International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Advance Electric Vehicle System for Minimization of Wiring Harness Using Iov

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Abstract:
The rapid growth of the electric vehicle (EV) market demands innovative solutions to optimize vehicle design, improve efficiency, and enhance user experience. Traditional vehicles heavily rely on extensive wiring harnesses to interconnect various components and systems, leading to increased weight, complexity, and production costs. This abstract presents an advanced electric vehicle system that leverages the power of the Internet of Vehicles (IoV) to minimize wiring harnesses, utilizing components such as Wi-Fi, Thinkspeak cloud, Buzzer, solar plat, charging storing in Battery, LED indicators, voltage and current sensor and other smart electronic devices. The proposed system employs Wi-Fi connectivity as a robust wireless communication technology within the vehicle. By utilizing Wi-Fi, the need for physical wiring is significantly reduced, enabling seamless data transfer between vehicle components and the central control unit using ESP-32 now wireless Communications. This approach streamlines the vehicle's internal architecture, leading to a cleaner and lighter design, ultimately improving energy efficiency and reducing manufacturing complexity.
Furthermore, the integration of the Thinkspeak cloud serves as a centralized data storage and analysis platform. Thinkspeak cloud enables real-time monitoring and remote access to critical vehicle parameters and performance metrics, facilitating efficient fleet management and predictive maintenance. The cloud-based solution enhances the vehicle's connectivity and allows for over-the-air updates, enabling continuous improvements and adaptability to emerging technologies.

Keywords: Electric vehicle, Thinkspeak cloud, Internet of Vehicles, real-time monitoring, ESP-32, Solar panel.

1. Introduction

The rapid advancement of electric vehicles (EVs) is transforming the automotive industry, with a growing focus on enhancing vehicle efficiency, safety, and user experience. One of the challenges in traditional vehicle design is the extensive use of wiring harnesses to connect various components and systems, leading to increased weight, complexity, and manufacturing costs. To overcome these challenges and improve the overall design, an Advanced Electric Vehicle System utilizing the Internet of Vehicles (IoV) is introduced [1].
The Advanced Electric Vehicle System aims to minimize the usage of conventional wiring harnesses and leverage the power of IoV technologies to enhance connectivity, data exchange, and vehicle

management. The key components involved in this system are Wi-Fi, Thinkspeak cloud, Buzzer, LED indicators, and other smart electronic devices. Let's explore how each component contributes to the system's functionality [2-4:

- ***Wi-Fi Connectivity:*** Wi-Fi is utilized as a reliable and high-speed wireless communication technology within the vehicle. It facilitates seamless data transfer between various components and the central control unit, reducing the need for physical wiring.
- ***Thinksppeak Cloud Integration:*** Thinkspeak cloud serves as a central hub for data storage, analysis, and visualization. It enables real-time monitoring and remote access to crucial vehicle parameters and performance metrics, contributing to efficient fleet management and predictive maintenance [5].
- ***Buzzer:*** The Buzzer serves as an audible alert system that notifies the driver or passengers about important events or alarms. It can warn the driver in case of system malfunctions, low battery levels, or potential safety hazards.
- ***LED Indicators:*** LED indicators provide visual cues to convey vital information about the vehicle's status, health, and operating conditions. These indicators can help the driver identify issues quickly and take appropriate actions [6-8].
- ***Minimization of Wiring Harness:*** By utilizing Wi-Fi and IoV technologies, the need for extensive wiring harnesses is reduced significantly. This leads to a cleaner and more lightweight vehicle design, which improves energy efficiency, reduces manufacturing complexity, and lowers maintenance costs.
- ***Smart Electronic Devices:*** The system incorporates various smart electronic devices that can communicate with each other and the central control unit via Wi-Fi. These devices include sensors, actuators, controllers, and intelligent modules that play key roles in monitoring and controlling vehicle functions [9-12].
- ***IoV Benefits:*** The adoption of IoV technologies provides numerous advantages, such as real-time data monitoring, predictive maintenance, remote diagnostics, over-the-air updates, and seamless integration with smart city infrastructures.

