Research Paper

AI-Driven Strategies for promoting Walkability in Riyadh, A New Urbanism Framework

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Abstract

Riyadh city's rapid urbanization, guided by Saudi Arabia's Vision 2030, causes critical challenges to its urban liveability as the city expansion causes growing car dependency which negatively impact human mobility and air quality. Moreover, it is evident that Riyadh city experiences walkability deficiency and non-human-centred public spaces, which diminishes the opportunities for social interaction and better quality of life. Artificial Intelligence (AI) presents transformative opportunities to address these concerns through utilizing its technologies within the urban built environment. With this motivation, this study explores the integration of AI technologies with New Urbanism Principles aiming to present a comprehensive urban transformation model that could help mitigate these challenges, with particular emphasis on promoting and enhancing walkability, in Riyadh city Kingdom of Saudi Arabia. The research utilizes a multi-stage qualitative methodology, starting with a literature review to establish the synergy between AI technologies and New Urbanism Principles, followed by a comparative analysis of the best global practices that employed the AI technologies to enhance and promote human experience in the built environments. Synthesizing all the findings, the paper presents a comprehensive urban transformation model for Riyadh City to enhance walkability, as well as introducing more inclusive public areas and mixed-use developments. Furthermore, this study provides guidelines for urban planners and policy makers for integrating AI tools in urban design processes, fostering collaboration with stakeholders and generating policies that prioritize walkability and community engagement. This integrated model offers framework for strategies aligned with Vision 2030's Quality of Life program, to provide a way towards transforming Riyadh into a more sustainable, vibrant and human-cantered metropolis. This research can be considered as relevant contribution to the dialogue on sustainable urban planning, within KSA Vision 2030, offering actionable framework that can guide policies and practices for cities with similar challenges globally.

Keywords

AI and Urban Planning, New Urbanism, Walkability, Sustainable urban development, Human-centric design, Saudi Vision 2030, Riyadh

1. Introduction

1.1 Riyadh Urbanization and Challenges

Riyadh, the capital of Saudi Arabia, has undergone significante urban changes starting the mid-20th century due to oil revenue, a rising population, and economic diversification. From 1990 to 2014, the urban area expanded at an average rate of 9.4% per year, resulting in urban sprawl that hampered pedestrian access and caused long travel distances (Aldegheishem, 2023), in addition to habitat destruction, traffic issues, ecological degradation, and sustainability challenges and extreme heat (Anwar et al., 2023). The existing urban environment prioritizes vehicles without giving any attention to pedestrian needs resulting in separate residential zones and inadequate access to daily distenations such as educational institutions. The existing urban structure is unsustainable; therefore, planning must align with Saudi Vision 2030 to provide enduring growth (Alosaimi et al., 2025).

Riyadh features significant walkability issues, marked by a car-centric urban design and insufficient pedestrian infrastructure which is documented in literature such as the conducted survey of 302 participants which indicated primary obstacles such as inadequate facilities, environmental discomfort, and lack of safety measures (Alkrides et al., 2025). Moreover, Riyadh's urban environment favors cars over pedestrians, with older traditional neighborhoods exhibiting slightly superior walkability ratings. Particular issues involve severe weather conditions, insufficient shade, inadequate sidewalks, and restricted pedestrian-friendly architecture which

indicate an urgent necessity for reliable urban redesign to enhance walkability and sustainable mobility (Rezzoug et al., 2025).

New Urbanism is one of the primary urban design concepts, its principles guides achieving human-centric environments that promotes walkability and reduce vehicle reliance (Porwal & Sharma, 2024). These design strategies encourage walking and also advance overarching urban sustainability objectives, such as less air pollution and enhanced public health (Iravani & Rao, 2020).

Literature continually shows that active urban design has the potential to transform vehicle-dominated areas into pedestrian-friendly environments. Conversely, Artificial Intelligence (AI) has a significant potential to enhance urban livability by transforming city management, infrastructure, and resident services through data-driven technology (Ullah et al., 2024).

