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AutoForenX: Mobile Application Development to Acquire Vehicular Telemetry as Investigative Aids

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ABSTRACT

Road accident investigations often involve contradictory claims regarding whether an incident was caused by vehicle malfunction or driver negligence, and the lack of consistent digital forensic evidence makes it difficult for authorities and insurance companies to accurately reconstruct events. The objective of this project is to develop a mobile application that can acquire reliable vehicular forensic data to support objective accident analysis. The proposed system retrieves key operational parameters from a vehicle via the OBD-II interface, including speed, braking-related data, throttle position, engine RPM, engine load, and diagnostic trouble codes, and synchronises these records using the mobile phone's system timestamp. By employing mobile-based time synchronisation, the system enables functional correlation between vehicle telemetry and the timeline of an incident. The expected outcome is a portable and cost-effective mobile solution that provides structured, time-aligned investigative aids to assist insurance assessments and preliminary accident investigations.

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1. INTRODUCTION

Road traffic accidents remain a major issue worldwide, often resulting in loss of life, property damage, financial losses, and legal disputes. With the advancement of automotive technology, modern vehicles generate a large amount of operational data through onboard sensors, Electronic Control Units (ECUs), and diagnostic systems. Previous studies have shown that this data can provide valuable information for accident reconstruction and vehicle forensic investigations when collected and analysed properly [1] [2].

Traditional accident investigations mainly rely on physical evidence, witness statements, and assumptions about vehicle behaviour. However, these methods may not always provide accurate information regarding the actual cause of an accident. Research has highlighted that the absence of digital forensic vehicle data can reduce the ability to determine liability and responsibility effectively [3].

On-Board Diagnostics II (OBD-II) is a standard vehicle diagnostic interface that allows access to important vehicle parameters such as speed, engine Revolutions per Minute (RPM), engine load, and diagnostic trouble codes. Recent studies have shown that mobile applications integrated with OBD-II technology provide an affordable and practical method for collecting vehicle forensic data [4]. Furthermore, mobile devices can provide localised timestamping, allowing vehicle data to be correlated with external evidence such as dashcam footage and Global Positioning System (GPS) records [5].

Despite the availability of vehicle operational data, accident investigations still face challenges due to the lack of objective and synchronised evidence. Vehicle data is often accessible only through specialised tools, and improper timestamp synchronisation may reduce the reliability of forensic analysis [6] [7]. Therefore, there is a need for a cost-effective system capable of collecting vehicle data and maintaining accurate timestamps for forensic purposes.

This project proposes AutoForenX, a mobile-based vehicle forensic data acquisition system that communicates

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with a vehicle through the OBD-II interface. The system collects important vehicle parameters such as speed, engine RPM, throttle position, braking information, and diagnostic trouble codes. The collected data is synchronised using the mobile device system clock and stored in a cloud database for future analysis.

The main objective of this project is to develop a mobile application that can collect and manage vehicle forensic data to support accident investigations. The application focuses on real-time data acquisition, incident detection, timestamp synchronisation, and cloud-based evidence storage. The system does not access manufacturer-specific vehicle data or advanced vehicle forensic information that requires proprietary interfaces [8].

By providing objective vehicle telemetry data, AutoForenX can support accident investigations, insurance claim assessments, and forensic analysis. Compared to traditional investigation methods, the system offers a more structured and data-driven approach to understanding vehicle behaviour before and during an incident. In addition, the use of low-cost OBD-II adapters makes the proposed solution accessible and practical for a wider range of users [9].

2. LITERATURE REVIEW

2.1 Vehicle Digital Forensics

Vehicle digital forensics has become increasingly important in road traffic accident investigations. Reviewing existing systems helps identify commonly used technologies, current challenges, and opportunities for improvement in forensic vehicle data collection [8]. Modern accident investigations increasingly rely on digital evidence obtained from vehicle systems, mobile devices, and external sensors to support accident reconstruction and determine liability.

