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A Review of Smart Tracking and Monitoring Technologies for Road Transport Systems in the USA

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Abstract

The road transport system in the United States is an essential infrastructure supporting economic and social needs for mobility and transport of goods. Smart tracking and monitoring technologies in road transport systems have dramatically enhanced efficiency, safety, and sustainability. This paper provides a comprehensive literature review of the emerging technologies, applications, limitations, and prospects in smart tracking and monitoring. The paper uses primary and secondary data considerations such as recent literature, case studies, and industry reports to present advancements like GPS-based tracking, IoT-based monitoring, AI-based analytics, and self-driving automobiles. Some facts relating to regulatory measures, security, and acceptance are highlighted for the discussion.

Keywords	Smart Tracking Technologies, Monitoring Systems, Transportation Technologies, Intelligent Transportation Systems (ITS), IoT in Transportation

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INTRODUCTION

The United States road transport system is a critical enabler of economic and social development, providing connectivity to over 4.2 million miles of public roads and enabling the carriage of about 72% of freight by weight (USDOT, 2022). However, this system poses challenges, some of which are partially solved, such as slow traffic flow that has been estimated to cost the economy 179 billion US dollars in loss of productivity (Schrank et al., 2021) and the recorded over 42915 deaths in traffic-related incidents in 2021 alone, based on National Highway Traffic Safety Administration. Furthermore, road transport contributes the most to greenhouse gas emissions, at 29 % of total emissions, and needs increased sustainability efforts (Environmental Protection Agency, 2023).

Advanced tracking and monitoring techniques have become significant solutions to these problems. Technological enhancements in the Internet of Things (IoT), artificial intelligence (AI), Global Positioning System (GPS), and 5G communication facilitate features such as real-time tracking, predictive analysis, and automated decision-making (Samaei, 2023). For instance, AI-based smart maintenance applications have proven to cut vehicle loss-of-run by 30% (Ferdowsi et al., 2019), and IoT-based fleet management applications improve fuel consumption by 15-20% (Degadwala et al., 2020). Likewise, large cities such as Los Angeles have installed adaptive traffic control systems, which have cut traffic congestion by 30 percent (USDOT, 2023). This systematic review synthesizes the progress, usage, issues, and prospective of smart tracking and monitoring systems in US road transportation. It focuses on how these technologies can enhance safety, productivity, and the environment in the future, where these key challenges could be met.

RESEARCH AIM

This systematic review will assess the development, productivity, issues, opportunities, and future of smart tracking and monitoring technologies in the US road transportation system. The aim is to evaluate how current technologies like IoT, AI, GPS, and self-driving systems can ensure efficiency in transportation, increase safety, and contribute to the sustainability of the environment to prove the concern despite regulatory challenges, cyber threats, and perception towards the new technology.

METHODOLOGY

LITERATURE SEARCH STRATEGY

This systematic review employed a broad search strategy in the titles and abstracts of articles sourced from research databases, including Google Scholar, ScienceDirect, JSTOR, IEEE Xplore, and SpringerLink. These sources were focused on articles published between 2018 and 2023. The emphasis was placed on peer-reviewed articles to study the recent advancements in smart tracking and monitoring technologies for road transport systems in the USA. The first search keywords were smart tracking technologies, monitoring systems, road transport systems, IoT and transport, artificial intelligence and traffic control, self-driving cars, GPS tracking, congestion management systems, and sustainable transport technologies. These keywords were linked using Boolean operators (AND, OR) that help expand or narrow the search result. To be more specific, only research articles that referred to road transport systems in the United States were considered for review. The automated search using the UW library database generated 430 articles, which were removed with less appropriate titles and abstracts. Of the 430 articles that underwent

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the initial assessment, 350 were considered potentially relevant. The removal based on these factors led to identifying 30 articles for full-text review based on relevance and methodological rigor.

DATA EXTRACTION

The data extraction for this systematic review was done using a predefined form that contains details of the information sought on smart tracking technologies and their utilization in smart mobility across the included studies. The data extraction's first and most significant objective was to evaluate smart tracking systems' technological context, approach, and outcome, specifically focusing on sustainability, mobility, and evolution trends inside the United States. The extracted data also looked into other models employed in assessing the performance and viability of urban mobility, with much focus on technological advancement and the effects on the environment, society, and economy. The following information was taken from each study:

STUDY DESIGN

Determining the study techniques, such as mixed-methods, quantitative, or qualitative approaches.