1.2 Research Aim

This study seeks to investigate the synergy between (AI) technology and New Urbanism concepts to improve urban walkability, especially in difficult dry conditions. The main objectives are:

1. Propose a new comprehensive model for reliable urban transformation that utilize AI dimensions for promoting Walkability in Riyadh.
2. Analyze global case studies of AI technologies integration in urban design to enhance pedestrian-friendly environments, and study their relevance to Riyadh

1.3 Significance of Study

This study is in aligned with Saudi Arabia's Vision 2030, especially its Quality-of-Life Program, which seeks improving the quality of life in Saudi cities and the users' well-being. It can assist with Sustainable Development Goal (SDG) 11, which seeks making cities more sustainable and inclusive by focusing on AI-enhanced designs. The findings are relevant worldwide and provide insights into fast urbanizing cities in dry or developing regions. They also emphasize the role of implementing technology into urban design to achieve humanizing cities.

1.4 Organization of the Manuscript

The document is organized as follows: Section 2 examines the literature about New Urbanism, AI applications in urban planning, and walkability in arid environments. Section 3 presents the methodology of the study. Section 4 provides a study of international case studies that utilize AI and New Urbanism. Section 5 presents a customized transformation model for Riyadh. Section 6 for the discussion addressing impact of AI tools on promoting walkability in Riyadh, and avenues for further research, and Section 7 culminates with insights and conclusion.

2. Literature Review

This study conducted a literature review to study the theoretical background of New Urbanism, the application of AI technologies in the context of urban design, and the synergy between them. Additionally, walkability metrics and human-centric design were studied through the examination of known frameworks, and qualitative indicators.

2.1 Theoretical Foundation of New Urbanism

New Urbanism is a reformative theory that emerged in the 1980s, examining the weakness of 20th-century urban design, heavily influenced by the 1933 Athens Charter. In the 1991 Ahwahnee principles was the first formalization of new urbanism guidelines and was articulated again in the 1996 Charter of New Urbanism, which emphasized a supportive urban framework for human well-being. The New Urban Agenda in 2016 presented by the UN got recognized globally, incorporating key new principles for sustainable urban development. (Mehaffy & Haas, 2020) The Congress for the New Urbanism (CNU) developed the Charter of the New Urbanism, which

includes 27 detailed principles, the application of these principles can acheive promoting walkable neighborhoods to promote social, economic, and environmental sustainability.

2.2 AI Technologies in Urban Planning and Design

In urban planning and design, there are plenty of uses for different AI technologies such as machine learning (ML), big data analytics, and robotics, to facilitate decision making and predictive modeling. These AI-tools help optimize many fields such as transportation and enhance citizen engagement, addressing many urbanization challenges (He & Chen, 2024). Applications include PlanFinder for design generation and Luma for visualization, while AI models like "Generative Adversarial Networks (GANs)" create urban layouts and can assess climate impacts (Sajjad Naseri, 2024). Additionally, Machine Learning enhances both traffic management and urban design adaptability (Y. Li et al., 2023; Sanchez et al., 2024), and Natural Language Processing (NLP) derives data and ideas from public feedback to help in guiding the design process and enhance existing conditions (Yigitcanlar et al., 2020). Agent-based modeling (ABM) can act as a key simulation technique for urban modeling, resulting in guided decision making in the planning process based on human behavior and needs (Crooks et al., 2021). Moreover, established software like NetLogo and AnyLogic provide strong base for these tools, promoting evidence-based urban development (JCoDe et al., 2021).

