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INTEGRATION OF AUTONOMOUS VEHICLES WITH SMART CITY INFRASTRUCTURE FOR ENHANCED PUBLIC TRANSPORTATION

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Abstract

The future of public transportation is taking shape, and autonomous vehicles (AVs) are at the forefront. [redacted] By integrating AVs with smart city infrastructure, we can create a transportation system that's not only efficient and safe but also sustainable. Our research explores the potential of AVs in smart cities, leveraging advanced technologies like IoT sensors, real-time data analytics, and AI-powered

Keywords: Autonomous vehicles, smart city infrastructure, public transportation, IoT, AI-powered traffic management, sustainable transportation.

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traffic management to optimize routes, reduce congestion, and enhance the passenger experience. We'll examine the technical, social, and economic implications of AV integration, including intelligent transportation systems, smart traffic signals, and public transit hubs. Our goal is to develop a comprehensive framework that ensures seamless integration, prioritizing safety, efficiency, and sustainability. The findings of this research will contribute to the development of future smart cities, enhancing the quality of life for citizens and promoting environmentally friendly transportation solutions. By shaping the future of public transportation, we can create a better, more sustainable world for generations to come.

Introduction

Urban areas around the world are facing growing pressure from population increases, traffic congestion, environmental concerns, and outdated public transportation systems (Drina Pojani, et al 2017). These challenges are prompting cities to rethink how people and goods move efficiently and sustainably J: Arabeyyat &et al (2023). One of the most exciting developments in this space is the integration of autonomous vehicles (AVs) Tiziana Campisi et at (2021) with smart city infrastructure a combination that has the potential to transform how cities operate and how residents experience mobility. According Divya Garikapati et al (2024) "Autonomous vehicles use cutting-edge technologies like artificial intelligence (AI), machine learning, and real-time data analytics to navigate roads and make decisions without human input". These vehicles are not just a Ming Zhu et al (2016) futuristic novelty they offer a real opportunity to improve road safety, reduce traffic bottlenecks, and provide more flexible transportation options, particularly when embedded within a smart urban ecosystem.

Smart cities, meanwhile, are built around the idea of using digital technology especially the Internet of Things (IoT) Mostafa Zaman et al (2024) to connect infrastructure, services, and people. When AVs are linked with systems like smart traffic lights, real-time route management, and centralized control platforms, the result is a city that can respond dynamically to traffic conditions and commuter needs. Public transportation, Melika Ansarinejad&et al (2025) long seen as the backbone of urban mobility, stands to gain tremendously from this integration.

Automated buses and shuttles could offer reliable, cost-effective, and accessible services, Emmanel Augustina Etukudoh & et al (2024) especially for underserved or remote communities. And with infrastructure that's able to communicate directly with vehicles, transit systems can become more efficient, responsive, and resilient.

This fusion of AVs and smart city infrastructure also supports broader goals for sustainability. With fewer emissions, smarter routing, and greater use of shared mobility, cities can move closer to meeting environmental targets and reducing their carbon footprint. However, reaching this future isn't without its hurdles. From regulatory challenges to public Emmanel Augustina Etukudoh & et al (2024) scepticism and the need for new infrastructure investments, there's a lot to consider. This paper takes a close look at how autonomous vehicles and smart city technologies can work together to improve public transportation. It explores current trends, identifies key challenges and opportunities, and proposes strategic frameworks for moving forward. Ultimately, this study aims to shed light on how cities can leverage innovation to become smarter, safer, and more sustainable for everyone.

Review of related Literature

Definition of Terms

Autonomous Vehicles (AVs)

Autonomous vehicles often called self-driving cars are cars that can drive themselves without needing a person behind the wheel. They use things like sensors, cameras, GPS, and artificial intelligence to "see" the road, make decisions, and safely navigate from one place to another. Some AVs still need a little help from a human driver, but others are designed to do everything on their own.

Smart City Infrastructure

Smart city infrastructure is what makes a city "smart" using technology and data to run things more smoothly and efficiently. Think of traffic lights that adjust based on real-time traffic, public Wi-Fi, or sensors that tell city workers when a garbage bin is full. All of these systems work together to make daily life easier and better for people living in the city.