GEOGRAPHIC LOCATION

By concentrating on US implementations, the research ensured that the study was region-specific and representative of regional adoption trends, infrastructure, and legislation.

TRANSPORTATION STRATEGIES EXAMINED

To ascertain their effect on sustainability and efficiency in transportation networks, the smart tracking technologies such as GPS tracking, IoT-enabled systems, AI analytics, and RFID systems used in diverse urban mobility contexts were evaluated.

KEY CONCLUSIONS ABOUT SUSTAINABILITY ISSUES

Obtaining information on how smart tracking technologies affect social, economic, and environmental sustainability, especially in cutting emissions, optimizing fuel use, and easing traffic congestion.

PROSPECTS FOR URBAN MOBILITY

Determining how smart monitoring technologies might be used to enhance urban mobility, with an emphasis on lowering traffic, improving public transportation, and promoting integrated, multimodal transportation options.

EFFECTS OF NEW TECHNOLOGIES

Recognizing how new technologies like 5G networks, driverless cars, and AI-powered traffic control will influence urban mobility in the future and support environmentally friendly transport systems.

CURRENT MODELS OR STRUCTURES

Gathering information on life cycle assessment (LCA) models, smart city frameworks, and sustainable mobility indices models used to measure urban transportation systems' sustainability and efficiency.

DATA COLLECTION TECHNIQUES AND SAMPLING STRATEGIES

The studies presented in this review used various data collection techniques to capture the different facets of smart tracking technologies and their implementations to smart mobility systems across the United States. These methods included systematic literature reviews, case studies, surveys, interviews, and meta-analyses, offering different insights into smart tracking systems' impact, efficiency, limitations, and possibilities in urban transport.

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DATA COLLECTION METHODS

SYSTEMATIC LITERATURE REVIEWS

Several of these works employed systematic literature reviews to ascertain trends, technologies, and policies associated with smart tracking in urban transport involving diverse sources. These reviews were valuable in identifying repetitiveness in aspects like autonomous cars and real-time traffic management to enhance the efficiency and sustainability of transport in cities.

CASE STUDIES

Another important method found in the reviewed literature was the case studies. These are often centered around case studies of intelligent tracking systems integrated in some US cities. For example, the case of GPS-equipped vehicles and real-time traffic information about San Francisco and Los Angeles was useful in demonstrating the necessary adjustments and advantages of incorporating new technologies. The financial, technical, and policy dimensions of putting these technologies in place were well described in the case studies, showing the challenges of changing urban transport systems.

SURVEYS AND INTERVIEWS

The questionnaire survey was adopted together with personal interviews in several surveys to establish the perception and attitude toward smart tracking technologies and sustainable transport. For instance, commuters were interviewed on their willingness and preparedness to use ITSs, Uber, and similar services, and EVs, and transnational transport planners and policy-makers were interviewed on the viability and constraints of up-scaling such services across the towns. (Degadwala et al., 2020) used cross-sectional questionnaires to assess people's attitudes towards sustainable transport modes such as bike riding, walking, and electric vehicles.

META-ANALYSIS

Another paper involved a meta-synthesis to compare the results of various papers and explore and conclude on the effectiveness of smart tracking technologies. This approach made it possible to compare the effects of different technologies on mobility in the city and towards sustainability objectives and to conclude on the factors that affect the success of such systems in the United States.

SELECTION CRITERIA

INCLUSION CRITERIA

FOCUS ON THE UNITED STATES

The articles reviewed need to devote their contents to sustainable urban transport systems in the United States only to address the issues such as policies, plans, and technologies in that country.

EMERGING TECHNOLOGIES

Research concerning possible developments of future technologies like electric autos, auto-mobile vehicles, Smart tracking systems, and other environment-friendly transport systems were given priority. These technologies have been underlined to decrease the effects of their existence on the environment and increase the possibilities of people's mobility in cities.

POLICY AND ECONOMIC ANALYSIS

Studies evaluating policy contexts, economic structures, and urban development policies relating to sustainable transport were incorporated. These studies provided information on how the government can support smart technologies through policy and funding in urban production.

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SOCIAL JUSTICE AND ACCESSIBILITY

In this area, research on how urban mobility systems can meet principles of social justice, accessibility issues, and enabling sustainable mobility systems that are good for the least marginalized groups was also of interest.