2.3 Synergy between AI and New Urbanism Principles for promoting walkability

AI technologies has the capability of enhancing urban walkability through several creative methods and datasets, these AI-driven improvements cause paradigm shifts in the design process and designs, as they identify integration gaps in the planning perspective and actual operation. They assess both all the involved factors to better guide pedestrian networks planning and promote transit-oriented developments (Delavar et al., 2025; Xiao & Song, 2024). NLP tools can help facilitating the collection of community feedback for better synthesizing the community actual needs, towards promoting walkability following users' requirements (Ötleş et al., 2021). In a different area; Computer vision (CV), which is used in line with street view data, is employed to in real time evaluation of visual quality, walkability, and urban disarray facilitating swift assessment of the pedestrian environment and highlighting the areas that require enhancement. Additionally, Frameworks like "GraphSAGE-LSTM" utilize both collected community data and CV to accurately simulate pedestrian comfort, that resulted in over 20% more accuracy than current models (Peng et al., 2024). Models that utilize deep learning such as DS-HRNet uses "urban big data" along with automate evaluation techniques to facilitate extensive assessments of street-level walkability (Huang et al., 2014; Xiao & Song, 2024). As for improving thermal comfort, AI-driven generative design optimizes urban designs to create "walkable urban cool area". (Y. Li et al., 2023). Furthermore, AI "clustering algorithms" like K-Means analyze urban datasets to better guide informing decisions on walkability and cyclability, aiding urban planners in creating adaptable sustainable urban strategies. (He & Chen, 2024)
All the above demonstrates substantial synergies between New Urbanism and AI technologies. New Urbanism prioritizes human-centric, pedestrian-friendly urban designs to help towards minimizing vehicle-reliance and promote communities that could be described as friendly, as articulated in the Charter of the New Urbanism. Table 01 demonstrates the fundamental technological tools utilized in urban planning and design, their particular applications in designing urban spaces, and the impact it has on promoting walkability, derived from recently published academic literature.

Table 01: AI Technologies towards promoting Walkability

AI Technology	Urban Planning Application	Walkability Impact
ML/DL	Pattern Recognition and sPrediction	Identifies Walkability Barriers and guides interventions
Computer Vision (CV)	Street view analysis and mapping	Assess pedestrian paths and guides updating walkability maps

NLP/LLMs	Stakeholders engagements/ Feedback analysis	Aligns improvements with community needs collected
Generative Models	Scenario Visualization/ Urban grid layout enhancement	Facilitates walkability-oriented designs/ Improve proximity, transit access and land use diversity
Agent Based Modeling	Walkable network simulation	Promote walkable accessible neighborhoods

2.4 Walkability metrics and Human Centered Design

Walkability indicators are essential for urban planning as they assess areas suitability to pedestrian activity to enhance community public health. These walkability metrics focus on many factors such as connectivity and accessible areas, land use, and the quality of pedestrian walkways, (Lo, 2011) emphasize consensus factors such as sidewalk accessibility and street connectivity, whereas (Riggs, 2017) concentrates on proximity to services and junctions denisty. Furthermore, (Abdelfattah et al., 2025) substantiate these findings with Frank Lawrence's framework on density and mixed-use development. Additionaly, (Zakaria et al., 2025) outlines eight performance metrics, encompassing safety and aesthetics, while (Blečić et al., 2015) have significantly critiqued currently used metrics as they are considered not able to diffrentiate between demographic and social and economic factors. It was concluded that the principal indicators for walkability encompass density, mixed-use development, street design, accessibility to destinations, being proximate to public transportation, socio-environmental elements, perceived friendliness, and demographic characteristics.

3. Methodology

This study adopts a multi-stage qualitative research methodology (as shown in Figure 01), this method is considered fit for urban design research because it emphasise on interpretive and exploratory approaches. Qualitative methodologies in urban planning enable understanding of complexity of socio-spatial phenomena, such as the integration of AI with New Urbanism principles, through investigating contextual significances, and emerging paradigms. This study clarifies the main aspects of walkability through interpretation of human-centric design and utilizing theoretical frameworks of New Urbanism to show how AI may enhance human-centric environments within Riyadh's unique desert and cultural environment. The exploration of literature and previous case studies can guide the discovery of novel synergies and applications, therefore permitting adaptation into a conceptual framework.

