International Journal of Basic and Applied Sciences, 14 (SI-1) (2025) 314-318

International Journal of Basic and Applied Sciences

Website: www.sciencepubco.com/index.php/IJBAS
https://doi.org/10.14419/wmfvgq72
Research paper

AI-Driven Predictive Analytics for Smart Cities and Urban Planning

Ankita Agarwal [1] *, Dr. Shashikant Patil [2], Dr. Prabhat Ku. Sahu [3], Evelyn Jeny [4], Dushyanth V. Babu [5], Ashish Verma [6], Yuvraj Parmar [7]

[1] Assistant Professor, Maharishi School of Engineering & Technology, Maharishi University of Information Technology, Lucknow, India
[2] Professor, uGDX, ATLAS SkillTech University, Mumbai, India
[3] Associate Professor, Computer Science and Information Technology, Siksha 'O' Anusandhan (Deemed to be University), Bhubaneswar, Odisha, India
[4] Assistant Professor, Department of Architecture, Sathyabama Institute of Science and Technology, Chennai, Tamil Nadu, India.
[5] Associate Professor, Department of Civil Engineering, Faculty of Engineering and Technology, JAIN (Deemed-to-be University), Ramnagar District, Karnataka, India
[6] Center of Research Impact and Outcome, Chitkara University, Rajpura, Punjab, India
[7] Chitkara Center for Research and Development, Chitkara University, Himachal Pradesh, India
**Corresponding author E-mail: ankita.agarwal@muit.in*

Received: May 2, 2025, Accepted: May 31, 2025, Published: October 30, 2025

Abstract

In recent years, artificial intelligence (AI) has emerged as a primary option for tackling the economic, social, environmental, and governance concerns confronting cities. AI's advanced capabilities can substantially assist local governments in attaining sustainable urban development. Nonetheless, the application of AI in urban planning remains a relatively uncharted territory, particularly in bridging theoretical concepts with practical implementation. This paper provides a comprehensive examination of the several facets of urban planning in which AI technologies are being investigated or actively utilized, and it explores how these technologies might facilitate or enhance smart and sustainable development. This research employs a systematic literature review following the PRISMA procedure. The principal findings are: (a) Early adopters' real-world applications of AI in urban planning are facilitating broader acceptance by local governments; (b) The expansion of AI utilisation in urban planning necessitates collaboration and partnerships among essential stakeholders; (c) Big data is imperative for the effective application of AI in urban planning; and (d) The integration of artificial and human intelligence is essential for addressing urbanisation challenges and attaining smart, sustainable development. These insights emphasize the necessity to improve planning procedures utilizing sophisticated data and analytical methodologies.

Keywords: *AI; Smart City; Urban; Planning.*

1. Introduction

Humans tend to handle tasks manually, while AI shines in executing high-volume tasks its Artificial Intelligence (AI) is really shaking things up for cities, making them smarter, more efficient, and a whole lot more enjoyable to live in. From easing traffic congestion to enhancing public safety, AI is transforming urban environments into what we now refer to as smart cities [3] [14]. own, doing so with remarkable reliability and efficiency [1]. Furthermore, AI possesses the ability to automate, replicate, learn from, uncover, and adapt to extensive datasets. By employing these methodologies, we can access a range of AI-driven technologies, such as evolutionary algorithms, ambient computing, distributed AI, autonomous systems, artificial neural networks, probabilistic programming, decision networks, computer vision, and natural language processing [7].In order to create an efficiently managed city with rapid and easy access to services and digitization of information, technological interventions are essential to urban rejuvenation and survivability initiatives [2]. In his 1910 address at the Royal Institute of British Architects, French urban planner Eugene Henard, a pioneer in shaping European urban development, asserted: "My purpose is to investigate the impact that advancements in modern science and industry may have on the planning and, specifically, the appearance of the Cities of the Future [15].

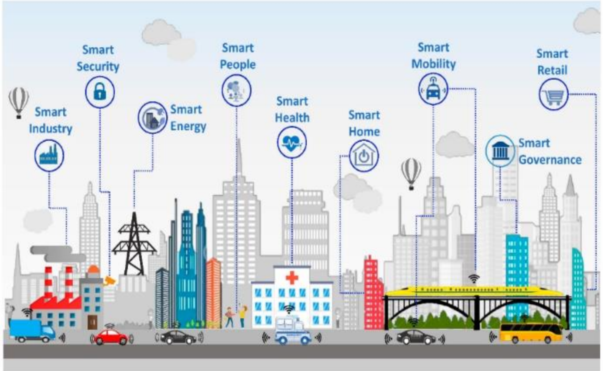

Fig. 1: Urban Planning and Smart City Decision Management.

