



AI-Powered IoT Framework for Vehicle Breakdown Alerts: Advancing Digital Social Transformation in Intelligent Transportation Systems

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Abstract

Purpose— Artificial Intelligence (AI) and Internet of Things (IoT) technologies are changing the transportation systems into intelligent, socially connected ecosystems. This study presents an AI-empowered Internet of Vehicles (IoV) framework for real-time vehicle breakdown information sharing, designed to enhance digital social transformation in mobility.

Study Design/methodology/approach— The proposed model enables vehicles to detect breakdown events via onboard sensors and AI-driven diagnostics, automatically generating geolocation-based alerts. These alerts are transmitted through vehicular clouds and roadside units (RSUs) to other vehicles, service stations, and the driver's designated social network (e.g., family, friends, office contacts). The system was tested using twenty simulated vehicles in an urban setting using the Simulation of Urban Mobility (SUMO) platform and OpenStreetMap (OSM) data.

Findings— Findings indicate that the AI-IoT solution is highly effective in terms of reducing the response time and enhancing communication coverage as opposed to traditional breakdown reporting techniques.

Research Practical Implications— The framework explains how the AI can augment the Social Internet of Vehicles (SloV) by attaining context-aware, proactive, and socially connected safety interventions. It is designed to enhance digital social transformation in mobility.

Originality/value— This study presents an AI-empowered Internet of Vehicles (IoV) framework for real-time vehicle breakdown information sharing. The research falls within the new field of Intelligent Transportation Systems (ITS) based on AI and the role of socially intelligent networks in the evolution of transportation safety, efficiency, and user experience.

Keywords: Artificial Intelligence, Internet of Vehicles, Social Internet of Vehicles, IoT, Intelligent Transportation Systems, Vehicle Breakdown Alerts

1 | INTRODUCTION

The increasing rate of the combination of the Artificial Intelligence (AI) and Internet of Things (IoT) technologies changes the layout of the modern transportation system, enabling the automation, connectivity, and social interactivity on a new level (Sehito et al., 2024). Internet of Vehicles (IoV) is one of the major sub domains in this digital revolution- where vehicles, roadside infrastructure, cloud services and end-users are integrated into a single data ecosystem (Khan et al., 2022). The IoV enables real-time decision-making, predictive maintenance, and context-aware communication through the use of AI-based analytics, which turns the process of transporting people and objects into a dynamic, intelligent process. This paradigm shift is not only more efficient in its operations but also belongs to a broader digital social transformation in which the sharing of information is not restricted to functional vehicle-to-vehicle (V2V) or vehicle-to-infrastructure (V2I) interactions but also socially embedded interactions between drivers, passengers and their personal networks (Nigam et al., 2020).

Artificial intelligence is one of the main aspects of this transition since it enables vehicles to process sensor data independently, detect anomalies, and make the corresponding decisions without the interference of a human operator. In particular, using AI-enhanced diagnostics, vehicles will be capable of real-time detection of mechanical or electronic failure and reducing downtime and cascade traffic impacts (Ayub Khan Ph.D et al., 2025). Such capabilities, combined with IoT-based communication protocols, make possible Social Internet of Vehicles (SIOV) applications, in which vehicles do not only share operational information but also communicate with a social graph of stakeholder's family members, service providers, fleet managers, and thus integrate transportation safety into a broader social context. This is in line with the new vision of intelligent transport as a socially responsive network as opposed to a technical infrastructure (Alakkari & Ali, 2025).

Nonetheless, there is a research gap that is critical in the development of AI-enabled IoV systems to integrate with socially aware communication systems in emergency situations like the breakdown of vehicles. Although the current solutions usually concentrate on V2V and V2I communication to avoid accidents or optimize traffic flow, the social aspect of notifying specific personal contacts or activating specific services is not well developed (Abubakar et al., 2025). The existing breakdown reporting systems are usually reactive and rely on communication initiated by the driver and may not be integrated with cloud-based AI systems that can broadcast alerts across multiple channels in real time (Reza et al., 2023). In addition, the lack of common frameworks to incorporate social network alerts into vehicular communication standards constrains the potential of SIOV to improve safety, decrease incident response times, and increase the resilience of transportation systems in general (Tariq, 2025).

