International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 07 Issue: 08 | August - 2023 SJIF Rating: 8.176 ISSN: 2582-3930

Review on Advance Electric Vehicle System for Minimization of Wiring Harness Using Internet of Vehicle

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Abstract: **The widespread adoption of electric vehicles (EVs) is hindered by the high demand side cost associated with their charging and discharging. As electric vehicles (EVs) gain prominence in the automotive landscape, the demand for innovative solutions to enhance their efficiency, reduce complexity, and improve overall performance is escalating. One such solution involves the utilization of the Internet of Vehicles (IoV) to minimize the wiring harness within EV systems. This literature review delves into the advancements in electric vehicle systems, particularly in the context of reducing wiring harness complexity through IoV integration. This paper presents a novel approach to address this challenge by developing a mathematical model that optimizes EV charging and discharging statuses, thereby minimizing demand side costs within predefined tariff structures. The model incorporates factors such as battery degradation cost, driving probability, and vehicle-to-grid rebates to formulate an effective cost minimization framework. In this paper proposed the literature review on Advance Electric vehicle (EV) System for Minimization of wiring Harness Using Internet of Vehicle. This paper focused on the review of Advance Electric vehicle System for Minimization of wiring Harness Using IoV.**

Keywords: **Internet of Vehicle, Internet of Things, ESP32 microcontroller, Wiring harness, Advance Electric vehicle.**

1. Introduction

The electric drivetrain of an HEV or EV is mainly composed of a high-voltage battery, inverters, and motors. The high-voltage wiring harness connecting the high-voltage battery and inverter is called an under-floor wiring harness, and its wire length is relatively long. The high-voltage wiring harness connecting the inverter and motor is called a power cable, and its wire length is relatively short. Both the high-voltage harnesses require shielding performance so that electromagnetic noise does not affect their surrounding electronic devices and signal lines. The under-floor harness is arranged under the floor of a vehicle, therefore the protector for protecting wires from external damage such as stone chipping is very important. Resin protectors and metal pipes are used for the protector [3-5]. Recently, there has been a trend that the length of power cable is becoming short since the distance between the inverter and motor is getting shorter. One is a downsized and weight reduced power cable. The Internet of Vehicle (IoV) field allows vehicles to communicate with drivers, other vehicles, management systems, pedestrians, other smart devices, and infrastructure, all in real-time. The review covers the fundamental concepts of electric vehicle technology, explores the potential of IoV, highlights recent research contributions, and discusses challenges and opportunities in this domain. The Figure 1 showed the wireless Electric Vehicle Master & Slave system.

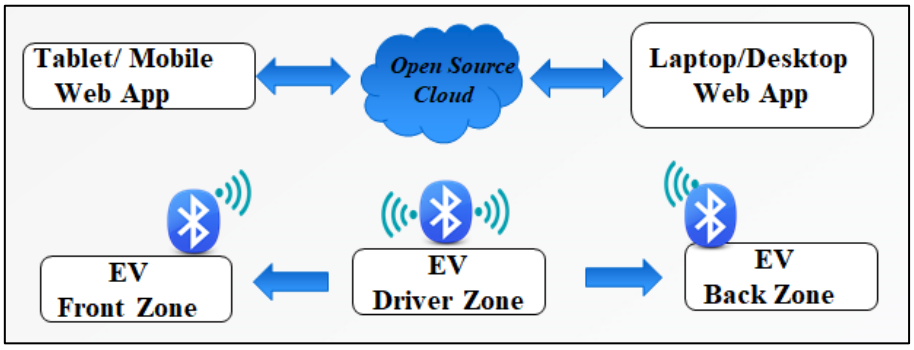

Fig.1: Wireless Electric Vehicle Master & Slave

Electric vehicles (EV) have emerged as a sustainable and energy-efficient alternative to conventional internal combustion engine vehicles. However, the complexity of wiring harnesses in EVs poses challenges in terms of weight, cost, maintenance, and design flexibility. This review paper focuses on the application of the Internet of Vehicles (IoV) to mitigate these challenges by minimizing the wiring harness within advanced electric vehicle systems.