Several technologies have been used to collect vehicle-related data, including Event Data Recorders (EDRs), On-Board Diagnostics II (OBD-II) interfaces, In-Vehicle Infotainment (IVI) systems, and telematics devices [8]. Among these technologies, EDRs are widely recognised for recording crash-related information such as vehicle speed, braking activity, and seatbelt status. However, EDR data extraction often requires specialised tools and trained personnel, making the process costly and less accessible to insurance companies and independent investigators [3].

OBD-II technology provides a more affordable alternative for vehicle data acquisition. Many commercial OBD-II mobile applications can retrieve parameters such as speed, engine RPM, and diagnostic trouble codes. However, these applications are primarily designed for vehicle diagnostics and monitoring rather than forensic investigations. As a result, issues such as inconsistent data management, limited timestamp synchronisation, and lack of forensic-oriented features reduce their suitability for accident investigations [10] [11].

2.2 Overview of Related Systems

This section reviews existing systems and technologies related to the acquisition of data from vehicles and the investigation of accidents that are relevant to the proposed AutoForenX system. The review compares existing solutions in terms of functionality, accessibility, suitability for forensic use, and limitations that will provide a basis to identify design opportunities and shortcomings that should be addressed by the proposed system.

Professional vehicle forensic tools, commercial OBD-II applications, and fleet management systems represent the main categories of existing solutions. Professional forensic tools provide high-quality and legally admissible data but are expensive and accessible only to authorised personnel [12]. Commercial OBD-II applications are affordable and portable but lack forensic evidence management capabilities [13]. Fleet management systems combine OBD-II and GPS technologies for vehicle monitoring but focus mainly on operational management rather than accident investigation [14].

Table 1 shows a comparison of the selected existing systems. The ratings provided for cost, portability, ease of use, and accessibility represent the authors' qualitative assessment based on the cited literature.

Table 1. Comparison of Existing Vehicle Data Acquisition Systems

Criteria	**Professional Vehicle Forensic Tools** [12]	**Commercial OBD Mobile Apps** [13]	**Fleet Management Systems** [14]	**Proposed App - AutoForenx**
Primary Purpose	Legal-grade accident investigation	Vehicle monitoring and diagnostics	Vehicle tracking and management	Accident investigation and forensic data collection
Cost	Very high (Specialised equipment)	Low to moderate	Subscription-based	Low (smart phone + OBD adapter)
Portability	Low	High	Moderate	High
Ease of Use	Requires trained experts	User-friendly	Requires system setup	User-friendly and investigator-oriented
Data Source	EDR, ECUs, proprietary systems	Standard OBD PIDs	OBDII + GPS	Standard OBD interface
Accessibility	Limited to authorities	Public users	Organisations only	Public users, investigators, insurers
Limitations	Expensive, not scalable	Not designed for forensics	Not accident-focused	Limited to standard OBD parameters

The comparison shows that no single solution offers both the affordability of mobile OBD-II applications and the forensic-oriented functionality required for accident investigations. Therefore, the proposed AutoForenX system combines low-cost OBD-II data acquisition with timestamp synchronisation, cloud-based evidence storage, incident detection, and incident review features. Although it cannot replace professional EDR extraction tools, AutoForenX provides a practical and accessible solution for vehicle forensic data collection and accident analysis [8] [11] [15].

The comparison of existing systems shows that each solution has its own strengths and limitations. Professional vehicle forensic tools provide accurate and legally accepted data for accident investigations, but they are expensive and require specialised equipment. Commercial OBD-II mobile

applications are affordable and easy to use; however, they mainly focus on vehicle diagnostics and lack forensic-oriented features such as evidence management and reliable timestamp synchronisation. Fleet management systems are effective for vehicle monitoring and driver behaviour analysis but are designed primarily for operational purposes rather than accident investigations.

To address these limitations, AutoForenX combines the affordability and portability of OBD-II mobile applications with features designed specifically for vehicle forensics. The system collects structured vehicle data and synchronises records using the mobile device system clock to improve the reliability of forensic evidence. Developed using Flutter and a Bluetooth OBD-II adapter, AutoForenX provides a practical and cost-effective platform for vehicle forensic data acquisition and analysis.

