



Artificial Intelligence (AI) and Internet of Things (IoT) Applications in Smart Cities: Literature Review

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ABSTRACT

Smart cities employ advanced technology like artificial intelligence (AI) and the Internet of Things (IoT) to resolve urban challenges and improve the quality of life. However, the literature lacks one comprehensive synthesis of AI and IoT's joint contribution to building smart city literature and beyond. The study wanted to take a systematic review to find the role and combined roles of AI and IoT. Researchers conducted research by following PRIMA guidelines, mostly on applications of AI and IoT in building smarter cities by taking many research papers as their sources. A total of 30 relevant peer-reviewed studies were identified from an initial pool of about 16,600 records generated primarily from four biggest databases: Science Direct, Scopus, Web of Science, IEEE Explore, and ProQuest, including related articles of the identified papers AI and IoT together play a vital role in six significant domains. AI, especially the Internet of Things (IoT), helps provide a broader data set in real-time. Whenever the AI techniques are set, it collects data and finds results in it to optimize and automate the city operations to improve the city's sustainability and public services. The most common domains of the application of IoT are: Data-driven urban service efficiency Energy efficiency and environmental sustainability Efficacy in smart transportation and traffic management to provide smart surveillance and avoid future cybersecurity threats. Urban planning also requires decision support.

1. INTRODUCTION

The urban population has proliferated, expanding from 751 million in 1950 to 4.2 billion in 2018, as per Nadir et al. (2019). According to UN estimates, there will be a 68% urban population worldwide by 2050. Urban areas are also designated as empaths of 70% of natural sources that end up contaminating, disturbing any ecological balance, and creating energy shortages. Cities are established for more job availability and lower costs at the expense of ruining the environment. The urban landscape would be more sustainable, too. There is an identification of a critical requirement to develop and employ novel and smart solutions to tackle these problems effectively (Nguyen et al., 2024). The concept of smart cities is intricate, and numerous academics and researchers have given different definitions. An obligatory between all these debates is attaining sustainable development in social, environmental, and economical aspects. In the urban way of life, they propose that to raise the standards of living of society and to create value for every individual, humanity must adapt to and use AI (artificial intelligence) and ICT (information and communication technologies). A city can be named a smart city if it is a city that uses these technologies in the decision-making process to develop efficiency and effectiveness in their resources even better than before and to generate value. There

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are numerous definitions and characterizations given by various researchers and academics (Vasco and Ferrero, 2015). The cities' technology component in terms of the decision-making process in a smart city can be defined as a technologically interconnected city or the integration of big data and artificial intelligence for intelligent and efficient resource management. It can also be defined as an online network consisting of millions of interconnected computers working as part of a big interconnected system, providing massive and quick access to facts and knowledge (Albino et al., 2015). There is a vast interest from academics, researchers, and entrepreneurs for the IoT due to its high capacity for providing various innovative features and services in various models of smart cities. Some such types employed by the smart city applications are smart homes, smart transportation, smart cars, smart hospitals, smart businesses, smart agriculture, and smart surveillance for these applications. It mainly includes smart sensors, smart devices, smart actuators, smart machines, and smart any moving objects whose posts can regularly sense changes in stimuli or changes in any condition surrounding them. It offers real-time communication. And it always includes taking input from the owner and behaves according to, for example, automated weather monitoring or temperature adjustment (Ahmed et al., 2021). One of the most recent technical directions that offers fresh insights and helps the implementations of these smart cities is artificial intelligence. Even in the case of artificial intelligence, digital technologies are required. The Internet of Things (IoT) is a system that creates a large network, wherein there is systematic and automated administration, regulation, and monitoring of the sensing, processing, and communication without or minimal human intervention (Ahmed et al., 2020). The heterogeneous sensors, devices, and systems are interconnected seamlessly without a need for any intervention by human beings (Ahmed et al., 2022). Along with artificial intelligence, the digital technologies in which cloud computing, cyber-physical systems, wireless networks (4G/5G), etc. are termed to be the essential aspects of the Internet of Things applications. As a result, the concept of the Internet of Things helps in bringing all the components of the smart city into the frame and easily regulates them. The most significant aspect of connecting the physical and digital worlds in smart cities is with the help of the Internet of Things (IoT). One such technology that has allowed to raise the number of applications of the Internet, communication, and artificial intelligence as well is the availability of big data. ICT is the term used for discussing information and communication technologies. There is no doubt that the role of ICT in the development of a smart city is at every level of the strategic approach, and not just in policy formulation, decision-making, implementation, and delivering of the services (Sajid et al., 2021). Energy management, temperature control, education, health and human services, water management, air quality management, traffic management, payments and finance, smart parking, and trash management are some areas where the city management requires hiring artificial intelligence (AI) (Ayaz et al., 2021). With the help of artificial intelligence and smart technologies, the city can be more effective and speedy. An intelligent, AI-powered city will help the city to save energy and resources, save the environment, enhance the quality of life of its residents, and make them adopt modern ICT faster. Following are some limitations and problems that make the process of smart cities more difficult (Saved et al., 2023). The lack of technology availability and reliability and the lack of data; dependency on other parties; lack of skill set; the ethical problems resulting from the use of artificial intelligence; and the challenges of regulations in the attempt to connect infrastructures and data are highly difficult (Saved et al., 2023). In the case of these limitations, for the application years now, complex computational solutions are heavily used. Data mining software is tools that allow data mining engineers to frame rules and test the data to increase the chances of gaining the potential result. Artificial intelligence is the ability of a computer program to think and teach itself by developing an evolutionary pattern. When the decision-making processes of these systems are hard to interpret, dependence on them is difficult. Therefore, it's assumed that these tools may not be reliable. Several attempts have been made in the last couple of years to use AI techniques to help enhance levels of transparency while resolving this problem. The information and communication technology (ICT) and Internet of Things (IoT)-enabled smarter city are the better-operating tools together with the task worthy resources. AI has led to the development of creative ideas to help improve resource management, which, like the rest of the world, enhances the managerial skills of the citizens and working procedures (Saved et al., 2021). The smart cities, along with several other urban centers with their Internet of Things (IoT), applications of artificial beings, and methods. Currently, several industrial tools allow the professionals from the urbanites to use AI and help buildings perform better. Smart cities are considered highly profitable for governance, operational effectiveness, and ability to maintain various services and sustainability potential to ensure the individuals' edge (Bourke and Keeper, 2022). Information and communication technologies (ICTs) and the IoT put together are the notion of significantly advanced cities. Of the available options, there are some possible solutions to the above problems in cities: AI and machine learning (ML) combined with deep reinforcement learning (DRL) to form an all-around countdown feature when and how to use it together with the owner's ever-present advantages (Abuja and Raghav, 2022). Any artificial intelligence (AI) technical tools and their benefits to the demand-driven methods of a poorly and with incalculable motivation for the urban city had no thinkers || the AI with the private sector. The flow mannerism was so click logo as AI with the level was general the last making techniques (Yigitcanlar et al., 2020). Ever cities using AI with ML and DRL systems become the owners of those vast amounts of data on the in Internet of Things (IoT) that can help make informed decisions and monitor civic management (Qurbanova et al., 2023). Intelligent transportation systems are one of the main industries where vehicle automation technology and AI technology are used along with economics and finance technologies. It is also noticed that AI technology also helps automobiles move by themselves using the AI sensors levels of emotional intelligence, changing the

order of use vehicles and robotics in the sectors of police with AI technologies and matching themes in crime detection applications. Benefits of AI are used in the series as reforming natural language processing, natural language data, automatic communication, automated theorems, proving, and autonomous transportation rather than the use of an intelligent agent. Police technology is the use of technology to create safe and smart cities in the regions where cities do not have appropriate systems. If police technology is implemented efficiently using AI technology, cities can become safe and smart cities using AI as well as modern technology and devices to solve social issues. One of the main contributions of AI technology to modern public transit methods is to help police technology, and if AI technology is suitable, police technology can work with police to help reform the alternative sources to combine information in a system that follows the ethics, including three fundamental ethical issues in the use of AI technology to create safe cities: data usage, bias events and the impact on people's rights and autonomy, privacy entropy. The answer to the question of how to technology their civil protection.