The multi-stage process progresses methodically as follows: initially, a literature review (Stage 01) consolidates existing knowledge on AI technologies and New Urbanism, establishing theoretical connections; subsequently, (Stage 02) analysis of global case studies to study best practices to derive tested strategies; finally, (Stage 03) data synthesis combine all the resulted findings into a proposed urban transformation model for Riyadh, employing conceptual mapping to investigate workable guidelines.

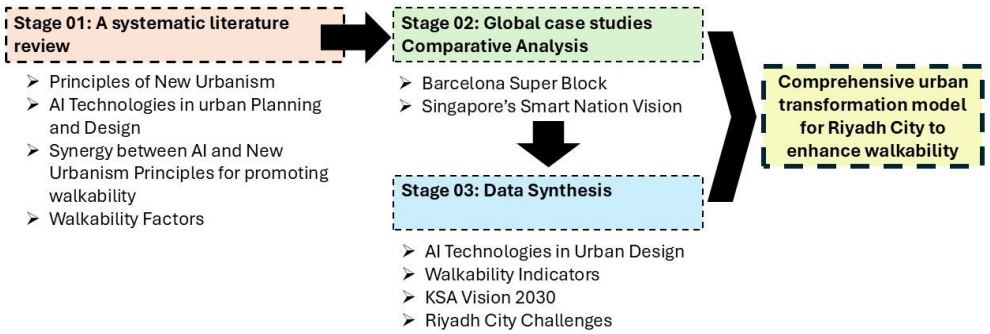


Figure 01: Stages of the study's Methodology (by the researchers)

4. Analysis of Global Best Practices

4.1 Criteria for Selection

Both models were chosen because they use AI to manage public spaces. Also cases that focused on making walking safer, more comfortable, and more sustainable. It fits with Saudi Arabia's urban situation (Vision 2030): the models offer flexible strategies that work with Saudi Arabia's Smart City projects and the Quality of Life Program and Vision 2030 goals.

4.2 Analysis of Barcelona case study

Barcelona's Superblocks project is a major step forward in changing cities as it changed how people get around, , and how easy it is to walk in small cities (Rueda, 2018). The city successfully reduced air pollution, noise levels, and the dominance of cars by reorganizing traditional city grids into interconnected zones that prioritize pedestrians (Nieuwenhuijsen et al., 2024), improving both physical and social connectivity. The Superblocks design incorprates slow-traffic streets, shaded public spaces, and bike lanes that make it easier for people to get around in an environmentally friend way (Ajuntament de Barchelona, 2016). Table 02 demonstrates Barcelona case study that analysing AI as a key part of Barcelona's Superblocks strategy as data are used to help improve pedestrian flows, make the city safer, and help with adaptive planning.

4.3 Analysis of Singapore Case study:

Singapore's Smart Nation Vision (2014–2030) is one of the most plans in the world for integrate AI, big data analytics, and digital governance into the daily life aiming at to making cities more livable, sustainable, and mobile by using smart technologies in the urban environment (MDDI, 2024). This project utilizes data-driven decisions that will improve both infrastructure performance and the experience of citizens (N. Li, 2023; LTA Annual Report, 2019). The Virtual Singapore project, a key part of this change, is a dynamic three-dimensional digital twin of the city that combines geospatial, environmental, and demographic data. This platform allows for predictive urban modeling, simulation of pedestrian and vehicular flows, and testing of design interventions prior to implementation (Report, 2023; Urban Redevelopment Authority-Singapore, 2021a). A summary of the Singapore case study analysis is presented in Table 3.