The proposed advanced electric vehicle system delivers numerous benefits, including reduced wiring complexity, increased energy efficiency, lower manufacturing costs, and enhanced vehicle connectivity. By embracing the Internet of Vehicles technologies, this system sets the stage for a more sustainable, interconnected, and user-centric future in the EV industry [13-16].

2. Objectives of proposed work and Goals of work

The main objective is to develop an energy-efficient feature for vehicles that minimizes energy consumption while maintaining the flexibility of using various components. The feature will connect the switches on the vehicle's dashboard to a server module, and the individual components (such as indicator lamps, headlamps, taillamps, etc.) will connect to client modules with Internet of vehicles (IoV) technology.

- **Energy Efficiency:** The feature must consume minimal energy from the vehicle's battery and activate components only when required, thereby optimizing energy usage.
- **Low Latency Response:** Ensure that the communication between the server and clients is fast and responsive, allowing components to be activated within a very short amount of time after receiving signals.

- **User-Friendly Interface:** Design an intuitive and user-friendly interface on the dashboard that allows drivers to control the various components effortlessly.
- **Real-World Testing:** Conduct thorough testing of the feature in real-world driving scenarios to validate its efficiency, responsiveness, and overall performance.
- **Cost-Effectiveness:** Strive to develop the feature in a cost-effective manner, considering both manufacturing and maintenance costs.

The system includes intelligent electronic devices, such as sensors, actuators, controllers, and smart modules, which communicate seamlessly with each other and the central control unit through Wi-Fi. This integrated approach enhances data exchange and enables swift decision-making, leading to improved vehicle responsiveness and safety.

3. Internet of vehicles (IoV)

IoV is a part of Internet of Things (IoT) and evolves from VANET. In the internet of vehicles (IoV) field, blockchain technology has been proposed for durable and trustworthy bookkeeping of the exchanged data. Internet of Vehicles (IoV) is a network of vehicles that exchange data and information over the internet using agreed-upon communication standards. It is essentially the implementation of Internet of Things (IoT) technologies in the automotive industry. IoV systems comprise a range of components, including sensors, software, communication protocols, and embedded hardware devices, to enable seamless data exchange and connectivity among vehicles and other entities [3].

IoV has evolved from Vehicular Ad Hoc Networks (VANETs) and combines the principles of VANETs with IoT, providing benefits in terms of safety, security, and convenience. By integrating IoT technologies into vehicles and their surrounding infrastructure, IoV addresses numerous challenges faced by the automotive industry, such as road safety, traffic congestion, fuel consumption reduction, and pollution control.

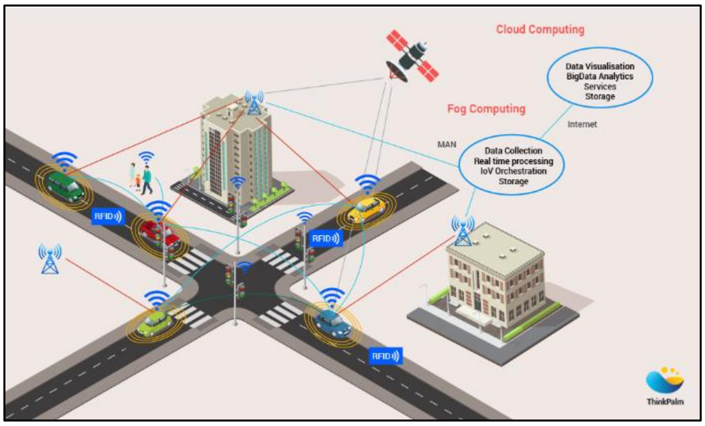

Fig.1: Internet of Vehicles (IoV) network for vehicles [3]

IoV offers a range of components and functionalities, including connected cars, smart driving features, vehicle tracking systems, and V2X communication capabilities. The integration of these components aims to enhance road safety, improve traffic management, optimize fuel efficiency, and provide a more convenient and connected driving experience for users. Automotive manufacturers are increasingly adopting IoV technologies to remain competitive in a rapidly evolving market and to meet the growing demands for safer, more efficient, and intelligent transportation solutions [3].