This section reviewed existing technologies and systems related to vehicle data acquisition and accident investigation. The review identified several limitations in current solutions, particularly in terms of accessibility, cost, forensic evidence management, and timestamp synchronisation. Based on these findings, AutoForenX is proposed as a mobile-based forensic solution that combines OBD-II data acquisition with structured data management and time synchronisation. The literature review also provided the foundation for selecting the technologies, system architecture, and development approach used in this project.

3. METHODOLOGY

This section describes the methodology used to design, develop, and evaluate the proposed AutoForenX mobile application. The methodology provides a structured approach to ensure that the system meets both technical and forensic requirements for vehicle data acquisition and accident investigation [16].

The development process consists of several stages, including requirement analysis, system design, implementation, testing, and deployment. These stages were used to guide the development of the system from initial planning to the final working application [17]. The selected approach also helps ensure that the project can be completed efficiently within the available time, resources, and hardware constraints.

By following this methodology, the proposed system can be developed systematically while ensuring reliability, functionality, and suitability for vehicle forensic data collection and analysis [2].

3.1 Development Approach

The proposed project uses the Rapid Application Development (RAD) model because it focuses on fast prototyping, iterative development, and continuous requirement refinement. RAD is suitable for mobile application and digital forensic system development as it allows early testing of system functions, data acquisition methods, and evidence handling processes. It also helps to evaluate feasibility, usability, and forensic relevance at an early stage before full system development.

The Requirements Planning phase involved identifying functional and non-functional requirements. Functional requirements were based on literature review and analysis of accident cases and existing vehicle forensic systems. The developed system communicated with the vehicle using the OBD-II interface and collected forensic data such as speed, brake status, throttle position, engine RPM, acceleration, and steering angle, while synchronising data with the mobile device system time. Non-functional requirements include data accuracy, integrity, reliability, usability, and forensic admissibility to ensure the data can be accepted as digital evidence.

In the Design phase, a system architecture was developed to show communication between the mobile application and OBD-II adapter, including data processing, timestamp synchronisation, storage, and visualisation. Data flow diagrams and logical models were used to describe the system. High-fidelity prototypes were developed using Figma to simulate real-time vehicle data display and forensic log generation. Feedback from the project supervisor and peers was used to improve the interface design and usability.

The Construction and Cutover phases involved incremental development, system integration, and testing. Modules such as Bluetooth OBD-II communication, real-time data parsing, timestamp synchronisation, and secure data storage were developed and tested individually. Final testing was done using simulated accident scenarios to verify data accuracy and compatibility with other evidence such as GPS and dashcam data. Overall, RAD supports early validation, flexibility, and iterative improvement, making it suitable for this project within limited time and resources.

3.2 Requirement Specifications

To identify the requirements for the AutoForenX system, we reviewed relevant research papers and analysed existing commercial OBD-II mobile applications. These methods were chosen to ensure that the system requirements were based on solid academic findings while also addressing practical limitations observed in existing solutions.

We have conducted a review of research literature related to vehicle forensics, accident reconstruction, and OBD-II data acquisition to identify the key vehicle parameters commonly used in forensic investigations. The importance of parameters such as vehicle speed, engine RPM, throttle position, braking-related data, acceleration, and steering wheel angle was highlighted by previous studies, as well as the need for accurate time synchronisation to support reliable accident analysis. The core functional requirements of the proposed system were defined by insights from these studies.

In addition, an evaluation of existing commercial OBD-II mobile applications was carried out to understand their features, usability, and limitations. While these applications are effective for vehicle monitoring and diagnostics, most were found to lack forensic-oriented features such as incident detection, secure evidence storage, and time-aligned data preservation. The limitations identified during this review informed the non-functional requirements of the system, including data integrity, security, portability, and ease of use for investigative purposes.

By combining findings from academic research and observations from existing commercial applications, a comprehensive set of system requirements was established. This approach ensured that AutoForenX addresses both

theoretical forensic requirements and real-world usability concerns, providing a solid foundation for the system design and development phases.

3.3 Logical Design



Fig. 1. Use Case Diagram of AutoForenX

The use case diagram in Figure 1 illustrates the functional requirements and user interactions of the implemented AutoForenX system. It outlines the system boundaries, user roles, and core functions. The main stakeholders include Vehicle Owner/User, Forensic Analyst, Insurance Company, and the System itself, where each actor has different responsibilities in the vehicle forensic data lifecycle.