Table 02: Enhancing AI standards and solutions for enabling walking in Barcelona

Walkability Factors	AI urban domain	Description	References
Accessibility & mobility	**ML/IOT**	Forecast pedestrian and traffic flows to optimize connectivity and reduce travel time. Real-time tracking of pedestrian mobility and smart crossings.	(Ajuntament de Barchelona, 2016b; Nieuwenhuijsen et al., 2024b; Salvador Rueda, 2019)
	CV	Analyze pedestrian density and accessibility by video data	(Sollazzo, 2022)
	GM	Generate alternative pedestrian network layouts	(Salvador Rueda, 2019)
	ABM	Simulate pedestrian flow scenarios and network efficiency	(Nieuwenhuijsen et al., 2024b)
	NLP	Linguistic data to understand users' experiences in public space. Integration of Social and Spatial Data to Improve Access.	(Nieuwenhuijsen et al., 2024b; Salvador Rueda, 2019; Sollazzo, 2022)
Human Scale	**ML/IOT**	Estimate crowd flows to design adaptable spaces. Smart benches, lighting, and irrigation	(Ajuntament de Barchelona, 2016b; Nieuwenhuijsen et al., 2024b; Salvador Rueda, 2019)
	CV	Monitor user activity, seating, and behavior in spaces.	(Sollazzo, 2022)
	GM	Propose street furniture layouts and micro-place making elements.	(Nieuwenhuijsen et al., 2024b; Salvador Rueda, 2019)

	ABM	Test behavioral interaction of public spaces.	(Nieuwenhuijsen et al., 2024b)
	NLP	Social Interaction in Public Space quality of public space through the integration of NLP and smart spatial systems	(Gehl j., 2010; Nieuwenhuijsen et al., 2024b; Sollazzo, 2022)
Safety &Security	**ML/IOT**	Predict risk-prone areas through proactive measures. Smart sensors detect motion and lighting	(Nieuwenhuijsen et al., 2024b; Sanyal et al., 2023)
	CV	Detect unsafe crossings and near-miss events	(Sollazzo, 2022)
	GM	Design safer street based on behavioral data.	(Salvador Rueda, 2019)
	ABM	Model accident probability and test intervention impacts.	(Nieuwenhuijsen et al., 2024b)
	NLP	Analysis of Community Texts to Monitor Security and Behavioral Problems in the Urban Sphere.	(Salvador Rueda, 2019; Sollazzo, 2022)
Mixed- Use & proximity	**ML/IOT**	Forecast service demand. IOT networks track functional proximity of services.	(Nieuwenhuijsen et al., 2024b; Salvador Rueda, 2019)
	CV	Track usage patterns of amenities and facilities	(Sollazzo, 2022)
	GM	Simulate mixed-use clustering for efficient access.	(Salvador Rueda, 2019)
	ABM	Model accessibility scenarios within the 15-minute city concept.	(Nieuwenhuijsen et al., 2024b)
	NLP	Integrate NLP with Spatial Data Systems to Enhance Functional Balance within Neighborhoods	(De Boeck, 2021; Nieuwenhuijsen et al., 2024b)
Socio cultural and friendliness	**ML/IOT**	Analyze data from urban sensors to understand patterns of use of public spaces and social interaction	(Nieuwenhuijsen et al., 2024b; Salvador Rueda, 2019)
	CV	Analyze camera images to extract data on the intensity of human interaction, movement patterns, and social behavior in spaces.	(Salvador Rueda, 2019)
	GM	Generating urban design alternatives based on social and behavioral data.	(De Boeck, 2021; Salvador Rueda, 2019)
	ABM	Simulate the behavior of individuals in public spaces and monitor patterns of social interaction.	(Nieuwenhuijsen et al., 2024b; Salvador Rueda, 2019)
	NLP	By identifying weaknesses and strengths in the quality of urban life, and supporting decision-making.	(Ajuntament de Barchelona, 2016b)
Comfort & Climate	**ML/IOT**	Anticipate thermal comfort patterns to plan shaded routes and rest zones.Heat, noise, and pollution sensors	(Ajuntament de Barchelona, 2016b; Nieuwenhuijsen et al., 2024b)
	CV	Assess heat exposure and sunlight patterns	(Sollazzo, 2022)
	GM	Optimize shade and material selections	(Salvador Rueda, 2019)
	ABM	Simulate thermal environments and comfort levels.	(Nieuwenhuijsen et al., 2024b)
	NLP	Employing NLP in Predictive Climate Modeling and Interactive Design for Environmental Comfort	(De Boeck, 2021)

