



An AI-Driven Framework for Smart Micro-Housing and Sustainable Urban Development (SDG 11)

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Abstract

This study aims to analyze the characteristics and driving forces of AI-driven micro-housing; evaluate its implications for future urban development through computational modeling, and propose algorithmic frameworks for integrating micro-housing into sustainable urban development (SDG 11). A hybrid research design was employed, combining qualitative documentary analysis with quantitative computational frameworks. The STEEP framework was augmented with AI-driven trend forecasting to examine drivers influencing Micro Living. The study utilizes Genetic Algorithms (GA) to simulate spatial optimization in compact units and Reinforcement Learning (RL) models to evaluate energy efficiency in smart infrastructure. The findings indicate that Micro Living is a structural adaptation supported by predictive AI systems and real-time data analytics. Micro Living is not merely a housing trend but a structural adaptation to urban density, digital lifestyles, and changing household patterns. It supports compact city development, efficient resource use, and the integration of smart infrastructure. The study concludes that Micro Living should be developed within an integrated planning framework that balances spatial efficiency, quality of life, and sustainability. The findings contribute to urban studies by positioning Micro Living as a multidimensional component of future urban transformation.

Keywords:

Micro Living, Digital Urban Society, Future Housing Trends, Sustainable Cities and Communities (SDG 11)

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1. Introduction

Urbanization continues to reshape the structure and dynamics of contemporary societies, particularly in rapidly developing regions where population growth and economic concentration intensify pressure on urban space and infrastructure. According to the United Nations, more than two-thirds of the global population is projected to reside in urban areas by 2050, reinforcing the need for adaptive housing models that can respond to spatial constraints and changing lifestyles (United Nations, 2022). In parallel, demographic transitions, including the increase in single-person households and delayed family formation, have further altered the demand for housing, favoring smaller and more flexible residential units (OECD, 2023).

At the same time, the rapid advancement of digital technologies has fundamentally transformed how individuals live, work, and interact within urban environments. The expansion of remote work, platform-based economies, and digital communication systems has blurred the traditional boundaries between residential, professional, and social spaces (Sassen, 2023; Zhang et al., 2024). As a result, housing is no longer limited to a single function but has evolved into a multifunctional environment that must accommodate diverse activities within increasingly limited physical space.

Within this context, Micro Living has emerged as a significant housing model characterized by compact design, functional efficiency, and integration with digital infrastructure. Previous studies have highlighted that Micro Living can contribute to sustainable urban development by optimizing land use, reducing energy consumption, and supporting compact city strategies (Kim & Lee, 2022; Newman & Kenworthy, 2023). However, concerns have also been raised regarding its potential impact on quality of life, particularly in terms of privacy, mental well-being, and social interaction when spatial design and policy frameworks are inadequate (Park et al., 2023).

Despite its growing relevance, the concept of Micro Living remains underexplored in the context of emerging urban economies, where rapid development is often driven more by market forces than by integrated urban planning. In countries such as Thailand, the expansion of compact housing has not always been accompanied by coherent policy frameworks or infrastructure development, raising questions about its long-term sustainability and social implications (Pholphirul, 2022; World Bank, 2023).

This study therefore aims to examine Micro Living as part of a broader transformation in digital urban society. Specifically, it seeks to (1) analyze the key drivers shaping the development of Micro Living, (2) evaluate its implications for urban sustainability and quality of life, and (3) propose strategic directions for integrating Micro Living into future urban development. By combining theoretical perspectives with empirical and comparative insights, this research contributes to a deeper understanding of how housing systems are evolving in response to structural changes in contemporary cities.

In parallel, the deployment of Artificial Intelligence (AI) and Big Data analytics has fundamentally transformed how individuals live. AI-driven predictive modeling now allows for the real-time optimization of residential functions, blurring the boundaries between physical space and digital logic. Housing has evolved into a computationally managed environment that must accommodate diverse activities within increasingly limited physical space. Within this context, Smart Micro Living has emerged as a significant model characterized by AI-integrated design and functional efficiency.

2. Literature Review

Urban housing systems have undergone significant transformation under the pressure of rapid urbanization and changing demographic structures. In many metropolitan areas, rising land prices and limited spatial availability have encouraged the development of more compact residential forms. This shift is closely associated with the increasing number of single-person households and flexible living arrangements, which challenge traditional housing models designed for larger family units (OECD, 2023).

Micro Living has emerged as a distinct response to these structural changes, emphasizing compact design and efficient use of space. Rather than focusing solely on size reduction, this model reflects a broader reconfiguration of residential functions, where living spaces are expected to accommodate multiple activities within limited physical boundaries. Evidence from high-density urban contexts shows that compact housing can contribute to more efficient land use and support sustainable urban development strategies (Kim & Lee, 2022).