In contrast to the cities of the past, the cities of the future will be more conducive to modification and embellishment [4]. Since then, several terms, including sustainable cities, eco-cities, green cities, compact cities, digital cities, and the most recent, smart cities [5] [10], have been used to characterize the features of the Cities of Tomorrow or Future Cities to better explain their changing complexity [9] [12]. To improve the quality of life and boost the productivity of the city's vital infrastructure and services, all these ideas promote the adoption of scalable solutions that leverage technological advancements like information and communication technology (ICT), the Internet of Things (IoT), smartphones, and online social media [11].

While this paper primarily discusses AI applications in flood control, AI is also being applied across other urban domains such as traffic optimization and energy management [19]. For instance, AI techniques like neural networks and decision networks are used in traffic management systems to optimize flow and reduce congestion (Kalusivalingam et al., 2021). Similarly, AI models are deployed in energy management systems for predictive maintenance, smart grid integration, and efficiency improvements in power distribution networks [20]. Artificial intelligence technologies in urban planning encompass several methodologies, including neural networks, probabilistic programming, and decision networks [16] [21]. Each has its strengths: neural networks excel in pattern recognition, probabilistic programming is useful for decision-making under uncertainty, and decision networks offer clear pathways for optimization in complex systems. Nonetheless, these methodologies encounter scalability issues, especially in resource-limited urban settings [17]. Subsequent research must concentrate on mitigating these constraints, particularly in underdeveloped countries, where data and resources are frequently scarce [18].

2. Materials and Methods

We aim to build and test this system to evaluate how effectively the advanced urban flood control methodology can reduce floodwater. This research expands upon the system presented in Chapter 4, wherein we proposed an IoT and fuzzy-based Storm Water Control Network Model intended for floodwater management. Our recent studies indicate that the floodwater reduction rate is merely 47.7%, and it presently accounts solely for the water levels of sub-catchments. The dataset we created was fairly constrained, encompassing only three sub-catchments and depending on real-time data gathered every 15 minutes. During severe rainfall, the system fails to manage floodwater efficiently due to the inadequacy of the 15-minute time limit for real-time data, which does not account for the rain's intensity. To improve the system's efficiency and enable it to manage substantial rainfall, our proposed study would integrate characteristics such as precipitation intensity, water flow, and water levels for each sub-catchment, while also leveraging the existing drainage network to regulate floodwater more effectively [6].

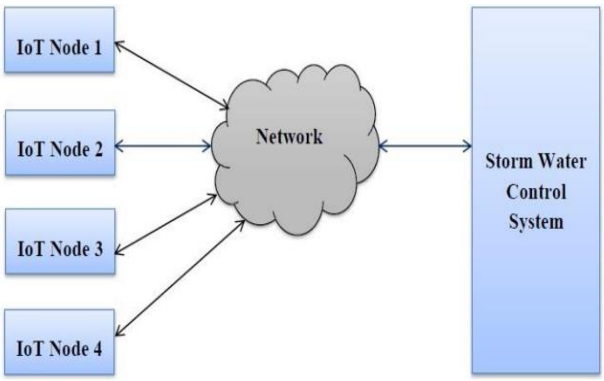

Fig. 2: System Block Diagram.

2.1. Ethical considerations

The use of AI in urban planning introduces significant ethical challenges, including privacy concerns, biases in decision-making, and inequality in access to technological benefits. For example, biased datasets may result in discriminatory urban planning decisions that disproportionately affect marginalized communities. Privacy concerns also arise from the extensive data collection required by IoT-based AI systems, raising questions about data ownership and security. Studies such as Raman et al. (2024) have highlighted the importance of developing AI systems that incorporate fairness and transparency to address these ethical concerns.

3. Results and Discussion

We've now expanded the number of sub-catchments to four, and I'm excited to share that we've successfully rolled out the prototype of the system. Instead of gathering flood data every 15 minutes, we can now pull real-time information from each catchment every minute. When heavy rain hits and water levels rise, this system really helps lighten the load on the Storm Water Control Network by making good use of the existing drainage system [13].

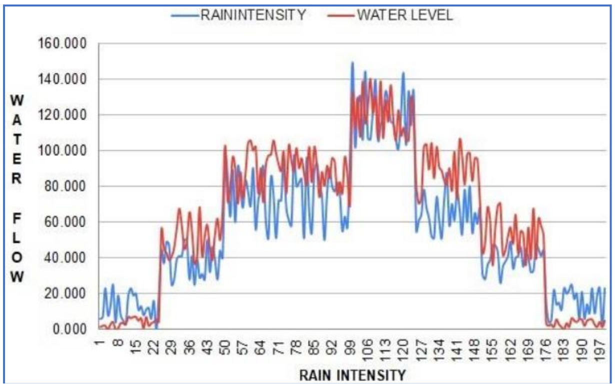

Fig. 3: Graph of Rain Intensity and Water Level of Sub Catchments C1.

