International Journal of Applied Power Engineering (IJAPE)
Vol. 15, No. 2, June 2026, pp. 808~817
ISSN: 2252-8792, DOI: 10.11591/ijape.v15.i2.pp808-817

Adaptive telematics integration for enhanced EV fleet management and data acquisition

Kavitha Kumaraswamy[1], Pasumarthi Usha[1], S. Ashok Kumar[2], Deekshitha Arasa[1], Suganthi Neelagiri[1]
[1]Electrical and Electronics Engineering Department, Dayananda Sagar College of Engineering, Visvesvaraya Technological University, Bengaluru, India
[2]Electrical and Electronics Engineering Department, Bangalore Institute of Technology, Visvesvaraya Technological University, Bengaluru, India

Article Info

Article history:

Received Oct 17, 2024
Revised Feb 19, 2026
Accepted Mar 12, 2026

Keywords:

Fleet management system
Real-time monitoring
Sensor integration
Telematics control unit
Universal compatibility
Vehicle data acquisition

ABSTRACT

Telematic control units (TCUs) and on-board diagnostics (OBD-II) systems are commonly used to monitor vehicles and enable real-time communication. However, traditional OBD-II systems provide limited data, making it difficult to accurately detect faults and analyze performance, especially in hybrid, flex-fuel, and electric vehicles. A TCU is an embedded system installed in vehicles that enables wireless communication with external networks. This paper introduces a standalone device designed to seamlessly integrate with electric vehicles (EVs) by utilizing TCU capabilities to enhance data acquisition. The TCU uses a combination of sensors to collect important real-time vehicle data, such as GPS location, battery charge level, and voltage levels. The collected data is processed to generate meaningful insights that support decision-making and system optimization. The proposed system uses the TCU as a core component to transmit real-time data to a fleet management system (FMS). By providing enhanced data to the FMS, the system improves diagnostic accuracy, strengthens EV safety monitoring, and enables more efficient fleet management across diverse vehicle types. This approach allows deeper monitoring of EVs and improves overall fleet efficiency. The framework offers a cost-effective and scalable solution for advanced monitoring and optimization of electric vehicle fleets.

Corresponding Author:

Kavitha Kumaraswamy
Electrical and Electronics Engineering Department, Dayananda Sagar College of Engineering
Visvesvaraya Technological University
Bengaluru, India
Email: kavithakgowda77@gmail.com

1. INTRODUCTION

A telematic control unit (TCU) is a smart device built into vehicles that helps them stay connected by enabling wireless communication with external systems and networks. It processes data from various in-vehicle sources such as sensors and control units, enabling real-time decision-making, and also provides crash alerts or fault notifications. On-board diagnostic II (OBD-II) is the upgraded version of a built-in system included in most cars and light trucks that helps monitor various vehicle subsystems, including the engine, transmission, and emissions systems, by communicating with multiple electronic control units (ECUs) such as the engine control module (ECM) and TCU. Rybitskyi *et al*. [1] analyzed the OBD-II technology extensively and proposed a practical software model that utilizes cost-effective hardware to enable comprehensive diagnostic functions. Suzen and Kayaalp [2] have presented a practical and integrated solution for remote vehicle diagnostics and performance monitoring. It uses standard OBD-II protocols along with affordable hardware. A web-based interface is included to improve vehicle safety and make maintenance more efficient.

When full data is unavailable, it becomes difficult to find the exact cause of problems in a vehicle and also more difficult to improve vehicle's overall performance. This is particularly the case for hybrid and flex-fuel vehicles, as they utilize more than one type of energy source. OBD-II data covers only a limited range, it can make it harder to build accurate models for tracking emissions and fuel efficiency. The feasibility of using cost-effective OBD data to develop detailed engine maps and analyze the urban taxis' fuel efficiency and CO_2 emissions under real-world, practical driving conditions is discussed in [3]. The method proposed in this paper combines a 'vehicle specific power' analysis with OBD-collected data and enables a detailed assessment of vehicles without the need for expensive equipment like portable emission measurement systems.

Heavy vehicles are tracked through a mix of GPS technology, telematics solutions, and onboard diagnostic systems OBD-II. Heavy machinery is usually monitored through advanced telematics and internet of things (IoT) technologies instead of traditional OBD-II systems. The heavy machinery, characterized by legacy equipment and high upgrade costs, presents challenges. With the support of external sensors to the existing vehicle's system that gather necessary data without changing the vehicle, the warranty for these EVs complies, and logical issues can be improved. The data gathered gets transmitted to the fleet management system through Wi-Fi with high-speed transfer and an inbuilt buffer storage mechanism to maintain data integrity even during data network disruptions.

Rimpas *et al*. [4] compared the actual fuel consumption of the vehicle with calculated values using the OBD-II data, sensor data, and software. The results show that fuel consumption is closely tied to driving habits: stop-and-go driving burns more fuel, whereas steady, consistent driving keeps fuel use in check. Dhananjayan *et al*. [5] have used external sensors to monitor driver's real time health and behavior, and fuel consumption, along with OBD-II data and monitored through a mobile App developed about vehicle conditions and route tracking.