4. Block diagram description and process

To create a Driver Zone Transmitter and Receiver system using the Internet of Vehicles with "thinkspeak cloud" and components like ESP-32 now wireless Communications, switches, relay, and a light indicator in a car, you can follow the steps outlined below. The block diagram of vehicle front zone transmitter and Driver Zone Transmitter & Receiver are shown in figure 2 and 3 respectively and similarly principal work on vehicle back zone receiver.

a) Components Required:

- ESP-32 microcontroller with Wi-Fi capability
- Switches (e.g., door open switch, seatbelt switch)
- Relay module
- Light indicator (e.g., LED)
- Internet connection for ESP-32 (Wi-Fi or other network connectivity)
- "Thinkspeak cloud" account for data logging and visualization

b) Driver Zone Transmitter: The Driver Zone Transmitter will be responsible for monitoring the driver zone and sending relevant information to the "thinkspeak cloud" for remote monitoring.

- **Switch Inputs:** Connect switches (door open switch, seatbelt switch, etc.) to ESP-32 now wireless Communications digital input pins. These switches will be used to detect whether the door is open or closed and whether the driver has fastened the seatbelt.
- **Data Processing:** Write a firmware for the ESP-32 that continuously monitors the status of the switches. Whenever there is a change in switch states, the ESP-32 should process the data and create a message with the relevant information (e.g., door status, seatbelt status).
- **Connectivity:** The ESP-32 should connect to the Internet through Wi-Fi or other connectivity options. Utilize the "Thinkspeak cloud" API to send the processed data to the cloud for logging and visualization.
- **Data Transmission:** Use HTTP or MQTT protocols to send data to the "Thinkspeak cloud." The data could include timestamps, switch status, and other relevant information.