Public Transportation

Public transportation includes all the buses, trains, subways, and trams that move people around in a city or region. It's designed to be shared by everyone and is often more affordable and environmentally friendly than driving a personal car. Good public transit helps reduce traffic, pollution, and commuting stress while making cities more accessible for all.

Internet of Things (IoT)

The Internet of Things or IoT for short is all about everyday objects being connected to the internet and able to talk to each other. In cities, this might include traffic cameras, weather sensors, or even streetlights that turn on when someone walks by. These connected devices collect and share data to help the city make smarter decisions in real time.

AI-Powered Traffic Management

AI-powered traffic management uses artificial intelligence to help control and improve traffic flow. It can predict when and where traffic jams might happen, adjust traffic lights automatically, or help emergency vehicles get to their destination faster. By learning from patterns and real-time data, it helps keep cities moving more safely and efficiently.

Sustainable Transportation

Sustainable transportation is about getting people where they need to go in a way that’s good for the environment and for future generations. This includes walking, biking, using public transport, or driving electric vehicles. It’s all about reducing pollution, saving energy, and making sure everyone has access to safe, reliable ways to travel. The idea of combining autonomous vehicles (AVs) with smart city infrastructure has been gaining a lot of attention in recent years and for good reason. As technology continues to advance and cities face growing demands for better, more efficient transportation, this integration is starting to look like a powerful solution. Researchers from different fields have been exploring what this could mean from multiple angles not just in terms of the technology itself, but also how it could impact city infrastructure, the environment, and even the everyday lives of people who rely on public transportation.

The Role of AI in Urban Mobility

AI-powered systems are central to both AV navigation and smart city traffic management. Machine learning models can predict traffic flows, identify congestion patterns, and optimize routes in real-time (Chen et al., 2017). In public transportation, AI can be used to adjust schedules dynamically, reduce delays, and allocate resources more effectively. Gkartzonikas and Gkritza (2019) highlight the synergy between AI and AVs in improving safety, efficiency, and user experience, particularly when integrated into a city-wide smart infrastructure.

Benefits of Integration for Public Transportation

Several researchers have explored the potential benefits of integrating AVs into public transit networks. Burns et al. (2013) envision a future where AVs operate as shared, on-demand transport services that complement traditional mass transit, especially for first-mile and last-mile connectivity. Studies by ITF (2017) show that shared autonomous vehicle (SAV) systems could reduce the number of vehicles on the road while maintaining or even improving service quality. Moreover, hybrid models that combine autonomous shuttles with real-time passenger data can lead to more inclusive, accessible, and efficient transport services.

Sustainability and Environmental Considerations

From a sustainability perspective, integrating AVs with smart city infrastructure supports efforts to reduce carbon emissions, energy consumption, and urban sprawl. Milakis et al. (2017) argue that the environmental benefits of AVs are maximized when deployed in shared, electric, and coordinated systems all of which are enabled by smart infrastructure. Moreover, connected transportation systems can reduce idle times and congestion, further contributing to a greener urban environment.

Challenges and Limitations

Despite the promise of AV-smart city integration, the literature also identifies several challenges. Technical issues include data security, system interoperability, and the need for ultra-reliable low-latency communication (URLLC) (Lu et al., 2014). Social concerns, such as public trust, data privacy, and job displacement in the transportation sector, are also significant (Shladover, 2018). Regulatory

uncertainties and the high cost of infrastructure upgrades further complicate large-scale implementation.

Statement of the Problem

Urban transportation systems are under increasing pressure. As cities continue to grow, so do the problems associated with traffic congestion, long commute times, environmental pollution, and gaps in public transportation access. Despite ongoing efforts to modernize infrastructure and improve mobility, many cities still struggle to deliver transportation that is safe, efficient, and equitable for all residents.