This paper focuses on integration of adaptive telematics which offers significant advantages for both operational efficiency and data-driven decision-making. Telematics systems allow fleet operators to monitor, control, and optimize their EVs in real time, facilitating better management of resources and improving sustainability with enhanced data acquisition capabilities for EVs to enable efficient fleet management.

2. LITERATURE REVIEW

2.1. Overview of telematic control units (TCUs)

Urban transport creates a lot of air pollution and is actively responsible for over 25% of the world's greenhouse gas emissions. Vehicle telematics can play a big role in making city travel safer, reducing pollution, and creating an eco-friendlier and more sustainable ways to travel. Vehicle telematics uses GPS technology combined with onboard sensors to track a vehicle's exact location along with the time that data is recorded. Telematics devices inside the vehicle continuously records where the vehicle is, by helping fleet managers or owners keep track in real time. Telematic data is also used to find [6] vehicle emissions, driving cycle, driver behavior, driving styles, driving risks, real world traffic, fleet management, remote diagnostics, safety, and is also used by insurance sector.

The TCU is equipped with a comprehensive set of software tools, along with microcontrollers, radiofrequency/internet communication modules, and GPS receivers. The integration of hardware and software [7] in the vehicle provides valuable information to fleet operators, insurers, and other interested parties. Information access services allow people inside the vehicle to connect to and use information from sources outside the vehicle [8]. These provide bi-directional communication of all types of data through a standardized interface. Many vehicles are equipped with tracking systems that keep an eye on where they are in real time. This information helps a system predict when the vehicles will arrive and leave, and these updates are shared with passengers to make their travel easier. Vehicle telematics also provide context aware services like vehicle component states, traffic, weather, and pollution conditions, accurate parking, on demand entertainment, and information about nearby points of interest [8]. This variety of usage contributes to vast applications in an array of industries, including transportation, logistics, and automotive insurance.

The TCU is an essential constituent of advanced vehicle connectivity, which enables stakeholders to use these data to make prompt and pertinent judgments and improve road productivity, fuel consumption, and safety [9]. Data extraction from the OBD port in internal combustion engine vehicles adheres to an industry-standard protocol but electric vehicles are not bound by such a standard. Data extraction from the OBD port of electric vehicles and to synthesis of the collected data on various parameters on EV energy consumption is discussed in [10].

2.2. Existing fleet management systems (FMS)

Fleet management is the process of monitoring a company's vehicles and assets to improve operational efficiency, reduce costs, and increase performance. Fleet management systems (FMS) are integrated software and hardware solutions designed to help organizations efficiently manage their fleet of vehicles through key functionalities like driver behavior monitoring, vehicle tracking, diagnostics, fuel management, maintenance management, safety, and risk management. A cloud-based fleet management [11] system is an online service that allows large-scale organizations to manage their vehicle fleets' costs effectively and more efficiently. This system works on cloud infrastructure and can be accessed from anywhere via the internet. It offers features including vehicle tracking, route optimization, driver management, fuel management, and maintenance scheduling. The FMS discussed in [12] integrates vehicle units with sensors, GPS, and GSM technology to enhance scheduling, improve productivity, and reduce transportation costs. The designed system addresses security concerns like driver over-speeding and unauthorized private use, benefiting fleet owners and administrators. Fleet management plays a crucial role in intelligent transport systems (ITS) [13], optimizing large-scale vehicle fleet operations in transport companies. The proposed FMS uses tachographs for monitoring vehicle and driver activities.

The existing few FMS solutions in the market are Geotab and Verizon Connect. Geotab stands as one of the pacesetters in the FMS field and is widely known for the powerful telematics system that it provides. Geotab delivers business solutions, including real-time GPS tracking, vehicle statistics, driver mode rating, and vehicle maintenance schedules. The system features interactive reports and dashboards that fleet managers can tailor to their specific data needs for more informed decision-making.

Verizon Connect has a good source of FMS; they provide advanced FM software solutions to enhance the efficiency and safety of fleets. The platform includes fuel management, good driving habit scoring, routing optimization, and fleet prospection. Verizon Connect also features comprehensive third-party integration and application programming interface (API) functionality, making it very flexible when telling the story of EVs and assets.

2.3. Challenges in vehicle data acquisition

Vehicle data acquisition comes with a variety of challenges that can be quite complex and involve many different factors. Various methods of data acquisition systems are shown in Figure 1. The major difficulties are gathering efficiently, memory requirement, privacy concerns, managing data redundancy and processing vast amounts of data from various sensors. A specially designed unique data acquisition system is proposed [14], which emphasizes the need for advanced data acquisition system with preprocessing of data and intelligent strategies to analyze complex data vehicle dynamic movement data and the associated human behaviour data while driving in challenging environments. Gathering and analyzing of real-world vehicle data, particularly for electric vehicles [15], comes with quite a few challenges from technical hurdles to legal considerations. The challenges in case of automated vehicles [16] will specifically be data logging, collection, storage, annotation, reprocessing, and evaluation to ensure automated vehicles behave consistently and reliably. The data extraction and processing is tough in highly heterogeneous traffic [17] with poor lane discipline. In this situation, the vehicles interact both front-to-back and also laterally.