TABLE 1. Summary of Recent Studies on Artificial Intelligence and IoT Applications in Smart Cities

Study	Application Area	Methodology	Research Objective	Results	Recommendations
Farzaneh et al., 2021	Artificial Intelligence in Smart Buildings for Energy Efficiency	Review of recent studies with an evaluation framework	The paper aims to review recent studies on the application of artificial intelligence (AI) technologies in smart buildings through building management systems (BMS) and demand response programs (DRPs).	The use of AI technologies in smart buildings can reduce energy consumption through better control, improved reliability, and automation.	The paper discusses open challenges and future directions for research on the application of AI in smart buildings.
Yigitcanlar et al., 2021	Green Artificial Intelligence for Smart Cities	Literature review and theoretical analysis	The aim is to highlight the fundamental shortfalls in mainstream AI system conceptualization and practice and advocate for the adoption of green AI to support smart city transformation.	The paper emphasizes the need for green AI to move away from technocentric efficiency solutions toward sustainable and equitable ones.	The adoption and deployment of AI systems that address efficiency, sustainability, and equity issues in cities are essential for smart city transformation.
Alahi et al., 2023	IoT and AI Integration for Smart Cities	Literature review and analysis	To provide an overview of IoT and AI integration in smart cities and discuss how these technologies can enhance sustainability, productivity, and comfort for urban dwellers.	The integration of IoT and AI has significant potential to improve smart city infrastructures, leading to enhanced quality of life, sustainability, and productivity.	Future research should explore the synergistic impact of 5G networks and AI in smart city development.
Li et al., 2024	AI's Impact on Urban Energy Efficiency	Empirical study using panel data and super-efficiency SBM model	To study the impact of AI on urban energy efficiency in China and analyze its relationship with energy structure	AI development significantly increases urban energy efficiency and optimizes the	Governments should increase funding for AI research and foster international collaborations to

				optimization and green technology innovation.	energy structure, particularly in regions with higher human capital and government support.	enhance urban energy efficiency.
Zamponi and Barbierato, 2022	AI in Smart Cities	Literature analysis		To explore the role of AI and information in supporting decision-making and energy management in smart cities.	AI and information are foundational pillars for smart cities, driving innovation in energy consumption forecasting and smart grid optimization.	AI should be integrated into smart grids, electric vehicles, and smart buildings to enhance innovation and efficiency.
Anthopoulos and Kazantzi, 2022	AI and Big Data in Urban Energy Efficiency	Literature analysis and taxonomy development		To analyze how AI and big data contribute to urban energy efficiency and propose a unified assessment model.	AI and big data technologies are reshaping energy efficiency assessments in cities, but require standardization and new models for policy-making.	Policymakers should focus on developing unified models for assessing the energy efficiency of AI and big data technologies in urban contexts.
Garlik, 2022	Energy Performance in Smart Cities	Literature review and analysis		To examine the role of AI and IoT in optimizing energy performance in buildings and smart city systems.	The integration of AI and IoT in building management systems can significantly reduce energy consumption and CO2 emissions.	Policymakers should focus on the implementation of AI and IoT technologies in smart cities to achieve sustainability goals, including near-zero energy buildings.
Li et al. 2024	Smart Metering and AI in Smart Cities	Case study using AI and IoT-based smart metering systems		To explore the potential of IoT and AI in enhancing energy efficiency and forecasting energy consumption through smart meters.	The IoT-AI-assisted Smart Metering System (IoT-AI-SMS) can predict energy consumption, optimize load scheduling, and improve grid efficiency.	Further research is needed to integrate this technology with smart grids to enhance energy efficiency and accommodate renewable energy sources.
Wang et al, 2021	Adoption Challenges of AI	DEMATEL-based analysis		To explore the challenges hindering the adoption of AI and	Lack of infrastructure, insufficient	Policymakers should prioritize overcoming infrastructure and trust

	and IoT in Smart Cities	of expert opinions		IoT technologies in smart cities, focusing on developing countries.	funds, cybersecurity risks, and trust issues are major barriers to adopting AI and IoT in smart cities.	challenges while addressing cybersecurity risks to facilitate the adoption of AI and IoT.
Nguyen et al 2024	IoT and AI Integration in Smart Cities	Literature review and survey	and	To examine the role of IoT and AI in creating sustainable, comfortable, and efficient smart cities.	AI-driven IoT technologies play a vital role in improving urban management across sectors like transportation, healthcare, and agriculture.	Future research should focus on addressing the unsolved challenges in AI-IoT integration, especially in real-time decision-making for urban systems.
Ahmed et al., 2024	Waste Management in Smart Cities	Review and system architecture proposal	and	To design an AI and IoT-based system for efficient waste management.	The proposed system reduces waste collection frequency, optimizes truck routes, and cuts operational costs.	Municipalities should adopt this scalable system to improve waste management efficiency and sustainability.
Jagatheesaperumal et al., 2024	Transportation Safety in Smart Cities	Framework proposal for AIoT integration	for	To enhance road safety in smart cities using AIoT technologies.	The system integrates multiple sensors (eye blink, ultrasonic, alcohol) and optimizes vehicle communication using Li-Fi for better road safety.	Implement AIoT frameworks in smart city transportation to ensure safer roads and reduce traffic-related accidents.
Sharma et al., 2021	Big Data and Security in Smart Cities	Proposal of AI and blockchain integration		To address security, privacy, and data analysis issues in smart cities by integrating AI with blockchain.	AI and blockchain integration improved security and data handling efficiency in IoT applications.	Policymakers should focus on AI and blockchain integration to solve privacy and security issues in smart cities.
Kuguoglu et al., 2021	Scaling AIoT in Smart Cities	Literature study and expert interviews		To identify barriers preventing the scaling up of AIoT initiatives in smart cities.	Strategic factors, data governance, and organizational challenges hinder the scaling of AIoT projects.	Cities should develop comprehensive strategies that address organizational readiness, data management, and proof-of-value to scale

						AIoT initiatives successfully.
Ahmed et al., 2022	Smart City Sustainability	Conceptual framework proposal		To examine the convergence of AI and blockchain for sustainable IoT applications in smart cities.	Proposed a smart framework integrating AI, blockchain, and cloud computing to improve IoT applications.	Future research should address the open issues in AI-blockchain convergence for scalable, secure smart city solutions.
Ahmed et al., 2021	Security in Smart Cities	Literature review and analysis		To address security and privacy concerns in smart city applications using AI and machine learning.	AI and machine learning can optimize smart city security, particularly for smart health, transport, and energy.	Smart cities should incorporate AI and machine learning to improve security measures and safeguard privacy.
Bokhari and Myeong, 2022	Smart Decision-Making	Survey-based analysis		To explore the role of social innovation in AI-driven decision-making in smart cities.	Found a significant mediating effect of social innovation in the relationship between AI and decision-making.	Local governments should integrate social innovation into decision-making processes to enhance smart city governance.
Ilyas, 2021	IoT in Smart Cities	Literature review		To explore how IoT and AI enable smart city development across various sectors.	IoT and AI are integral for enhancing smart city functions such as infrastructure, transportation, and healthcare.	Cities should invest in IoT and AI technologies to address future challenges in urbanization and energy use.
Annadurai et al., 2022	Security in Smart Cities	Proposed biometric-based intrusion detection system		To propose a secure method for intrusion detection in smart cities using AI and IoT.	The proposed biometric authentication system improved intrusion detection performance in smart cities.	Implement biometric authentication and AI-powered intrusion detection systems in smart city infrastructure.
Ullah et al., 2023	Data-centric smart cities	Literature review and case study analysis		To explore the role of IoT and machine learning in building data-driven smart cities.	Found that IoT and ML can transform cities into more livable and efficient spaces, though challenges in data privacy and security remain.	Emphasize addressing privacy, security, and ethical concerns to fully unlock the potential of smart cities.