Autonomous vehicles (AVs) have emerged as a potential solution, promising to reduce human error on the roads, lower emissions, and provide more convenient travel options. At the same time, cities are becoming "smarter" using technology to manage resources more effectively, collect real-time data, and respond dynamically to changing needs. However, in many cases, these two innovations AVs and smart city systems are developing on separate tracks. Without a clear strategy to bring them together, cities risk missing out on the full benefits that this integration could offer, especially in the realm of public transportation.

One of the most pressing challenges is that public transportation systems are often outdated and rigid, making them less responsive to modern mobility needs. Integrating AVs into these systems for instance, through automated buses or last-mile shuttles could make transit more accessible, reduce costs, and improve service coverage. But this can only happen if smart city infrastructure is ready to support these vehicles through connected roadways, intelligent traffic signals, and data-driven management platforms. There are also significant barriers standing in the way. Technological compatibility, regulatory uncertainty, public scepticism, and high infrastructure costs all pose serious obstacles. Moreover, if this integration is not done thoughtfully, it could widen existing inequalities or lead to unintended consequences, such as increased vehicle usage or reduced employment in the transit sector. This research is driven by the need to better understand how autonomous vehicles can be effectively integrated with smart city infrastructure in a way that truly enhances public transportation not just in theory, but in practice. It asks: What are the key components of successful integration? What are the benefits and risks? And what steps can cities take to

ensure that this transformation leads to more sustainable, inclusive, and efficient urban mobility?

Traffic Congestion

Growing vehicle populations and inadequate infrastructure contribute to traffic jams, resulting in wasted time, fuel consumption, and increased emissions. According to Arti Choudhary & et al (2022) Traffic congestion is a regular phenomenon on urban roads, particularly in developing countries. There are number of triggering factor reported in literature such as traffic flow pattern, road capacity, driver behaviour including merging cooperation, unexpected lane change and certain manoeuvre. The trigger in these factors potentially leads to congestion on roads. It is often more critical at traffic intersections and junctions and results into frequent stop and go, constant shifting of driving modes

Outdated Public Transportation:

Inadequate or poorly maintained public transportation systems limit accessibility and can contribute to traffic congestion, especially in densely populated urban centres.

Economic Impacts:

Traffic congestion and inefficient transportation can lead to reduced productivity, increased costs for businesses, and hindered economic growth.

Social Impacts:

Traffic delays, pollution, and limited access to public transport can negatively impact residents' quality of life, including their health, well-being, and ability to participate in community life.

Environmental Impacts:

Urban areas are major sources of pollution, contributing to climate change, air quality problems, and other environmental issues.

Invest in public transportation:

Expanding and improving public transportation systems, including buses, trains, and subways, can reduce reliance on private vehicles and improve efficiency.

Develop smart transportation solutions:

Implementing smart traffic management systems, integrated mobility platforms, and advanced technologies can optimize traffic flow and reduce congestion.

The advent of information technology and the proliferation of vehicular ad hoc networks (VANETs) facilitating vehicle-to-pedestrian (V2P), vehicle-to-infrastructure (V2I), and vehicle-to-vehicle (V2V) communications have unlocked new prospects for enhancing intersection management systems Kriebitz, A.; Max, R.; Lütge, C. 2022. Contemporary transportation networks are grappling with challenges due to escalating travel demands and the finite capacity of road infrastructure (Yang, J.; Yang, K.; Xiao, Z.; Jiang, H.; Xu, S.; Dustdar, S. 2023), Luo, J.; Wang, G.; Li, G.; Pesce, G. 2022), Yang, H.; Zhang, X.; Li, Z.; Cui, J. 2022). In contrast to highway systems, urban roadways are plagued by prolonged travel times, inconsistent journey durations, excessive fuel consumption, and heightened emission levels, particularly at intersections where vehicles engage in frequent stopping and starting (Jin, Q.; Wu, G.; Boriboonsomsin, K.; Barth, M.2012).