Automotive ECUs usually get supported for 10 to 30 years, which is often much longer than the lifespan of many of their electronic parts [18]. Redesigning obsolete ECUs with new components and corresponding software redevelopment involves lots of effort and cost. The data acquiring from EV integrated with diverse vehicle types, including ensuring compatibility with vehicle-to-grid (V2G) communications, data transmission through 5G networks is also challenging [19].

The data collection and accurately interpreting data from the in-vehicle networks of heavy-duty vehicles using CAN bus is discussed in [20]. Interfacing TCU and fuel sensors to monitor the fuel levels [21] and to manage fuel pilfering in commercial vehicles is presented in [21]. Saghaei [22] has used a web-based software and a trackerRAD100 to find the live location of the vehicle, travelled path, and fuel consumption rate. The fleet management (FM) software implementation, improvement in fleet operation, savings and design at various levels FM are discussed in [23] to meet the varying requirements, characteristics, and operational needs. The use of vehicle telematics data like speed, braking, distance travelled, and driver behavior is used for vehicle insurance application is documented by Boylan *et al*. [24]. The vehicle telematics data is used for understanding urban mobility, vehicle emissions, with geospatial data were presented in detail by Ghaffarpasand and Pope [25]. The objective of this paper is to develop a cost effective a cost-effective transmission control unit that can work across different EV models in a fleet management system. It focuses on building a unit that can reliably gather important data by using sensors that send key information from the battery management system (BMS) to the telematics control unit.

3. METHODOLOGY AND SYSTEM IMPLEMENTATION

3.1. Design of the telematics control unit (TCU)

The overall system architecture is shown in Figure 1. The TCU is a central element and vital in-vehicle telematics system. The TCU is responsible for data acquisition, computation, and transmission in a modern vehicle telematics system with many embedded hardware and software. There are 3 different modes of acquiring data by TCU as shown in Figure 1, in mode 1 data from only OBD-II, in mode 2 it gathers data from OBD-II and external sensors, and in mode 3 only from external sensors. In this paper, mode-2 that is data from sensors and OBD-II has been taken for controlling and managing the vehicle.

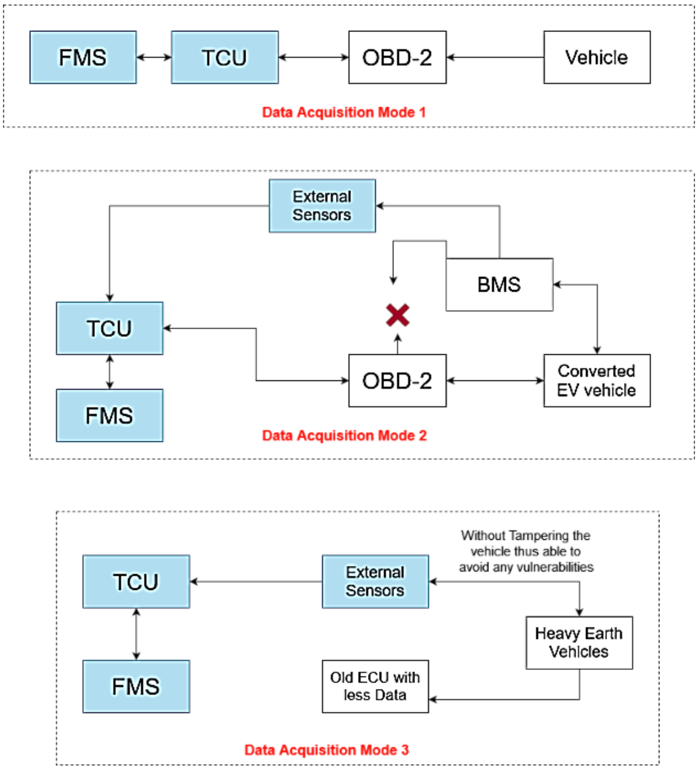

Figure 1. Existing mode of data acquisition methods

The TCU has advanced hardware features such as microcontrollers, wireless communication radios (like Wi-Fi and Bluetooth), GPS interfaces, and a broad range of sensors. Vehicles commonly use two main types of speed sensors: wheel speed sensors and vehicle speed sensors. These sensors rely on different technologies, including the Hall effect, magnetic (variable reluctance), and magnetoresistance sensors, to accurately monitor speed and support essential vehicle systems. The complete block diagram of the developed model is depicted in Figure 2, where FMS, sensor cluster, and signal transmission system are shown.

