Drone Technology for Road Traffic Planning:
Enhancing Data-Driven Road Safety Management in Zambia

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Keywords: Drone technology, Traffic monitoring, Road safety, Smart transport planning, Data-driven decision making, Urban mobility.

Background

Urban traffic management in Zambia faces persistent challenges due to rapid vehicle growth and insufficient real-time traffic data. Traditional monitoring methods such as road tube counters and CCTV cameras provide point-specific data but fail to capture spatial traffic dynamics, queue lengths, and lane usage comprehensively. Limited data impedes planners' ability to optimize traffic flow and implement safety interventions effectively. Integrating drone technology offers a flexible, low-cost approach to capturing high-resolution aerial traffic data, enabling evidence-based planning and improved road safety outcomes.

Aim

To evaluate the feasibility and impact of integrating drone technology into urban traffic monitoring to enhance road safety and optimize traffic planning in Lusaka, Zambia.

Method

A mixed-methods approach was employed:

Qualitative: Semi-structured interviews with RTSA officials, Zambia Civil Aviation Authority (ZCAA), and licensed drone operators (e.g., Zanifi, TerraVia) assessed operational, regulatory, and safety considerations.

Quantitative: Traffic data were collected at key intersections (e.g., Great North Road & Makishi Road) using a DJI Mini drone and Apollo automated road tube counters. Data included vehicle counts, speeds, flow patterns, and queue lengths. Centurion software facilitated data extraction and analysis.

Analysis: Traffic flow dynamics were assessed using median speed (50th percentile), congestion patterns, and spatial vehicle distribution. Qualitative data underwent thematic analysis to extract operational protocols, regulatory requirements, and implementation challenges.

Figure 1 image of the instrument used for data collection

Results

- Drones captured real-time spatial traffic data, filling gaps left by traditional counters.
- Peak traffic periods (6:25–6:40 AM) showed high vehicle density; drones enabled precise measurement of queue lengths and turning movements.
- Median speed analysis revealed compliance trends and areas for targeted enforcement.
- Integration of drones with automated counters provided a comprehensive traffic profile, allowing planners to optimize lane usage, manage congestion, and support road safety strategies.
- Qualitative insights identified key requirements for drone deployment, including regulatory approval (ZCARS Part 18), licensing, safety protocols, and inter-agency coordination.

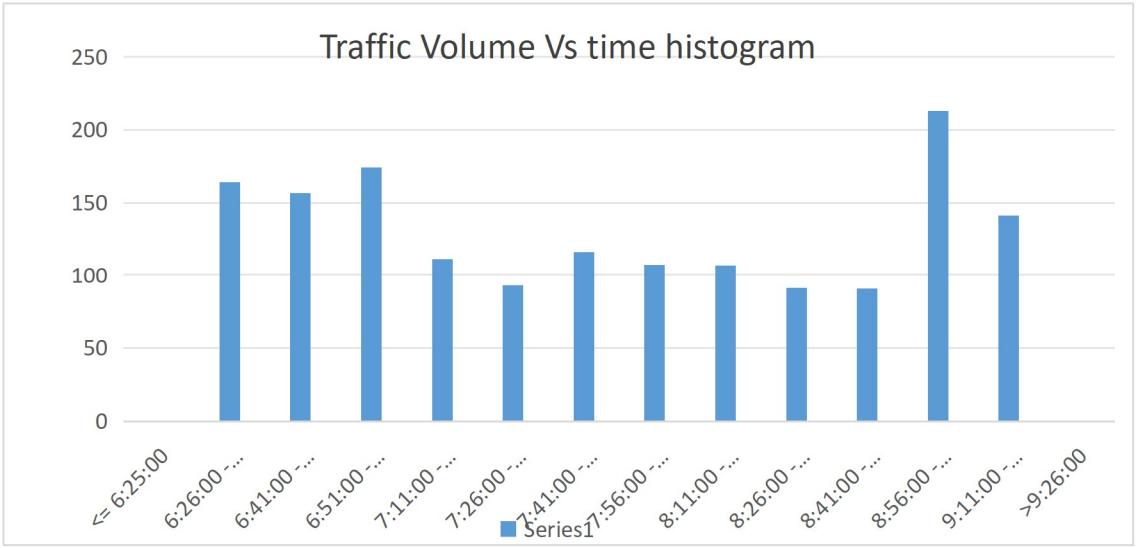

Figure 2. Traffic Volume vs Time histogram.

Conclusions

- Drone technology significantly enhances traffic monitoring accuracy and coverage, enabling data-driven traffic management.
- Combined with automated counters, drones support optimized traffic flow and improved road safety.
- Successful implementation requires clear regulatory frameworks, operator coordination, and capacity building.
- Adoption of UAV-based traffic monitoring represents a scalable, low-cost innovation for African urban mobility challenges, with potential for broader application across the continent.