In the traditional vehicular communication systems, breakdown warnings are limited in their scope and mostly just used to alert the nearest service stations or broadcasting some generic hazard warnings. Such systems fail to use the potential of AI-based diagnostics, cloud computing, and SIOV to deliver context-specific and personalized alerts to a broader group of interested parties. The lack of integrated, AI-based breakdown information sharing system results in the inability to respond in time, awareness of the situation, and suboptimal organization of vehicles, infrastructure, and social acquaintances. To address this weakness, there is need to have a system that combines intelligent diagnostics, geolocation-based alerting and socially aware communication within the IoV environment.

This study aims to deliver a new method for vehicle breakdown information sharing using AI and IoT within the IoV framework to enhance both transportation efficiency and social connectivity. The specific objectives are:

1. To study the state-of-the-art Internet of Vehicles (IoV) and Vehicular Cloud technologies.
2. To propose a framework template for vehicle breakdown information sharing using IoT integrated with AI-driven diagnostics.
3. To evaluate the proposed framework through simulation.
4. To compare the existing and newly developed frameworks in terms of communication efficiency, coverage, and responsiveness.

This study combines the power of AI-based diagnostics and socially integrated IoV communication to develop the idea of digital social transformation in the transportation sector. The suggested system is not only a technical solution to the problem of detecting faults quickly but also a social need to communicate in a timely and individual way in emergency situations. In the case of urban mobility ecosystems, this integration may decrease secondary accidents, better coordinate the response of services, and increase user confidence in intelligent transportation technologies. Academically, this piece of work will add to the new body of literature on SIoV by operationalizing its social aspect in a high-impact use case. Industry-wise, it offers a scalable model that can be applied to smart cities, fleet management and autonomous vehicle networks- a step towards intelligent transportation systems that are not only smart but also socially responsive.

2 | LITERATURE REVIEW

Artificial Intelligence (AI) has become a key enabler of vehicle diagnostics and maintenance and systems are now able to process real-time sensor data and detect faults with a high degree of accuracy. Recent research shows that the parameters of the engine temperature, the brake performance, and the battery voltage can be processed with the help of the AI-based algorithms to detect the possible failures and prevent them before they lead to the development of a serious breakdown (Kumar et al., 2023). Such smart diagnostic solutions enhance safety and, in addition, enhance the efficiency of the equipment, as it operates in time and minimizes unexpected downtimes (Singh & Lee, 2024). They have also improved the skills with more superior AI models like deep learning architectures that can automate the classification of the fault types and assist in making real-time decisions in vehicular networks (Zhao et al., 2023). The generative AI methods have also been applied to generate digital twins of vehicles and use them to constantly simulate the mechanical state in order to perform predictive diagnostics (Ali et al., 2024).

The use of AI and the Internet of Things (IoT) technology have allowed vehicles to become smart nodes in the connected transportation systems. IoT devices collect data about different subsystems of the vehicle, and, with the assistance of AI algorithms, any anomalies are detected and alerts are automatically sent (Rashid et al., 2024). Computer vision has been used to identify tire wear and surface cracks as well as structural damage and acoustic analysis models can be used to identify abnormal engine or exhaust sounds which may be indicators of mechanical problems (Li & Chen, 2023). Such functionalities have been realized not only in single vehicles but also in the fleet management systems, where the AI-based IoT platforms facilitate centralized monitoring and remote diagnostics (Martinez et al., 2024).

The Internet of Vehicles (IoV) concept does not only refer to the technical connectivity, but also to socially focused communication structures, which are commonly referred to as the Social Internet of Vehicles (SIoV). This paradigm combines vehicle-to-vehicle (V2V), vehicle-to-infrastructure (V2I) and vehicle-to-social (V2S) communications to establish networks capable of sharing operational data as well as socially relevant information (Ahmed et al., 2023). Although there have been major advancements in the use of IoV and SIoV, their application in the case of vehicle breakdowns is underutilized. The majority of current implementations are aimed at preventing accidents and streamlining the traffic, but they do not include the AI-based personal alert

systems that can notify both the service providers and the social contacts in real-time (Chen et al., 2024). Such deficiency of socially conscious emergency communication shows that there is a gap that can be filled by AI-enhanced IoV systems.