EXCLUSION CRITERIA

NON-U.S. CONTEXT

Works that were not solely to do with the United States or had to do with transport systems that are not sustainable or those located outside cities were excluded.

PRE-2018 PUBLICATIONS

Pre-2010 articles were filtered out primarily, but works that introduced unique perspectives or overarching theories regarding sustainable urban transport were included.

LOW-QUALITY METHODOLOGY

Government policy papers not related closely to sustainable development in the context of urban transport, low methodological quality, or insufficient focus on the agenda were not included. This approach meant only papers with methodical, rigorous research frameworks, including those adopting quantitative, qualitative, and mixed-method research, would be featured in the final synthesized paper.

SYNTHESIS OF RESULTS

From the pool of 350 articles, 250 articles met the criteria, and 100 records were excluded as they were unrelated to urban transport systems or sustainable development. Further, 100 articles were removed due to the time of their publication being before 2015 or due to the current knowledge that they are not essential to the field. After carefully reading the complete texts of the studies, 10 were eliminated because of low methodological quality or little emphasis on sustainability in urban transport. In the end, 30 quantitative articles were chosen for qualitative meta-synthesis, giving a rich and detailed picture of smart tracking technologies' key themes and issues and their contribution to developing sustainable transport systems in America. The following key themes emerged from the synthesis:

TECHNOLOGICAL INNOVATIONS

Electric vehicles, autonomous vehicles, and smart tracking systems were recognized as revolutionary technologies that will enhance traffic conditions, eliminate traffic congestion, and decrease city greenhouse gas emissions. These innovations were identified to play a considerable role in enhancing environmental sustainability and developing smart cities.

URBAN PLANNING

Concerns about urban planning and its links to implementing sustainable transport systems were highlighted, as well as how smart city development can enhance the transport systems and their mobility networks.

SOCIAL EQUITY AND PHYSICAL ACCESSIBILITY

The research explained how comprehensive approaches to sustainable transport systems could solve social equity and access problems among deprived groups. Based on these technologies, it was established that communities in underprivileged areas could have much higher mobility within urban settings.

ENVIRONMENTAL SUSTAINABILITY

The communication efficiencies provided by advanced warn tracking technologies were another recurrent feature, with research indicating a potential for at least 5% cuts in carbon emissions and similar improvements in overall fuel and traffic traffic. The

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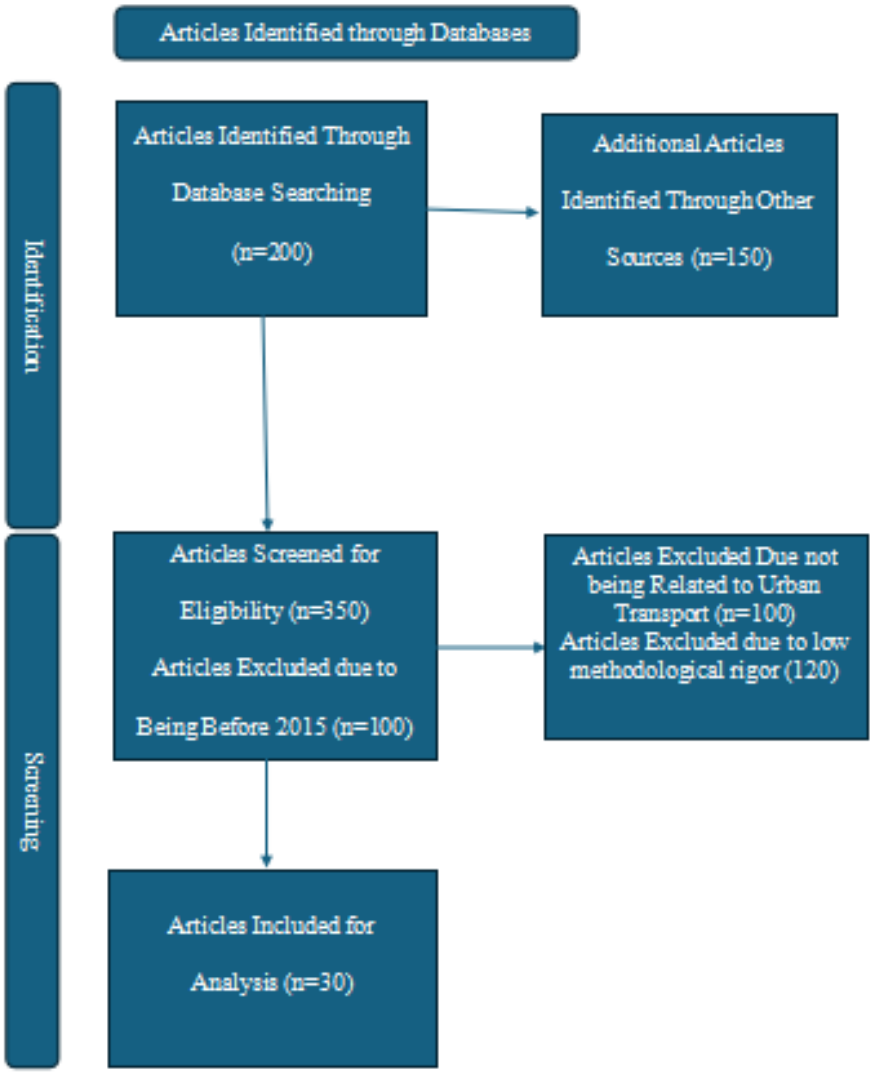
presented results aligned with the potential of emerging technologies to promote improvements in sustainable urban transportation.
The flowchart tracks the selection process.