2. Objectives of project

In this paper, we introduced the following three objective ideas related to advance electric vehicle system for minimization of wiring harness using IoV.

A. To optimized the energy factor, because it is a major issue and it breaks the flexibility of use of many features in a vehicle.

B. The developing in a feature which consumes very less energy of the battery and it consumes power only in the case of requirement.

C. According to the signal of vehicle driver, server will communicate the particular client; client will receive that signal and give proper respond signal to specific component within very less amount of time at RTOS.

3. Related Work

This design implements the system using the BLE or Wi-Fi Technology concept. This whole procedure is based on the ESP32 with wireless communication module. The ESP32 consumes less power as compared to other modules and is cost efficient too. Strong wireless connection is bind between the server and client to do further work as per the instructions given by the user to server and server will communicate to client [10-13]. The literature review for the "Advance Electric Vehicle System for Minimization of Wiring Harness Using Internet of Vehicles (IoV)" project reveals that many smart parking systems proposed in recent years have focused on various aspects such as parking availability information, reservation systems, occupancy detection, and real-time navigation within parking facilities. However, the review also highlights that there is a notable lack of attention to two crucial aspects:

Real-Time Detection of Improper Parking:

Most existing smart parking systems have not adequately addressed the issue of detecting improper or illegal parking. Improper parking can lead to congestion, safety hazards, and inefficient use of parking spaces. Addressing this problem is essential to enhance the overall efficiency and usability of parking facilities.

Automatic Collection of Parking Charges:

Another aspect that has been largely overlooked is the automation of parking fee collection. Implementing an automatic payment system can significantly improve the user experience, reduce administrative overhead, and ensure efficient revenue management for parking operators. The identified gaps in the literature suggest that the proposed "Advance Electric Vehicle System" aims to address these shortcomings by incorporating real-time detection of improper parking and automatic collection of parking charges into the design. By leveraging the capabilities of the Internet of Vehicles (IoV), the system aims to enhance parking management, provide a seamless experience for vehicle owners, and optimize the utilization of parking spaces.

The literature review serves as a basis for the proposed project, emphasizing the need for a comprehensive smart parking system that goes beyond conventional parking solutions. By integrating advanced technologies, such as IoT-enabled sensors, cloud computing, and data analytics, the project seeks to revolutionize parking management and contribute to the development of more efficient and sustainable transportation systems [16-18].

[1]. Jianyu Zhao and et al. ***"The technological innovation of hybrid and plug-in electric vehicles for environment carbon pollution control"*** Environmental Impact Assessment Review, Volume 86, January 2021. explores the potential of hybrid and plug-in electric vehicles (PHEVs) as promising solutions for reducing air pollution in cities. The researchers highlight that electric vehicles (EVs) play a crucial role in optimizing environmental management and achieving low carbon mobility in the future. While EVs offer significant environmental benefits, their effectiveness relies on how they are used in real-world scenarios, considering both temporal (time-related) and spatial (location-related) factors. The authors point out that the adoption and implementation of electric vehicles face certain challenges, particularly with regards to the limited driving range of some EV models, making it complex to fully roll out EVs as a mainstream transportation option. The paper specifically investigates the impact of environmental carbon pollution in cities and examines how plug-in hybrid electric vehicles (PHEVs) can contribute to control and prevent such pollution [5].

