

Abstract

In Africa, there is a serious problem that requires an urgent call for an integrated, data-driven, community-owned, and community-centered road network system that addresses and provides a solution to Africa's growing demand for a safe road network system and framework anchored on local empowerment, involvement, and ownership. This is because Africa continues to record tremendous numbers of injuries and deaths related to Road network systems. Aside from that, there is increased urbanization and motorization in many cities, which have led to traffic congestion, inefficient parking systems, increased toxic emissions from burning fossil fuels by internal combustion vehicles, and increased road safety risks. The lack of real-time road and parking information contributes to unsafe and dangerous driving behaviors such as illegal parking, obstructed and distracted driving. Existing road network management systems are often costly and poorly adapted to the local and African context, thereby limiting their effectiveness.

This study aims to develop an integrated real-time road and parking network system framework designed to enhance road safety, improve traffic efficiency, and promote community empowerment and ownership through decentralized digital infrastructure.

The proposed framework captures real-time and near-time data from mobile phones, sensors, and vision-based recognition to inspect and monitor road and parking conditions. Data is then piped and processed at the edge to reduce latency and bandwidth before being moved to a central platform. A mobile-based interface provides drivers with navigation support coupled with a graphical user interface that includes safety signage, potential road hazards, and real-time parking availability information. The system emphasizes modularity, scalability, and affordability to support deployment in resource-constrained environments. Community participation is incorporated through local monitoring, reporting mechanisms, and a shared sustainable platform.

The developed prototype shows that a real-time parking detection and navigation system can reduce parking search time, unnecessary vehicle circulation, and air pollution. It also results in improved traffic flow near parking infrastructure, and reduced unsafe behavioral conduct was noticed. Enhanced system responsiveness under limited network conditions and improved local engagement and system adaptability were observed. The integrated real-time road network framework provides and demonstrates potential to improve road safety and traffic systems in Africa. It addresses both technical and social challenges linked to road transport mobility, by processing the captured real-time data with community centered principles. The designed framework provides a scalable and cost-effective foundation for community-driven and community-owned safe and smart mobility in Africa.

Keywords: Africa, integrated, safe, community-driven, digital infrastructure, safety signage.