RESULTS

The 30 chosen studies are summarized in the following matrix, which includes important information about the findings, methodological rigor, findings, what the authors say on technological innovation, urban planning, social equity and physical accessibility, and environmental sustainability.

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Authors	Year	Methodological Rigor	Findings	Technological Innovation	Urban Planning	Social Equity & Physical Accessibility	Environmental Sustainability
Alsrehin et al.	2019	Literature review	The authors provide an overview of data mining & ML in transport systems	They summarize the applications of data mining and machine learning (ML) in transportation systems, focusing on improving decision-making, flow optimization, and traffic control.	The authors discuss how data mining and machine learning help urban traffic control systems become more effective and flexible in response to shifting traffic patterns.	Although they don't detail particular equity issues, they do discuss how these technologies may make systems more accessible to a wider group of users.	A more sustainable transportation system might be achieved by lowering emissions by applying cutting-edge route optimization and traffic management technologies.
Bernas et al.	2018	Empirical Study	The authors compared low-cost traffic monitoring sensors	They study cost-effective traffic sensing and data-collecting solutions by comparing inexpensive traffic monitoring devices.	The paper emphasizes how such affordable sensor technology might improve traffic flow and eliminate congestion, among other aspects of	There hasn't been much talk about social fairness, but adding inexpensive sensing technology may help underprivileged or underfunded metropolitan	The emphasis is on energy-efficient technology, implying that more environmentally friendly traffic control techniques may result from inexpensive

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				urban mobility infrastructure	regions.	sensors.
Biggi & Stilgoe	2021	Bibliometric analysis	The authors discovered that AI plays a significant role in self-driving car research.	The scientometric examination of AI applications in smart city mobility systems is the main topic of this bibliometric investigation, which examines AI's involvement in self-driving automobiles.	The authors look at how AI applications might affect mobility in smart cities, especially when integrating driverless cars.	Although the article focuses more on technology than particular equity issues, it examines how AI may be used to fulfill the mobility demands of a wide range of society.	The importance of AI in lowering carbon footprints is highlighted, emphasizing possible energy and emission savings, especially in the context of driverless cars.

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Boukerche & Wang	2020	Model-based research	The authors explore the significance of traffic prediction using ML for ITS in urban transport.	They examine how artificial intelligence (AI) can forecast traffic patterns to enhance overall traffic management by incorporating machine learning (ML) into traffic prediction models for intelligent transportation systems (ITS).	The authors emphasize how ML-based prediction models might help city planners optimize transportation networks by managing urban traffic more effectively and efficiently.	Although the text offers insights regarding equality and accessibility, it does not focus on addressing these issues. It implies that predictive models can improve fair access to transportation networks.	The study indirectly contributes to sustainability by lowering emissions and increasing fuel economy through traffic flow optimization and congestion reduction.