Table 03: Enhancing AI standards and solutions for enabling walking in Singapore

Walkability Factors	AI urban domain	Description	References

Accessibility & mobility	**ML/IOT**	Mapping foot O–D via Bluetooth/LBS to reveal missing pedestrian links and prioritize cut-through near MRT/bus stations	(Authority, 2022; Land Transport Authority, 2019)
	CV	Analyze pedestrian density and detect accessibility barriers in downtown areas.	(Urban Redevelopment Authority-Singapore, 2021)
	GM	Generate alternative for walkways and crossings based on pedestrian heat maps and travel-time.	(Buda et al., 2023)
	ABM	3D digital twin computes 5/10/15-min walksheds; simulates routing during works/events	(Urban Redevelopment Authority-Singapore, 2021)
	NLP	Analyze textual data to improve mobility experience Integrate NLP with spatial models and geo data.	(Land Transport Authority, 2019; Urban Redevelopment Authority-Singapore, 2021)
Human Scale	**ML/IOT**	Anonymous device pings for dwell time & co-presence; informs seating clusters & layouts Crowdsourced micro-audits (width/shade/crossings);	(Authority, 2022; B. Li et al., 2023)
	CV	CV models classify sitting/standing/play/micro-events; guides furniture & shade placement	(B. Li et al., 2023)
	GM	Simulate user interaction in virtual environments to assess accessibility, safety, and inclusivity.	(B. Li et al., 2023)
	NLP	Integrating NLP with Digital Twins to Analyze Behavioral Patterns in Public Spaces	(Authority, 2022; Buda et al., 2023)
Safety &Security	**ML/IOT**	Combines crash, speed, curb geometry KSI risk; outputs black-spot treatments Edge models flag lighting failures & low-presence segments; dispatch maintenance	(Bachanek et al., 2021; Bank, 2019; *Lta Annual Report 2020/21*, 2020)
	CV	Detect unsafe crossings, violations, near-misses	(Urban Redevelopment Authority-Singapore, 2021)
	NLP	Analyze text reports to enhance intelligent security response	(Bachanek et al., 2021; Lta Annual Report 2020/21, 2020; Urban Redevelopment Authority-Singapore, 2021)
Mixed- Use & proximity	**ML/IOT**	Graph centrality & catchments reveal amenity gaps in 800–1200m walksheds Collect real-time data on user movements between residential, retail, and recreation areas.	(B. Li et al., 2023; Urban Redevelopment Authority-Singapore, 2021)
	GM	Generative setbacks/arcades maximize continuous shade & active edges	(Urban Redevelopment Authority-Singapore, 2021)
	ABM	Agent-based itineraries quantify trip substitution when new connectors/arcades added	(Authority, 2022)
	NLP	Analyze planning and community texts to understand land use patterns and services	(Szczepánska et al., 2023; Urban Redevelopment Authority-Singapore, 2021)
Socio cultural and friendliness	**ML/IOT**	Analyze real-time data from sensors to understand patterns of social interaction within public spaces,	(Upadhyay et al., 2022; Urban Redevelopment Authority-Singapore, 2021)