Rejeb et al., 2022	IoT in smart cities	Bibliometric analysis	To map global research on IoT in smart cities and identify gaps in knowledge.	Identified key technologies (e.g., AI, blockchain) used in IoT for smart city applications, with notable growth in research.	Focus on addressing research gaps, particularly in integrating IoT with other emerging technologies like AI and blockchain.
Singh et al., 2022	AI and blockchain in smart cities	Literature review	To explore the integration of AI and blockchain for enhancing smart city infrastructures.	Found that AI and blockchain can help build secure, efficient smart city ecosystems but face security challenges.	Further research should explore security solutions and the regulatory framework for AI-blockchain applications in smart cities.
Batool et al., 2021	Smart city ecosystems	AI modeling with ANN	To develop an intelligent ecosystem model for smart cities using IoT and machine learning.	Proposed a model using ANN that achieved 91.55% accuracy in improving smart city ecosystems.	Implement ANN-based approaches for smart city ecosystem management, particularly in urban infrastructure.
Chavhan et al., 2022.	AI and IoT in transportation	Edge computing and multi-agent system approach	To propose an energy-efficient AI-IoT transportation system for smart cities.	Demonstrated that edge-based AI-IoT systems can reduce energy consumption and greenhouse gas emissions in urban transportation.	Integrate edge computing and AI-IoT systems to optimize transportation efficiency and reduce emissions in smart cities.
Chander et al., 2022	Industry 5.0	Literature review	To explore the role of AI-based IoT in Industry 5.0 and its integration with edge computing.	AI and IoT technologies are central to Industry 5.0, enhancing manufacturing automation and critical thinking in operations.	Focus on improving AI-based models for edge computing and addressing security concerns in IoT networks.
Alshamrani, 2021	Healthcare	Survey analysis and	To survey the integration of IoT and AI in remote healthcare monitoring (RHM) systems for smart cities.	IoT and AI can significantly enhance healthcare efficiency, offering personalized care strategies and	Explore the potential of AI and ML in clinical decision-making, and address limitations in current healthcare IoT applications.

Kamruzzaman, 2022	Energy-efficient communication	Systematic review	To identify key technologies and trends in IoT for energy-efficient 6G wireless communication in smart cities.	monitoring vital health metrics.	Quantum communication, blockchain, and 6G technologies are crucial for energy-efficient smart city communication systems.	Future research should focus on optimizing 6G IoT applications for smart cities, especially in transport and energy systems.
Jagatheesaperumal et al., 2022	Explainable AI in IoT	Literature review	To explore explainable AI (XAI) frameworks for IoT applications and identify their role in enhancing trust and security.	XAI improves trust in IoT applications, especially in security, medical IoT, and industrial IoT systems.		Develop and implement XAI models for diverse IoT applications, focusing on enhancing user trust and system transparency.
Bi et al., 2022	Smart Libraries	Literature review	To review AI and IoT technologies in smart libraries, focusing on services, sustainability, and security.	AI and IoT are revolutionizing libraries by enhancing services, sustainability, and security through automation and smart technologies.		Future smart libraries should continue to integrate AI and IoT for improved public services, sustainability efforts, and security measures.
Musa et al., 2023	Smart Cities, Traffic Management	Literature review and framework development	To establish a sustainable framework for smart city traffic management using IoT and Intelligent Transportation Systems (ITS).	A hybrid approach using real-time data from AI sensors and ITS devices for traffic management shows promising results in reducing congestion and environmental impact.		Implement AI and IoT solutions for traffic management to reduce congestion, improve decision-making, and promote low-carbon transportation alternatives.

2. MATERIALS AND METHODS

To evaluate how artificial intelligence technology and the internet of things are integrated, the process was followed by redesigning the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines which were conducted systematically. The review was properly established as the research strategy, implementation and exclusion criteria and multi-level screening of literature similar to the PRISMA guidelines (Moher et al. 2015).

2.1 Search Strategy:

A thorough study was performed by using Google Scholar as it encompasses the results of several databases to discover all published work on the internet of things and artificial intelligence and how it is integrated into a smart city. Ultimately, the literature search covered peersurvey's from newspapers by July 31,2030. The quest would have the phrase and keyword versions of 'smart city', 'artificial intelligence', 'AI', 'Internet of things' or 'IoT', 'urban sustainability', 'technology integration' which included a broad variety of work as it searching. The search yielded exceptionally broad outcomes initially (listed examples includes around 16600 records- articles of various subjects relevant to urban technology and management), which required to limit search as it has a very broad scope. The survey is also only in English and rivalled only scholarly articles so that information was filtered at the beginning and distributed for school standard expectations including student theses, patents, etc., were eliminated.

2.2 Eligibility Criteria:

To decide on inclusion or exclusion, the following rules were employed for publication along with the filter sets up to make the quest as pertinent as possible. The inclusion requirements and exclusion criteria are:

2.2.1 Inclusion criteria:

Studies should explicitly focus on the implementation or impact of ai and the internet for things combined on city infrastruc ture, facilities, or sustainability in a smart city context.

2.2.2 Publication:

The paper must be published after peer-reviewed in the newspaper years starting from 2021-2024.

2.2.3 Publications that resulted in full-text English versions from where a sufficient particle can be derived from each source, to make this list.

Exclusion Criteria:

Ah authentic article talking about any other things like news articles, (not the health-related ones), magazines article or column papers, critique paper or column and or any abstract that provided no full papers, Review, or meta-analysis not used before . Articles published in a language rather than English, or did not provide any full English versions of the published thing. Did not explicitly talk about AI and IoT included is missing in the smart city aspect. That is the studies that talk about general technology trends, but did not discuss AI and IoT, or which talk about AI or IoT and nothing else. That is the studies that do not have a clear connection with the studies conducted. Example: an article that relies on energetic industries, general but not with smart cities.

Perished to become new to the shop. Built to rebuild, and the work was to hundreds of diseases, one person. This very informa tion did not have any retired person. By using this technique, we can save the trees we and in making books. This system has its advantages when it comes to helping a retired person.

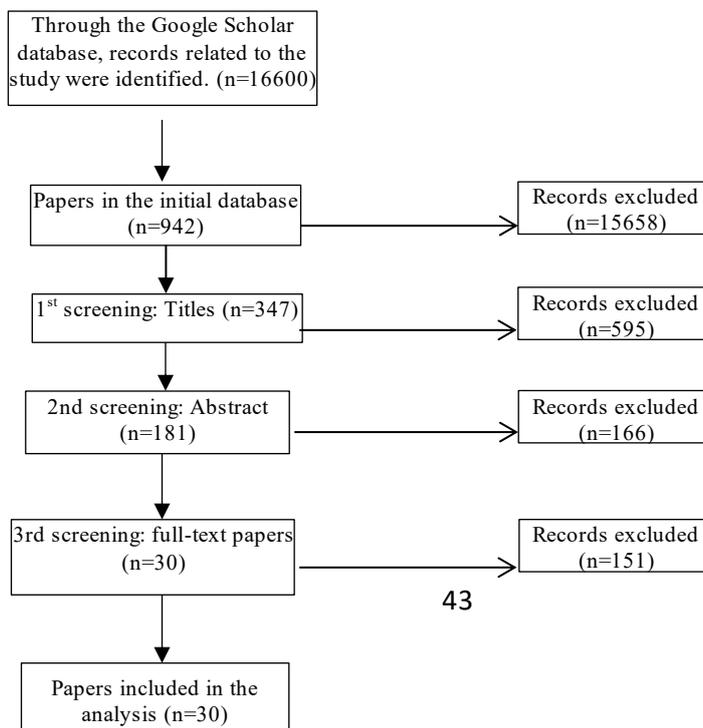


Figure 1. Overview of the screening process.