Table 1: Objectives of the Study

S/N	Objective
1	To explore how autonomous vehicles can be effectively integrated into existing public transportation systems.
2	To examine the role of smart city infrastructure such as IoT, connected roads, and AI systems in supporting autonomous transportation.
3	To identify the potential benefits of AV and smart infrastructure integration for commuters and city-wide mobility.
4	To assess the challenges and barriers (technological, regulatory, and social) that could affect successful integration.
5	To propose practical strategies and frameworks for implementing AV-supported public transportation in smart cities.
6	To evaluate how this integration can contribute to sustainable, efficient, and inclusive urban mobility.

Mumtaz Wasif& et al (2025) Autonomous mobility is revolutionizing urban transportation by leveraging Artificial Intelligence (AI) to enhance safety, reduce

traffic congestion, and improve overall transportation efficiency. The development of autonomous vehicles (AVs) and connected vehicle technologies is a critical component of smart city transportation systems, offering the potential for safer and more

sustainable urban mobility. One of the primary benefits of autonomous mobility solutions is the reduction of human error, which is a leading cause of traffic accidents. AI-powered self-driving vehicles are equipped with sophisticated sensors, cameras, and machine learning algorithms that allow them to navigate and respond to their environment without human intervention. These technologies enable AVs to process vast amounts of real-time data, detect obstacles, predict potential hazards, and make decisions faster and more accurately than human drivers. As a result, autonomous vehicles have the potential to significantly reduce road accidents and fatalities, leading to safer transportation networks. Connected vehicle technologies, which enable communication between vehicles (Vehicle-to-Vehicle, V2V) and between vehicles and infrastructure (Vehicle-to-Infrastructure, V2I), further enhance the safety and efficiency of autonomous mobility. By exchanging real-time data with other vehicles and traffic signals, autonomous vehicles can better anticipate and respond to changing road conditions, traffic signals, and other vehicles' actions.

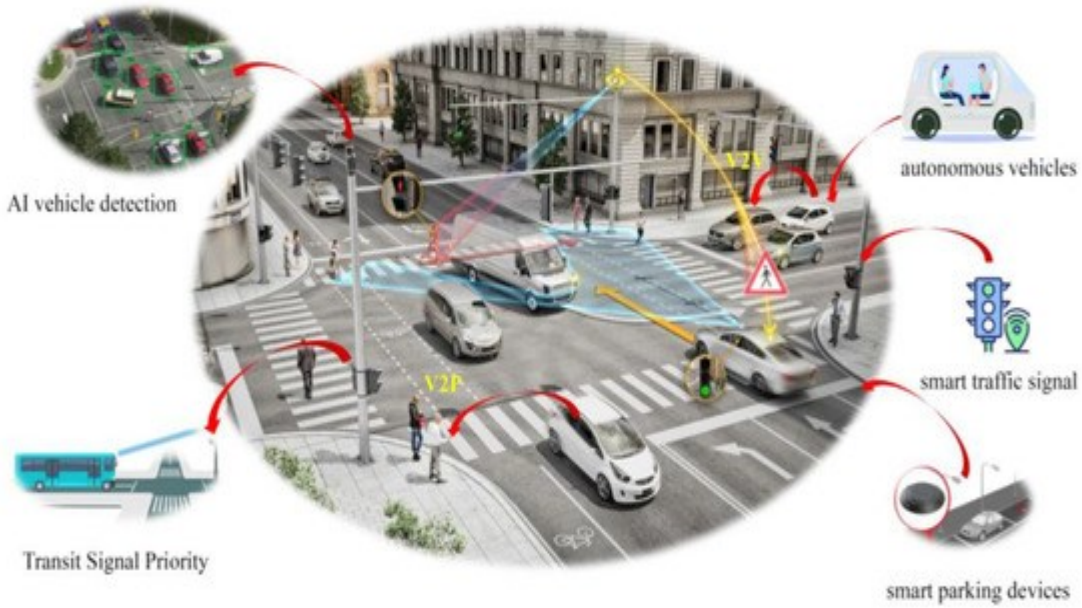


Figure 1 Smart intersection Technology (Masoud Khanmohamadi & et al (2025)

According to Kalasova A & et al (2006) collaboration allows for smoother traffic flow, reduces congestion, and optimizes route planning, contributing to a more efficient transportation system overall.