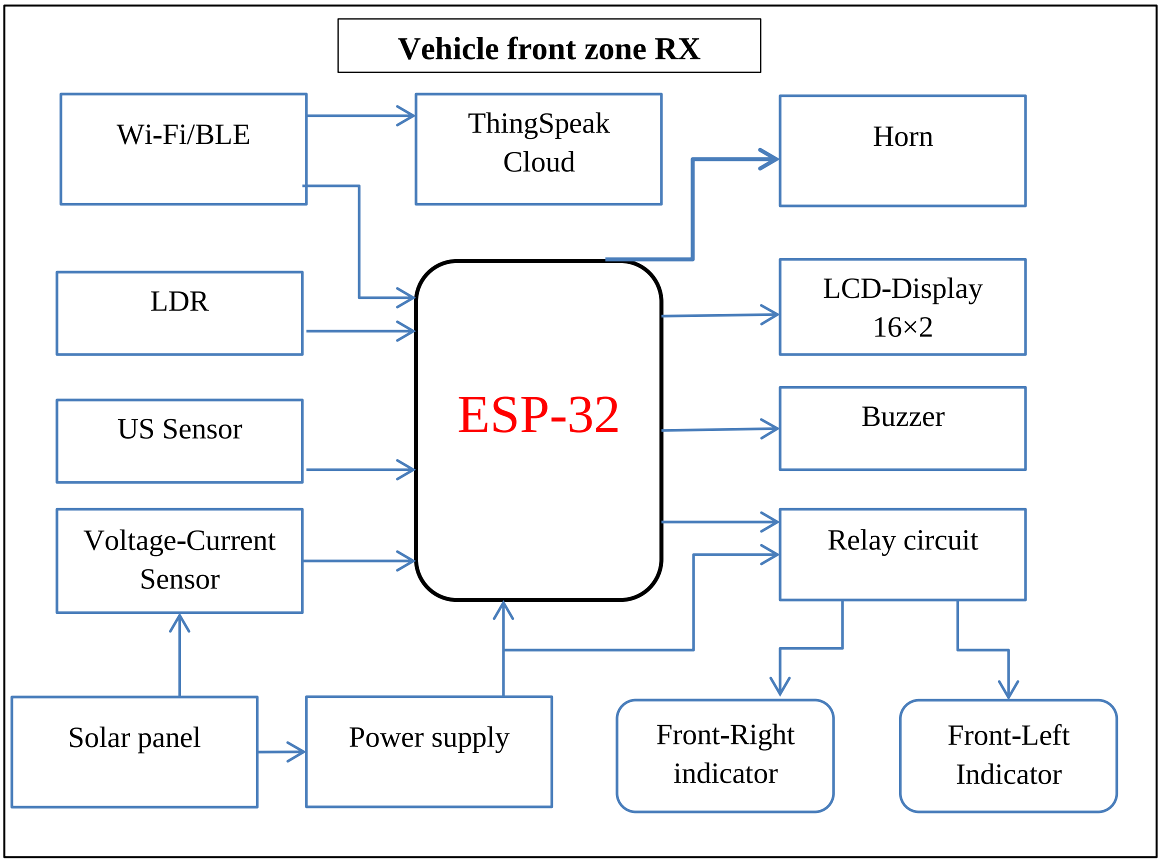

Fig. 2: Block diagram of vehicle front zone transmitter (Tx)

c) **"Thinkspeak Cloud" Integration:** Set up an account on "Thinkspeak cloud" and create a channel to store the data received from the Driver Zone Transmitter. Obtain the API key and the channel ID, which will be used in the firmware of the ESP-32 to send data to the cloud.

d) **Driver Zone Receiver:** The Driver Zone Receiver will be installed in a remote location (e.g., a monitoring station) to receive and interpret the data sent from the Driver Zone Transmitter.

- **Internet Connectivity:** Ensure that the monitoring station has a stable internet connection to access the "Thinkspeak cloud" platform.
- **Data Retrieval:** Use the "Thinkspeak cloud" API to retrieve data from the cloud platform. This can be done periodically or in real-time, depending on the requirements.
- **Data Interpretation and Alerting:** Process the received data to interpret the status of the driver zone. For example, if the door is open or the seatbelt is not fastened, trigger alerts or warnings through visual indicators (e.g., LEDs) or notifications to the monitoring personnel.