3.1.1. TCU setup and configuration

RC car integration: in this paper, TCU is the element that physically connects the autopilot to the RC car while enabling telemetry communication between the autopilot and the microcontroller. The integrated IC ESP32 has been used in TCU which is a low cost, energy efficient micro controller. This has inbuilt Wi-Fi and Bluetooth which helps in connecting to the internet or other devices. Controlled by a built-in ESP32 microcontroller and an L290 motor driver, the TCU processes the input to control the robot's speed and track direction; it works like an actual vehicle control unit. These components are shown in the Figure 2 block diagram.

Bluetooth communication: the TCU uses the ESP32 BLE module to imitate the vehicle's Bluetooth communication, allowing it to work exactly like the car's built-in Bluetooth system. This creates uninterrupted integration between the TCU and data acquisition and control. Comprehensive sensor suite: the functionality of TCU has not been limited to simple types of sensors, the sensors used in the paper are proximity sensor, temperature sensor, humidity sensor, speed sensor, and for location the position GPS module, SoC battery monitoring and voltage, and battery temperature.

Realistic vehicle simulation: this paper uses an RC car to prototype and test a TCU. The TCU is tested in a smaller, safe environment. Even though the RC car is just a model, it gives the TCU a real place to connect with sensors, send and receive data, and act just like it would in a real car. The findings show that this type of systems have strong potential for use in managing fleets of vehicles. Resource optimization: the paper carries out the RC car setup, and therefore, it proves that through fleet optimization, TCU provides fleet resource management services. By using different data acquisition methods, TCU improves productivity in operating equipment and aids in organizing managers' decisions into more informed ones.

The TCU's software element processes and assesses the net result of collected data rapidly and effectively. The software processes online data, checks real-time fault detection, vehicle condition and transmitting data to external system the FMS. Additionally, the TCU has embedded hardware SD card that ensures that network disruptions do not affect data integrity and reliability. Even in the case of network failure, the vehicle can safely carry out the driving task relying on the buffered and stored data on the SD card.

The TCU's hardware and software components can be designed separately and then integrated; this modular nature allows flexibility and scalability to upgrade the TCU system used in vehicles. This reassures technical professionals that the TCU will remain a reliable and effective component in their systems, even as technology continues to evolve. Figure 3 shows the prototype of RC car with TCU and data acquisition system developed.

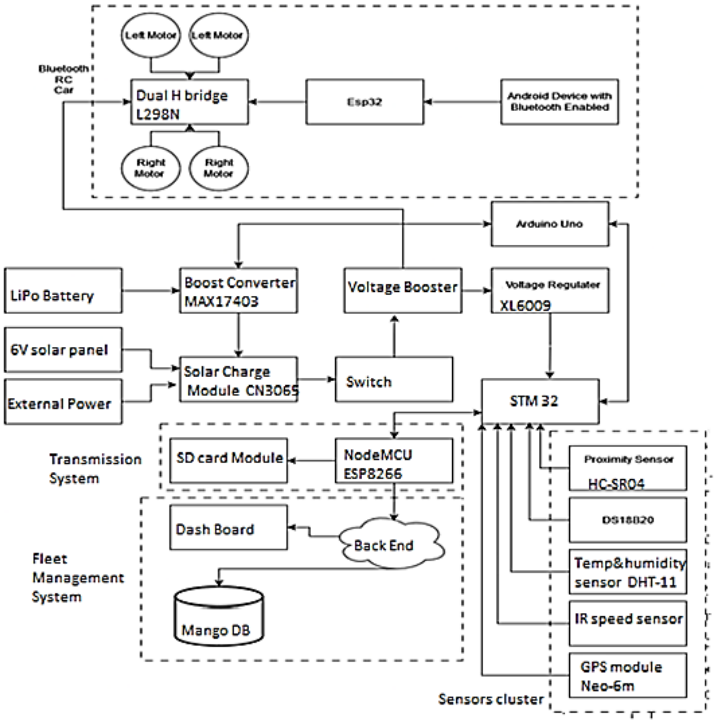

Figure 2. Block diagram of the developed model

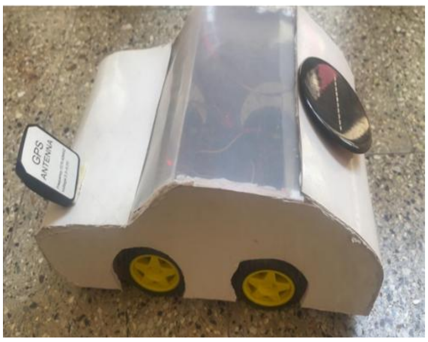

Figure 3. Prototype of data acquisition and TCU module

3.2. Data acquisition, processing, storage mechanisms, and transmission process

This section presents the mechanisms involved in data acquisition, processing, storage, and transmission within the TCU system. It outlines how vehicle data is collected, analyzed, and reliably delivered to support real-time monitoring and decision-making.