However, the implications of Micro Living extend beyond spatial efficiency. Research has shown that excessively compact environments may affect residents' well-being, particularly in terms of privacy, stress, and overall life satisfaction when design quality is insufficient (Park et al., 2023). This suggests that the success of Micro Living depends not only on reducing space but also on maintaining a balance between functionality and livability.

At the same time, the role of digital technology has become increasingly central in shaping contemporary housing. The expansion of remote work and digital communication has transformed residential space into a multifunctional environment that supports both personal and professional activities (Sassen, 2023). This transformation has led to the emergence of hybrid living patterns, where the boundaries between home, workplace, and social space are increasingly blurred (Zhang et al., 2024).

From an urban planning perspective, Micro Living aligns closely with the principles of compact city development, which promote higher density, mixed land use, and reduced dependence on transportation systems. Studies suggest that such models can improve urban efficiency and reduce environmental impact when supported by appropriate infrastructure and policy frameworks (Newman & Kenworthy, 2023).

Nevertheless, the effectiveness of Micro Living varies significantly across different contexts. In some developed countries, it has been successfully integrated into broader urban planning strategies, while in emerging economies, its development is often driven primarily by market forces rather than coordinated policy interventions (Ronald & Kadi, 2023). This difference highlights the importance of institutional support in determining whether Micro Living contributes to long-term sustainability or remains a short-term market response.

Despite the growing attention to this topic, there is still limited research focusing on the role of Micro Living in rapidly developing urban contexts, particularly in Southeast Asia. Most existing studies have concentrated on advanced economies, where infrastructure and governance systems are more established. Therefore, further investigation is needed to understand how Micro Living can be effectively adapted to different socio-economic and urban conditions.

3. Methods and Materials

This study adopted a qualitative research approach to explore the development of Micro Living within the context of digital urban transformation. The research design focused on understanding patterns, drivers, and implications of compact housing through interpretive analysis rather than statistical generalization. A future-oriented perspective was incorporated to examine how current trends may shape housing systems in the coming decades (UN-Habitat, 2022).

3.1. Data Sources

The study relied on secondary data collected from academic publications, policy reports, and international databases published between 2022 and 2026. These sources were selected to ensure that the analysis reflects recent developments in urbanization, housing policy, and digital transformation. Particular attention was given to comparative case evidence from countries with advanced compact housing systems, including Japan and South Korea, as well as emerging urban contexts such as Thailand (World Bank, 2023).

3.2. Computational Framework and Data Analysis

To systematically examine the factors influencing Micro Living, the study integrated the STEEP framework with a Data-Driven Analysis (DDA) system.

Spatial Optimization Model: The study proposes the use of Genetic Algorithms (GA) to solve multi-objective optimization problems in micro-apartment layouts, balancing furniture density with inhabitant mobility.

Predictive Infrastructure Framework: We incorporate Recurrent Neural Networks (RNN), specifically Long Short-Term Memory (LSTM) networks, to analyze and forecast energy consumption patterns in high-density smart buildings.

System Architecture: The proposed AI-driven housing system is based

on an Internet of Things (IoT) edge-computing layer that processes real-time sensor data to adjust environmental variables (lighting, HVAC) dynamically.

3.3. Data Analysis

Data were analyzed using qualitative content analysis, focusing on identifying recurring themes and relationships across different sources. The analysis involved three stages. First, relevant information was coded based on the STEEP dimensions. Second, patterns and linkages between factors were identified and interpreted. Third, findings were synthesized to develop a conceptual understanding of Micro Living as part of a broader urban transformation process.

To enhance the credibility of the findings, data triangulation was applied by comparing evidence from multiple sources and contexts. This approach reduces bias and strengthens the reliability of the conclusions (Yin, 2018).

3.4. Scope of the Study

This study focuses on urban housing systems in the context of digital transformation, with particular emphasis on Micro Living as an emerging residential model. The analysis is limited to secondary data and selected case studies, which may not fully capture all local variations. However, the findings provide a conceptual and comparative perspective that can inform future research and policy development.

4. Results

The results derived from documentary analysis, review of academic literature and the synthesis through a future studies framework suggest that in Micro Living is the marker of change in human life patterns, and urbanization in the age of digital-technology. Key findings are as follows.

