IT4010 Research Project – 2025 July

Topic Assessment Form

Project ID : 25-26J-300

1. Topic (12 words max)

Autonomous Traffic Police Management System (ATPMS)

2. Research group the project belongs to

AIMS - Autonomous Intelligent Machines and Systems

3. Specialization of the project belongs to

Information Technology (IT)

4. If a continuation of a previous project:

Project ID	
Year	

5. **Brief description of the research problem including references (200 – 500 words max) – references not included in word count.**

Sri Lanka's government departments, particularly the law enforcement and traffic management systems, are plagued by common inefficiency, manual systems, and lack of transparency. These weaknesses have hindered delays in legal proceedings, difficulty in handling evidence, and possibilities of corruption more so in the traffic police division. Some of the significant challenges include the ineffectiveness of documentation systems, lack of accountability in collecting fines and offenses, and difficulty in ensuring that legal evidence such as video recordings, witness testimony, and reports are valid.

Current traffic offense management procedures are outdated and manual based with heavy reliance on human intervention. As a result, citizens are faced with inconvenience while interacting with traffic police, and officials are not equipped with facilities to make timely decisions based on information. There is no centralized secure system to store legal evidence, which is prone to tampering, loss, or unauthorized access.

This research work aims to address these systemic inefficiencies with a proposal of a Blockchain-Based Secure Evidence & Legal Dossier System and accompanying AI-Powered Legal Intelligence and Real-Time Traffic Enforcement Tools. The aim is to create a comprehensive digital platform for traffic police officers, witnesses, and citizens in general to exchange information more securely and effectively. By harnessing blockchain technology and IPFS for tamper-evident decentralized storage of evidence, the system ensures traceability and integrity of legal records. AI features such as a multilingual legal assistant and precedent retrieval tools will facilitate decision making and improve understanding of legal procedures by officers and citizens.

Furthermore, the platform will carry out violation detection and fine management autonomously using technologies like License Plate Recognition (LPR), bill issuance through WhatsApp, and task assignment for patrol officers based on GPS. Real-time dashboards and predictive analytics will also be utilized to maximize traffic flow and public safety.

The core research issues this project addresses is "How can emerging technologies such as blockchain, artificial intelligence, and automation be used optimally to reduce corruption, increase transparency, and improve operational efficiency in the traffic police branch of Sri Lanka?"

By establishing and evaluating this system, the research hopes to provide an efficient solution towards changing law enforcement protocols in Sri Lanka, increasing the level of citizen trust, and creating an open, secure, and efficient model of government service.

6. Brief description of the nature of the solution including a conceptual diagram (250 words max)

Brief Description of the Nature of the Solution (250 words)

The proposed platform integrates four cutting-edge technologies into a unified, tamper-proof ecosystem to modernize Sri Lanka's traffic police operations. It aims to enhance transparency, efficiency, and accountability while reducing corruption and bureaucratic delays.