- Data collection: the TCU system uses a smart setup to gather all the important details about the vehicle that are needed. The data it collects is of GPS paths, battery charge state, voltage levels, temperature readings, proximity data, and vehicle speed.
- Data processing: the TCU collects the information, after which the server performs various data analytics tasks to generate improved insights and carry out the required computations. This involves aggregation, analysis, and processing of the raw data into results that make significant contributions to decision-making.
- Transmission via Wi-Fi: after collecting the necessary data, the TCU is designed to send this information to a specific server using a node MCU's Wi-Fi connection. With vehicle telematics, fleet managers get instant updates of their vehicles in real time and this helps them respond quickly to important situations.
- Network redundancy: the TCU is built with a backup system to handle issues like dropped connections or brief network outages. Whenever the Wi-Fi connection is lost, it automatically switches to saving data locally on an SD card, keeping all important information safe until the network is restored. Once the network connection is restored, TCU transmits the stored data smoothly and continuously without interrupting the server. As a result, fleet transportation is monitored continuously, registering every detail of the vehicle data at all times.

3.3. Development of the fleet management system (FMS)

Developing an FMS creates a complex software infrastructure that provides the platform to integrate data from different sections to control fleet operations through data collecting, storage, and visualization. Setting up the back-end server with middleware tools like Node.js and Express helps with receiving, saving, updating, or manipulating data as needed. Node.js is a tool that lets to run JavaScript outside of a browser, such as on a server or computer. It can handle many tasks at the same time without waiting for one to finish before starting another. Because of this it's also very fast and can easily manage lots of communications or requests simultaneously, making it ideal for FMS.

In this paper, for database management, MongoDB, a popular open-source, document-oriented NoSQL is implemented. This stores data in a binary form that is more efficient for storage and processing by computers. An FMS administrator server equipped with Node.js and Express can process data from incoming EVs and store it in a MongoDB database. As MongoDB has a document-oriented approach, data in structured and unstructured forms is easy to access. Consequently, the capability to handle the different data types collected from various EVs is realized and this enhances the database's universal applicability.

For building front end user interfaces (UIs), open-source JavaScript library React.js is used. React.js helps create interactive and changing user interfaces by dividing the screen into small, simple parts called components. The frontend is a user-friendly dashboard; this is the key technical part that powers the FMS. Figure 4 shows the web app signal flow in FMS.

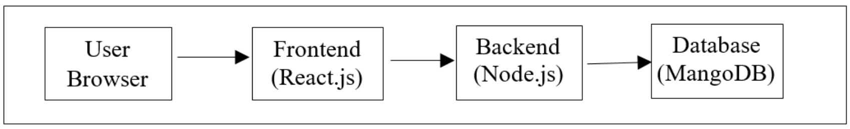

Figure 4. The flow of signal in FMS

4. RESULTS AND DISCUSSION

Integrating the TCU with FMS system is crucial, transforming the way fleet management operations are handled. This integration enables sophisticated and varied data collection across various vehicle types, capturing large volumes of data and providing real time insights. The highlight that integrating various EVs with a TCU and an efficient FMS is both practical and achievable.

The dashboard works in real time updating the information received by TCU from vehicles. By increasing the use of dynamic data visualization tools, fleet managers can monitor vehicle health conditions, battery status in real time which helps them in making managerial decisions adequately. The FMS frontend dashboard is built with React and Tailwind CSS which has two-way communication feature, which provides fleet managers with seamless data visualizations and actionable insights.

The dashboard also provides selective summary data generated by the data collection process. Figure 5 shows the FMS dashboard, which consists of 4 vehicles linked with the fleet management portal. The type of vehicle, vehicle number, and condition of each vehicle is displayed. The summaries give clear and simple insights into how EVs perform on the job.

Figure 6 shows that location and route tracking capabilities is the dashboard's ability to track routes is one of its most useful feature. Fleet managers can quickly see the status of every vehicle in a congested area and can do route planning, easily identify opportunities for improvement, helping the fleet run more smoothly and efficiently. The FMS evolves to enhance robustness, scalability, and humanization to the benefit of fleet managers, and they are equipped with the necessary tools to help them make the right decisions and simplify the fleet management process.