Another benefit of autonomous mobility solutions is their ability to integrate with shared mobility services Kari Koskinen (2024). Autonomous ride-hailing services, such as self-driving taxis, are already being tested and implemented in several cities. These services offer an efficient alternative to private car ownership, reduce the number of vehicles on the road, and provide greater accessibility to transportation, particularly for underserved populations. Furthermore, Venkata Sai Chandra Prasanrh Narisetty & et al (2024) autonomous mobility solutions can support the development of multimodal transportation systems, where different modes of transport, such as buses, bikes, and AVs, work in synergy to meet the mobility needs of urban residents.

Smart cities are increasingly recognized as thriving urban environments Filipo Marchesani & et al (2023) characterized by strong economies, modern infrastructure, and high standards of living. At the heart of the smart city concept is the idea of using cutting-edge technologies to create safer, more efficient, and more sustainable urban spaces that promote steady economic progress and improve the everyday lives of residents. A key driver in this transformation is the integration of information and communication technologies (ICT), which not only supports smart services but also serves as a benchmark for evaluating how advanced a city is in adopting smart solutions (Vishnivetskaya & Alexandrova, 2019).

The smart city model typically encompasses six core dimensions: smart economy, smart mobility, smart environment, smart people, smart living, and smart governance (Orlowski & Romanowska, 2019; Moura & de Abreu e Silva, 2019; Winkowska et al., 2019; Kumar & Dahiya, 2017).

- **Smart economy** ResearchFDI (2023) focuses on fostering innovation and entrepreneurship, improving productivity, encouraging labour market flexibility, and promoting global cooperation. It represents a city's capacity to adapt to economic shifts and leverage technology for growth.
- **Smart mobility** refers to the development of safe, efficient, and sustainable transport systems Melanie Kay Smith (2024). This includes the

use of ICT to improve transportation accessibility and reduce congestion, ultimately enhancing how people and goods move through the city.

- **Smart environment** deals with ecological sustainability and urban resilience. It involves the use of smart technologies to manage resources, control pollution, and promote environmental protection key indicators include air and water quality, waste management, and green space preservation.
- **Smart people** describe a population that is well-educated, open to innovation, culturally diverse, Alaa Ababneh (2023) and actively engaged in civic life. It emphasizes lifelong learning, creativity, and social inclusiveness.
- **Smart living** aims to improve the overall quality of urban life through better healthcare, housing, safety, cultural experiences, and social connectivity. It reflects how technology can enhance day-to-day living and social well-being.
- **Smart governance** focuses on transparent, responsive, and participatory city management. This involves using digital platforms to improve public services, promote citizen involvement in decision-making, and ensure the effective implementation of urban policies and strategies (Winkowska et al., 2019; Kumar & Dahiya, 2017).

Together, these elements form the foundation of a smart city and serve as a framework for how modern cities can evolve in ways that are intelligent, inclusive, and future-ready.

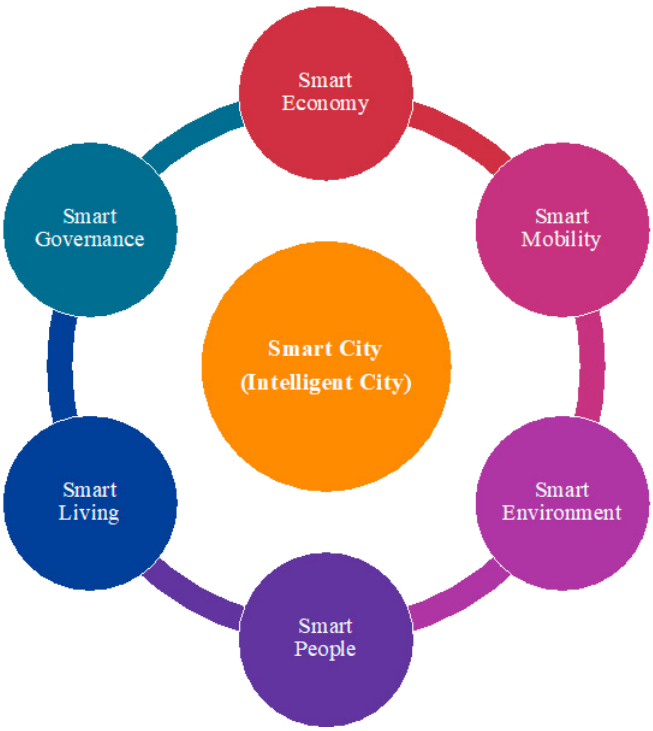


Figure 2: Element of smart cities (Eman A. Algherbal & et al (2024)

