Inteligencia artificial y configuración ágil de rutas en el transporte en Colombia: una nueva oportunidad para las economías en desarrollo

Artificial Intelligence and Agile Route Configuration in Transportation in Colombia: A New Opportunity for Developing Economies

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Resumen

Este documento de trabajo examina la aplicación de la inteligencia artificial (IA) en la optimización de rutas de transporte urbano y nacional en Colombia, con especial énfasis en la plataforma HERE Technologies. La propuesta plantea una implementación ágil de esta tecnología para mejorar significativamente la logística, la eficiencia operativa, la movilidad urbana y la distribución de mercancías, especialmente en la entrega bajo el modelo de última milla. Se prevé que la adopción de estas soluciones no solo reducirá los costos y los tiempos de entrega, sino que también generará nuevas oportunidades económicas, especialmente en contextos de economías emergentes como Colombia.

Adicionalmente, este documento busca ofrecer herramientas medibles para los gobiernos locales, regionales y nacionales, permitiéndoles analizar datos críticos mediante mediciones basadas en IA. Esto facilitará la correcta asignación de presupuestos para infraestructura vial en los próximos 30 a 40 años, incluyendo análisis integrales del crecimiento económico, la demanda, el estado actual de las vías y el desarrollo de sistemas de transporte multimodal.

Palabras clave:

inteligencia artificial, optimización del transporte, configuración de rutas, Colombia, implementación ágil, movilidad urbana.

Abstract

This working paper examines the application of artificial intelligence (AI) in optimizing urban and national transportation routes in Colombia, focusing specifically on the HERE Technologies platform. The proposed approach emphasizes the agile implementation of this technology to significantly enhance logistics, operational efficiency, urban mobility, and the distribution of goods, particularly in achieving perfect or last-mile logistic model delivery. It is anticipated that implementing these solutions will not only reduce costs and delivery times but also create new economic opportunities, especially in the context of emerging economies like Colombia and the challenges it currently faces.

Additionally, this document aims to provide measurable tools for local, regional, and national governments, enabling them to analyze critical data through AI measurements. This will facilitate the correct allocation of budgets for road infrastructure over the next 30 to 40 years, which includes comprehensive analyses of economic growth, economic demand, current road conditions, and the development of multimodal transport systems.

Keywords:

Artificial Intelligence, Transportation Optimization, Route Configuration, Colombia, Agile Implementation, Urban Mobility.

Introduction

The evolution of artificial intelligence (AI) has transformed multiple sectors, including transportation and logistics. For developing countries like Colombia, optimizing transportation routes through AI presents a unique opportunity to improve urban mobility, enhance the distribution of goods, and reduce operational costs (Rodríguez & García, 2021).

In this working paper, we explore how the implementation of HERE Technologies, an advanced data and geolocation platform, can contribute to transforming transportation infrastructure in Colombia. By leveraging real-time analytics and predictive data, HERE Technologies enables route optimization, improved traffic management, and more efficient logistical planning (HERE Technologies, 2022). This makes it possible to forecast the infrastructure required for the next 30 years and address the challenges of economic growth to maximize national resources effectively.

Context and Transportation Issues in Colombia

Colombia faces critical challenges in both urban and national mobility. Cities such as Bogotá, Medellín, and Cali suffer from high levels of vehicular congestion, resulting in long travel times and elevated operational costs (González & Peñaloza, 2019). At the national level, goods distribution routes are often inefficient, negatively impacting businesses and consumers by increasing transportation costs, prolonging delivery times, and falling short of service quality expectations.

These inefficiencies, coupled with inadequate road infrastructure and a growing demand for transportation services, necessitate innovative technological solutions. AI offers an agile and scalable approach to addressing these issues,

with platforms like HERE Technologies positioning themselves as viable tools for integrating such advancements into Colombia's transportation system.

HERE Technologies: AI-Based Solution

HERE Technologies is an advanced platform that provides geolocation solutions, real-time traffic data, and predictive analytics. This technology has been successfully implemented in various cities and regions worldwide, where it has enabled route optimization, reduced vehicular congestion, and significantly improved logistical management (Bennett, 2021).

Key Features

- **Real-Time Data:** HERE Technologies gathers information from multiple sources—including connected vehicles, sensors, and satellites—to offer a real-time view of traffic and road conditions.
- **Route Optimization:** By applying AI algorithms, the platform analyzes historical and real-time data to suggest the fastest and most efficient routes, thus reducing travel times and operational costs (Klein & Garcia, 2020).
- **Predictive Analytics:** Through machine learning, HERE Technologies can forecast future traffic patterns, enabling businesses and authorities to plan transportation and logistics operations more effectively.

Global Use Cases

In cities like London and Berlin, HERE Technologies has played a key role in managing traffic, reducing congestion, and optimizing public transportation. Logistics and transportation companies using this platform have reported notable improvements in operational efficiency and reductions in distribution costs (Bösch, Becker, Becker, & Axhausen, 2018).

Applicability of HERE Technologies in Colombia

The implementation of HERE Technologies in Colombia could result in significant improvements across several sectors, including public transportation, goods distribution, and logistics.

Urban Transportation

In congested cities such as Bogotá and Medellín, AI-based traffic optimization is essential. HERE Technologies could support local governments in making informed decisions regarding traffic management, enabling more effective planning of road infrastructure and real-time monitoring of road conditions (Hernández & López, 2021). This would enhance user experiences by reducing travel times and improving overall quality of life.