	CV	Determine the density of gatherings, the extent of demographic diversity, and movement. Monitor the use of spaces by older people and children.	(Land Transport Authority, 2019; Urban Redevelopment Authority-Singapore, 2021)
	GM	Generate design alternatives for public spaces based on data on social behavior, population density, and cultural activities. Assess the impact of future design decisions on social cohesion and urban belonging.	(Szczepánska et al., 2023; Urban Redevelopment Authority-Singapore, 2021)
	ABM	Simulated thousands of 'virtual agents' representing populations of different ages, culture, and movement patterns.	(Bachanek et al., 2021; Urban Redevelopment Authority-Singapore, 2021)
	NLP	Determine the level of social satisfaction and cultural affiliation of citizens. Integrated with spatial data systems to provide urban friendliness maps.	(Bachanek et al., 2021; Urban Redevelopment Authority-Singapore, 2021)
Comfort & Climate	**ML/IOT**	Anticipate microclimate variations to plan shaded pedestrian corridors and rest zones. Real -time noise/PM sensors trigger dynamic screens & low-noise timing plans	(Authority, 2022; Urban Redevelopment Authority-Singapore, 2021)
	CV	Downscales LST via street-level imagery; informs shading retrofits on arcades/connectors	(Urban Redevelopment Authority-Singapore, 2021)
	ABM	Microclimate digital twin simulates wind/shade/radiant exchange - 'cool corridors'	(Szczepánska et al., 2023)
	NLP	Analysis of environmental texts to assess thermal comfort and pedestrian behavior	(Bachanek et al., 2021; Urban Redevelopment Authority-Singapore, 2021)

5. The new urbanism model (AI-UDM)

The model presents an extensive approach that combines walkability indicators with AI factors to make new analytical tools that help with intelligent urban design and redesign projects. The framework is built on the idea that AI technologies like digital twins, predictive analytics, and computer vision can work with human-centered design principles and walkability metrics such as safety, accessibility, and connectivity. This integration makes dynamic hybrid indicators that help cities make decisions and improve the quality of life for people. As illustrated in Figure 02, the proposed AI-UDM framework integrates key five AI urban domains with six core walkability indicators: mobility and accessibility, safety and security, human scale, mixed-use proximity, socio-cultural friendliness, and climate comfort to generate adaptive urban design outcomes aligned with Saudi Vision 2030's Quality of Life goals.