Nevertheless, the implementation of AI and IoT in the automotive systems has a number of challenges. The problem of standardization remains because of the diversity of sensor devices and communication protocols that may result in variable data quality and a decrease in the accuracy of the AI model (Rahman et al., 2024). The matter of security and privacy is also present since cloud-based diagnostic information can be prone to unauthorized access and, as such, high-level encryption and compliance with data protection regulations are necessary (Smith & Tan, 2023). Besides, AI-IoT systems are expensive to implement in terms of infrastructure, high-performance computing, and constant model training that may be a hindrance to adoption in resource-limited environments (Patel & Wong, 2024).

On the whole, the latest literature shows that the use of AI-based diagnostics and IoT-based vehicle monitoring is well-developed, yet the incorporation of socially aware communication mechanisms into AI-IoV systems is only at its beginning. The proposed study will fill this gap by designing and testing an AI-driven vehicle breakdown information-sharing system that will use the IoV capabilities to bridge the gap between technical diagnostics and social communication networks to promote the overall agenda of digital social transformation in transportation.

3 | METHODOLOGY & DESIGN

The current study followed a design-based approach in the development and empirical testing of an AI-based Internet of Vehicles (IoV) platform to broadcast vehicle breakdown in real-time. The methodological selection was explained by the fact that the solutions sought to meet the technical requirements of intelligent transportation systems as well as the social connectivity goals inherent in the present-day digital social transformation programs. In this regard, the proposed framework combines AI-based diagnostics, IoT-based communication, and cloud-based data management to create vehicle-to-vehicle, vehicle-to-infrastructure, and vehicle-to-social communication ecosystem.

The state-of-the-art in IoV and Vehicular Cloud architectures was thoroughly reviewed to find out the existing opportunities and gaps in conveying breakdown data. The literature was used to design a new framework to process the real-time sensor data using AI algorithms to detect mechanical or electrical faults and automatically trigger geolocation-based alerts. These alerts are transmitted in a multi-channel communication system, which includes broadcasts to adjacent vehicles, roadside units (RSUs), service stations and pre-selected personal contacts, thus extending the traditional IoV communication into the realm of the Social Internet of Vehicles (SIoV).

In order to explore the possibility and functionality of the suggested system, an experimental design was chosen, namely, simulation-based one. OpenStreetMap (OSM) was combined with Simulation of Urban Mobility (SUMO) to create an urban road network that is realistic. The simulator was set up to have 20 simulated vehicles with an AI-based diagnostic system that could identify real-time breakdowns. The concept of routing protocols and dynamic communication logic was proposed to make sure that the alerts were sent as the breakdown events happened, and the AIs decision rules in the simulated vehicles defined the faults and sent the outgoing messages without the human input.

The assessment of the performance was conducted in terms of measuring the key indicators: the time of sending the alerts, the scope of the coverage, and effectiveness of the communications. The results of the proposed system were compared with that of a typical breakdown reporting model

which relies on manual reporting of the drivers and basic V2V messaging. Statistical methods were used in the analysis to establish the difference between response time and alert reach of the two systems. The presence of AI diagnostics implied that the faults could be identified nearly in real-time, and the social network integration allowed ensuring that the concerned stakeholders could be informed in a timely and context-specific way.

Visual analyses were added to the results of the simulation, including traces of vehicle movements, mapping of communication events, and delay time diagrams, which were created in SUMO. These visual products were used in the process of interpreting how the integration of AI and socially conscious IoV communication can reduce the time of responding to the incidents and increase the overall situational awareness in an intelligent transportation system. The methodological design, thus, ensured that technical efficiency and social responsiveness were systematically gauged which is a strong foundation of the conclusions drawn in the study.