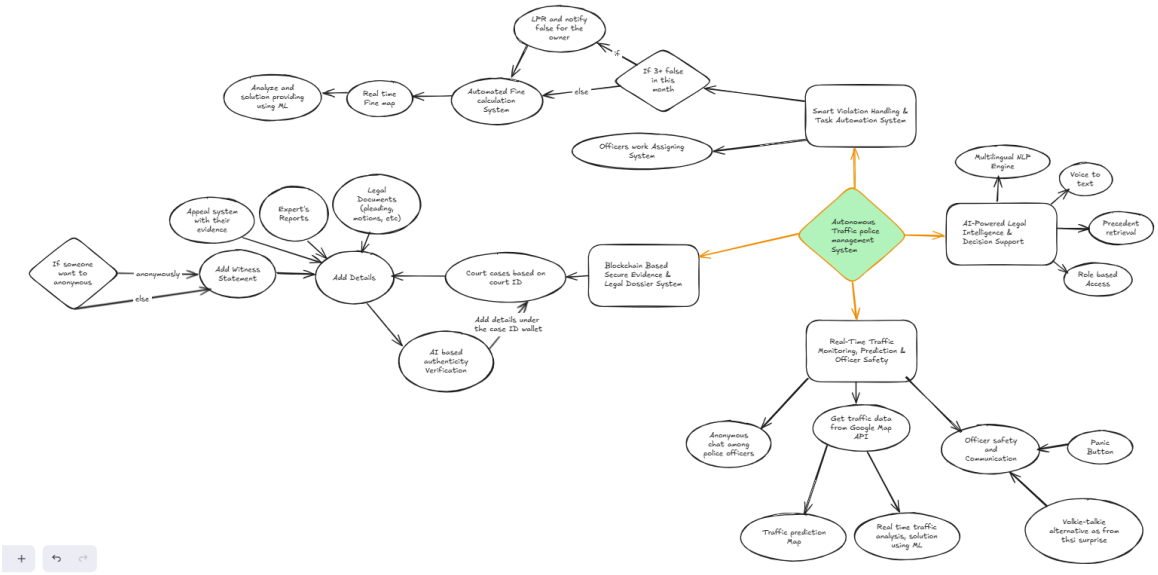
1. **Blockchain-Based Secure Evidence & Legal Dossier System**
   A decentralized system that creates case-specific wallets accessible to courts, police officers, and relevant legal parties. Each wallet stores legal documents (motions, filings), hashed witness statements (using zero-knowledge proofs), expert reports, and multimedia evidence (via IPFS). AI-based authenticity verification detects fake or altered evidence. All uploads are geo-tagged and time-stamped, ensuring traceability.

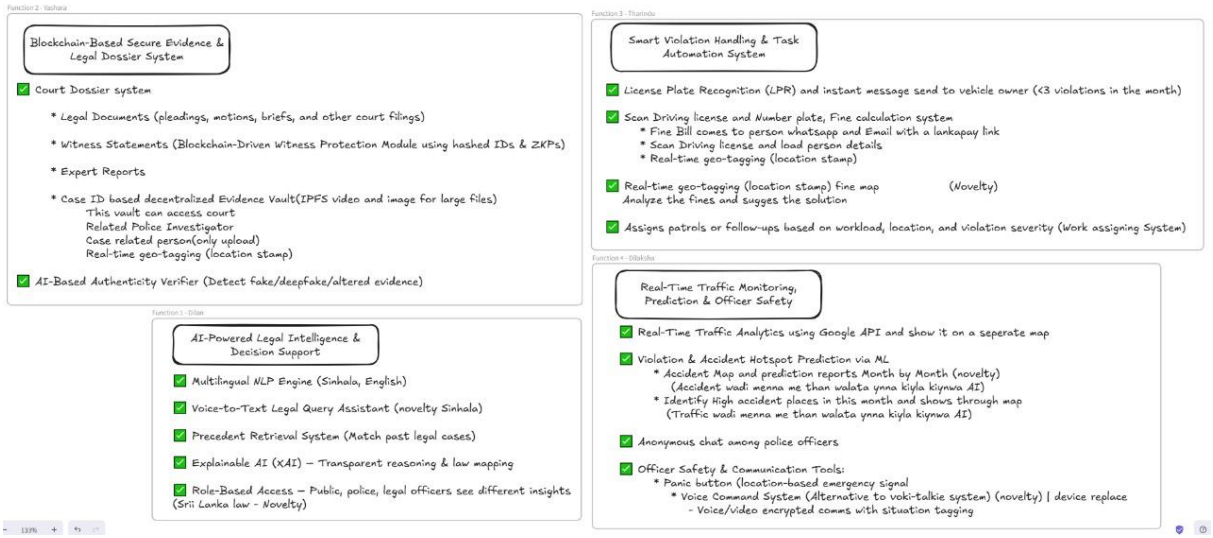
2. **AI-Powered Legal Intelligence & Decision Support**
   A bilingual (Sinhala + English) NLP-driven chatbot assists officers and citizens by interpreting incidents, identifying relevant laws, and retrieving similar legal precedents. It guides users through legal procedures in real time, simplifying legal literacy and decision-making.

3. **Intelligent Violation Management & Task Automation**
   License plate recognition enables real-time detection of violations. The system auto-generates fines, delivers them via WhatsApp/email with LankaPay payment links, and optimizes field assignments through a workload-aware scheduler. AI-driven analytics identify hotspots, trends, and recommend policy changes to reduce recurring offences.