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Hasrul et al.	2023	Book (data analytics)	The authors provided an in-depth analysis of data analytics in ITS	With an emphasis on applying analytics to improve transportation efficiency, this study delves into data analytics for enhancing intelligent transportation systems (ITS).	The paper explores the application of data-driven insights to maximize urban mobility, resulting in improved urban transportation services and infrastructure	It tackles accessibility concerns in ITS, emphasizing the use of data to enhance services for all urban users, particularly underserved populations.	The paper highlights how smart data may help reduce the environmental implications of urban transportation, with a particular focus on the environmental aspects of ITS.
Çınar et al.	2020	Literature review	The authors explored predictive maintenance for smart manufacturing in urban transportation.	They investigate the application of machine learning (ML) to optimize urban transportation networks and predictive maintenance for smart industrial systems.	Predictive maintenance is presented as a way to maximize urban transportation networks while maintaining the effectiveness and upkeep of infrastructure	They emphasize environmentally friendly urban transportation techniques, but they don't specifically address issues of accessibility or social fairness.	By lowering waste and resource consumption, the authors show how AI and predictive maintenance may support sustainable practices that promote environmental sustainability.

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Cocks & Johnson	2021	Case study	The authors explored Smart city initiatives in Columbus, Ohio	The writers talk about smart city technologies that integrate state-of-the-art developments in urban infrastructure, such as smart grids and intelligent	They look at how these developments influence Columbus, Ohio's urban mobility and how they fit into the design of smart cities.	The smart city projects they explore strongly emphasize accessibility and inclusion, highlighting the necessity of fair access to contemporary urban	Reducing energy consumption and fostering sustainability in urban development are the objectives of the emphasis on energy-efficient smart
Degadwala et al.	2023	Experimental study	The authors discovered that IoT-based fleet management for tracking is significant in urban transportation.	IoT-based fleet management solutions, which use IoT sensors to monitor and improve fleet operations, are covered in the article.	By increasing the effectiveness of car fleets in cities, these technologies play a big part in smart transportation networks.	The research emphasizes how fleet management may improve urban mobility, potentially helping various urban communities, even if it does not specifically address accessibility.	By using resources more effectively, which lowers emissions and energy consumption, the authors highlight the sustainability of fleet management.

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Englund et al.	2021	Literature review	The authors conclude that urban transportation heavily depends on AI in road vehicle automation.	They investigate how artificial intelligence (AI) may be used to automate road vehicles, namely in intelligent traffic planning and control.	They apply AI to enhance urban mobility, optimize traffic flows, and reduce congestion.	They discuss how everyone should have equal access to mobility systems and how AI can make transportation more accessible	AI integration in traffic management systems can result in lower fuel and pollution levels, which is good for the environment.
Ferdowsi et al.	2019	Overview	The authors explored deep learning for edge analytics in ITS	To improve intelligent transport systems (ITS), they concentrate on mobile edge computing and deep learning.	The paper explores how these developments contribute to the growth of urban ITS, which enhances the urban mobility experience and improves traffic management.	While social issues are not specifically addressed, edge computing technologies can improve accessibility by improving urban infrastructure.	The writers strongly emphasize energy-efficient ITS solutions, which help lower energy usage and advance environmental sustainability in transit networks.

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Greer et al.	2018	Report	The authors explored the cost-benefit analysis of ITS	This research examines the cost-benefit analysis of ITS implementation to assess the potential of intelligent transport systems (ITS) to optimize urban traffic systems.	It discusses how sensor technologies improve urban mobility management by fostering smarter, more effective urban settings.	By discussing how sensor-based systems might offer equitable access to transportation, the study highlights inclusion and accessibility.	The authors emphasize how sensor technology may support environmentally friendly transportation by streamlining traffic and cutting down on needless emissions
Guerrero-Ibáñez et al.	2018	Literature review	The authors discovered that sensor technologies in ITS have revolutionized urban transport.	The paper examines sensor technologies' function in ITS, focusing on how they help cities' smart infrastructure.	It talks about how sensor technologies can make cities smarter and more efficient and improve how urban transportation is managed	By discussing how sensor-based systems might offer equitable access to transportation, the study highlights inclusion and accessibility.	The authors emphasize how sensor technology may support environmentally friendly transportation by streamlining traffic and cutting down on needless emissions