Methodology



Figure 3: Smart city transportation Steve Mazur (2020)

Methodology

Research Design

This study employs a quantitative research approach, using a structured survey to understand how residents of Lagos perceive the integration of autonomous vehicles (AVs) with smart city infrastructure. A survey-based method was selected due to its efficiency in capturing insights from a large and diverse population, making it ideal for the dynamic urban setting of Lagos.

Survey Instrument Development

The questionnaire was based on the Unified Theory of Acceptance and Use of Technology (UTAUT) **Osifeko Martins2018),** adapted to reflect local realities in Lagos. It covered:

Preferences between owning vs. sharing AVs

Safety and trust issues with AV technology

Willingness to adopt AVs in public transit

Awareness of smart city systems

Socio-demographic **Owan, V. J., & Asuquo, M. E. (2021)** details like age, gender, income, education, and occupation were also gathered to analyze response trends.

Sampling and Data Collection

A stratified random sampling method ensured a diverse cross-section of respondents from Lagos. Two modes of survey distribution were used:

Online: Via WhatsApp, Facebook, and Twitter to reach digitally active residents

In-person: At bus terminals, markets, universities, and community centers to reach those without stable internet access

This hybrid strategy ensured inclusivity and geographic spread across Lagos.

Sample Size

Using a 90% confidence level, 7% margin of error, and an estimated population variability of 0.5, the calculated sample size was 139. To compensate for non-responses, 140 participants were targeted and successfully surveyed.

Data Analysis

Data were analyzed using:

Descriptive statistics (e.g., means, percentages)

Inferential statistics including chi-square tests and logistic regression, to explore relationships between socio-demographics and AV attitudes.

Results and Discussion

The survey captured data from 140 Lagos residents across various age and socio-economic backgrounds.

Gender Distribution

52% male

48% female

This relatively equal split offers a balanced view of opinions across genders.

Educational Background

35% had undergraduate degrees

25% held diplomas
20% had postgraduate education

This indicates a tech-aware population familiar with innovation trends like AVs.

Public Attitudes Toward AVs
60% are willing to own an AV
25% prefer shared AVs for reasons such as cost or sustainability
15% are hesitant, mainly due to safety and affordability concerns

These insights show that Lagosian are open to AVs, but they want assurance on infrastructure, security, and cost.

Table 2: Summary of Demographic Details

Variable	Minimum	Maximum	Mean	Std. Dev.
Age	**1**	**7**	**3.51**	**1.375**
Gender	**0**	**1**	**1.54**	**0.500**
Occupation	**1**	**6**	**1.99**	**0.877**
Distance from home to work/study Place	**1**	**6**	**3.01**	**1.360**
Marital Status	**1**	**4**	**1.70**	**0.765**
Level of Education	**1**	**5**	**2.84**	**1.140**

Recommendations
Invest in Smart Infrastructure To prepare Lagos for autonomous vehicles, it's crucial to upgrade physical and digital infrastructure. This means developing AV compatible roads with clear lane markings and sensors, installing IoT-enabled traffic lights that can communicate with vehicles in real time, and expanding mobile broadband coverage to support real-time data exchange. These upgrades lay the groundwork for a safer, more efficient urban mobility network. Build Public Trust Through Education and Outreach Public understanding and confidence in autonomous vehicles are essential. Launching awareness campaigns, hosting community workshops, and partnering with media platforms can help demystify AV technology. When people understand how AVs work and how they benefit safety and convenience they're more likely to accept and use them.