3. FINDINGS

The discussions about 30 selected literature on smart cities reveal that the integration of Artificial Intelligence and the Internet of Things is promoting the different aspects of smart cities. The findings of the studies have been categorized into six domains of application which represent the essential aspects of a smart city. Here we provide a summary of how the technologies of AI and IoT are used to make urban-systems effective in each domain. The following are the examples retrieved from literature:

3.1 Data-Driven Urban Service Efficiency:

One major way in which AI and IoT support smart cities are through the application of data-driven decision-making mechanisms. IoT networks embedded into a city's infrastructure collect data on a massive scale. AI algorithms then 'stream' through these data streams to optimize public and resource management services in real-time. Several articles emphasize that AI-IoT integration is essential for optimizing city operations and managing the 'big data' common in urban contexts (e.g., Wang et al. 2021; Nguyen et al. 2024; Ahmed et al. 2024). A practical application of the same is where the smart city includes IoT sensors that monitor traffic flow, energy consumption, air quality, smart waste collection bins, public transport usage and other service metrics. An AI system processes and analyzes this sensor data to figure out usage patterns, predict future use, and recommend decisions which optimize the delivery of services (e.g., Kamruzzaman, 2022)

One example includes the smart energy management where the electrical grids and the modern building management systems of smart cities use IoT sensors to figure out if energy is being wasted in any specific part of a city or a particular time of the day (e.g., lights or air conditioning running in an unoccupied room). AI-based analytics can be used to predict energy usage trends, and the AI system can automatically adjust controls or suggest strategies to reduce consumption during peak times (e.g., Chan der et al. 2022).

Another example is the smart waste management service where the AI system of smart cities can detect the level of the public dustbin and inform the waste collection services of that block whether it is time to empty the dustbin or not. AI can also suggest new locations for high-demand waste collection bins and its timings; the public are requested to follow it to reduce waste (more specifically recyclables).

In their work, (2022) developed a study on improving the waste management system where they installed IoT+AI (Internet of Things plus Artificial Intelligence) sensors on the bins. They defined some sensors that created the work protocols for filling of the bins and garbage collection trucks. Those sensors implemented the troubling bins and schedule the garbage trucks. The sensors in the bins generated an alert when it became full and the garbage truck reached that bin to collect the garbage and it. This process of picking the garbage and the way to throw the bin could automatically get to the nearest short route to save fuel.

The detection of the houses nearly filled use the determination of trucks and the and these IoT+AI (2022) that are employed to build a city smart, and the types of waste management through the AI-driven route optimization that can save a significant amount of fuel and improve the efficiency of these services. These have been demonstrated in serving in many "(Ahmed et al.)", efficient libraries and smart healthcare services.

3.2 Environmental sustainability and energy efficiency:

The evaluation of the fuel that can be saved from the installation of such systems "(Alshamrani, 2021)" could be shown in some case studies. Remote healthcare monitoring systems have been installed in such smart cities. Have you ever got wondered confidence is related to idioms that are created over the years. Wearable types of medical (wearable IoT medical monitoring) which can give the heart rate (Athar Amir Khan), blood pressure, glucose levels that can be wearable.

These devices indicate the human body and send those data to an AI-driven health analyses. They received by the sensors and sent to the nearest hospital when something disturbing that the hospitals do the needful to help the patients before they suffered from the sickness. The readers these implants can know about how the wearable (wearable IoT medical monitoring) and

(Healthcare Alert). The AI algorithm can calculate the person's health and indicate the person about his health. The changes that appeared to the patient's data could detect by the AI algorithm.

One of them is energy efficiency and saving, and sustainability. Smart cities need better resource consumption optimization, AI & IoT along with sensors & data analytics are the precise tool that can be used for the same. This application is being achieved as smart bulbs, water pumps, refrigerators, washing machines, air conditioners AI & IoT being married to internet are taking place. It is shown that up to 20% of power consumption can be curtailed by using AI & IoT in these appliances latest market analysis (Roben 2022, Weko et al., 2021).

3.3 Smart Transportation and Traffic Management

Another one of the urban applications of energy as resource conservation is composts & solid pesticides. AI-IoT can help by setting up an intelligent-composter public utility systems. It can reduce the volume of biodegradable waste by maximum amounts along with producing revenue from the sale of bio-fertilizers composed. That would both reduce lands occupied by landfills along with reducing resources like electricity, water, land use ventilation, which we are now consuming on landfills.

There are many other significant social problems like mental health, which can be minimized by bringing up considerable changes in the city's social infrastructure, but without their smart city change among cities to a large possible.

AI & IoT technologies are said to have the potential to innovate cities so much that they flush out all their historical problems and introduce themselves in a new era of social and mental happiness, rather than intelligent hospitals & police stations, recycling systems, etc. That would lead to reduce the rate of depression birth rates for ADHD would get dropped, leading to good growth in the nation.

As per Shacks-Baez (2021), energy efficiency can be derived from the integration of Artificial Intelligence (AI) and Power Line Communication (PLC). Hence, smart cities AI blockchains can possibly create a breakthrough outcome in the future. On the other hand, to protect urban infrastructure, Li et al., 2024, and many other scholars recommend journals that AI can be integrated into nature to reduce environmental degradation and to sustain the earth. To predict energy consumption accurately, AI-based predictive code can be written. The reader must be programmed to understand and make data-driven decisions. Anthopoulos and Kazantzi (2022) ponder on what role politicians play in application of AI to enhance energy efficiency in the cities.

Moreover, smart transportation in smart cities should come with the lowest carbon footprint and a merger of PLT and AI can introduce smart transportation for the third world, and traffic blocks can be effectively managed. Musa et al., 2023, proposed that traffic into Urban areas should be managed using a sustainable traffic control plan in combination with AI and IoT to make it a smarter city. Traffic can be skewed when the travel time is least in the city. Since smart meters installed report directly to the city for alert to avoid blackout situation, Falk et al. (2022). Rise of in energy consumption due to traffic increases and to prevent that one can predict traffic events and work accordingly and incase to save time and fuel, providing the best route by smart sensors and surveillance cameras, Musa et al. (2023). The nature of traffic and the nature of travel changes with the addition of AI algorithms, which will increasingly be developing at falloff of twigs and leaves every autumn (Musa et al. 2023). Furthermore, the researchers will predict events of traffic jams or any other events (congestion), were to change or correct (proactive). Chavhan et al. (2022) how Edge Computing enhances the energy efficiency of smart cities and improved smart transportation.

Moreover, AI is smart enough to check the passenger's information and provide recommendation in public transportation for deploying artificial intelligence, blockchain is also combining, Sharma (2021) and Ahmed et al. discussed in smart mobility. The researchers guaranteed the following of transportation system using the blockchain which makes smart private data secure and manage the resources in a proper way to make the project of the intelligent city more sustainable.

3.4 Cybersecurity and Smart Surveillance

Smart cities with the help of AI are becoming hyper and hyper everyday day by day. The upward movement of smart cities have brought Cybersecurity and Surveillance to the topmost slots of their AI and IoT and have also made them rank high with advanced monitoring AI and IoT in the safety and security and have given birth to make their smart cities in-human challenges for the public to fight against for public trust, Smart cities contain thousands of IoT's (cams and sensors and connected infrastructure) that have provided the smart cities with an innumerable number of benefits and profit and helps them to yield the profit in a very less time. But as a Smart city contains thousands of IoT's and the city being so vulnerable to cyber-attacks making the public and IoT to protect themselves becomes weak. Smart cities also provide data breach and cyber-attacks thus the Smart Cities entire system of AI and IOT should be taken proper care of or else the interest of the general public will be lost in the smart city and

will start believing untrustworthy. For saving a smart city from data breach and security, the entire threat should be done with AI for its proper surveillance.

“IOT, AI and blockchain for security in smart cities have given rise to numerous benefits to the hypercities Annadurai and Agarwal (2022)” AI Technologies and threat detection, growth of IoT and sensitivity of data, rapid and in a huge sum of IoT usage, cities can feel free from attacks, urban surveillance and AI technologies. With the IOT network fueling cities, it spreads a huge amount of IOT-device driven private and social data every single day around the world. The video feed from cams, personal data that the smart city carries within a device connected to the smart city, and controlling the signal from the critical infrastructure. Therefore those with malicious intentions will try to have an access to the sensitive data by cyber-attacking into the control of the smart city. The city depends upon the smartness of the smart city and the city stands vulnerable for the location of the unconditional data. Smart cities also give birth to data breach which will, in turn, prove to be a problem and a threat for the smart city to grow. The invasion of the privacy of the public will create hasles and”public will not be interested and come up with the smart city and then invest their intelligence of the smart city. The plans of the smart city will get destroyed and will not be active. Annadurai et al. (2022); Sharma et al. (2021); Ahmed et al., 2021, COVID19 and impact. Due to this increase in the threat for the smart cities, AI based system therefore holds back to detect or prevent the threat by any chances of head-anomaly that are being seen in the traffic data network. AI uses an attacking AI that directs the threat and also helps in maintaining a certain threat amount. IT has put in the continuous spread of COVID19, Artificial Intelligence helped to put an end to the spread as AI detects if there is a person present on the road or there is a power break down every day. With these applications, the brightness on the road side will decrease. AI then checks the local city’s time and decides for being able to put a back to back light on the road, stating that the road is under maintenance. The cars and the rides at that time will move out so the people will tend to stay at the home and maintain the regulation. Artificial intelligence will also schedule for a day off for the flyover and for maintaining the city under lights, then AI helps to check on the electricity used and relate to the previous data.