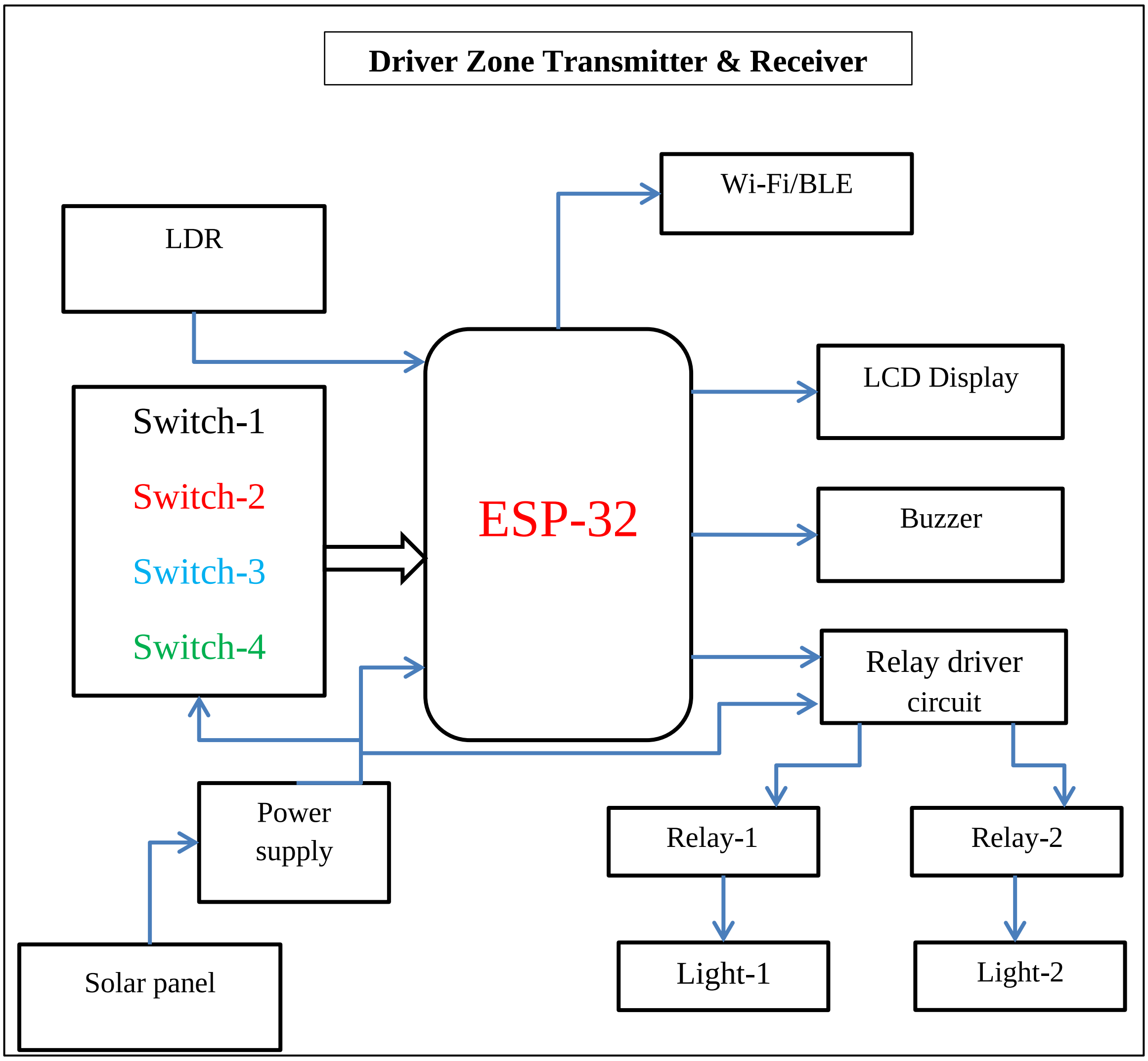

Fig. 3: Driver Zone Transmitter & Receiver

e) **Light Indicator in Car:** The light indicator inside the car can serve as a warning or reminder for the driver to check the status of the door or seatbelt.

- **Light Connection:** Connect an LED to the ESP-32 digital output pin. When the ESP-32 detects a relevant event (e.g., door open or seatbelt not fastened), it can control the LED to turn on and off accordingly.
- **Light Behaviour:** Define the behaviour of the light indicator based on the detected events. For instance, the light may blink or stay on continuously to indicate the status of the door or seatbelt.

f) **Safety Considerations:** Always ensure that the electronic components and connections in the car are properly insulated and secured to avoid interference with the vehicle's electrical system. Additionally, prioritize safety while implementing any warning or alerting mechanisms, as they are intended to enhance driver awareness and safety.

5. Working of proposed design

In this project there are three zones: the electric vehicle zone, the driver zone, and the back zone of the vehicle. The front zone houses four switches, with one switch designated for the ESP32 module, which has built-in WiFi and Bluetooth capabilities. The ESP32 module receives commands and sends them out.

Once the ESP32 now wireless communications [15-18] module sends a command, it continuously checks the loop to determine if any data has been received. Upon receiving data from the vehicle, the module processes it and displays a command on the LCD screen. Subsequently, the module activates the indicator on the relay, which triggers a corresponding action on the connected circuit. This is the complete functioning of the relay system.

The Relay system operates with a 230V DC supply, and the design currently does not incorporate any additional elements. However, the project is open to updates if required. Notably, the lighting system in the project has two cases: one for the driver zone and another for the vehicle zone. Each case includes an LDR sensor to sense light conditions and activate the appropriate lighting setup.