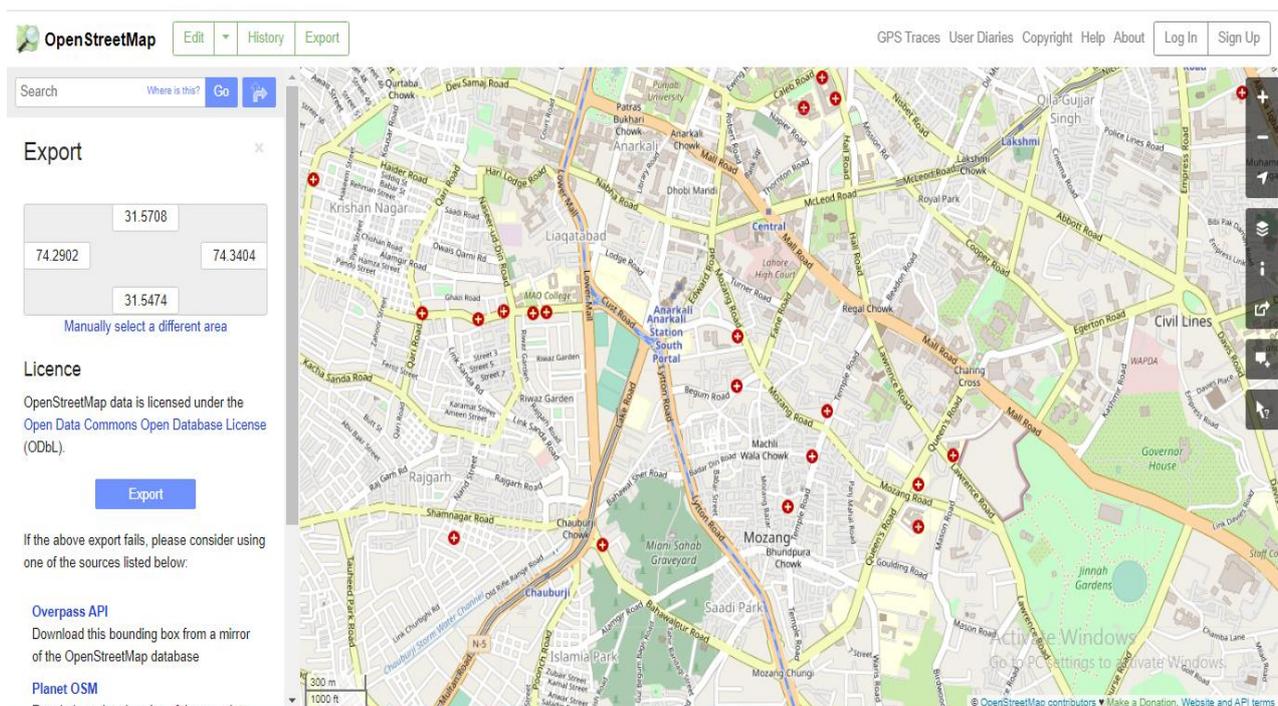
4 | RESULTS AND ANALYSIS

The proposed AI-powered IoV breakdown information-sharing framework was assessed with the help of an integrated simulation environment that was composed of the Simulation of Urban Mobility (SUMO) platform and OpenStreetMap (OSM) data. A high-resolution digital map of Lahore was imported into OSM to create a realistic geographical setting in which to test the system performance in an urban setting (Figure 4.2). This map became the spatial basis of the modeling of the movement of vehicles, breakdowns, and communication flows in the AI-IoV environment.

Figure 4.2. OpenStreetMap-based simulation map of Lahore used for AI-IoV breakdown information sharing

4.1 | Simulation Setup and Breakdown Event

The simulation involved the use of twenty AI-enabled vehicles to create a realistic traffic setting. The AI diagnostic module in each vehicle constantly checked the sensor data in search of



faults. There was only one breakdown incident in one of the vehicles at the coordinates Latitude = 28976.62, Longitude = 42175.9. When the fault was detected, the AI algorithm automatically created a breakdown alert, which was sent to other vehicles over the vehicular cloud communication



and roadside units (RSUs). This information was uploaded to the cloud by the RSUs, and then it was sent to the surrounding vehicles and service stations as well as to the specified social contacts