In 2022 has developed an AI-based intrusion detection system using bio mimics verification and machine learning algorithm to monitor the IoT network in a smart city. The system along with anomaly pattern recognition and machine learning algorithms detects the intrusion or unusual access to flag any suspicious data flow or unauthorized access, boosting the city’s competence to detect and defend against cyber-threats keeping the attack at bay. Similarly, machine learning models for spotting anomaly are also executed or smart utility grids or systems regulating traffic for detecting patterns that are beyond the normal range and might result in sabotage or fault and prompt the system to give alert. In concern of data privacy, researchers including 2021 find efficient ways of securing the data officers in the smart city by modifying or using the existing AI system to identify the weak or insecure areas in the smart city IoT devices for safeguarding the transmitted data of and avoiding any illegal access. The data breach is anticipated to be a huge issue in the upcoming years, but AI techniques along with robust encryption method will be applied properly to avoid any mishandling of the data already collected by IoT sensors used in smart city matters and to ensure proper uses. The main challenge to accept any AI enabled surveillance and security system is based on the explanation of the decision taken by AI in the case of any emergency supported by proper proof, 2022 has introduced the concept of Explainable AI (XAI) for proving transparent decisions of the AI in building the trust among the user of automated surveillance and security system. On the smart surveillance side, AI system on the IoT sensors, uniquely on cameras and microphones enhances the capability of a city to ensure public safety and prove themselves the most efficient anti-crime system possible. With the installation of AI-enabled video surveillance systems, the city can now stream the footage of the CCTV camera on the ground to a central server using the internet and computer vision can be used to identify any ‘dubious’ behavior or situation for further check.

Smart surveillance is nothing but surveillance of a country or citizen by using the Internet of Things that is IoT in a much smarter and advanced way. AI in IoT is promising in a range of ways from real-time detection of criminal suspects in surveillance cameras feed which will be capable of identify 8 wanted criminal on the street as well as from crowd forming in an unusual area, alerting the law enforcement. By evaluating the video data 24/7 that AI performs, smart surveillance can catch an incident such as theft, attested, or even accidents faster than the human operators watching several screens. Thus, enhance city security and promptness of response. Other smart use of smart surveillance is predictive policing Boydugo crime analytics by the help of extracting machine learning models. Such hooked learning models are developed to conduct predictions and interpretations of the historical crime data feeds, mostly sourced from the IoT-based reporting systems or any open data portals.

Though this AI in smart surveillance and predictive private policing methods of using video analytics have their ethical considerations, as the other citizens will not be happy with the law enforcement agencies have their citizens monitored by AI. More than advantage technique and experiments should also be made making the AI transparent. The provided smart city uses of cyber-security were also explained by Choudhary & Sarthy (2022). Enabling the security of smart environment requiring that

all the administrative levels i.e. certain growth agencies, government of a city, and often the citizens to existing in the smartphones maintains a cyber-secure city.

This has claimed security needs and practices. Expertise and to learn the cyber-secure city status, it must be contained cyber secure city strategies engagement of citizens, awareness of the ins and outs and cybersecurity, creation of security programs, training of necessary personnel found in any firewall 'has contained thesis creation, security management, threat protection and recovery maintenance, and improving and rebuilding and creating a network for private and government financials for hosting programs for cyber-secure cities. In conclusion, AI helps in the security of the IoT-rich environment as it conducts meaningful threat monitoring and the number of senses. IoT provides AI with the number of diagnosis it needs for the conduct effective surveillance and security management. According to the researches made by Kuguoglu & Sent% C3% BCrk (2020), security in smart.

The fusion of IoT and AI in smart cities is managing big facts approximately frameworks, need for a asset, and patterns in conduct related to humans to plot smarter towns.

3.5 Decision support in smart urban

Making plans many cities are trying to encompass smart technology into the spaces of their public areas to enhance the lives in their residents. There are numerous clever metropolis projects from throughout the sector which might be being performed concurrently assisting city planners to investigate how guidelines and technologies can be integrated with the practical existence of regions, each regionally and distant.

In addition to protecting vital structures from cyber-assaults, the combination of AI and IoT help city authorities notice and reply to protection incidents to make smarter cities. Information approximately the area on phone towers, networks, and IoT gadgets comes into play with inside the kind of having access to authorities to construct smarter transportation systems.

The main course in that conceptual which refers back to the development of innovations inclusive of interconnected automobile systems, all with the capability to be included into our phones.

The foremost vital of these demanding situations appealed or compassionate about the legitimate worries as intelligent city projects require some huge investments of cash and statistics- inclusive of keeping neutrality and the rights to people's non-public privacy. Therefore, the usage of synthetic intelligence in clever cities can't result in privacy rights being violated. A set of automated or improved information expands the infrastructure might be an excellent alternate for making cities that are subsidized with the aid of using AI extra livable and effective for humans to occupy.

Worstyrokenet/essay-on-undergraduate-create-from-201-degreeweek/a few-things-who- will-move-unnoticed and got permission to release this assignment on Bartleby by having our books to become a Bartleby contributor. More than approximately authors contributed to the paper with the information that Wu et al resumed the paper. With given that in 2022, Blockchain-Based Integration of AI could attain a secure and sustainable digital environment for smart cities, we have tried to understand whether other applications of blockchain can improve cybersecurity and data security. Besides, in smart cities, AI aids in improving the execution of the smart contracts through automating administrative operations as well as ensuring transparency in the urban development (Ahmed et al., 2022).

4 .Discussion: Key Trends, Challenges, and Recommendations

There are several trends in the current research and practice of AI and IOT applications in smart cities. Several challenges are faced in implementing AI and IOT in cities. The literature provides several recommendations and future directions to overcome those challenges and achieve maximum benefits from AI and IOT in cities. In this section, we provide the collective major trends, pointing to the key insights of the work. Emerging Trends: Broadening the scope of smart city applications for AI and IOT is a trend noticed. Early research in this area typically focused on AIoT solutions for isolated domains of cities such as traffic control or energy management. More recent studies that are increasingly found in the literature showcase efforts to integrate AI and IoT solutions across multiple city functions. For instance, the convergence of AI with big data and IOT finds applications in environmental sustainability, public health, civic and urban governance. Another trend is incorporating additional technologies along with AI and IOT solutions. The growing interest in integrating blockchain (non-relational databases) with AIoT finds applications in smart cities to meet security requirements. Another trend is 5G and edge computing. Together, 5G and edge computing technology make AI-IOT systems several times faster than traditional cloud computing. Notably, the two

technologies together significantly decrease latency, allowing smart city services to respond to data in real time. It is possible by using 5G and edge computing technology applications such as real-time traffic adjustments and instantaneous emergency responses get fastened. Also, a green revolution is evolving in the industry. Industry experts have realized the significant energy consumption of these technologies. Hence, AI researchers are critically investigating the energy footprint of these technologies itself. Researchers show concern about the environmental consequences of AI and IOT.

This has been a maturation in this field where technology implementation should not be the only aim of city officials, where it is expected that all such technologies should be applied in a sustainable manner. The most common drawbacks and resistances encountered by the various cities while implementing the AI and IoT technologies are:

-Technical and Infrastructure Challenges: Even though the technology has been improved to great extents, cities that are still at a primary level have their share of limitations. Inadequate digital infrastructure due to ISO, lack of excellent internet connectivity and inability of the different systems and devices to interact with each other (Wang et al, 2021).