Fig. 4: Demonstration of proposed project hardware

The presented project related to advanced electric vehicle systems and the Internet of Vehicles (IoV) with various advantages by using different advance components such as solar panels, battery charging and storage, voltage and current sensors, total power monitoring, and automatic ultrasonic-based distance detection for horn control. This system aims to minimize the wiring harness in electric vehicles. Overall, this advanced electric vehicle system with IoV integration and various smart features aims to enhance the efficiency, safety, and sustainability of electric vehicles while minimizing the complexity of the wiring harness.

In summary, the project focuses on the relay-based control system for an electric vehicle, with separate zones for the driver and vehicle areas. The ESP32 module serves as the central controller, communicating with the vehicle and activating corresponding actions through the relay system. The lighting system includes LDR sensors for adaptive illumination in the driver and vehicle zones [19]. The used component with descriptions is listed in table 2 and the figure 4 demonstration of proposed project hardware.

Table 2: List of used Component in the proposed project

S. No	Component	Descriptions
1	ESP Module	32-S
2	LCD	16*2
3	Relay	12V DC
4	bc-547	NPN Transistor
5	Power supply	AC-DC & DC-AC
6	Capacitor	1000µf-25V
7	IC	IC-7805
8	LED	5mm, Red, Green, Blue
9	Register	1K, 2.2K & 10 K
10	Ultrasonic sensor	
11	Buzzer	
12	LDR sensor	
13	Lights	
14	Switches	
15	Solar panel	

6. Result analysis

The Advanced Electric Vehicle System for Minimization of Wiring Harness Using IoV is a cutting-edge solution that optimizes vehicle architecture, performance, and management. It empowers the automotive industry to embrace innovation, enhance user experience, and advance towards a cleaner and more sustainable transportation future. The proposed Schematic Layout of Vehicle Zone circuits is shown in the figure 5 in this circuits we have used bridge rectifier circuits with the help of diodes and other components like IC-7805, Register, LED and Capacitors. The one more schematic layout circuits have been shows the Driver Zone circuits as shown in figure 6. The resultant output of proposed work are ploted betwn Voltage V/S Date, Current V/S Date and Power V/S Date for Advance electric vehicle system for Minimaztion of wiring harness using IoV are represnted in figure 7, figure 8 and figure 9 respectively.