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Haghighat et al.	2020	Literature review	The authors discovered that deep learning applications in ITS will improve future urban transportation efficiency.	The authors concentrate on deep learning and how it might be used in ITS for vehicle automation and traffic control.	By boosting municipal infrastructure and traffic flow, deep learning helps with urban mobility solutions.	While social equality is not specifically addressed, improvements in urban mobility benefit all users and may increase system accessibility.	Energy-efficient and environmentally friendly urban transportation systems are facilitated by using deep learning for traffic flow management.
Cho et al.,	2021	Literature review	The author discovered that autonomous systems in self-driving vehicles will revolutionize urban transportation.	The revolutionary role of self-driving technologies is examined in this paper, with particular attention to how they are changing autonomous systems in transportation.	It discusses how self-driving cars might increase urban mobility and boost city efficiency by lowering traffic and streamlining route management.	The research looks at how autonomous cars could offer fair mobility choices to people who are underserved or unable to drive, such as the elderly or disabled.	According to the report, autonomous cars may help reduce carbon emissions by optimizing driving patterns and lowering fuel consumption associated with traffic.
Karnati & Mehta	2022	Theoretical analysis	The authors discovered that the future of urban transportation relies on AI	The article explores how artificial intelligence (AI) is incorporated	It highlights how AI-powered self-driving cars could affect city	The authors talk about how artificial intelligence (AI) can make it possible for	It looks at how driving habits may be optimized with AI to use less fuel and create

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			applications in self-driving cars.	into self-driving automobiles, discussing its many uses, such as enhanced navigation and safety features.	infrastructure, especially in building smart highways and effective traffic systems.	self-driving automobiles to improve mobility and accessibility for underserved groups.	more environmentally friendly transportation systems.
Khayyam et al.	2020	Book chapter	The authors analyzed the significance of AI and IoT in autonomous vehicles	This article explores how AI and IoT work together in autonomous cars, emphasizing how these technologies improve system performance, communication, and decision-making.	It investigates how the Internet of Things might improve traffic control, facilitate easier urban transportation, and lessen congestion.	The study highlights how IoT and AI might increase underprivileged populations' access to autonomous cars.	It emphasizes how linked autonomous cars might help the environment, especially by lowering emissions via improved coordination and route planning.

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Lea	2017	Overview	The author explored Technology trends in smart cities	The article examines several technical developments essential to creating smart cities, such as artificial intelligence and the Internet of Things.	It covers how smart city technologies, including intelligent transportation systems, improve energy efficiency, infrastructure management, and mobility to improve urban living.	According to the report, by guaranteeing that all city dwellers use technical breakthroughs, particularly in the areas of mobility and accessibility, smart cities seek to promote social equity.	By optimizing energy consumption and minimizing environmental impacts, smart city technologies including smart transportation systems help to promote sustainability.
Mahrez et al.	2021	Review article	The authors discovered that Smart urban mobility systems are enhancing efficiency in urban transportation in the United States.	The relationship between smart data and mobility systems is examined in this paper, focusing on how big data analytics and artificial intelligence are changing urban transportation.	It talks about how smart data integration into transit systems may increase urban mobility's effectiveness by easing traffic and improving traffic flow.	The writers discuss how intelligent urban mobility may build more inclusive systems that give every person equitable access to modes of transportation.	The study examines how data-driven traffic management and smart mobility solutions might lower carbon emissions and encourage environmentally friendly driving habits.

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Nadikattu	2019	Conceptual paper	The authors explored new directions in AI	The article examines recent developments in artificial intelligence, such as its use in creating driverless cars and intelligent transportation systems.	It emphasizes how artificial intelligence (AI) may help create better, more effective urban transportation systems that improve traffic flow and lessen congestion.	The article briefly discusses how those with impairments or those without access to personal automobiles might move more easily, thanks to AI-powered transportation solutions.	It looks at how AI might optimize routes and cut emissions to lessen the negative effects of transportation on the environment.
Oladimeji et al.	2023	Overview	The authors discovered that smart transport technologies were crucial in improving urban transportation.	An overview of smart transportation technologies, such as artificial intelligence (AI), machine learning, and the Internet of Things (IoT), and how they are used in driverless cars is given in this article.	It talks about how these technologies might improve urban mobility by increasing the effectiveness and responsiveness of transportation systems to current	The authors stress how intelligent mobility systems may give people, especially those in underprivileged places, more equitable access to transportation.	The paper emphasizes how intelligent transportation may lower traffic emissions and encourage more environmentally friendly urban settings.
Ran et al.	2019	Survey	The authors	Predictive	It talks about	While social	According to

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Samaei	2023	Algorithmic study	The author discovered that AI-driven transportation improvements have significantly revolutionized urban transportation.	An AI-driven algorithm is presented in this article to optimize urban transportation networks to increase productivity and lessen traffic.	The study investigates how artificial intelligence (AI) might be used in urban transportation systems to improve traffic control and expedite public transit lines.	Although the study primarily discusses efficiency, it also subtly discusses how all residents, especially those with restricted access to private automobiles, may profit from efficient transportation networks.	By maximizing traffic flow and reducing fuel use, the algorithm lowers emissions and promotes greener metropolitan areas.