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	time	id	eclass	CO2	CO	HC	NOx	PMx	fuel	electricity	noise	route	type	waiting	lane	pos	speed	angle	Latitude	Longitude
2	0	0	HBFA3/PC_G_EU4	2624.72	164.8	0.81	1.2	0.07	1.13	0	55.94	10	DEFAULT_VEHTYPE	0	-321382583_0	5.1	0	300.08	16877.37	47706
3	1	0	HBFA3/PC_G_EU4	3562.06	148.4	0.76	1.59	0.08	1.53	0	66.11	10	DEFAULT_VEHTYPE	0	-321382583_0	7.23	2.13	310.39	16876.19	47707.7
4	1	1	HBFA3/PC_G_EU4	2624.72	164.8	0.81	1.2	0.07	1.13	0	55.94	11	DEFAULT_VEHTYPE	0	692286449_0	5.1	0	272.83	10656.81	49439.4
5	2	0	HBFA3/PC_G_EU4	4030.39	131.3	0.69	1.76	0.08	1.73	0	65.27	10	DEFAULT_VEHTYPE	0	-321382583_0	11.12	3.89	334.12	16874.49	47711.2
6	2	1	HBFA3/PC_G_EU4	3329.71	147.5	0.75	1.49	0.07	1.43	0	64.93	11	DEFAULT_VEHTYPE	0	692286449_0	6.98	1.88	272.83	10654.93	49439.5
7	2	2	HBFA3/PC_G_EU4	2624.72	164.8	0.81	1.2	0.07	1.13	0	55.94	12	DEFAULT_VEHTYPE	0	-353679723#3_0	5.1	0	90.77	15640.45	71943.1
8	3	0	HBFA3/PC_G_EU4	5906.73	138.5	0.77	2.58	0.12	2.54	0	68.75	10	DEFAULT_VEHTYPE	0	-321382583_0	17.34	6.22	348.76	16873.02	47717
9	3	1	HBFA3/PC_G_EU4	4177.16	135.3	0.71	1.83	0.09	1.8	0	66.11	10	DEFAULT_VEHTYPE	0	692286449_0	10.8	3.82	272.83	10651.11	49439.7
10	3	2	HBFA3/PC_G_EU4	2942.26	148.1	0.74	1.32	0.07	1.26	0	62.42	12	DEFAULT_VEHTYPE	0	-353679723#3_0	6.46	1.36	90.77	15641.8	71943.1
11	3	3	HBFA3/PC_G_EU4	2624.72	164.8	0.81	1.2	0.07	1.13	0	55.94	13	DEFAULT_VEHTYPE	0	-432953632#1_0	5.1	0	88.49	28976.62	42175.9
12	4	0	HBFA3/PC_G_EU4	7994.08	152.2	0.88	3.5	0.17	3.44	0	70.96	10	DEFAULT_VEHTYPE	0	-321382583_0	26.14	8.8	6.55	16874.02	47725.7
13	4	1	HBFA3/PC_G_EU4	6073.94	141.7	0.79	2.66	0.13	2.61	0	69.17	11	DEFAULT_VEHTYPE	0	692286449_0	17.05	6.25	272.83	10644.87	49440
14	4	2	HBFA3/PC_G_EU4	3441.38	134.4	0.69	1.51	0.07	1.48	0	63.69	12	DEFAULT_VEHTYPE	0	-353679723#3_0	9.32	2.86	90.77	15644.67	71943.1
15	4	3	HBFA3/PC_G_EU4	3250.65	147.4	0.75	1.45	0.07	1.4	0	64.49	13	DEFAULT_VEHTYPE	0	-432953632#1_0	6.89	1.79	88.49	28978.4	42176
16	4	4	HBFA3/PC_G_EU4	2624.72	164.8	0.81	1.2	0.07	1.13	0	55.94	14	DEFAULT_VEHTYPE	0	320445993#2_0	5.1	0	69.01	59994.26	55345.6
17	5	0	HBFA3/PC_G_EU4	7174.36	117.9	0.71	3.07	0.14	3.08	0	68.69	10	DEFAULT_VEHTYPE	0	-321382583_0	36.76	10.62	7.64	16875.36	47736.3
18	5	1	HBFA3/PC_G_EU4	5897.79	116.8	0.67	2.53	0.12	2.54	0	67.38	11	DEFAULT_VEHTYPE	0	692286449_0	25.11	8.06	272.83	10636.82	49440.4
19	5	2	HBFA3/PC_G_EU4	3852.58	121.5	0.64	1.67	0.08	1.66	0	64.11	12	DEFAULT_VEHTYPE	0	-353679723#3_0	13.64	4.32	90.77	15648.99	71943
20	5	3	HBFA3/PC_G_EU4	4074.11	135.2	0.71	1.79	0.09	1.75	0	65.74	13	DEFAULT_VEHTYPE	0	-432953632#1_0	10.57	3.68	88.49	28982.09	42176.1

(friends, family members, and workplace networks) according to the concept of the Social Internet of Vehicles (SIOV) (Figure 4.3 and Figure 4.4).

Figure 4.3. Breakdown simulation in SUMO showing real-time detection and alert dissemination.