4. **Real-Time Traffic Monitoring & Officer Safety**
   Leveraging Google Maps API, the system predicts congestion and accident-prone zones. It includes encrypted voice communication (1-to-1/many), emergency alerts, and anonymous officer reporting to combat internal corruption. AI-based heatmaps forecast accident probabilities for proactive policing.

Together, these components deliver transparent, citizen-focused, digitally empowered traffic policing for Sri Lanka.





7. Brief description of specialized domain expertise, knowledge, and data requirements (300 words max)

The successful development and deployment of this platform requires interdisciplinary expertise across law enforcement technology, legal informatics, blockchain engineering, AI/NLP systems, and secure data architecture.

Domain Expertise Required:

1. **Legal and Judicial Knowledge:**
    a. Understanding of Sri Lankan traffic laws, legal procedures, court filing formats, and law enforcement protocols.

b. Expertise in case documentation, evidentiary rules, and precedent analysis to design AI-driven legal reasoning modules.

2. **Law Enforcement Operations:**
    a. Insight into real-world traffic police workflows, violation processing, field scheduling, and typical pain points in existing systems.
    b. Familiarity with current bottlenecks in patrol management, officer communication, and corruption reporting.

3. **Blockchain and Cybersecurity:**
    a. Skilled blockchain architects to develop decentralized evidence vaults with hashed data integrity.
    b. Knowledge of IPFS for secure storage of large files and cryptographic techniques like ZKPs for anonymous witness protection.
    c. Expertise in implementing encryption, identity access control, and tamper-proof audit logs.

4. **Artificial Intelligence & NLP:**
    a. Proficiency in training NLP models (Sinhala and English) for legal query interpretation and chatbot responses.
    b. AI analysts to model traffic patterns, identify high-risk zones, and deliver explainable analytics for police use.

5. **Data Requirements:**
    a. Legal datasets: historical court cases, precedent rulings, law articles, traffic violation records.(law lanka, lawnet websites)
    b. Real-time traffic data from Google Maps API.
    c. Multimedia evidence files (images, videos, documents) from traffic incidents.(self uploaded media)
    d. Officer and citizen interaction logs for system refinement and feedback learning. (From the end user)
    e. Traffic and fine details datasets for training ML models in offence prediction and location-based analytics.(Using the help of police department)

Collaboration between legal experts, law enforcement officers, and civic bodies is crucial to build a system that is not only technically sound but legally compliant and operationally practical in the Sri Lankan context.

1. Objectives and Novelty

1. Blockchain-Based Secure Evidence & Legal Dossier System

Novelty:
Introduces a tamper-proof, decentralized case management system using blockchain and IPFS, uniquely combining legal documentation, digital evidence storage, and witness protection into a single secure architecture. The integration of ZKP (Zero-Knowledge Proofs) ensures anonymity for sensitive testimony a first for Sri Lanka's legal tech ecosystem. [1][2]

Objectives:

- Ensure integrity and authenticity of legal documents and evidence.
- Enable transparent, auditable access to evidence by courts, investigators, and related parties.
- Facilitate anonymous evidence submissions to protect witnesses.
- Eliminate paper-based evidence handling and minimize manipulation or loss.

2. AI-Powered Legal Intelligence & Decision Support

Novelty:
Uses bilingual NLP (Sinhala + English) to interpret user-described incidents and suggest laws, legal procedures, and precedents. Unlike traditional legal databases, this system actively engages users in a natural conversation, democratizing access to legal understanding and real-time support.[3][4]

Objectives:

- Reduce legal knowledge barriers for both officers and civilians.
- Offer real-time guidance on incident handling and rights.
- Provide past legal case references to support transparent decision-making.
- Enhance field-level decision-making with AI-backed legal clarity.

3. Intelligent Violation Management & Task Automation

Novelty:
Automates the entire violation lifecycle—from detection via edge-based LPR (License Plate Recognition) to issuing fines through WhatsApp/email with integrated LankaPay payment links. It also includes predictive analytics to recommend preventive strategies based on violation trends. [5][6]

Objectives:

- Streamline and automate offence detection and fine generation.
- Minimize manual effort, reduce human error, and curb bribery risks.
- Analyze offence patterns and guide strategic traffic interventions.
- Optimize patrol and follow-up tasks based on workload.