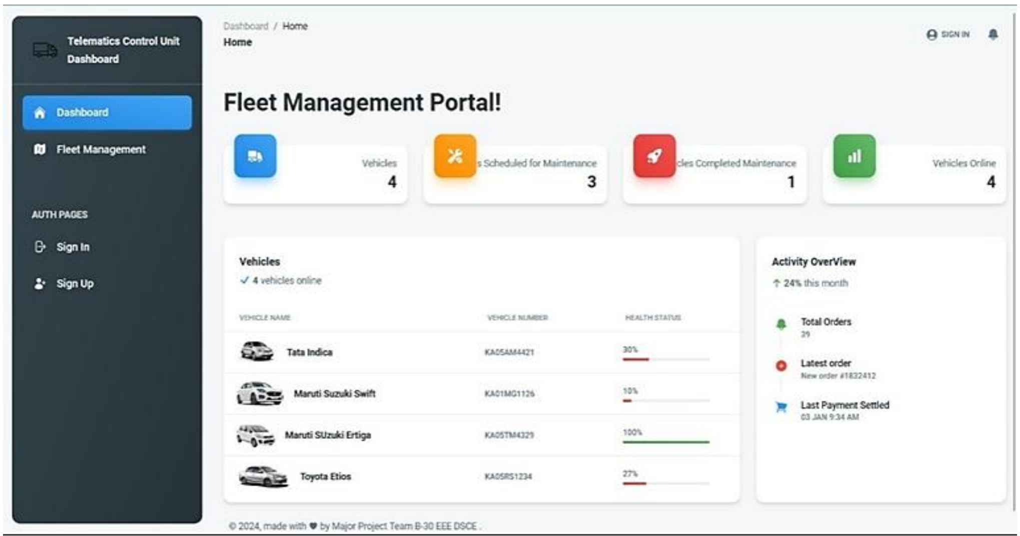

Figure 5. FMS dashboard

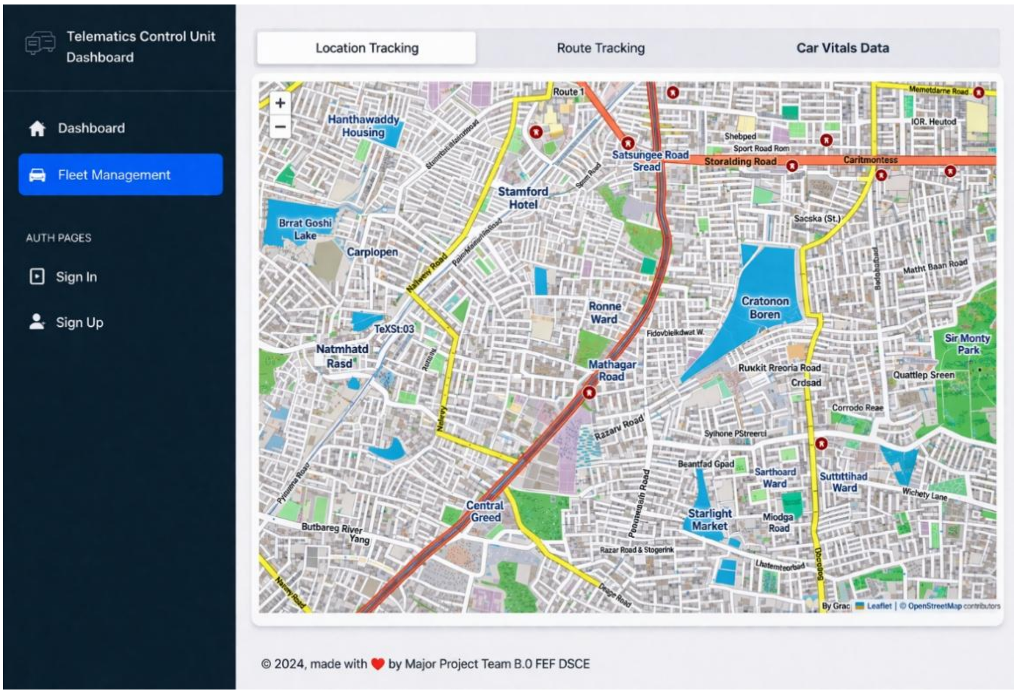

Figure 6. Location and route tracking

5. CONCLUSION

A cost-efficient TCU has been designed with the capability to integrate various EV models, functioning as part of an FMS. The TCU is built using a low-cost microcontroller with built-in Wi-Fi and Bluetooth features. On the FMS server, data processing is handled using Node.js and Express, with MongoDB serving as the database solution. The TCU is configured to buffer data during connectivity losses to ensure data integrity once the connection is restored. Additionally, a front-end dashboard has been developed to visualize and summarize real-time data, as well as track vehicle routes and movements. Future work on this topic can explore the use of advanced communication technologies like 4G/5G and vehicle-to-everything (V2X) to improve connectivity and reliability. It can also include integrating the system with smart charging infrastructure and traffic management systems to support smart city applications. Overall, these improvements can make telematics-based fleet management systems more efficient, intelligent, and scalable.

FUNDING INFORMATION

Authors state no funding involved.

AUTHOR CONTRIBUTIONS STATEMENT

This journal uses the Contributor Roles Taxonomy (CRediT) to recognize individual author contributions, reduce authorship disputes, and facilitate collaboration.

Name of Author	C	M	So	Va	Fo	I	R	D	O	E	Vi	Su	P	Fu
Kavitha Kumaraswamy	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	
Pasumarthi Usha		✓				✓			✓	✓			✓	
S. Ashok Kumar		✓	✓	✓	✓		✓		✓	✓				
Deekshita Arasa			✓		✓	✓		✓		✓				
Suganthi Neelagiri			✓		✓		✓			✓				

C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

CONFLICT OF INTEREST STATEMENT

Authors state no conflict of interest.