National Transportation and Logistics

Colombia encounters considerable challenges in optimizing its logistics routes, particularly in transporting goods between regions. Logistics companies could benefit significantly from HERE Technologies by planning more efficient routes, minimizing fuel consumption, and improving delivery timelines. This is particularly relevant given Colombia's diverse geography, where terrain and road conditions vary widely (Optibus, 2023), compounded by climatic phenomena or rainy seasons that often lead to landslides, temporary road closures, or limitations.

Economic Benefits

The adoption of HERE Technologies in Colombia would not only improve operational efficiency but also generate long-term economic benefits. Shorter travel times and lower operational costs would enhance the competitiveness of domestic companies, while advancements in logistics and transportation infrastructure would attract foreign investment and support trade expansion (Cárdenas, Hincapié, & Restrepo, 2020).

Success Cases

HERE Technologies and AWS

HERE Technologies has successfully implemented artificial intelligence and cloud computing solutions in collaboration with Amazon Web Services (AWS) to optimize its Tour Planning API, achieving significant savings and improvements. By migrating to AWS Graviton-based instances, HERE Technologies has achieved:

1). **Cost Reduction:** Up to a 30% reduction in per-request costs for asynchronous workloads and a 19% overall savings for the HERE Delivery Platform (Amazon Web Services, n.d.).
2). **Performance Improvement:** Response times up to 50% faster for synchronous workloads (Amazon Web Services, n.d.).
3). **Sustainability:** Energy consumption reduced by up to 60%, supporting HERE's goal of achieving net-zero carbon emissions by 2035 (Amazon Web Services, n.d.).

UPS and Route Optimization with the ORION App

United Parcel Service (UPS) uses AI algorithms to optimize its delivery routes and package sorting processes. These algorithms analyze data related to packages, delivery addresses, and real-time traffic conditions to determine the most efficient routes for drivers. Since the implementation of its On-Road Integrated Optimization and Navigation (ORION) system, UPS has achieved remarkable results:

1). **Mileage Reduction:** ORION reduces the number of miles driven by 6 to 8 miles per driver per day. This translates to approximately 100 million miles saved annually, resulting in cost savings of around USD 300 to 400 million each year (Weise, n.d.).
2). **Fuel Savings:** The system has contributed to saving approximately 10 million gallons of fuel and reducing CO_2 emissions by 100,000 tons (Weise, n.d.).

3). **Operational Efficiency:** ORION evaluates over 200,000 routing options per delivery route, allowing for real-time recalculations based on evolving conditions, such as traffic (Weise, n.d.).

Colombian Example Needing Implementation

Based on my experience working in the logistics sector for the past 20 years, I emphasize the importance and urgency of implementing AI technologies in Colombia due to the following factors:

1). **Infrastructure Limitations:** Many rural areas in Colombia suffer from poor road conditions, affecting delivery times and costs. AI can optimize routing by analyzing real-time traffic and road quality, enhancing logistics efficiency.
2). **E-commerce Growth:** The growth of e-commerce increases the demand for efficient logistics. AI can improve order fulfillment and inventory management, enabling companies to respond quickly to customer needs. According to McKinsey, significant growth in Latin American e-commerce highlights the need for better logistics capabilities.
3). **Cost Efficiency:** Logistics companies often operate on narrow profit margins. AI can reduce operational costs by optimizing delivery routes and resource allocation. The Inter-American Development Bank emphasizes that adopting technology can lead to substantial logistics savings.
4). **Global Competitiveness:** To succeed in a globalized market, Colombian logistics companies must adopt innovative technologies. AI implementation can enhance operational efficiency and strengthen competitive positioning both nationally and internationally.
5). **Environmental Impact:** Sustainable logistics practices are increasingly needed to combat climate change. AI can help reduce the carbon footprint through optimized routes and better fleet management. The World Bank advocates for sustainability in logistics operations.
6). **Security:** Colombia's logistics sector also faces challenges related to theft and vandalism. AI can strengthen security measures, such as real-time route monitoring and threat prediction, ultimately improving delivery safety.

Agile Implementation in the Colombian Context

To maximize the impact of AI in configuring transportation routes in Colombia, agile implementation is essential to adapt to the country's evolving needs. This working paper proposes a phased implementation of HERE Technologies, beginning with pilot projects in highly congested urban areas like Bogotá and other major cities, and later expanding nationwide.

Phase 1: Pilot Projects in Bogotá and Medellín

- Identify critical congestion points in both cities.
- Implement sensors and real-time data collection using HERE Technologies.
- Analyze results to adjust traffic management and optimize both public and private transportation routes.

Phase 2: National Expansion

- Integrate HERE Technologies into Colombia's main logistical routes.
- Offer the platform to transportation and logistics companies to improve their operations.
- Evaluate long-term economic and sustainability outcomes.

Conclusions

Optimizing transportation routes through AI—specifically via HERE Technologies—presents a significant opportunity to improve mobility and logistics in Colombia. This platform offers advanced technological solutions to reduce costs and delivery times, while also promoting economic development and enhancing national competitiveness.

The agile implementation of this technology has the potential to transform Colombia's transportation landscape, resulting in a more efficient and resilient system that benefits both citizens and businesses. Moreover, it supports the development of road infrastructure aligned with economic growth, encourages investment in underdeveloped transport modes, revitalizes abandoned systems, and promotes digitized multimodal transportation networks.

In this sense, the information presented here seeks to guide the formulation of budgets that effectively allocate resources toward AI integration, ensuring timely and strategic decision-making.

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