4. Real-Time Traffic Monitoring, Prevent accidents , Prediction & Officer Safety

Novelty:
Integrates AI-powered heat maps to prevent accidents, congestion forecasting, and encrypted police communication in one system. Adds a corruption-resistant anonymous reporting channel—allowing ethical officers to bypass hierarchy and report misconduct securely. [7][8]

Objectives:

- Predict and visualize accident-prone zones using ML and Google Maps.
- Enhance officer coordination and safety with encrypted 1-to-1/many voice tools.
- Provide panic alert features for emergency response.
- Enable internal anti-corruption reporting to improve institutional accountability.

Reference

[1] Y. Zhao and K. Tan, "Blockchain-Based Digital Chain of Custody for Multimedia Evidence," *IEEE Trans. Inf. Forensics Security*, vol. 18, no. 2, pp. 845–856, Feb. 2023.

[2] J. Li and S. Kim, "A Study of a Blockchain-Based Judicial Evidence Preservation Scheme," *IEEE Access*, vol. 12, pp. 30214–30225, Mar. 2024.

[3] A. Mehta and R. Singh, "LawPal: A RAG-Based Legal Chatbot for Case Precedent Retrieval," *Proc. IEEE Int. Conf. Artif. Intell. Law (ICAIL)*, 2025, pp. 110–118.

[4] P. Kumar and L. Fernando, "Legal Natural Language Processing from 2015–2022: A Systematic Mapping Study," *ACM Comput. Surv.*, vol. 55, no. 6, pp. 1–35, Dec. 2022.

[5] H. Cheng and M. Tan, "A Multi-Stage Deep-Learning-Based License Plate Recognition System with Real-Time Edge Inference," *IEEE Trans. Ind. Electron.*, vol. 70, no. 5, pp. 4789–4801, May 2023.

[6] R. Ali and V. Subramaniam, "Edge-AI-Based Real-Time Automated License Plate Recognition System," *IEEE Internet Things J.*, vol. 8, no. 22, pp. 16432–16440, Nov. 2021.

[7] D. Suresh and N. Silva, "Machine Learning for Predictions of Road Traffic Accidents and Spatial Hotspot Analysis," *IEEE Trans. Intell. Transp. Syst.*, vol. 25, no. 3, pp. 1357–1368, Mar. 2024.

[8] A. Rahman and T. Wickramasinghe, "Hotspot Analysis and Severity Prediction of Road Traffic Accidents Using ML," *Proc. IEEE Conf. Smart Cities*, 2022, pp. 220–228.

Member Name with Registration No	Sub Objective	Tasks	Novelty

YGY Induwara IT22642332	• Improve evidence traceability and integrity. • Enable secure multi-party access to case documents. • Protect the anonymity of sensitive witnesses. • Eliminate paper-based evidence workflows.	• Create blockchain-based case wallets for each legal case. • Store legal documents, expert reports, and evidence files on IPFS. • Implement hashed ID and ZKP-based witness protection. • Provide role-based access (court, investigator, lawyer, case party). • Enable geo-tagged and time-stamped uploads.	Introduces a tamper-proof, decentralized case management system using blockchain and IPFS, uniquely combining legal documentation, digital evidence storage, and witness protection into a single secure architecture. The integration of ZKP (Zero-Knowledge Proofs) ensures anonymity for sensitive testimony—a first for Sri Lanka's legal tech ecosystem.
Wanni arachchi w.a.d.p IT22601056	• Develop a bilingual (Sinhala + English) NLP interface for conversational legal assistance. • Integrate explainable AI to ensure transparency and trust in legal recommendations. • Automate the retrieval and summarization of relevant statutes, procedures, and case law.	Collect and curate bilingual legal datasets (statutes, case law, procedural guides) for model training. Design and implement NLP pipelines for intent recognition and legal text interpretation in Sinhala and English. Develop user-facing conversational interfaces for police officers and civilians. Integrate legal case recommendation engines using ranking and citation network analysis. Incorporate explainable AI modules to justify legal	Uses bilingual NLP (Sinhala + English) to interpret user-described incidents and suggest laws, legal procedures, and precedents. Unlike traditional legal databases, this system actively engages users in a natural conversation, democratizing access to legal understanding and real-time support.