DATA AVAILABILITY

Data availability is not applicable to this paper as no new data were created or analyzed in this study.

REFERENCES

[1] O. Rybitskyi, V. Golian, N. Golian, Z. Dudar, O. Kalynychenko, and D. Nikitin, "Using OBD-2 technology for vehicle diagnostic and using it in the information system," *Bulletin of National Technical University "KhPI". Series: System Analysis, Control and Information Technologies*, no. 1 (9), pp. 97–103, Jul. 2023, doi: 10.20998/2079-0023.2023.01.15.

[2] A. A. Suzen and K. Kayaalp, "Web based tracking of vehicle fault and performance data on OBD II," *Scientific Journal of Mehmet Akif Ersoy University*, vol. 1, no. 1, pp. 13–16, 2018.

[3] F. Rosero, C. X. Rosero, and C. Segovia, "Towards simpler approaches for assessing fuel efficiency and CO2 emissions of vehicle engines in real traffic conditions using on-board diagnostic data," *Energies*, vol. 17, no. 19, p. 4814, Sep. 2024, doi: 10.3390/en17194814.

[4] D. Rimpas, A. Papadakis, and M. Samarakou, "OBD-II sensor diagnostics for monitoring vehicle operation and consumption," *Energy Reports*, vol. 6, pp. 55–63, Feb. 2020, doi: 10.1016/j.egyr.2019.10.018.

[5] K. S. Dhananjayan, M. M, P. Kayalvizhi, P. Lakshmanan, P. N, and O. S. Senthooriya, "Development of a telematic control unit for capturing vital vehicle data without using company fitted telematic ports," in *2024 International Conference on Science Technology Engineering and Management (ICSTEM)*, IEEE, Apr. 2024, pp. 1–5, doi: 10.1109/ICSTEM61137.2024.10561194.

[6] O. Ghaffarpasand, M. Burke, L. K. Osei, H. Ursell, S. Chapman, and F. D. Pope, "Vehicle telematics for safer, cleaner and more sustainable urban transport: a review," *Sustainability*, vol. 14, no. 24, p. 16386, Dec. 2022, doi: 10.3390/su142416386.

[7] K. Khorsravinia, M. K. Hassan, R. Z. A. Rahman, and S. A. R. Al-Haddad, "Integrated OBD-II and mobile application for electric vehicle (EV) monitoring system," in *2017 IEEE 2nd International Conference on Automatic Control and Intelligent Systems (I2CACIS)*, IEEE, Oct. 2017, pp. 202–206, doi: 10.1109/I2CACIS.2017.8239058.