[2]. Muhammad Salman Bin Ahmad and et al. ***"Electric Vehicle Modelling for Future Technology and Market Penetration Analysis"*** Front. Mech. Eng., 01 July 2022 Sec. Engine and Automotive Engineering, Volume 8 – 2022. Explores the role of electrified powertrain technologies in reducing greenhouse gas (GHG) emissions in the transportation sector. The researchers emphasize that the transportation sector is a significant contributor to global GHG emissions, accounting for up to 25% of total emissions. To address this environmental challenge and work towards a more sustainable future, the introduction of electrified powertrain technologies is considered a viable solution. These technologies include Hybrid Electric Vehicles (HEVs), Battery Electric Vehicles (BEVs), and Fuel Cell Electric Vehicles (FCEVs). The paper highlights the importance of reducing the usage of fossil fuels, which is achievable by the widespread adoption of electrified powertrain technologies. HEVs combine internal combustion engines with electric propulsion systems, while BEVs rely solely on electric power stored in batteries. FCEVs, on the other hand, use hydrogen fuel cells to generate electricity, providing an alternative zero-emission option. Of these electrified powertrain technologies, the research indicates a significant shift towards the development and rollout of Battery Electric Vehicles (BEVs). As a result, there is a growing emphasis on research and development to improve BEV performance and enhance its competitiveness in the market. The study focuses on the modeling and analysis of electric vehicles, particularly BEVs, to better understand their potential impact on reducing GHG emissions and achieving sustainability goals. By examining the technology and market penetration of BEVs, the research aims to provide insights into how BEVs can effectively contribute to a more sustainable and environmentally friendly transportation system [6].

[3]. Bhaskar P. Rimal and et al. ***"Smart Electric Vehicle Charging in the Era of Internet of Vehicles, Emerging Trends, and Open Issues"*** Energies 2022, 15(5). Discusses the potential of the Internet of Vehicles (IoV) in the context of smart grids and city sectors for creating a sustainable society. The Internet of Vehicles (IoV) is a concept where various entities, including people, fleets of electric vehicles (EVs), utility companies, power grids, distributed renewable energy sources, and communication and computing infrastructures, are interconnected. the paper emphasizes the potential of IoV and its integration with emerging technologies like IoT, edge computing, and cloud computing to create smart and sustainable solutions for managing power grids and electric vehicle charging. The presented cloud-based EV charging framework exemplifies how IoV can be effectively utilized to tackle challenges in the transportation and energy sectors, paving the way for a more sustainable and efficient society [7].

[4]. Julio A. Sanguesa and et al. ***"A Review on Electric Vehicles: Technologies and Challenges"*** Smart Cities 2021, 4(1), 372-404. The paper begins by highlighting the increasing popularity of EVs, driven by factors such as price reductions, growing climate and environmental awareness, and the push for sustainable transportation solutions. It acknowledges the significance of EVs as a key component in the transition towards a greener and more sustainable transportation system. Furthermore, the authors discuss emerging research challenges and open opportunities in the field of EVs. These challenges span across various domains, including battery technology advancements, charging infrastructure expansion, vehicle-to-grid (V2G) integration, and overall system

optimization. The paper offers a comprehensive outlook on the advancements, challenges, and opportunities in the realm of electric vehicles. The review provides valuable insights for both the industry and academic communities, guiding future research and development efforts to drive the continued growth and improvement of EV technologies and their integration into smart and sustainable cities [8].

4. Major challenges of Internet of Vehicle

There are three major challenges to designing an IoV ecosystem that's capable of supporting these services:

- High reliability
- High scalability
- Desirable trade-off between accuracy and real-time processing

Once the IoV service is up and running, it needs to run continuously – unexpected crashes or downtime may have critical consequences.

5. Problem Statement

The fast acceptance of electric vehicles (EVs) as a sustainable and environmentally friendly mode of transportation is currently undergoing a fundamental transition in the automotive industry. Even though electric vehicles (EVs) have many benefits, the complicated wire harnesses that connect the many parts of the car are a difficult problem. The traditional method of designing and integrating wiring harnesses not only makes the car heavier and more expensive overall, but it also makes maintenance more difficult and restricts the design options. The problem at hand revolves around the need to comprehensively review the literature on the integration of IoV in advanced EV systems for minimizing wiring harnesses. By addressing this problem, the review aims to contribute to a better understanding of how IoV can reshape the landscape of EV technology, leading to more efficient, connected, and environmentally friendly transportation solutions.

6. Proposed Approach

Our proposed approach is to design advance electric vehicle system for minimization of wiring Harness Using IoV with the help of Eagle Software, Software IDE. The proposed model connected and test with the different communication technology Bluetooth Low Energy or Wi-Fi Technology [19-21], Embedded System, Embedded Communication, Cloud and Wireless Communication.