Figure 3 illustrates the correlation between rainfall intensity and water levels, which is critical in predicting flood events and optimizing the stormwater control system.
The research highlighted in this paper points to various existing and upcoming technologies that can help tackle these challenges. It also emphasizes that thoughtful algorithmic urban planning can play a crucial role in fostering smart and sustainable development. However, for AI to be more widely embraced in our cities, it's essential that researchers, planners, organizations, and communities—the main players in urban decision-making—work together and collaborate effectively [8].

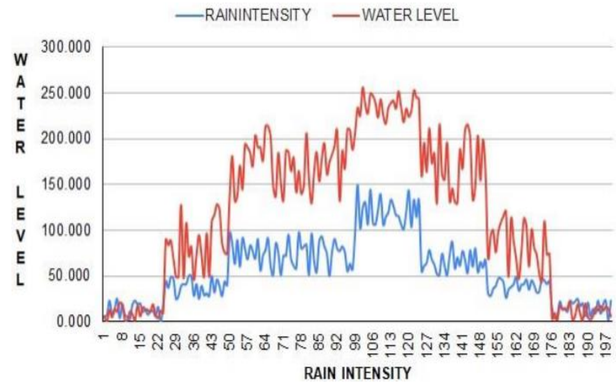

Fig. 4: Rainfall Intensity vs. Water Level Trends in Sub Catchment C1.

Privacy, biases, and inequality are still tricky issues that require careful thought, especially when it comes to figuring out how to reduce these risks while using AI technologies in urban planning.

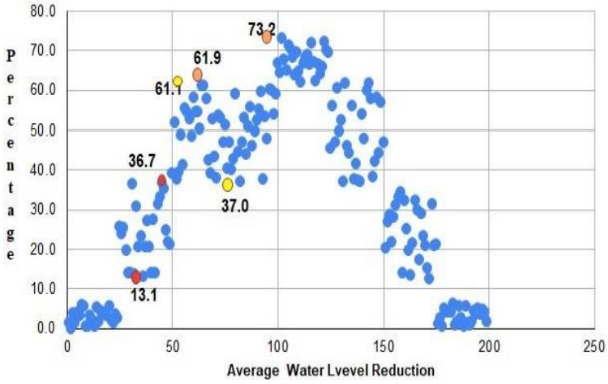

Fig. 5: Average Water Level Reduction of C1.

To evaluate how well the proposed system works, we created and tested a smaller model, sharing the results afterward.

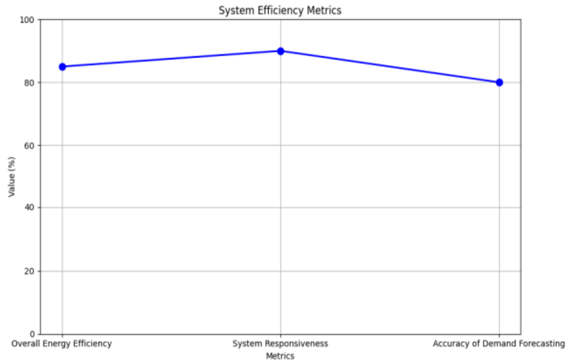

Fig. 6: System Efficiency Metrics.

During this testing phase, we scaled down the storm and drain pipe dimensions to just 0.5 inches, while in real life, these pipes usually measure between 12 and 15 inches.

Fig. 7: Comparison of State of the Art.

Managing city flood control is a vital part of urban planning and infrastructure management, as it aims to reduce the devastating effects of floods on cities and their residents [9-10].

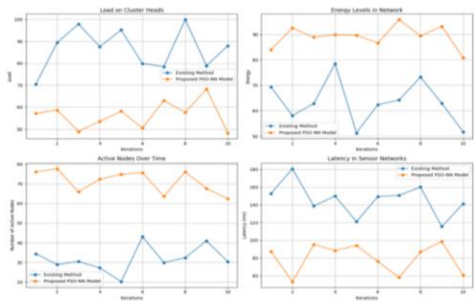

Fig. 8: IoT Device Performance.

Both qualitative and quantitative comprehension of system dynamics methodology benefit from simulating system archetypes. Graphs produced by simulating system archetypes show potential patterns of behavior and recommendations on how they can be applied to different issues.