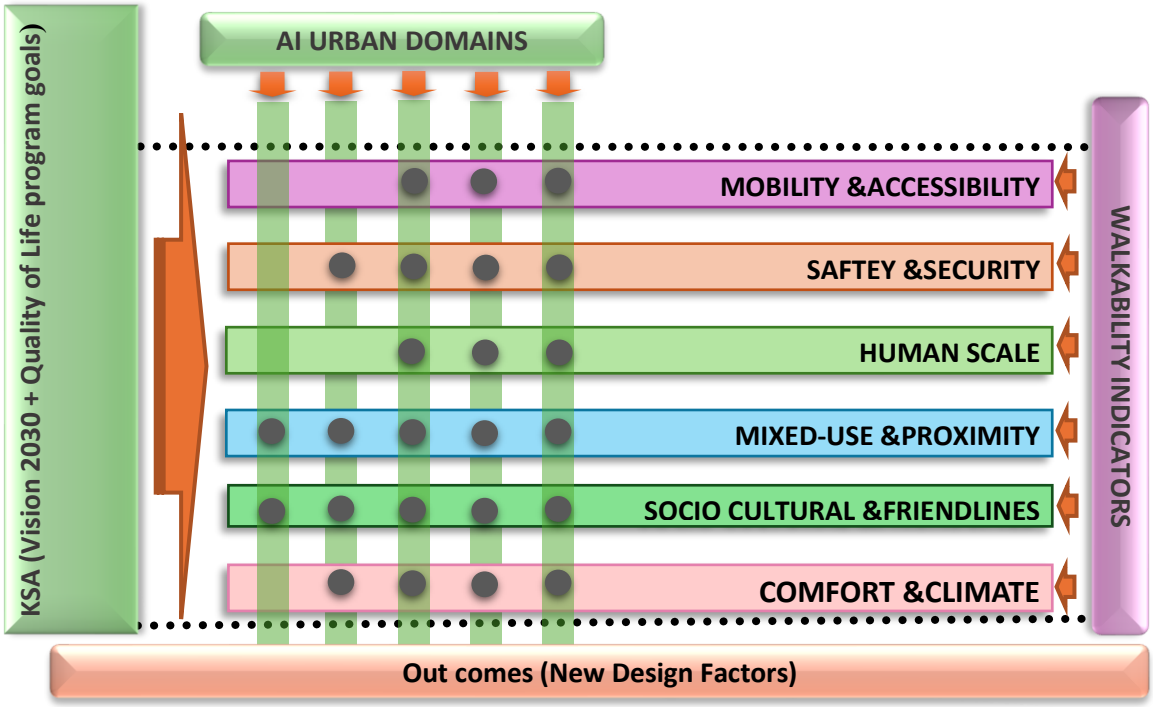


Figure 02: AI urban domain Model (AI-UDM) (By the researchers)

6. Discussion

6.1 Impact of AI urban domains on promoting walkability in Riyadh

The research demonstrated the application of tools such as Machine Learning (ML), Internet of Things (IoT), Computer Vision (CV), Agent-Based Modeling (ABM), Geospatial Modeling (GM), and Natural Language Processing (NLP) in the development of comprehensive urban domains that promote walkability in Riyadh.

Regarding mobility and accessibility, ML and IoT support predictive analysis of pedestrian and vehicular movement, improving transport connectivity, reducing congestion, and enhancing last-mile accessibility aligning with Quality of life program and Vision 2030. For urban safety and security, CV, ML, and smart sensing systems enable proactive identification of unsafe crossings and high-risk pedestrian zones, allowing anticipatory design interventions and more responsive public spaces.

Emphasizing on the value of human-scale urban design, ABM and GM simulate pedestrian movement, behavioural responses, and social interactions which in return shifts the planning from a purely physical exercise toward evidence-based, behaviour-informed urban design.

A further implication lies in supporting mixed-use proximity and 15-minute city principles, as ML and spatial analytics improve the evaluation of service distribution, land-use balance, and destination accessibility, helping reduce automobile reliance and strengthen urban resilience. In addition to AI's effective role in enhancing socio-cultural inclusivity and community cohesion through the use NLP, CV, and ABM. These frameworks capture public sentiment and social interaction patterns, reinforcing culturally responsive and human-cantered urban environments that responding to the real feedback of Riyadh's residents.

Finally, integrating ML, IoT, and generative modelling into thermal comfort and microclimatic design is especially relevant to Riyadh's arid climate as real-time monitoring of shading, cooling, and environmental conditions supports climate-responsive pedestrian networks and improving comfort.

6.2 Opportunities for Future research and initiatives

Future research seeks to confirm the AI-New Urbanism model through pilot studies in Riyadh such as AD'Diryah, emphasizing the integration of quantitative metrics to evaluate walkability effects through AI data analytics. Moreover, this framework could be customized for other Saudi cities like Jeddah and Dammam, or it could be adapted for dry cities around the world and to include innovative AI technologies, such as real-time digital twins, in scientific projects. In Alignment with Saudi 2030 Vision, future research should prioritize collaborative partnership with AI agencies, urban planning authorities and private sector to accelerate the development, testing and implementation of AI- drivin solutions in the built environment.

7. Conclusion

This study developed an integrated AI-driven urban design model (AI-UDM) that combines AI technologies with New Urbanism principles towards promoting walkability in Riyadh. The findings confirm that the merging AI tools, and human-cantered urban theory can provide a robust framework for addressing the cities' challenges of car dependency, fragmented public space, and limited pedestrian comfort.

By synthesizing insights from the literature, the best global practices, and Riyadh's specific socio-climatic conditions, the research demonstrates that AI can significantly strengthen evidence-based urban planning processes. The proposed framework supports dynamic assessment of walkability through multiple dimensions, including accessibility, safety, mixed-use proximity, socio-cultural interaction, and climate-responsive comfort. The study contributes to advancing the synergy between AI and New Urbanism offering an action planning model aligned with Saudi Vision 2030's Quality of Life and sustainability agendas.

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