Pilot Shared AV Programs in High-Traffic Areas Start with small-scale shared autonomous shuttle services in places like Victoria Island, Ikeja, or the Lekki corridor. These pilot programs can demonstrate the value of AVs in easing congestion and providing reliable last-mile connectivity, especially in business hubs and residential zones with limited transit options.

Partner with Nigerian Universities and Startups Leverage local talent by involving institutions like the University of Lagos, Covenant University, and local tech startups. Joint research on vehicle design, data analysis, and user experience can help create AV solutions tailored specifically to Nigeria's road conditions, user preferences, and regulatory needs. Supporting home-grown innovation makes the technology more sustainable and inclusive.

Conclusion

With its fast-growing population, complex traffic patterns, and rising demand for better urban transport, Lagos is well-positioned to become a pioneer in smart mobility across Africa. A strong majority showed interest in AV ownership or sharing, highlighting a readiness to embrace innovative transport solutions. However, challenges remain particularly around safety, affordability, and infrastructure. By investing wisely, educating the public, and tapping into local innovation, the city can build a future where transportation is safer, smarter, and more inclusive for all.

Reference

Ajao, Q., Sadeeq, L., & Sadiq, O. O. (2024). Drivers of Electric Vehicle Adoption in Nigeria: An Extended UTAUT Framework Approach. *African Journal of Environmental Sciences and Renewable Energy*, 16(1), 229-251. https://doi.org/10.62154/ajesre.2024.016.010326

Akanmu, A., Salisu, U. O., & Sanni, S. M. (2022). From Cradle to Auto-Mobility: The Autonomous Vehicle Operation in Nigeria. In *Transport Technology and Innovations in Nigeria: Policy Guide to a Sustainable Future* (pp. 158-173). Nigerian Institute of Transport Technology, Zaria. https://www.researchgate.net/publication/381917709_From_cradle_to_auto-mobility_the_autonomous_vehicle_operation_in_Nigeria

Alaa Ababneh (2023) Smart urban management of green space, December 2023, Journal of Design for Resilience in Architecture and Planning 4(3):339-353, DOI:10.47818/DRArch.2023.v4i3101

Arti Choudhary & et al (2022)Urban traffic congestion: its causes-consequences-mitigation, November 2022, Research Journal of Chemistry and Environment 26(12):164-176

Davor Brcic (2018) The Role of Smart Mobility in Smart Cities, DOI:10.5592/CO/CETRA.2018.812, Conference: Fifth International Conference on Road and Rail Infrastructure

Divya Garikapati et al (2024) Autonomous Vehicles: Evolution of Artificial Intelligence and the Current Industry Landscape, DOI:10.3390/bdcc8040042

Drina Pojani, et al (2017) The Urban Transport Crisis in Emerging Economies, DOI:10.1007/978-3-319-43851-1_1, ISBN: 978-3-319-43849-8

Eman A. Algherbal & et al (2024) Smart Cities and Intelligent Transportation Systems: Integration of Autonomous Vehicles and Their Impact on Congestion and Safety https://creativecommons.org/licenses/by-nc-nd/4.0

Emmanel Augustina Etukudoh & et al (2024) A Review of sustainable transportation solutions: Innovations, challenges, and future directions, World Journal of Advanced Research and Reviews 21(1):1440-1452, ***DOI:10.30574/wjarr.2024.21.1.0173***

Filipo Marchesani & et al (2023) Urban Environment in the Smart City, The Global Smart City, ISBN: 978-1-83797-576-1, eISBN: 978-1-83797-575-4, Publication date: 14 December 2023 Permissions

Gazanfer Mancino (2022) The Role of Autonomous Vehicles and AI in Smart Transportation Systems: Enhancing Traffic Management, Route Optimization, and Predictive MaintenanceDOI:10.13140/RG.2.2.23868.04483

J: Arabeyyat &et al (2023) Citation: Enhancing City Logistics for Sustainable Development in Enhancing City Logistics for Sustainable Development in Jordan: A Survey-Based Study, DOI:10.3390/logistics8010001