7. Used components

The hardware components used in the "Advance Electric Vehicle System for Minimization of Wiring Harness Using Internet of Vehicles (IoV)" project are listed below [19-21]:

A. ESP Module 32 now wireless communication module: The ESP32 is a powerful microcontroller module that includes built-in WiFi and Bluetooth capabilities. It serves as the central processing unit and communication interface for the electric vehicle system.

B. LCD 16×2: The 16x2 LCD display is used to provide visual feedback and display relevant information to the user, such as vehicle status, sensor readings, and system messages.

C. Relay 12V DC: The 12V DC relay is an electromagnetic switch used to control high-power electrical devices or circuits. It enables the ESP32 to control various vehicle components such as lights, motors, or actuators.

D. BC-547 NPN Transistor: The BC-547 is a general-purpose NPN bipolar transistor used as a switching and amplifying device in electronic circuits.

E. Power Supply (AC-DC & DC-AC): The power supply converts the available electrical power into the required voltage and current levels for different components in the electric vehicle system.

F. Capacitor 1000µF-25V: The capacitor is used to store electrical energy and stabilize the voltage supply in the circuit, reducing voltage fluctuations and noise.

G. IC-7805: The IC-7805 is a voltage regulator that ensures a stable 5V supply to power low-power components in the system.

H. LEDs (5mm, Red, Green, Blue): LEDs are used as indicators to show the status of various functions, such as power on, system status, and sensor readings.

I. Resistors (1K, 2.2K & 10K): Resistors are used to limit current flow, set voltage levels, and provide necessary resistance in different parts of the circuit.

J. Ultrasonic Sensor: Ultrasonic sensors are used to measure distances by emitting ultrasonic waves and calculating the time taken for the waves to return after hitting an object. They enable obstacle detection and parking assistance.

K. Buzzer: The buzzer is an audio output device used to generate audible alerts or warnings for the driver or users.

L. LDR Sensor: Light Dependent Resistors (LDR) are light-sensitive devices used to detect changes in ambient light levels. They can be used for automatic headlights or adjusting display brightness based on ambient light conditions.

M. Lights: The lights in the electric vehicle system may include headlights, taillights, indicators, and interior lights.

N. Switches: Switches are used to control various functions of the electric vehicle, such as turning on or off specific systems or components.

O. Solar: The project might incorporate solar panels to harness solar energy for charging the vehicle's battery or powering auxiliary systems.

The combination of these components forms an advanced electric vehicle system that utilizes the Internet of Vehicles (IoV) concept to minimize the wiring harness, enhance control and communication capabilities, and improve the overall efficiency and performance of the electric vehicle.

8. Software/Tool Explanation

A. Arduino for coding: Arduino is an open-source software and hardware platform widely used for programming and prototyping electronic projects as shown in figure 6. It provides a simple and user-friendly Integrated Development Environment (IDE) that allows developers to write, compile, and upload code to Arduino microcontrollers. The Arduino IDE uses a C/C++ based language to create sketches (programs) that control various electronic components and sensors connected to the Arduino board.

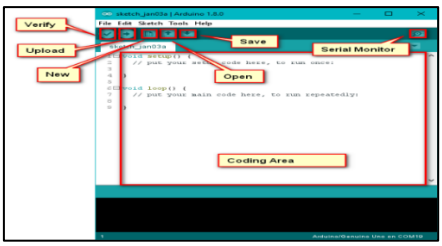

Fig.6: Arduino IDE

B. Eagle-Circuit design: Eagle (short for EAGLE - Easily Applicable Graphical Layout Editor) is popular Electronic Design Automation (EDA) software developed by Autodesk. It is used for designing electronic circuits, printed circuit boards (PCBs), and schematics. With Eagle, users can create and layout complex circuit schematics, design custom PCBs, and generate manufacturing files for PCB fabrication.