The Vehicle Owner/User interacts with the system by connecting to the ELM327 OBD-II adapter, creating a user profile, viewing live vehicle data, checking incident summaries, viewing event logs, and changing system settings. This allows real-time monitoring and review of driving activities. On the other hand, Forensic Analyst and Insurance Company actors mainly access incident summaries and event data to support accident investigation, insurance evaluation, and legal analysis based on objective vehicle data. The system also includes automated functions such as monitoring driving events, updating the database, sending incident notifications, and managing data storage by overwriting non-critical data when there is no incident. However, important incident data will be stored and protected for forensic purposes.

The flowchart in Figure 2 details the operational logic of the completed AutoForenX mobile application. The process starts when the user opens the application, and the system attempts to connect to the OBD-II dongle through wireless communication. If the connection fails, the system will retry automatically to reduce user intervention. Once connected, the system continuously reads and logs vehicle data in real time, storing it temporarily for monitoring and analysis.

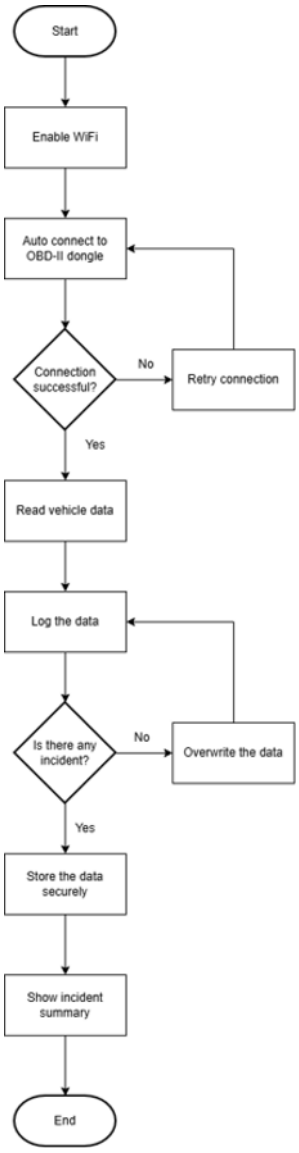


Fig. 2. Flowchart of AutoForenX

The system then checks for abnormal events such as sudden braking, sharp speed changes, or threshold violations. If no incident is detected, older data is overwritten in a rolling log to save storage space on the mobile device. While this manages storage efficiently, it introduces a significant forensic trade-off by risking the deletion of continuous telemetry that falls outside predefined incident thresholds. If an incident is detected, the relevant data is permanently stored with timestamp synchronisation for forensic analysis. Finally, the system generates an incident summary for review. Overall, the use case diagram and flowchart help ensure AutoForenX is designed as a reliable, efficient, and secure vehicle forensic data acquisition system.

3.4 Database Design

AutoForenX database was designed using an Entity Relationship Diagram (ERD) to define the relationships between main entities, which are User, Vehicle, Session, OBD_Data, and Incident, as shown in Figure 3. The design uses one-to-many relationships, where one vehicle can have multiple sessions, and each session can generate many OBD data records. This structure supports real-world vehicle data collection and ensures proper storage, traceability, and

effective forensic analysis. The User and Vehicle entities help to maintain accountability and ensure that each data record is linked to a specific user and vehicle. The Session entity represents each data collection process, while OBD_Data stores vehicle parameters such as speed, RPM, braking, throttle position, steering angle, acceleration, and diagnostics, which can be synchronised with external evidence like timestamps.