[8] I. Cassias and A. L. Kun, “Vehicle telematics: a literature review,” 2007. [Online]. Available: https://static.aminer.org/pdf/PDF/000/304/560/integration_of_telematics_for_efficient_management_of_carrier_operations.pdf.
[9] N. Kushiro, Y. Oniduka, and Y. Sakurai, “Initial practice of telematics-based prognostics for commercial vehicles,” *Procedia Computer Science*, vol. 112, pp. 2155–2164, 2017, doi: 10.1016/j.procs.2017.08.244.
[10] C.-M. Tseng, W. Zhou, M. Al Hashmi, C.-K. Chau, S. G. Song, and E. Wilhelm, “Data extraction from electric vehicles through OBD and application of carbon footprint evaluation,” in *Proceedings of the Workshop on Electric Vehicle Systems, Data, and Applications*, New York, NY, USA: ACM, Jun. 2016, pp. 1–6, doi: 10.1145/2939953.2939954.
[11] Shrihari and N. G. S, “Cloud web services based fleet management system,” in *2023 7th International Conference on Computation System and Information Technology for Sustainable Solutions (CSITSS)*, IEEE, Nov. 2023, pp. 1–6, doi: 10.1109/CSITSS60515.2023.10334166.
[12] V. Kukreja, A. Marwaha, B. Sareen, and A. Modgil, “AFTSMS: Automatic fleet tracking & scheduling management system,” in *2020 8th International Conference on Reliability, Infocom Technologies and Optimization (Trends and Future Directions) (ICRITO)*, IEEE, Jun. 2020, pp. 114–118, doi: 10.1109/ICRITO48877.2020.9197819.
[13] P. Brlek, I. Cvitkovic, N. Kolarevic, K. Stojanovic, and Z. Sovreski, “Application of fleet management in intelligent transport systems,” in *2022 57th International Scientific Conference on Information, Communication and Energy Systems and Technologies (ICEST)*, IEEE, Jun. 2022, pp. 1–4, doi: 10.1109/ICEST55168.2022.9828676.
[14] I. R. Lima and J. Santos-Victor, “A data acquisition system to capture extreme human driving behaviour,” in *2023 IEEE International Conference on Autonomous Robot Systems and Competitions (ICARSC)*, IEEE, Apr. 2023, pp. 37–43, doi: 10.1109/ICARSC58346.2023.10129538.
[15] V. Kolarova, T. Kuhnimhof, and S. Trommer, “Assessment of real-world vehicle data from electric vehicles – potentials and challenges,” in *11th International Conference on Transport Survey Methods ISCTSC*, 2017.
[16] M. Komorkiewicz, A. Chin, P. Skruch, and M. Szelest, “Intelligent data handling in current and next-generation automated vehicle development—a review,” *IEEE Access*, vol. 11, pp. 32061–32072, 2023, doi: 10.1109/ACCESS.2023.3258623.
[17] B. Dutta and V. Vasudevan, “Data collection in countries with extreme vehicle heterogeneity and weak lane disciplined traffic,” in *Lecture Notes in Civil Engineering*, vol. 69, 2020, pp. 215–228, doi: 10.1007/978-981-15-3742-4_14.
[18] T. Heinz and J. Schneider, “The legacy ECU software problem - approach and research challenges,” in *Software Engineering 2008 - Workshopband, Fachtagung des GI-Fachbereichs Softwaretechnik*, 2008, pp. 98–102.
[19] T. Skouras, P. Gkonis, C. Ilias, P. Trakadas, E. Tsampasis, and T. Zahariadis, “Electrical vehicles: current state of the art, future challenges, and perspectives,” *Clean Technologies*, vol. 2, no. 1, pp. 1–16, Dec. 2019, doi: 10.3390/cleantechnol2010001.
[20] R. Walter and E. Walter, *Data Acquisition from HD Vehicles Using J1939 CAN Bus*. SAE International, 2016.
[21] G. Dhivyasri, R. Mariappan, and R. Sathya, “Telematic unit for advanced fuel level monitoring system,” in *2015 IEEE 9th International Conference on Intelligent Systems and Control (ISCO)*, IEEE, Jan. 2015, pp. 1–7, doi: 10.1109/ISCO.2015.7282260.
[22] H. Saghaei, “Design and implementation of a fleet management system using novel GPS/GLONASS tracker and web-based software,” in *1st International Conference on New Research Achievements in Electrical and Computer Engineering*, 2016.
[23] K. Rogić, B. Šutić, and G. Kolarić, “Methodology of introducing fleet management system,” *Promet-Traffic&Transportation*, vol. 20, no. 2, pp. 105–111, 2008.
[24] J. Boylan, D. Meyer, and W. S. Chen, “A systematic review of the use of in-vehicle telematics in monitoring driving behaviours,” *Accident Analysis & Prevention*, vol. 199, p. 107519, May 2024, doi: 10.1016/j.aap.2024.107519.
[25] O. Ghaffarpasand and F. D. Pope, “Telematics data for geospatial and temporal mapping of urban mobility: new insights into travel characteristics and vehicle specific power,” *Journal of Transport Geography*, vol. 115, p. 103815, Feb. 2024, doi: 10.1016/j.jtrangeo.2024.103815.

BIOGRAPHIES OF AUTHORS

Kavitha Kumaraswamy is currently serving as an assistant professor in the Electrical and Electronics Engineering Department at DSCE, Bangalore. She completed B.E. in 2018, followed by M.Tech. in power system engineering in 2021. Her areas of interest are power system, high voltage, renewable energy, and control system. She can be contacted at email: kavithakgowda77@gmail.com.

Pasumarthi Usha received the B.Tech. and M.Tech. degrees from J.N.T.U. College of Engineering, Kakinada, in 1990 and 1992, and the Ph.D. in HVDC power transmission from Visvesvaraya Technical University in 2013. She is currently working as a professor in the Department of Electrical and Electronics Engineering, Dayananda Sagar College of Engineering. Her research areas HVDC power transmission systems, microgrid, and power electronics. She can be contacted at email: pu1968@yahoo.co.in.

S. Ashok Kumar received the bachelor's degree in 2007, master's degree in 2010, and Ph.D. in high voltage insulation engineering from Visvesvaraya Technical University in 2023. He is currently working as an assistant professor in the Department of Electrical and Electronics Engineering, Bangalore Institute of Technology, Bangalore. His research areas HV insulation systems and power systems. He can be contacted at email: ashokkumars@bit-bangalore.edu.in.

Deekshitha Arasa completed B.E. in 2007 and M.Tech. in 2019. Presently working as an assistant professor in the Department of Electrical and Electronics Engineering, Dayananda Sagar College of Engineering and pursuing her Ph.D. at Dayananda Sagar University. Her areas of interest are image processing, machine learning, signal processing, and programming. She can be contacted at email: deekshitha-eee@dayanandasagar.edu.

Suganthi Neelagiri received the bachelor's degree in 2001, the master's degree in 2013, and Ph.D. from Visvesvaraya University in 2025. She is currently working as an assistant professor at the Department of Electrical and Electronics Engineering, Dayananda Sagar College of Engineering. Her research areas include microgrid, renewable energy systems, and energy storage systems. She can be contacted at email: suganthi_neelagiri@yahoo.com.