-Decay of Old Technologies: Many cities still run on old technologies, and their levels resist the implementation of IOT devices. One of the main problems regarding an already excellent infrastructure is that it will not support the different features of IOT. This issue needs to be regulated and controlled, but it is one of the most difficult tasks to be done.

-Ignorance of City Case Studies: Reports from officials of smart cities confess that most cities fail to plan all the activities related to published or implemented were adopted. These are not being taken into consideration by almost 90% of the cities.

The above are the main drawbacks to implementing the city's AI and IoT devices or systems. More detailed study from various cities in ways and methods in planning and keeping their city smart can lead us to many unknown answers. This skills lack can slow down projects and cause over-reliance on vendors without internal capacity building. Additionally, a few city administrations might resist change or be siloed in terms of organization, hindering the cross-departmental collaboration that many smart city projects need (Kuguoglu et al., 2021). Budget Limits: Smart city projects, especially those using cutting-edge AI and extensive IoT infrastructure, can be costly. Budget limits are a practical challenge to many projects, especially in smaller municipalities. Li et al. (2024) found that AI-driven efficiency improvements were more prevalent in regions with greater government funding and assistance. They have less to spend on such new experimental and, in many cases, untested technologies. However, when the investment is uncertain or the funding is not coming from external sources (e.g. national grants, private investors), these leaders might delay such projects indefinitely and never see the benefits (Zhang et al., 2023). Javed et al. (2023) argues that a weakness in smart city systems, including IoT and AI, is the lack of advances in hardware and software communication. A device may use an AI model to help control a city's infrastructure (e.g. traffic) but send out incorrect signals or orders across a network. Conventional methods of communication may not always transmit the innovative AI-driven data seamlessly, which may cause accidents, damages, and financial losses in cities (Aslam et al., 2022). Anthopoulos and Kazantzi (2022) suggest making common assessment and planning frameworks for cities for adopting AI in the energy sector. Similarly, developing universal models and procedures for transportation, health, etc., can share the best practices and data among cities.

-Boost Interoperability and Prevent Vendor Lock-in: Standards for IoT devices and data formats can increase the interoperability of systems and avert vendor lock-in (Choudhary & Sarthy, 2022). Cities adopting smart technologies should follow global standards irrespective of the vendors responsible for providing the service.

-Increase Cybersecurity and Privacy Measures: The cybersecurity strategy should be included from the start in any smart city endeavor. This involves technical measures such as encryption, intrusion detection systems, and routine security assessments of all systems and data. Equally significant are innovative mechanisms including the use of blockchain (discussed previously) to make sure that cities and the general public have faith in the systems. Cities must also enforce stringent constraints on the privacy of how data is collected and used and shared. Explaining AI (XAI) must be employed for critical decisions like surveillance and allotments to keep the public in the loop (Jagatheesaperumal et al., 2022).

-Capacity Building and Collaboration: Developing local talent is significant for the success of smart city projects. This can be done by running courses on data science and urban informatics, through collaborations with universities, and by hiring skilled persons from all over the world for their excellence. Collaboration with industries and government bodies are often recommended (Kuguoglu et al., 2021, Li et al., 2024). Public-private partnership (PPP) can provide the capital and know-how.

-Policy Support and Funding: Government at the national and regional levels should look for ways to assist the SMART city notion. This may include giving grants, giving incentives, and even building a support system for the cities opting for AI/IoT

products. They should make regulations that will allow the pilot of new systems and products with minimum to no penalty towards the end.

Li et al. (2024) suggests increasing investment in the field of AI dedicated to addressing urban issues and global collaborations; forums or together projects tackling climate resilience or pandemic response by the aid of AI and IoT. - Focus Towards Sustainable and Equality: A lot of authors suggested aligning projects with sustainability goals and equality to ensure that the smart city technologies brought positive changes in society. Yigitcanlar et al. (2021) suggested adhering to Green AI practices (efficient algorithms, powered by renewables, etc.) to reduce the environmental effects of smart city technologies. And when deploying AI services, a city

should also look after the needs of all sectors of society; for example, the smart mobility services should be accessible to the elderly and disabled and other groups who may not benefit from such technologies, or AI tools in public services should not mistreat any part of society. Getting stakeholders of the community involved in planning and feedback for avoiding type-1 errors would ensure more inclusive models.

Future Research directive: The literature also spoke of 13 such areas papers of which yet to be written. For instance, long-term evaluations for the AI-IoT systems that have been implemented would quantify benefits and time-caused drawbacks that might not have been expected. More research needs to be conducted on the scalability, i.e., technical and administrative, of a project after a pilot test in the early stages and full-scale deployment. Emerging areas such as the role of federated learning too (Pandya et al., 2023), enabling cities to work together without sharing data to improve each one's AI model still needs to be written about. Also, research for continuously improving AI transparency and ethics (Javed et al., 2023) will always be essential with more volatile technology. In conclusion, AI and IoT have shown promises to smart cities in several areas, but taking the full advantage would require science in these areas to navigate through harmful techniques though. Mode_COMPLETE the propositions above are an abridged version of the various studies. These can help the administration of cities and their allied authorities, scientists and techies to improve the development of the smart city.

5. CONCLUSION

This literature review aims to uncover the prevalent application of artificial intelligence and the Internet of Things to develop smart cities. They have revolutionized urban planning and development processes. Effective AI-IoT solutions significantly impact the performance of any city. The cities with AI-IoT technology are better performing. Throughout this review, we have included the findings of about 30 studies. Dividing our review into six extensive domains, smart city objectives have been met almost entirely. Each of the features of the domains has been achieved with the introduction of AI-IoT technology in a city. Our review also highlighted three significant domain categories that needed real-time digital testing in urban development. Also, in our study, we reflected on the requirement of additional qualifications for applying these technologies in urban settings. Artificial intelligence has been predicted to cover about 31.7 billion USD by 2025. Over five years, it could represent 45% of value multiple combined with the IoT market. The addition of IoT to AI enhances insight generation. In cities, the entry barrier is relatively high for such a new technology. For smart urban development, technical and organizational issues are causing concerns. The area includes security concerns about cyber, privacy problems of data collected, shortage of men, restriction in the construction of infrastructure, and uncertainties about more experts, policy, and a board of governance required to adopt new IoT. Security and access to a broad cybersecurity issue exist because with connectivity, data becomes vulnerable, a privacy, confidential issue. Technology must have a unique code and might be patched later when a loophole is found for better development or efficient working. Smart cities should engage with the private sector, pool their experiences to invent something better, share knowledge, and generate income through their help. But they should remain an independent entity to prevent misuse or lack of understanding of people immersed in the private parties. Smart urban communities can use their AI resources adequately with the assistance of the industry. The whole community and their partners can be united through supportive government planning, urging the most ideal use. The merger of AI and IoT in a city appears to be more effective when supported by authoritative public guidelines. The grouping and disturbance of communities (financial specialists, comrades, industry, and partners) should likewise be upheld by public guidelines. Experts suggest different activities in the process to create smart urban communities. It includes interests in advanced foundation, receiving trustworthy information, supervisory practice, and decision-making dependent on qualities. A smart city can be made by offering the city the required assets, preparing a workforce, and providing public guidance support. The suggested steps to place AI and IoT in urban areas through different activities, as recognized from the data.