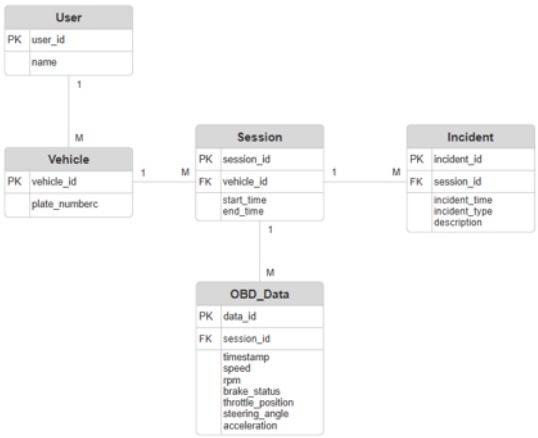


Fig. 3. Entity Relationship Diagram of AutoForenX

The system uses a cloud-based relational database to support centralised storage, scalability, and secure access for authorised users such as investigators and insurance personnel. Basic security features such as user authentication and role-based access control are implemented to protect data integrity and confidentiality. Overall, this database design provides a structured, reliable, and forensically sound foundation for vehicle accident reconstruction and insurance investigation purposes.

3.5 Legal and Ethical Consideration

Because AutoForenX continuously records individual driving behaviour and vehicle telemetry, the system's deployment must adhere to strict ethical guidelines and data privacy regulations, such as the Personal Data Protection Act 2010 (PDPA) in Malaysia.

- Driver Consent: The application mandates explicit, opt-in consent from the vehicle owner during the initial profile setup before any data acquisition or cloud synchronisation begins.
- Data Protection: All transmitted records are secured within the cloud database using role-based access controls to prevent unauthorised modification or exposure.
- Retention Periods: Data retention is strictly limited. Routine telemetry is managed via a rolling-overwrite mechanism, while incident-specific records are retained in the cloud only for the active duration of an investigation or insurance claim, after which they are permanently purged.
- Lawful Access: The forensic records remain the property of the vehicle owner. Third parties (such as insurance adjusters, independent forensic investigators, or law enforcement) may only lawfully access the incident summaries if the owner explicitly authorises data sharing or if access is compelled by a formal legal subpoena.

3.6 Testing

The evaluation of the AutoForenX application was conducted through a focused phase of functional and integration testing. To validate the core workflow of vehicular forensic data retrieval and processing, the scope of this evaluation was strictly limited to five fundamental test cases. These cases were selected to systematically verify the application's primary operational lifecycle, from the initial hardware handshake with the vehicle to the final off-site data storage. Notably, this experimental design did not encompass performance testing; quantitative metrics such as data sampling rate, transmission latency, and packet loss were excluded from the current scope. Table 2 outlines the specific test cases defined for this phase and their corresponding objectives.

To execute these predefined test cases and evaluate the application's overall real-world functionality, system testing was conducted directly within an actual vehicle. This process evaluated the complete system behaviour rather than isolated modules and was divided into two physical deployment scenarios:

- Static Testing: Conducted with the vehicle stationary and the engine idling. This environment provided a controlled baseline to verify OBD-II connectivity (TC-01) and accurate initial data retrieval on the user interface without the variables of physical movement.
- Dynamic Testing: Conducted under normal driving conditions on active roads. This phase assessed the application's operational stability during transit, focusing on continuous live telemetry logging (TC-02), the accuracy of incident detection triggers during physical motion (TC-03, TC-04), and the reliability of cloud synchronisation while driving (TC-05).

The system evaluation was conducted using a single test vehicle (Perodua Axia) equipped with a standard ELM327 Bluetooth OBD-II adapter paired with a mobile device running the AutoForenX application. The evaluation comprised both static testing (stationary with engine idling) and dynamic road testing. Testing was executed across five driving sessions around the International Islamic University Malaysia Gombak campus, covering a total distance of approximately seven (7) km over a cumulative duration of thirty (30) minutes, during which five structured functional and integration test cases (TC-01 through TC-05) were carried out.

Table 2. Test Cases and Their Objectives

Test Case ID	Test Case Name	Testing Type	Objective
TC-01	OBD-II Connection Test	Integration	To verify successful Bluetooth/Wi-Fi pairing and data communication between the AutoForenX app and the vehicle's OBD-II adapter.
TC-02	Live Data Monitoring Test	Functional	To ensure synchronised vehicular telemetry (e.g., speed, RPM, engine load) is accurately retrieved, parsed, and displayed on the user interface.