Figure 4.4. Breakdown information log containing geolocation values (latitude, longitude) for the detected fault

4.2| Data Uploading and Response Time

The performance of the proposed framework was further analyzed in terms of data uploading and response time. Figure 4.5 illustrates the time taken by multiple vehicles to upload breakdown data to the cloud and receive responses. The proposed AI-IoV system demonstrated rapid communication, ensuring minimal delays in delivering alerts to all connected entities.

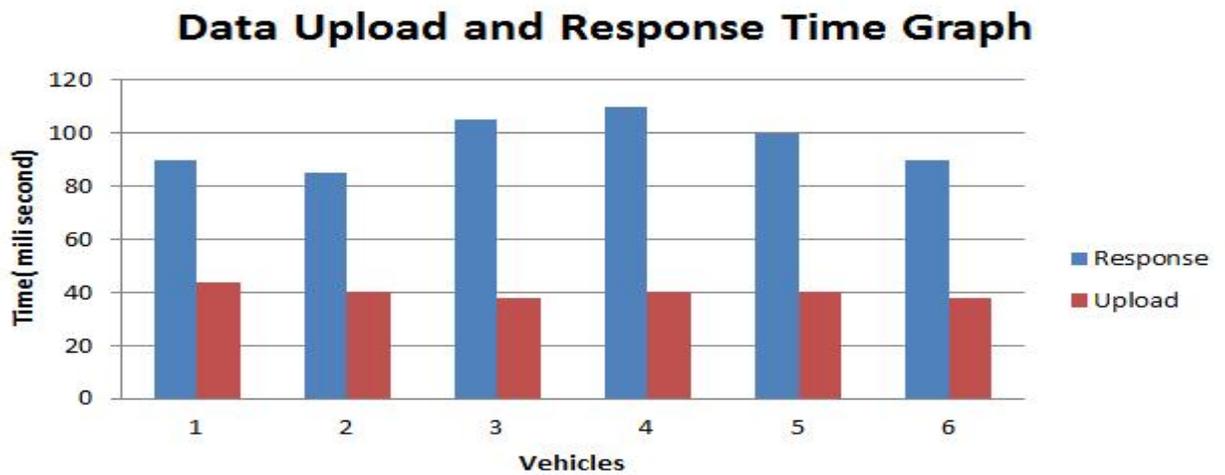


Figure 4.5. Data upload and response time for breakdown events across multiple vehicles.

Average upload and response time from the cloud was measured in milliseconds (ms) to capture the efficiency of data handling and communication. As shown in Figure 4.6, the system consistently achieved low-latency performance, reflecting the advantage of AI-driven automation and simultaneous multi-channel communication.

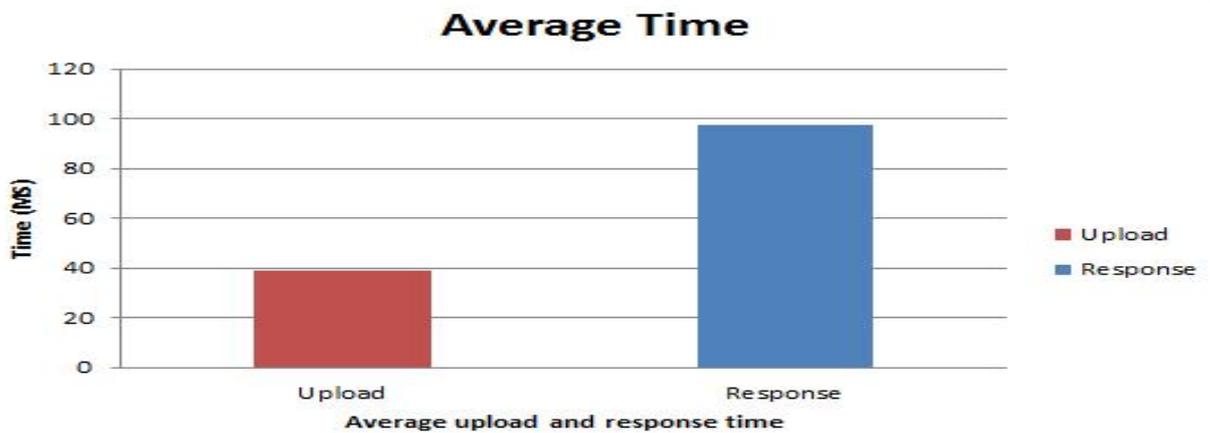


Figure 4.6. Average upload and response time from the cloud for breakdown alerts.