C. Tinkercad- Simulation: Tinkercad is a web-based 3D design and simulation tool developed by Autodesk. While it is primarily known for 3D modeling, it also offers basic circuit simulation capabilities. Users can create virtual electronic circuits by connecting components and simulate their behavior. Tinkercad's intuitive interface makes it suitable for beginners to learn and experiment with electronic circuits without needing physical components.

D. ThingSpeak: Data streams in the cloud: ThingSpeak is an Internet of Things (IoT) platform developed by MathWorks as shown in figure 7. It provides cloud-based storage and analysis of sensor data from IoT devices. With ThingSpeak, users can create channels to store and visualize data sent from various IoT sensors. It offers APIs and integration options to connect IoT devices and applications to the cloud for data monitoring and analysis.

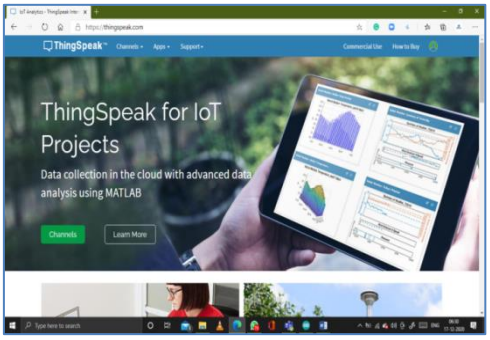

Fig. 7: ThingSpeak Website view For IoT Platform

Each of these software/tools plays a crucial role in different stages of the electronic project development process:

- Arduino is used for coding and programming the microcontroller, allowing the project to control and interact with various electronic components.
- Eagle is employed for designing the circuit schematic and PCB layout, enabling the physical realization of the project as shown in figure 8.

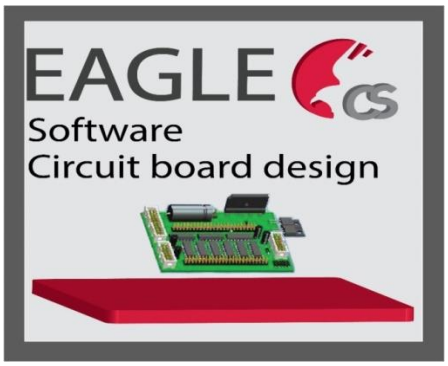

Fig. 8: Eagle Software for PCB Design

- Tinkercad offers a platform for virtual circuit simulation, allowing developers to test and validate the electronic circuit before physical implementation.
- ThingSpeak provides a cloud-based solution for storing and analyzing sensor data, enabling the project to interact with the cloud and implement IoT functionalities.

9. Proposed study on PCB layouts

The printed circuit board is the main process for electronic hardware implementation the consists of designing and developing both methods first we need to design the circuit diagram with help of software.

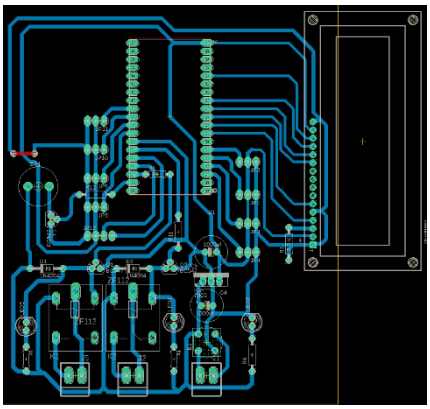

Fig. 2: Vehicle zone Board layout

For designing of the circuit, there are lots of software are available we use anyone. To developing of this system we have used eagle software. We have proposed Vehicle zone Board layout as shown in figure 2.

10. Conclusion

The spread of electric cars is increasing rapidly. However, ICE vehicles still make up most vehicles in Germany and almost all countries worldwide. The retrofitting of ICE vehicles to EVs is a solution to accelerate the transition to more sustainable transport in a resource- efficient way. A viable approach to reducing wiring harness complexity is the incorporation of Internet of Vehicles (IoV) into sophisticated electric car systems. The importance of electric vehicle technology, the promise of IoV, new research contributions, and difficulties in this field were addressed in this literature review. The synergies between EVs and IoV have the potential to influence the future of effective and connected transportation as the automotive industry continues its move towards electrification.

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