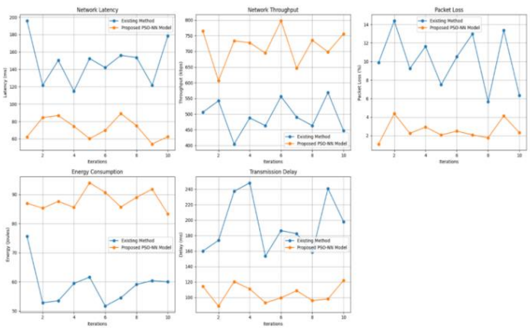

Fig. 9: Network Communication Analysis.

We envision an area of future Internet applications that are made feasible by using semantically rich data obtained from presence and mobility traces in the real world. Providing reports on data collected, creating real-time content concurrently with the trace gathering process, and forecasting the behavior of the monitored population can be the primary goals of such systems. This type of data indicates people's mobility around the city, which can be used to identify urban anomalies or, over time, to research the functional areas of a city in relation to urban design.

4. Conclusion

The first element of a smart city is smart mobility, which is a crucial component that comprises smart services for public transportation, ICT-based transport and traffic control management systems, and a strong walking infrastructure. Smart cities are advancing superior mobility alternatives through innovations such as ridesharing, bike and vehicle sharing, intelligent transit systems, real-time transit mobile applications, smart traffic signals, and intelligent parking solutions. It is possible to forecast future needs for new parking lots, structures, or locations for the construction of new or extended highways based on data supplied by smart parking and vehicle traffic. We envision an area of future Internet applications that are made feasible by using semantically rich data obtained from presence and mobility traces in the real world. Providing reports on data collected, creating real-time content concurrently with the trace gathering process, and forecasting the behavior of the monitored population can be the primary goals of such systems. This type of data indicates people's mobility around the city, which can be used to identify urban anomalies or, over time, to research the functional areas of a city in relation to urban design.

References

[1] Rimon, S. M. T. H., Sufian, M. A., Guria, Z. M., Morshed, N., Mosaddeque, A. I., & Ahamed, A. (2024). Impact of AI-powered business intelligence on smart city policy-making and data-driven governance. *IET Conference Proceedings CP908, 2024*(30), 475–481. Stevenage, UK: The Institution of Engineering and Technology. https://doi.org/10.1049/icp.2025.0295.

[2] Mitra, S. (2024). AI-driven predictive models for traffic flow in IoT-driven smart cities. *Uncertainty Discourse and Applications, 1*(2), 170–178.

[3] Badii, A., Carboni, D., Pintus, A., Piras, A., Serra, A., Tiemann, M., & Viswanathan, N. (2013). CityScripts: Unifying Web, IoT and smart city services in a smart citizen workspace. *Journal of Wireless Mobile Networks, Ubiquitous Computing, and Dependable Applications, 4*(3), 58–78.

[4] Haldorai, A., Murugan, S., & Balakrishnan, M. (2024). Empowering smart cities: AI-driven solutions for urban computing. In *Artificial Intelligence for Sustainable Development* (pp. 197–208). Cham: Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-53972-5_10.

[5] Raman, A., Arokiasamy, A. R., Batumalai, C., Kuppusamy, M., Balakrishnan, R., & Louis, S. A. (2024). A trust-based security and privacy protection for data collection in smart city. *Journal of Internet Services and Information Security, 14*(3), 18–28. https://doi.org/10.58346/JISIS.2024.I3.002.

[6] Chintala, S. (2024). Harnessing AI and BI for smart cities: Transforming urban life with data driven solutions. *International Journal of Science and Research (IJSR), 13*(9), 337–342. https://doi.org/10.21275/SR24902235715.

[7] Senthil, T., Rajan, C., & Deepika, J. (2022). An efficient handwritten digit recognition based on convolutional neural networks with orthogonal learning strategies. International Journal of Pattern Recognition and Artificial Intelligence, 36(01), 2253001. https://doi.org/10.1142/S0218001422530019.

[8] Senthil, T., & Deepika, J. (2025). Ruggedized RF transmitter design for high-temperature aerospace environments. National Journal of RF Circuits and Wireless Systems, 3(2), 50–56.

[9] Lemeon, M., & Caddwine, H. (2025). Energy-efficient 3D-stacked CMOS–memristor hybrid architecture for high-density non-volatile storage in edge computing systems. Journal of Integrated VLSI, Embedded and Computing Technologies, 2(3), 38–46.

[10] Tandi, M. R., & Shrirao, N. M. (2025). Deep residual U-Net for accurate medical image segmentation in limited data scenarios. National Journal of Signal and Image Processing, 1(4), 30–37.