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Salazar-Cabrera et al.	2020	Review article	The authors discovered that sustainable vehicle tracking has significantly improved urban transport in the United States.	The paper examines transit vehicle tracking systems that improve transportation operations using new communication technologies and intelligent transportation systems (ITS).	It talks about how these technologies help manage urban transit fleets, guaranteeing better-coordinated and efficient transportation services.	The study emphasizes how ITS may enhance public transportation services, making them more dependable and available to a wider spectrum of individuals, particularly those in underprivileged areas.	The paper highlights how ITS may lower energy consumption and environmental effects by streamlining vehicle routes and guaranteeing more sustainable transit operations.

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Toh et al.	2020	Overview	The authors discovered that smart roads for smart cities are the new approach to improving urban transportation in the United States.	The article discusses how smart roads will help create future smart cities by integrating intelligent transportation systems and driverless cars.	It focuses on how smart roads may improve overall city infrastructure and facilitate better traffic flow, improving urban mobility.	The authors examine how smart roads may provide equitable access to urban transportation by enhancing safety and accessibility for everyone, including bicycles and pedestrians.	According to research, by encouraging effective traffic management and lowering emissions through improved vehicle coordination, smart roads help promote environmental sustainability.
Wallace & Welch	2021 2021	Theoretical Case Study	The authors The author discovered connected vehicle data for autonomous mobility can revolutionize urban transport in the United States.	The main The study investigates applying deep learning technologies, decision-making algorithms, and real-world connected car data to enhance autonomous vehicle control	It talks about It emphasizes how smart mobility projects may be supported by these technologies, which will help to enhance urban transportation networks and traffic management.	According to The study discusses how AI-powered and data-connected autonomous cars may make transportation more accessible, especially for marginalized communities.	According to Fuel consumption and emissions may be decreased by optimizing vehicle routes and driving habits using linked data and artificial intelligence.

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Woodward & Kliestik	2021	Case Study	The authors explored the significance of autonomous vehicle perception systems on urban transportation in the United States.	This study looks at intelligent transportation apps and sensor data from autonomous vehicles to develop more effective and sustainable urban mobility systems.	Smarter city transport networks that are more sensitive to current conditions are made possible by integrating autonomous cars into urban infrastructure .	The study highlights how autonomous cars may improve accessibility for those with mobility impairments, hence promoting more inclusive transportation networks.	It discusses how self-driving cars with built-in decision-making algorithms may improve driving habits, save energy, and support sustainable urban transportation.
Won	2020	Literature Review	The author discovered that Intelligent traffic monitoring is an approach that can improve urban transportation in the United States.	This article's review mainly emphasizes the potential of intelligent traffic monitoring systems to categorize cars and improve traffic flow in real-time.	By effectively controlling traffic and easing congestion, these technologies may enhance urban transportation infrastructure .	Although accessibility is not specifically discussed in the article, better traffic control may help create more egalitarian urban transportation.	According to research, by decreasing emissions, improving traffic flow, and lowering congestion, intelligent traffic monitoring can help promote environmental sustainability.

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Yuan et al.	2022	Survey	The authors discovered that machine learning can improve urban transportation in the United States.	With an emphasis on enhancing decision-making in autonomous cars and traffic management systems, the paper thoroughly analyzes how machine learning technologies influence the development of intelligent transportation systems (ITS).	It investigates how machine learning might enhance urban transportation systems, increasing their effectiveness and easing traffic in metropolitan areas.	The authors talk about how machine learning may improve accessibility for marginalized groups by making transportation systems more adaptable to various demands.	According to the report, machine learning can lower emissions and energy consumption by improving traffic flow and vehicle performance.

DISTRIBUTION BY YEAR

These analyzed articles were published from 2017 to 2023, and there is a noted influx of publications from 2019 onwards. For example, early studies, including Lea (2017) and Khayyam et al. (2020), centered their research subjects on the definitions of AI and IoT for AVs. On the contrary, many current works, including Islam (2023), Karnati & Mehta (2022), and Mahrez et al. (2021), demonstrate the possibilities of deep learning, 5G, and predictive analytics for improving the effectiveness and security of AVs and smart mobility solutions. The increase in publications from 2019 may be because of the developments in the execution of autonomous driving and the importance of efficient, environmentally friendly urban transportation systems.