Test Case ID	Test Case Name	Testing Type	Objective
TC-03	Incident Detection Test	Functional	To validate the application's ability to continuously monitor live data and correctly trigger an alert when predefined incident thresholds or anomaly signatures are met.
TC-04	Incident Summary Test	Functional	To confirm the accurate compilation, formatting, and logging of pre- and post-incident forensic data into a standardised summary report.
TC-05	Cloud Synchronisation Test	Integration	To test the secure, complete, and automated upload of the generated incident summary to the remote cloud server for centralised forensic access.

4. RESULTS

The AutoForenX system was developed and tested to evaluate its ability to collect, process, and store vehicle forensic data using an OBD-II interface. The testing was carried out using a vehicle equipped with an OBD-II port and an ELM327 Bluetooth adapter connected to the AutoForenX mobile application. The main objective was to check whether the system can reliably obtain vehicle data, detect important driving events, synchronise timestamps correctly, and store all records securely in a cloud database for forensic analysis. Overall, the application successfully passed all five test cases, demonstrating reliable execution from the initial OBD-II hardware handshake to the final cloud synchronisation.

During testing, the system successfully established a stable Bluetooth connection with the OBD-II adapter and maintained communication throughout the driving sessions. After pairing, the application immediately started retrieving vehicle data. The system collected and displayed key parameters such as speed, RPM, throttle position, engine load, coolant temperature, and diagnostic trouble codes (DTCs), depending on vehicle availability. These data were shown in the Live Data dashboard, allowing real-time monitoring of vehicle conditions, as shown in Figure 4.

The Live Data module consistently updated the user interface as data was received from the adapter. Changes in vehicle parameters, such as speed and RPM, were reflected during the driving session. For example, increases in speed were reflected together with changes in RPM and throttle position. This shows that the system is capable of accurately capturing real-time vehicle behaviour, which is important for forensic purposes such as accident reconstruction.

The Incident Detection feature, as shown in Figure 5, was also tested using different driving scenarios. To verify the software's event-triggering logic, arbitrary threshold values were set for dynamic testing (e.g., overspeeding was triggered at speeds >30 km/h, and harsh braking was triggered upon rapid deceleration). These values were chosen strictly to allow safe functional testing during normal driving sessions rather than to represent scientifically derived accident parameters. The system triggered and recorded these events when the specified limits were exceeded. Each event was automatically stamped with the mobile device's system time to ensure accurate chronological order. This makes the data suitable for forensic investigation because it clearly shows when each driving behaviour occurred.

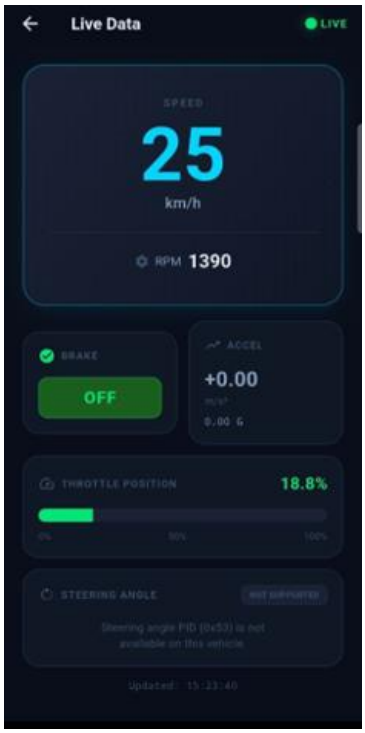


Fig. 4. Live Data Page of AutoForenX

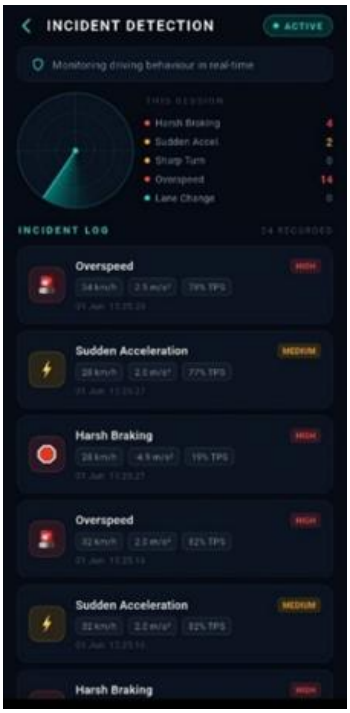


Fig. 5. Incident Page of AutoForenX

In addition, the Incident Summary feature, as shown in Figure 6, successfully retrieved historical data from the cloud and generated a structured overview of each driving session. The summary includes maximum speed, average speed, total driving duration, and number of detected events, which helps