REFERENCES

- [1] J. Kou, "Estimating the number of clusters via the GUD statistic," *J. Comput. Graph. Statist.*, vol. 23, no. 2, pp. Abuga, D., & Raghava, N. S. (2021). Real-time smart garbage bin mechanism for solid waste management in smart cities. *Sustainable Cities and Society*, 75(103347), 103347. <https://doi.org/10.1016/j.scs.2021.103347>
- [2] Ahmed, I., Ahmad, M., Rodrigues, J. J. P. C., Jeon, G., & Din, S. (2020). A deep learning-based social distance monitoring framework for COVID-19. *Sustainable Cities and Society*, 102571. <https://doi.org/10.1016/j.scs.2020.102571>
- [3] Ahmed, I., Anisetti, M., & Jeon, G. (2021). An IoT-based human detection system for complex industrial environment with deep learning architectures and transfer learning. *International Journal of Intelligent Systems*. <https://doi.org/10.1002/int.22472>
- [4] Ahmed, I., Zhang, Y., Jeon, G., Lin, W., Khosravi, M. R., & Qi, L. (2022). A blockchain- and artificial intelligence-enabled smart IoT framework for sustainable city. *International Journal of Intelligent Systems*. <https://doi.org/10.1002/int.22852>
- [5] Ahmed, K., Kumar Dubey, Dr. M., Kumar, A., & Dubey, S. (2024). Artificial Intelligence and IoT Driven System Architecture for Municipality Waste Management in Smart Cities: A Review. *Measurement: Sensors*, 101395. <https://doi.org/10.1016/j.measen.2024.101395>
- [6] Ahmed, S., Md. Biplob Hossain, Kaiser, M. L., Manan, Mahmud, M., & Chakraborty, C. (2021). Artificial Intelligence and Machine Learning for Ensuring Security in Smart Cities. *Advanced Sciences and Technologies for Security Applications*, 23–47. https://doi.org/10.1007/978-3-030-72139-8_2
- [7] Alahi, M. E. E., Sukkuea, A., Tina, F. W., Nag, A., Kurdthongmee, W., Suwannarat, K., & Mukhopadhyay, S. C. (2023). Integration of IoT-Enabled Technologies and Artificial Intelligence (AI) for Smart City Scenario: Recent Advancements and Future Trends. *Sensors*, 23(11), 5206. MDPI. <https://www.mdpi.com/1424-8220/23/11/5206>
- [8] Albino, V., Berardi, U., & Dangelico, R. M. (2015). Smart Cities: Definitions, Dimensions, Performance, and Initiatives. *Journal of Urban Technology*, 22(1), 3–21. <https://doi.org/10.1080/10630732.2014.942092>
- [9] Alifi, R., & Supangkat, S. H. (2016). Information extraction for traffic congestion in social network: Case study: Bekasi city. 53–58. <https://doi.org/10.1109/ictss.2016.7792848>
- [10] Alshamrani, M. (2021). IoT and artificial intelligence implementations for remote healthcare monitoring systems: A survey. *Journal of King Saud University - Computer and Information Sciences*, 34(8). <https://doi.org/10.1016/j.jksuci.2021.06.005>
- [11] Al-Turjman, F., & Baali, I. (2022). Machine learning for wearable IoT-based applications: A survey. *Transactions on Emerging Telecommunications Technologies*, e3635. <https://doi.org/10.1002/ett.3635>
- [12] Ang, K. L.-M., Seng, J. K. P., Ngharamike, E., & Ijamaru, G. K. (2022). Emerging Technologies for Smart Cities' Transportation: Geo-Information, Data Analytics and Machine Learning Approaches. *ISPRS International Journal of Geo-Information*, 11(2), 85. <https://doi.org/10.3390/ijgi11020085>
- [13] Annadurai, C., Nelson, I., Devi, K. N., Manikandan, R., Jhanjhi, N. Z., Masud, M., & Sheikh, A. (2022). Biometric Authentication-Based Intrusion Detection Using Artificial Intelligence Internet of Things in Smart City. *Energies*, 15(19), 7430. <https://doi.org/10.3390/en15197430>
- [14] Anthopoulos, L., & Kazantzi, V. (2022). Urban energy efficiency assessment models from an AI and big data perspective: Tools for policy makers. *Sustainable Cities and Society*, 76, 103492. <https://doi.org/10.1016/j.scs.2021.103492>
- [15] Batool, T., Abbas, S., Alhwaiti, Y., Saleem, M., Ahmad, M., Asif, M., & Sabri Elmitwally, N. (2021). Intelligent Model Of Ecosystem For Smart Cities Using Artificial Neural Networks. *Intelligent Automation & Soft Computing*, 29(3), 513–525. <https://doi.org/10.32604/iasc.2021.018770>
- [16] Benavente-Peces, C. (2019). On the Energy Efficiency in the Next Generation of Smart Buildings—Supporting Technologies and Techniques. *Energies*, 12(22), 4399. <https://doi.org/10.3390/en12224399>
- [17] Bi, S., Wang, C., Zhang, J., Huang, W., Wu, B., Gong, Y., & Ni, W. (2022). A Survey on Artificial Intelligence Aided Internet-of-Things Technologies in Emerging Smart Libraries. *Sensors*, 22(8), 2991. <https://doi.org/10.3390/s22082991>
- [18] Bibri, S. E., & Krogstie, J. (2017). Smart sustainable cities of the future: An extensive interdisciplinary literature review. *Sustainable Cities and Society*, 31(1), 183–212. <https://doi.org/10.1016/j.scs.2017.02.016>

- [19] Bokhari, S. A. A., & Myeong, S. (2022). Use of Artificial Intelligence in Smart Cities for Smart Decision-Making: A Social Innovation Perspective. *Sustainability*, 14(2), 620. <https://doi.org/10.3390/su14020620>
- [20] Chander, B., Pal, S., De, D., & Buyya, R. (2022). Artificial Intelligence-based Internet of Things for Industry 5.0. *Internet of Things*, 3–45. https://doi.org/10.1007/978-3-030-87059-1_1
- [21] Chavhan, S., Gupta, D., Gochhayat, S. P., N, C. B., Khanna, A., Shankar, K., & Rodrigues, J. J. P. C. (2022). Edge Computing AI-IoT Integrated Energy Efficient Intelligent Transportation System for Smart Cities. *ACM Transactions on Internet Technology*. <https://doi.org/10.1145/3507906>
- [22] Choudhary, P., & Sarthy, P. (2022). Transforming Cities for Sustainability: Role of Standards on Smart City. 2022 2nd International Conference on Power Electronics & IoT Applications in Renewable Energy and Its Control (PARC), 1–6. <https://doi.org/10.1109/parc52418.2022.9726674>
- [23] Farzaneh, H., Malehmirchegini, L., Bejan, A., Afolabi, T., Mulumba, A., & Daka, P. P. (2021). Artificial Intelligence Evolution in Smart Buildings for Energy Efficiency. *Applied Sciences*, 11(2), 763. MDPI. <https://doi.org/10.3390/app11020763>
- [24] Fayyaz, M., Farhan, A. A., & Javed, A. R. (2021). Thermal Comfort Model for HVAC Buildings Using Machine Learning. *Arabian Journal for Science and Engineering*. <https://doi.org/10.1007/s13369-021-06156-8>
- [25] Ferdowsi, A., Challita, U., & Saad, W. (2019). Deep Learning for Reliable Mobile Edge Analytics in Intelligent Transportation Systems: An Overview. *IEEE Vehicular Technology Magazine*, 14(1), 62–70. <https://doi.org/10.1109/mvt.2018.2883777>
- [26] Galindo, F. (2014). Methods for Law and ICT: An Approach for the Development of Smart Cities. *Lecture Notes in Computer Science*, 26–40. https://doi.org/10.1007/978-3-662-45960-7_3
- [27] Garlik, B. (2022). Energy Centers in a Smart City as a Platform for the Application of Artificial Intelligence and the Internet of Things. *Applied Sciences*, 12(7), 3386. <https://doi.org/10.3390/app12073386>
- [28] Golinska-Dawson, P., & Sethanan, K. (2023). Sustainable Urban Freight for Energy-Efficient Smart Cities—Systematic Literature Review. *Energies*, 16(6), 2617–2617. <https://doi.org/10.3390/en16062617>
- [29] Ilyas, M. (2021, December 1). IoT Applications in Smart Cities. *IEEE Xplore*. <https://doi.org/10.1109/ICEIB53692.2021.9686400>
- [30] Jagatheesaperumal, S. K., Bibri, S. E., Huang, J., Rajapandian, J., & Parthiban, B. (2024). Artificial intelligence of things for smart cities: advanced solutions for enhancing transportation safety. *Computational Urban Science*, 4(1). <https://doi.org/10.1007/s43762-024-00120-6>
- [31] Jagatheesaperumal, S. K., Pham, Q.-V., Ruby, R., Yang, Z., Xu, C., & Zhang, Z. (2022). Explainable AI Over the Internet of Things (IoT): Overview, State-of-the-Art and Future Directions. *IEEE Open Journal of the Communications Society*, 3, 2106–2136. <https://doi.org/10.1109/OJCOMS.2022.3215676>
- [32] Javed, A. R., Ahmed, W., Pandya, S., Maddikunta, P. K. R., Alazab, M., & Gadekallu, T. R. (2023). A Survey of Explainable Artificial Intelligence for Smart Cities. *Electronics*, 12(4), 1020. <https://doi.org/10.3390/electronics12041020>
- [33] Javed, A. R., Faheem, R., Asim, M., Baker, T., & Beg, M. O. (2021). A smartphone sensors-based personalized human activity recognition system for sustainable smart cities. *Sustainable Cities and Society*, 71, 102970. <https://doi.org/10.1016/j.scs.2021.102970>
- [34] Javed, A. R., Shahzad, F., Rehman, S. ur, Zikria, Y. B., Razzak, I., Jalil, Z., & Xu, G. (2022). Future smart cities requirements, emerging technologies, applications, challenges, and future aspects. *Cities*, 129(1), 103794. <https://doi.org/10.1016/j.cities.2022.103794>
- [35] Kamruzzaman, M. M. (2022). Key Technologies, Applications and Trends of Internet of Things for Energy-Efficient 6G Wireless Communication in Smart Cities. *Energies*, 15(15), 5608. <https://doi.org/10.3390/en15155608>
- [36] Kuguoglu, B. K., van der Voort, H., & Janssen, M. (2021). The Giant Leap for Smart Cities: Scaling Up Smart City Artificial Intelligence of Things (AIoT) Initiatives. *Sustainability*, 13(21), 12295. <https://doi.org/10.3390/su132112295>
- [37] Li, X., Wang, Q., & Tang, Y. (2024). The Impact of Artificial Intelligence Development on Urban Energy Efficiency—Based on the Perspective of Smart City Policy. *Sustainability*, 16(8), 3200. <https://doi.org/10.3390/su16083200>
- [38] Li, X., Zhao, H., Feng, Y., Li, J., Zhao, Y., & Wang, X. (2024). Research on key technologies of high energy efficiency and low power consumption of new data acquisition equipment of power Internet of Things based on artificial intelligence. *International Journal of Thermofluids*, 100575. <https://doi.org/10.1016/j.ijft.2024.100575>