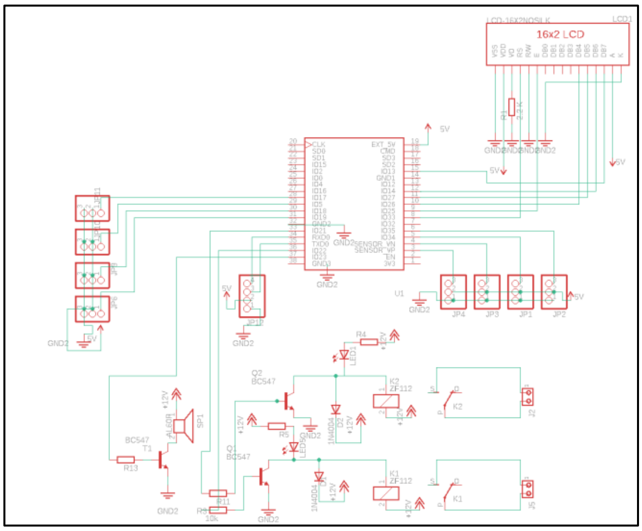

Fig.5: Schematic Layout of Vehicle Zone circuits

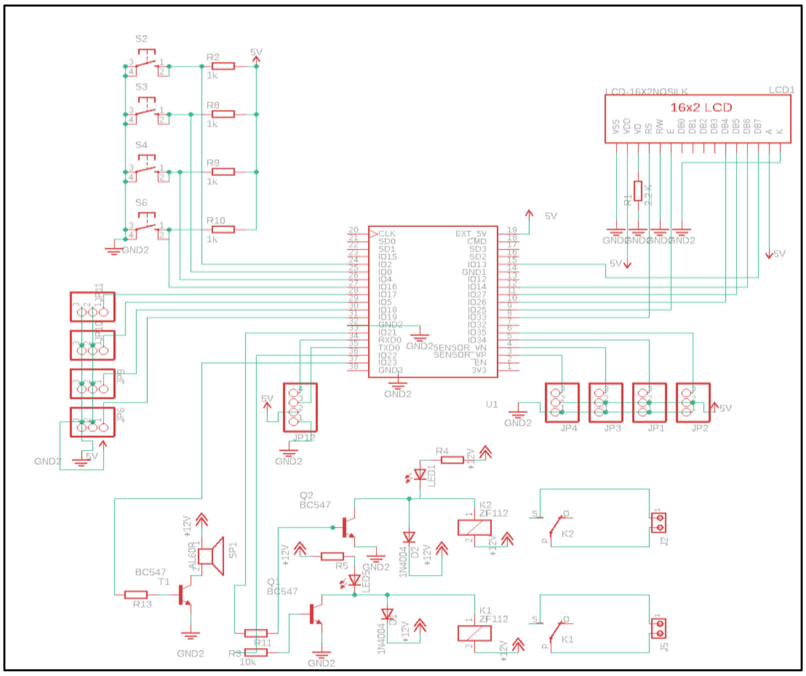

Fig.6: Schematic Layout of Driver Zone circuits

Fig.7: Vltage sensor v/s Date plot for Advance electric vehicle system for Minimaztion of wiring harness using IoV

Fig.8: Current sensor v/s Date plot for Advance electric vehicle system for Minimaztion of wiring harness using IoV

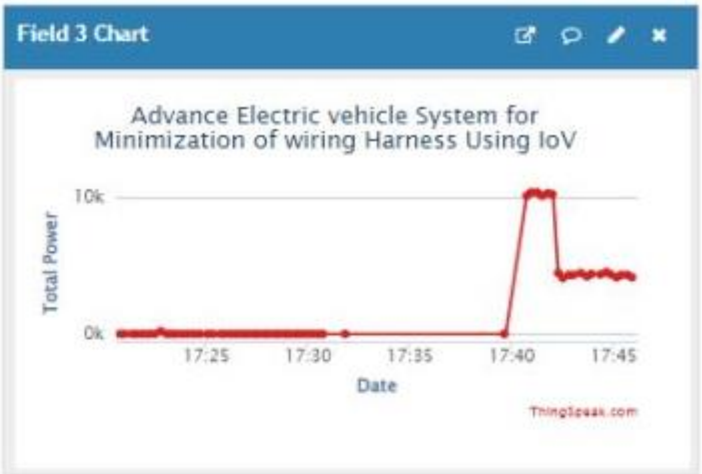

Fig .9: Total power calcultion for Advance electric vehicle system for Minimaztion of wiring harness using IoV

7. Conclusion

The Advanced Electric Vehicle System for Minimization of Wiring Harness Using IoV is a cutting-edge solution that leverages Wi-Fi, Thinkspeak cloud, Buzzer, LED indicators, and other smart electronic components to revolutionize the design, performance, and management of electric vehicles. By embracing IoV technologies, this system enhances the overall user experience, simplifies maintenance, and paves the way for a more sustainable and interconnected future in the automotive industry. To further enhance user awareness and safety, the system incorporates a Buzzer and LED indicators. The Buzzer provides audible alerts for driver notifications, system malfunctions, low battery levels, or safety hazards. Simultaneously, the LED indicators offer visual cues to convey essential vehicle status and operating conditions, assisting drivers in identifying issues promptly and taking appropriate actions. This system aims to minimize the wiring harness in electric vehicles. Overall, this advanced electric vehicle system with IoV integration and various smart features aims to enhance the efficiency, safety, and sustainability of electric vehicles while minimizing the complexity of the wiring harness.

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