users understand vehicle behaviour without reviewing raw data. All detected events were successfully stored in the cloud database, allowing centralised access for authorised users such as investigators and insurance personnel. This improves data availability and reduces the risk of data loss from the mobile device.

Overall, the testing results show that AutoForenX meets its main objectives. The system successfully integrates real-time data acquisition, incident detection, timestamp synchronisation, and cloud storage into a single mobile platform. The results prove that smartphone-based OBD-II systems can be used effectively for vehicle forensic data collection. This makes AutoForenX a practical and cost-effective solution for accident analysis, insurance investigation, and digital forensic applications.



Fig. 6. Incident Summary Page of AutoForenX

5. LIMITATIONS AND FUTURE WORK

5.1 Limitations

The AutoForenX results show that the acquisition of vehicle forensic data with mobile devices and OBD-II technology is feasible, but the results also show a number of limitations. It uses standard OBD-II parameters as the main source of data and does not allow access to manufacturer-specific and proprietary vehicle data. As a result, some vehicle models may not have advanced forensic data like detailed brake pedal position, steering wheel angle, airbag deployment data, or vehicle-specific data.

Additionally, the capabilities of the Bluetooth OBD-II adapter can affect the quality and completeness of the data collected. Communication stability and supported parameter identifiers (PIDs), as well as data sampling rates, can be different depending on the adapter, which can affect the reliability of the generated forensic records. Because data sampling rates and communication stability differ depending on the adapter, this study did not conduct quantitative performance benchmarking. Critical network metrics necessary for production-grade forensic tools (such as the achieved sampling rate (Hz) for specific PIDs, the distribution of end-to-end latency, dropped-frame rates, and Bluetooth reconnection recovery times) were excluded from the current testing scope.

Furthermore, the existing incident detection system relies on fixed threshold limits to detect events. Because this study focused on functional software integration, the thresholds were not scientifically justified against real-world crash dynamics. Additionally, the system's detection accuracy was not evaluated against a manually annotated ground truth dataset of driving manoeuvres; therefore, critical classification metrics such as precision and recall for each event class remain unknown. Although effective for computation, the solution is not based on advanced accident reconstruction methods or machine learning techniques and can therefore not incorporate sophisticated driving situations in its interpretation.

The system validation was limited to a single vehicle model (Perodua Axia) and a single commercial adapter (ELM327 Bluetooth adapter) evaluated across five test sessions. Consequently, the performance, PID compatibility, and connectivity stability across diverse vehicle manufacturers, ECU architectures, and alternative hardware adapters remain unverified. Thus, additional testing should be performed by more manufacturers, ECU versions, and accident scenarios to further assess the robustness and generalizability of the systems.

A major limitation of the current system is its reliance on the mobile device's system clock for timestamping. Mobile device clocks are susceptible to hardware drift, irregular operating system adjustments, and manual user alterations. Because the system's time was not measured against an independent reference (such as GPS time or a Stratum-1 Network Time Protocol (NTP) source), the precise time uncertainty attached to the logged events is unknown. As a result, the system has not been formally certified for legal evidence acquisition, and the timestamps should be treated as sequential estimates rather than absolute evidential records. Lastly, AutoForenX includes forensic features like timeline synchronisation and structured data support, but they are meant to support forensic investigation and have not been formally certified for legal evidence acquisition. Therefore, the gathered records should not replace specialised forensic systems, but rather be used to complement them.

Another critical limitation of the current architecture is the rolling-overwrite storage design. To conserve device memory, the system deletes historical telemetry if a predefined incident threshold (e.g., harsh braking, overspeeding) is not triggered. This design conflicts with standard digital forensic preservation practices. If a collision or dispute occurs without exceeding these specific thresholds, the system will overwrite the exact continuous data necessary to establish a baseline of vehicle behaviour or exculpate a driver.