Jin, Q.; Wu, G.; Boriboonsomsin, K.; Barth, M. Multi-agent intersection management for connected vehicles using an optimal scheduling approach. In Proceedings of the 2012 International Conference on Connected Vehicles and Expo (ICCVE), Beijing, China, 12–16 December 2012; pp. 185–190. [Google Scholar]

Kalasova A & et al (2006) Smooth traffic flow as one of the most important factors for safety increase in road transport 2006, Transport 21(1), DOI:10.1080/16484142.2006.9638037

Kari Koskinen (2024) Shared benefits and sustainable mobility – A case of autonomous https://doi.org/10.1016/j.cstp.2024.101286

Kriebitz, A.; Max, R.; Lütge, C. 2022 The German Act on Autonomous Driving: Why ethics still matters. *Philos. Technol.* [Google Scholar] [CrossRef]

Luo, J.; Wang, G.; Li, G.; Pesce, G. Transport infrastructure connectivity and conflict resolution: A machine learning analysis. *Neural Comput. Appl.* 2022, *34*, 6585–6601. [Google Scholar] [CrossRef]

Masoud Khanmohamadi & et al (2025) Smart Intersections and Connected Autonomous Vehicles for Sustainable Smart Cities: A Brief Review *Sustainability* 2025, *17*(7), 3254; https://doi.org/10.3390/su17073254

Melika Ansarinejad& et al (2025) Autonomous Vehicles in Rural Areas: A Review of Challenges, Opportunities, and Solutions, DOI:10.3390/app15084195

Ming Zhu et al (2016) Public Vehicles for Future Urban Transportation, IEEE Transactions on Intelligent Transportation Systems 17(12):1-10, DOI:10.1109/TITS.2016.2543263

Melanie Kay Smith (2024) Smart Living And Quality Of Life: Domains And Indicators, Journal Of Urban And Regional Analysis 16(2), Doi:10.37043/Jura.2024.16.2.1

Mostafa Zaman et al (2024) A Review of IoT-Based Smart City Development and Management, Journal of Smart Cities 7(3):1462-1500, DOI:10.3390/smartcities7030061

Mumtaz Wasif& et al (2025) Smart City Development and AI: Revolutionizing Urban Infrastructure Optimization for Efficient Transportation Planning 2025

Ofoegbu, E. O. (2023). Autonomous Vehicles: Theoretical and Practical Challenges for Efficient and Inclusive Transport in Africa. *INDECS*, 21(1), 41-51. https://ideas.repec.org/a/zna/indecs/v21y2023i1p41-51.html

Osifeko Martins2018) An Empirical Study of Unified Theory of Acceptance and Use of Technology Model for E-Health Technology in Lagos, Nigeria

Owan, V. J., & Asuquo, M. E. (2021). Assessment of Socio-Demographic Factors and Students' Satisfaction with the Study of ICT in Secondary Schools. Pedagogical Research, 6(3), em0101. https://doi.org/10.29333/pr/11087

ResearchFDI (2023) How technology is changing the landscape of economic development

Tiziana Campisi et at (2021) The Development of the Smart Cities in the Connected and Autonomous Vehicles (CAVs) Era: From Mobility Patterns to Scaling in Cities, *Infrastructures* 2021, 6(7), 100; https://doi.org/10.3390/infrastructures6070100.

Venkata Sai Chandra Prasanrh Narisetty & et al (2024) Revolutionizing Mobility:The Latest Advancements in Autonomous Vehicle Technology, DOI:10.48550/arXiv.2412.20688

Yang, H.; Zhang, X.; Li, Z.; Cui, J (2022). Region-level traffic prediction based on temporal multi-spatial dependence graph convolutional network from GPS data. *Remote Sens.* 2022, *14*, 303. [Google Scholar] [CrossRef]

Yang, J.; Yang, K.; Xiao, Z.; Jiang, H.; Xu, S.; Dustdar, S. Improving commute experience for private car users via blockchain-enabled multitask learning. *IEEE Internet Things J.* 2023, *10*, 21656–21669. [Google Scholar] [CrossRef]