- [39] Lourenço, V., Mann, P., Guimarães, A. P. O., Paes, A., & Oliveira, D. de . (2018). Towards Safer (Smart) Cities: Discovering Urban Crime Patterns Using Logic-based Relational Machine Learning. <https://doi.org/10.1109/ijcnn.2018.8489374>
- [40] Mendling, J., Decker, G., Hull, R., Reijers, H. A., & Weber, I. (2018). How do Machine Learning, Robotic Process Automation, and Blockchains Affect the Human Factor in Business Process Management? *Communications of the Association for Information Systems*, 43, 297–320. <https://doi.org/10.17705/1cais.04319>
- [41] Moher, D., Shamseer, L., Clarke, M., Ghersi, D., Liberati, A., Petticrew, M., ... & Prisma-P Group. (2015). Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement. *Systematic reviews*, 4, 1-9
- [42] Musa, A. A., Malami, S. I., Alanazi, F., Ounaies, W., Alshammari, M., & Haruna, S. I. (2023). Sustainable Traffic Management for Smart Cities Using Internet-of-Things-Oriented Intelligent Transportation Systems (ITS): Challenges and Recommendations. *Sustainable Traffic Management for Smart Cities Using Internet-of-Things-Oriented Intelligent Transportation Systems (ITS): Challenges and Recommendations*, 15(13), 9859–9859. <https://doi.org/10.3390/su15139859>
- [43] Nasiri, H., Nasehi, S., & Goudarzi, M. (2019). Evaluation of distributed stream processing frameworks for IoT applications in Smart Cities. *Journal of Big Data*, 6(1). <https://doi.org/10.1186/s40537-019-0215-2>
- [44] Nguyen, H., Nawara, D., & Kashef, R. (2024). Connecting the Indispensable Roles of IoT and Artificial Intelligence in Smart Cities: A Survey. *Journal of Information and Intelligence*, 2(3). <https://doi.org/10.1016/j.jiixd.2024.01.003>
- [45] Nguyen, H., Nawara, D., & Kashef, R. (2024). Connecting the Indispensable Roles of IoT and Artificial Intelligence in Smart Cities: A Survey. *Journal of Information and Intelligence*, 2(3). <https://doi.org/10.1016/j.jiixd.2024.01.003>
- [46] Pandya, S., Srivastava, G., Jhaveri, R., Babu, M. R., Bhattacharya, S., Maddikunta, P. K. R., Mastorakis, S., Piran, Md. J., & Gadekallu, T. R. (2023). Federated learning for smart cities: A comprehensive survey. *Sustainable Energy Technologies and Assessments*, 55, 102987. <https://doi.org/10.1016/j.seta.2022.102987>
- [47] Qurbonova, B., Sulaymanova, S., Akhmedova, N., & Yunusaliyev, M. (2023). Big Data, Artificial Intelligence and Smart Cities. *E3S Web of Conferences*, 402, 03013–03013. <https://doi.org/10.1051/e3sconf/202340203013>
- [48] Rejeb, A., Rejeb, K., Simske, S., Treiblmaier, H., & Zailani, S. (2022). The big picture on the internet of things and the smart city: a review of what we know and what we need to know. *Internet of Things*, 19, 100565. <https://doi.org/10.1016/j.iot.2022.100565>
- [49] Sajid, F., Javed, A. R., Basharat, A., Kryvinska, N., Afzal, A., & Rizwan, M. (2021). An Efficient Deep Learning Framework for Distracted Driver Detection. *IEEE Access*, 9, 169270–169280. <https://doi.org/10.1109/access.2021.3138137>
- [50] Sharma, A., Podoplelova, E., Shapovalov, G., Tselykh, A., & Tselykh, A. (2021). Sustainable Smart Cities: Convergence of Artificial Intelligence and Blockchain. *Sustainability*, 13(23), 13076. <https://doi.org/10.3390/su132313076>
- [51] Singh, J., Sajid, M., Gupta, S. K., & Haidri, R. A. (2022). Artificial Intelligence and Blockchain Technologies for Smart City. *Intelligent Green Technologies for Sustainable Smart Cities*, 317–330. <https://doi.org/10.1002/9781119816096.ch15>
- [52] Ullah, A., Anwar, S., Li, J., Nadeem, L., Mahmood, T., Khan, A. U., & Saba, T. (2023). Smart cities: the role of Internet of Things and machine learning in realizing a data-centric smart environment. *Complex & Intelligent Systems*, 10. <https://doi.org/10.1007/s40747-023-01175-4>
- [53] Vesco, A., & Ferrero, F. (Eds.). (2015). *Handbook of Research on Social, Economic, and Environmental Sustainability in the Development of Smart Cities. Advances in Environmental Engineering and Green Technologies*. <https://doi.org/10.4018/978-1-4666-8282-5>
- [54] Wang, K., Zhao, Y., Gangadhari, R. K., & Li, Z. (2021). Analyzing the Adoption Challenges of the Internet of Things (IoT) and Artificial Intelligence (AI) for Smart Cities in China. *Sustainability*, 13(19), 10983. <https://doi.org/10.3390/su131910983>
- [55] Yigitcanlar, T., Desouza, K. C., Butler, L., & Roozkhosh, F. (2020). Contributions and Risks of Artificial Intelligence (AI) in Building Smarter Cities: Insights from a Systematic Review of the Literature. *Energies*, 13(6), 1473. <https://www.mdpi.com/1996-1073/13/6/1473>
- [56] Yigitcanlar, T., Mehmood, R., & Corchado, J. M. (2021). Green Artificial Intelligence: Towards an Efficient, Sustainable and Equitable Technology for Smart Cities and Futures. *Sustainability*, 13(16), 8952. <https://doi.org/10.3390/su13168952>

- [57] Zamponi, M. E., & Barbierato, E. (2022). The Dual Role of Artificial Intelligence in Developing Smart Cities. *Smart Cities*, 5(2), 728–755. <https://doi.org/10.3390/smartcities5020038>