While this study qualitatively compared AutoForenX against commercial OBD-II mobile applications, a major limitation is the absence of an empirical, side-by-side quantitative benchmark. The system was not tested in parallel

with existing widely used commercial diagnostic applications; therefore, comparative performance metrics regarding data sampling rates, comprehensive parameter coverage, and timestamp drift behaviour remain unverified.

5.2 Future Work

Subsequent upgrades may involve adding more support for manufacturer-specific diagnostic protocols and manufacturer-specific proprietary PIDs to increase the scope of the forensic data available. Connection to other evidence, such as dashcam and smartphone sensors, could offer a more complete picture of what happens during an accident and help make more accurate reconstructions.

To establish the reliability of the incident detection module, future research must evaluate the system against a manually annotated ground truth dataset of driving manoeuvres to accurately report precision and recall metrics per event class. Additionally, future iterations should explore machine learning techniques to transition away from rigid threshold-based classification.

Advanced forensic security features such as cryptographic hashing, digital signatures, and chain-of-evidence management could also be integrated to enhance data integrity and authenticity. Furthermore, the platform could be extended to include cloud-based forensic analytics, multi-vehicle monitoring, and electric and connected vehicles.

In summary, a range of large-scale field trials across different driving conditions, accident types, and vehicle types is recommended to verify the system's efficacy, reliability, and forensic value in real-world driving conditions. Future iterations of AutoForenX must undergo rigorous quantitative performance benchmarking using standardised, high-fidelity OBD-II adapters to establish precise data sampling rates, latency distributions, and robust reconnection behaviours.

To establish evidential reliability, future iterations of the system must validate timestamp accuracy by measuring the offset and drift of the mobile device clock against an independent reference, such as a Stratum-1 NTP source or GPS time, over extended driving sessions. This will allow future versions to calculate and report the exact time uncertainty attached to every logged forensic event.

To resolve the data preservation conflicts caused by the current rolling-overwrite design, future iterations of AutoForenX must implement a continuous, compressed background logging mechanism. This will allow the system to retain a complete, uninterrupted telemetry log alongside the specific, threshold-triggered event records without overwhelming device storage.

To establish a genuine quantitative contribution, future research must conduct parallel testing sessions running AutoForenX alongside established commercial OBD-II applications. This comparative evaluation will be essential to benchmark achieved sampling rates, parameter coverage, and the reliability of timestamp synchronisation against existing industry standards.

6. CONCLUSION

In conclusion, this project successfully developed and implemented AutoForenX, a mobile application designed to acquire vehicular telemetry via the OBD-II interface to serve as objective investigative aids. Functional testing demonstrated that the system is capable of retrieving standard vehicle parameters (such as speed, engine RPM, and brake status) and chronologically aligning this data using the mobile device's system clock. By integrating synchronised data acquisition with threshold-based event logging and cloud synchronisation, the system provides a functional proof-of-concept for affordable telemetry extraction.

However, the evaluation also highlighted significant constraints that must be addressed before the system can be deployed for formal forensic evidence collection. Specifically, the system currently relies on the varying performance of commercial hardware adapters, lacks quantitative benchmarking for sampling rates and latency, and utilises a rolling-overwrite storage mechanism that risks the deletion of non-event telemetry. Furthermore, the absence of cryptographic hashing and independent time synchronisation (e.g., NTP or GPS time) prevents the output from meeting strict evidential standards.

Future iterations of the platform must resolve these limitations by implementing continuous, tamper-evident compressed logging, machine-learning-based incident classification, and rigorous performance benchmarking against existing commercial OBD-II applications. Ultimately, while AutoForenX cannot currently replace specialised forensic data extraction tools, it provides a cost-effective framework capable of generating objective digital records to assist insurance and investigative processes. By converting a regular smartphone into a practical tool for generating investigative aids, this project can help strengthen transparency on the road and ensure the circumstances surrounding an accident are documented through objective vehicular telemetry.

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