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ANALYSIS BY KEY FINDINGS

A common trend that has been observed across various studies is the use of AI combined with IoT in self-driven cars as well as in smart transportation systems. In their articles, Islam and Khayyam et al. have looked into the future countries focusing on the importance of AI in enhancing decision-making about AVs with references to self-driving cars as the future of safe and optimized roads. Yuan et al. (2022) also highlight the use of machine learning for ITS, emphasizing traffic data processing in real-time for increased efficiency in urban traffic systems. Another common theme is the consideration of smart cities and smart roads as means of practicing sustainable mobility. Toh et al. (2020) and Woodward & Kliestik (2021) explored the concept of smart infrastructure and using the predictive control algorithm for developing intelligent road systems that help provide efficient AVs-traffic management integration. The need for sustainability is also captured, as such papers as Salazar-Cabrera et al. (2020) explain how ITS may allow for adopting environmentally-friendly transportation by cutting emissions and increasing tracking of transit vehicles.

DATA COLLECTION METHODS

The studies employ mainly simulation models, case studies, and real-life data to address the research questions and hypotheses. For example, Mahrez et al. (2021) used simulation models to estimate the effectiveness of Intelligent Transportation Systems, while Zhao et al. (2018) provided real-world tests of AV sensors and control procedures. One more common approach is the application of machine learning and data analysis, and that is how Ran et al. (2019) and Samaei (2023) device AI forecasts and predictive maintenance data to enhance the functioning of AVs and related transportation facilities.

KEY VARIABLES INVESTIGATED

The studies primarily examine technological integration, environmental impact, and transportation efficiency variables. Key variables include the performance of AI-driven decision-making algorithms (Islam, 2023), the impact of smart roads and connectivity on AV performance (Toh et al., 2020), and the use of predictive analytics for traffic flow management (Ran et al., 2019). Environmental considerations are also central, with several studies (e.g., Salazar-Cabrera et al., 2020) discussing how AI and IoT technologies can reduce emissions and enhance the sustainability of urban

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transportation systems. Another important variable is the social equity of AV deployment, with studies like Samaei (2023) emphasizing the need for inclusive policies that address the transportation needs of marginalized communities.

DISCUSSION

A review of the most recent publications on AVs and smart transportation systems shows that advanced technologies such as AI, machine learning, and IoT are increasingly introduced to enhance urban mobility. One is the increasing awareness of the need for safer, more efficient, and environmentally friendly modes of transport. Some of the areas in which AI is considered crucial for underpinning and augmenting decision-making of AVs and improving traffic management are thought to increase road safety and decrease traffic density notch up by researchers (Khayyam et al., 2020; Welch, 2021). The studies present more specific ideas like smart roads and control algorithms for predicting and maintaining/ changing car interactions with the cityscape and traffic patterns in real-time, with the goal of optimization (Toh et al., 2020; Woodward & Kliestik, 2021).

Moreover, the studies present a global outlook as research from developed and developing nations to Av technological advancements (Yuan et al., 2022). On the positive impact on the environment, emphasis is put on pragmatic aspects focusing on AI-driven transportation systems and their availability regarding different population groups (Oladimeji et al., 2023; Samaei, 2023). In addition, it learns about the potential of big data accumulation and simulation models for testing such systems and points at the continuously rising (Ran et al., 2019) reliance on data analytics to enhance transport facilities. In conclusion, these works suggest that intelligent transport systems integrated with artificial intelligence will be the major factors that define the transport systems in cities in the future.

CONCLUSION

To conclude, using artificial intelligence, machine learning, and IoT in AV and smart transportation systems is seen to transform urban mobility. The study reveals that AI and its applications offer a great opportunity for effective decision-making, better traffic management, and more effective and safer transportation systems (Khayyam et al., 2020; Welch, 2021). Moreover, the introduction of smart features such as predictive algorithms and smart vehicles, which are connected, contribute

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significantly towards reducing congestion and encouraging the sustainability of urban roads (Toh et al., 2020; Woodward & Kliestik, 2021). It also emphasizes the ideas of fairness and availability for various groups of people regarding the environmental and operational advantages discussed in the research of Oladimeji et al. (2023) and Samaei (2023). In conclusion, using AI in transportation technologies provides prospects for better urban mobility, reducing traffic congestion, and increasing transportation safety for smarter and more sustainable cities.

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