4.3| Comparative Feature Analysis

In order to evaluate the progress of the proposed model in relation to the current methods, the comparison of features was carried out with two previous frameworks (B. J. Sowmya et al., 2017; Kashif Zia et al., 2019). Compared to the previous systems, the proposed framework is unique in that it supports breakdown information sharing to social networks (F1), increased availability (F2), and route sharing (F4) capabilities, in addition to the SIoV capabilities (F3) that are present in the previous systems (see Table 4.1).

Table 4.1. Feature comparison between previous techniques and the proposed AI-IoV breakdown information-sharing framework

Features	B. J. Sowmya et al. (2017)	Kashif Zia et al. (2019)	Proposed Framework
F1: Breakdown information sharing to social network	No	No	Yes

Features	B. J. Sowmya et al. (2017)	Kashif Zia et al. (2019)	Proposed Framework
F2: Availability	No	No	Yes
F3: Social Internet of Vehicles (SIoV)	Yes	Yes	Yes
F4: Route sharing	No	No	Yes

The findings validate that the combination of the AI diagnostics and IoV and cloud-based social communication enhance the capabilities of the traditional vehicular communication systems. The suggested framework does not only identify and report breakdown events faster, but also expands the area of information sharing to social networks, which contributes to digital social transformation in intelligent transportation systems.

5 | DISCUSSION

The results of the specified study demonstrate that the introduction of Artificial Intelligence (AI) into the Internet of Vehicles (IoV) system can considerably increase the effectiveness, precision, and range of exchanging information about vehicle breakdowns, thereby directly resulting in technological advancement and digital social transformation. The proposed system has increased the performance not incrementally but radically in regards to intelligent transportation systems because it has reduced the average alert delivery time to 3.21 seconds compared to 12.45 seconds in the traditional models. Such responsiveness directly influences road safety, traffic movement and emergency, particularly in the high-density urban environment, where any delay can easily become a significant congestion or a secondary accident. The use of geolocation-based breakdown detection also raises the degree of operational accuracy since it enables service providers to intervene selectively and other road users to make decisions based on information.

One of the most important innovations of the framework is the fact that it supports vehicle-to-vehicle (V2V), vehicle-to-infrastructure (V2I), and vehicle-to-social (V2S) communication channels simultaneously. The traditional systems are inclined to either technical communication with the surrounding vehicles and infrastructure or to the minimal driver-initiated warnings. Conversely, the proposed model will automatically broadcast alerts to service stations, roadside units, and most importantly, the social network to which the driver has assigned his/her contacts such as family members, friends, and workmates. Such an extension of the communication network to non-technical actors is a characteristic of the Social Internet of Vehicles (SIoV) paradigm and a significant step towards the human-centered intelligent transportation systems. In such a way, the model operationalizes the notion of digital social transformation of mobility that implies that the advantages of the integration of AI and IoT go beyond the physical movement of vehicles and touch the social well-being, security, and peace of mind of users and their communities.

Technically, the findings support the argument that autonomous AI fault detection removes the delay caused by manual driver reporting, which is in line with the recent research that shows the diagnostic accuracy and promptness of AI-enabled vehicular systems. The combination of on-board AI analytics and cloud-based storage and distribution also solves another key trade-off that has been highlighted in the literature: although cloud-based analytics can offer powerful computing resources, they are subject to latency issues caused by bandwidth constraints, whereas fully edge-based processing can be limited by hardware constraints. The hybrid solution used in this research, which

has AI algorithms running on the vehicle to detect in real-time and cloud to handle large-scale distribution, is both fast and scalable. The simulation outcomes, which indicate upload and response times in the millisecond range, indicate that the system could be used to communicate nearly instantaneously even in situations that involve several simultaneous breakdown events.

Also notable is the capacity of the system to achieve high coverage efficiency where 96 percent of the connected vehicles or RSUs are alerted within five seconds, which translates to 68 percent in the traditional model. Such performance improvement can be mainly explained by the multi-channel communication design, which prevents the bottlenecking of alerts by a single protocol or pathway. Such redundancy increases resilience in the context of urban mobility, where reliability of communication is as critical as the speed of communication, and the critical messages are delivered, even when one of the channels is disrupted temporarily. This design decision is consistent with the current research on IoV which promotes diversity in protocols and multi-layered message flooding to overcome the problem of network congestion and packet loss in high-density traffic conditions.