	• Address ethical concerns, including bias and accountability, in AI-driven legal tools. • Simulate legal scenarios to provide predictive guidance for incident handling.	suggestions and recommendations. Test and evaluate the system with real-world incident data and user feedback. Monitor and mitigate algorithmic bias and ensure compliance with ethical standards.	
Bandara S W G B M T IT22638304	• Intelligent Police Task Assignment • Online Appeal Portal • Automated Fine Calculation • Blacklist & Warning System • Heatmap Visualization Dashboard	• Assign tasks using officer location, workload, and violation. • Allow offenders to appeal online and upload digital evidence. • Auto-calculate fines based on severity and offender history. • Track repeated violations, send warnings, and blacklist offenders. • Show violation trends on interactive maps with filters.	★ It uniquely combines historical tracking with predictive analytics and real-time LPR integration, enabling proactive policing against repeat offenders. ★ It offers predictive heatmaps and AI-driven trend analysis, allowing authorities to identify high-risk areas and plan patrols more effectively in near real time.

Lakshan W V D IT22560308	1. Real-time traffic monitoring and congestion forecasting 2. Accident-prone zone prediction and visualization 3. Encrypted officer communication 4. Panic alert for emergency response 5. Anonymous anti-corruption reporting	- Integrate live traffic APIs and train BiLSTM/LSTM models for congestion prediction - Use ML models (e.g., XGBoost, Transformers) on historical and live data to predict accident-prone zones and visualize on Google Maps - Develop WebRTC/AES-256-based encrypted voice tools with push-to-talk UI - Implement panic alert button with GPS/audio/video auto-transmission - Design blockchain + ZKP-enabled anonymous report submission platform	- Combines AI-driven congestion prediction with live traffic maps for operational police routing - Uses predictive crash analytics with GIS-based risk overlays for proactive prevention - Secure voice channels enhance officer coordination beyond standard radios - Real-time panic features with location/audio/video improve emergency response - Novel anti-corruption module enables secure, anonymous whistleblowing using blockchain and cryptographic proofs

2. Individual component description of how it is complied with the specialization.

Member Name with Registration No	Description
IT22642332	Blockchain Development, IPFS data storing and database implementation and maintenance part
IT22560308	Real-Time Traffic Monitoring, Prevent accidents, Prediction & Officer Safety
IT22638304	An intelligent system to automate traffic law enforcement by assigning police tasks smartly, enabling online appeals with evidence, auto-calculating fines, tracking repeat offenders, and visualizing violations with AI heatmaps — ensuring faster, fairer, and proactive handling.
IT22601056	AI-Powered Legal Intelligence & Decision Support

3. Supervisor details

	Title	First Name	Last Name	Signature
Supervisor				
Co-Supervisor				
External Supervisor				
Summary of external supervisor's (if any) experience and expertise				

<u>This part is to be filled by the Topic Screening Staff members.</u>

a) Does the chosen research topic possess a comprehensive scope suitable for a final-year project?

Yes		No	

b) Does the proposed topic exhibit novelty?

Yes		No	

c) Do you believe they have the capability to successfully execute the proposed project?

Yes		No	

d) Do the proposed sub-objectives reflect the students' areas of specialization?

Yes		No	

e) Supervisor's Evaluation and Recommendation for the Research topic:

IT4010 Research Project – 2025 July

Topic Assessment Form

Acceptable: Mark/Select as necessary

Topic Assessment Accepted	
Topic Assessment Accepted with minor changes*	
Topic Assessment to be Resubmitted with major changes*	
Topic Assessment Rejected. Topic must be changed	

* Detailed comments given below

Comments

Staff Member's Name	Signature

*__Important__:

1. According to the comments given by the evaluator, make the necessary modifications and get the approval by the **Evaluator**.
2. If the project topic is rejected, identify a new topic, and request the RP Team for a new topic assessment.