supply level. The current reading reflects the maximum current drawn by the system to deliver power to the load. The power reading represents the actual power consumed by the system, calculated as the product of voltage and current. This reading demonstrates the system's capability to deliver power efficiently under maximum load conditions.

Sr. No.	Condition	Voltage (volt)	Current (amp)	Power (watt)
1.	No Load	48	0	0
2.	At Full Load	48	20	960
3.	Continuity Test	12	5	60

Table 1. For different condition

CONCLUSION

In summary, an essential instrument in the development of electric trikes is a Three-Wheeler EV Harnessing Testing Bench. It is essential to maintain the effectiveness, safety, and calibre of these cars. From the first idea to manufacturing, it offers insightful information and useful statistics that guide the design and development process. The creation of dependable and efficient electric trikes is crucial given the growing demand for environmentally friendly transportation, and a testing bench is a vital instrument in this process.

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