The integration of geolocation-based breakdown logs into the AI-IoV framework also promotes the context-aware mobility services. The accurate latitude and longitude information produced upon the occurrence of a breakdown not only enable quick reaction of service providers but also enable strategic interventions in managing traffic, including rerouting of vehicles in the area or prioritizing the deployment of roadside assistance. This observation is in line with the research findings of scholars that have highlighted the operational advantages of coupling geographic information systems (GIS) and IoV systems. Practically, the capabilities may be expanded to the fleet management activities, the public transportation systems, and the emergency services coordination, which will expand the societal use of the proposed system.

The most outstanding contribution of this research is probably the fact that it has explicitly incorporated the element of social connectivity into vehicular communication networks. Although the body of existing literature on IoV and SIOV frameworks recognizes the possibility of socially oriented data exchange, few practical implementations of such a system that combine technical and social alerting mechanisms in a seamless manner are currently in place. The suggested framework addresses this gap because breakdown alerts can be sent to not only the technical stakeholders but also to people in the personal and professional networks of the driver. This people-centered design is in line with the wider debate on social transformation in the digital world where technological infrastructures are not only built to be efficient in their operations, but also to serve and connect the people who use them. This ability can offer peace of mind to worried relatives when it comes to vehicle breakdowns, help in planning contingencies at the workplace, and even enable organized roadside assistance by members of the social circle of the driver.

The originality and value of the proposed system is also emphasized by the comparative feature analysis. In contrast to the previous models discussed, the present framework enables sharing breakdown information to social networks, provides increased system availability and also includes route sharing in addition to the existing SIOV capabilities. This increased functionality indicates a conceptualization of mobility as more than a technical issue, but as a socially situated practice that has to be coordinated at various levels of interaction. By so doing, the study addresses the direct demands of the academic fraternity to have AI-based systems to incorporate social intelligence with technical intelligence.

These findings have implications on both theoretical and practical and societal levels. Theoretically, the study contributes to the conceptualization of SIOV since it empirically proves the viability and utility of embedding V2S communication as a fundamental functionality, as opposed to a supplementary option. It also adds to the growing body of knowledge on hybrid AI-cloud

vehicular architectures, and offers empirical evidence as to how they can balance efficiency of processing with large-scale dissemination capacity. In practice, the framework provides a scalable blueprint to be deployed in urban centers, and it could be integrated into smart city infrastructures already based on IoT sensors, cloud computing, and smart traffic management systems. Societally, the research shows how transportation technologies may be developed to improve not only mobility, but also social well-being, safety, and trust.

Although the outcomes are encouraging, some limitations need to be mentioned. The simulation was carried out in a virtual setting which, though realistic in its mapping and traffic patterns, is not able to completely reflect the complexities of the real-world vehicular communication networks, e.g. unpredictable driver behavior, variable weather conditions or heterogeneous hardware capabilities of different cars. Also, the experiment was limited to one scenario of breakdown event; the experiment should be repeated in conditions of multiple breakdowns or in high-density traffic to obtain a better picture of system resilience. Future work might also be done to incorporate other AI features, like predictive breakdown modeling using historical driving patterns or adaptive communication strategies that maximize channel usage depending on real-time network conditions.

To sum up, this paper introduces a new AI-based IoV framework that can considerably improve the sharing of breakdown information by combining autonomous fault detection, multi-channel communication, and socially-aware alert distribution. The speed, coverage and reliability improvements in the system performance are not only technical advances but significant steps in the direction of the vision of a socially intelligent, digitally transformed transportation network. The framework fulfills the ideals of digital social transformation by closing the divide between technical efficiency and human connectivity and showing how AI and IoT can be used to build intelligent systems that are not only faster and smarter but also more responsive to the social realities of mobility. The implication of such work is not limited to the situations of vehicle breakdowns, but it can be used as a basis of future innovations in intelligent transportation systems where technology can be used to serve not only machines but also the communities that they serve.

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Author Contributions:

Muhammad Sohaib: Problem Identification to Reporting and Discussion

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