[11] Arvinth, N., & Gichoya, D. (2025). A scalable reconfigurable processor architecture for heterogeneous edge computing applications. SCCTS Transactions on Reconfigurable Computing, 3(2), 40–48.

[12] Kumar, T. S. (2025). Preclinical Evaluation of Targeted Nanoparticle-Based Drug Delivery in Triple-Negative Breast Cancer. Frontiers in Life Sciences Research, 14-22.

[13] Poornimadarshini, S. (2025). Mathematical Modeling of Rotor Dynamics in High-Speed Electric Motors for Aerospace Applications. Journal of Applied Mathematical Models in Engineering, 33-43.

[14] Kavitha, M., & Abdullah, D. (2023). Nutritional Transitions and the Rise of Non-Communicable Diseases in Urban Africa. National Journal of Food Security and Nutritional Innovation, 1(1), 17-24.

[15] Korada, L. (2021). Unlocking urban futures: The role of big data analytics and AI in urban planning – A systematic literature review and bibliometric insight. *Migration Letters, 18*(6), 775–795.

[16] Miladh, A., & Muralidharan, J. (2025). Wavelet-based multiresolution analysis for efficient compression of non-stationary signals in resource-constrained IoT devices. National Journal of Signal and Image Processing, 1(3), 8–14.

[17] Aleem, F. M., & Ulkilan, A. (2025). Spiking neural network-based neuromorphic signal processing for real-time audio event detection in low-power embedded smart sensors. Progress in Electronics and Communication Engineering, 3(2), 31–35.

[18] Ayesh, A. N. (2024). Enhancing urban living in smart cities using the Internet of Things (IoT). *International Academic Journal of Science and Engineering, 11*(1), 237–246. https://doi.org/10.9756/IAJSE/V11I1/IAJSE1127.

[19] Kalusivalingam, A. K., Sharma, A., Patel, N., & Singh, V. (2021). Enhancing smart city development with AI: Leveraging machine learning algorithms and IoT-driven data analytics. *International Journal of AI and ML, 2*(3).

[20] Baggyalakshmi, N., Harrsini, M. S., & Revathi, R. (2024). Smart billing software. *International Academic Journal of Innovative Research, 11*(1), 51–60. https://doi.org/10.9756/IAJIR/V11I1/IAJIR1106.

[21] Zafar, S. (2024). Smart cities: The role of AI in urban planning and sustainable development. *Artificial Intelligence Multidisciplinary Journal of Systems and Applications, 1*(1), 27–39.

[22] Garcia, E. (n.d.). Effective urban resilience through AI-driven predictive analytics in smart cities.

[23] Hadiyana, T., & Ji-hoon, S. (2024). AI-driven urban planning: Enhancing efficiency and sustainability in smart cities. *ITEJ (Information Technology Engineering Journals), 9*(1), 23–35. https://doi.org/10.24235/itej.v9i2.124.

[24] Abbas, M., Akhai, S., Abbas, U., Jafri, R., & Arif, S. M. (2025). AI-enabled sustainable urban planning and management. In *Real-World Applications of AI Innovation* (pp. 233–260). IGI Global Scientific Publishing. https://doi.org/10.4018/979-8-3693-4252-7.ch012.

[25] Addad, M., & Al-Taani, S. (2024). Leveraging AI for Energy-Efficient Smart Cities: Architectural and Urban Planning Solutions for Sustainable Growth—A Comparative Case Study of Amman City and International Examples. *Journal of Civil Engineering and Architecture*, *18*, 620-632. https://doi.org/10.17265/1934-7359/2024.12.006.

[26] Alnaser, A. A., Maxi, M., &Elmousalami, H. (2024). AI-powered digital twins and internet of things for smart cities and sustainable building environment. *Applied Sciences*, *14*(24), 12056. https://doi.org/10.3390/app142412056.

[27] Miftah, M., Desrianti, D. I., Septiani, N., Fauzi, A. Y., & Williams, C. (2025). Big data analytics for smart cities: Optimizing urban traffic management using real-time data processing. *Journal of computer science and technology application*, *2*(1), 14-23. https://doi.org/10.33050/corisinta.v2i1.56.

[28] Wasif, M. (2025). Smart City Development and AI: Revolutionizing Urban Infrastructure Optimization for Efficient Transportation Planning.

[29] Jayam, M. R. G., & Kanagavalli, V. AI-Based Smart City Simulation and Optimization Framework.

[30] Sanchez, T. W., Shumway, H., Gordner, T., & Lim, T. (2023). The prospects of artificial intelligence in urban planning. *International journal of urban sciences*, *27*(2), 179-194. https://doi.org/10.1080/12265934.2022.2102538.