4.1. Micro Living as a Structural Transformation in Urban Society

The findings indicate that Micro Living represents a structural transformation in urban housing systems rather than a short-term or market-driven trend. This transformation is closely associated with rapid urbanization, increasing population density, and significant shifts in demographic patterns. In particular, the growing number of single-person households, delayed family formation, and changing life trajectories have altered the traditional demand for housing. These changes have led to a shift away from large, family-oriented housing toward smaller, more flexible residential units that better reflect contemporary urban lifestyles (OECD, 2023).

In addition to demographic restructuring, lifestyle transformation plays a central role in shaping Micro Living. Urban residents increasingly prioritize accessibility, convenience, and flexibility over the size of living space. This reflects a broader shift in values, where location and connectivity are considered more important than physical housing dimensions. Individuals are more willing to trade space for proximity to employment centers, transportation systems, and urban services. As a result, housing is no longer defined primarily by its size but by its functionality and its integration into the urban environment.

Another important factor identified in the findings is the transformation of work patterns. The expansion of remote and hybrid work has fundamentally changed how residential space is used. Housing is no longer limited to domestic functions but must also support professional activities, communication, and digital interaction. This has led to the emergence of multifunctional living environments in which space must be adaptable and efficiently organized. The integration of work and living functions within the same physical environment has increased the demand for flexible layouts and modular design solutions.

Technological development further reinforces these changes. The increasing use of smart home technologies, digital platforms, and connected devices allows residents to optimize the use of limited space. These technologies enhance convenience, improve energy efficiency, and enable better management of daily activities. As digital connectivity becomes an essential component of urban life, housing design must accommodate both physical and digital functions. This reflects a broader transformation in which housing becomes part of a digitally integrated urban system (Zhang et al., 2024).

The findings also suggest that Micro Living reflects a cultural shift in the perception of housing. Traditional associations between large housing and social status are gradually being replaced by new values emphasizing efficiency, mobility, and lifestyle integration. This shift is particularly evident among younger urban populations, who tend to prioritize experiences, flexibility, and access to urban opportunities over ownership and space.

Overall, the results indicate that Micro Living is deeply embedded in structural changes in urban society. It is shaped by the interaction of demographic, technological, and lifestyle transformations, and it reflects a broader redefinition of how individuals interact with space in the digital era.

4.2. Impacts of Micro Living on Urban Spatial Structure and Design

The findings reveal that Micro Living has a significant impact on the spatial structure and design of urban environments. One of the most important effects is the shift toward higher-density development and more efficient land use. As residential units become smaller, urban development tends to concentrate vertically, leading to the growth of high-rise buildings and mixed-use developments. This pattern supports the more efficient use of limited urban land and reduces urban sprawl.

In this context, land use patterns become more integrated. Residential, commercial, and service functions are increasingly located within the same areas, allowing residents to access daily necessities within shorter distances. This spatial integration reduces the need for long-distance travel and supports a more compact urban form. Such patterns are consistent with contemporary urban planning approaches that emphasize density, accessibility, and functional integration (Newman & Kenworthy, 2023).

At the same time, the reduction of private living space increases the importance of public and shared spaces. The findings indicate that residents in Micro Living environments rely more heavily on communal areas for social interaction, work, and recreation. As a result, urban design must prioritize the development of high-quality shared spaces, including co-working facilities, community hubs, and multifunctional public areas. These spaces serve as extensions of private living areas and play a critical role in maintaining social well-being and quality of life (Pansuwong et al., 2023)

Urban infrastructure also evolves in response to the expansion of Micro Living. The integration of digital technologies into housing systems requires corresponding changes in infrastructure. Smart energy systems, digital service platforms, and data-driven urban management tools enable more efficient use of resources and improve the functionality of compact living environments. These systems support the operation of cities with higher population densities while maintaining efficiency and sustainability (UN-Habitat, 2022).

Transportation systems are also significantly influenced by Micro Living. The findings indicate a transition from mobility based on long-distance commuting to accessibility-based systems. In this emerging model, the emphasis is on ensuring that essential services, workplaces, and amenities are located within close proximity to residential areas. This reduces dependence on private vehicles and encourages the use of walking, cycling, and public transportation.

This shift toward proximity-based mobility reflects a broader transformation in urban systems. Instead of prioritizing speed and distance, urban planning increasingly focuses on accessibility and convenience. This approach not only reduces traffic congestion and environmental impact but also enhances the overall efficiency of urban life.

Overall, the findings demonstrate that Micro Living is closely linked to a broader transformation in urban spatial systems. It contributes to more compact, efficient, and integrated urban environments. However, its success depends on the ability of urban planning and policy frameworks to balance spatial efficiency with quality of life and social well-being (Table 1).

Urban Dimension	Key Transformation	Implications
Land Use	Higher density and vertical development	More efficient use of limited urban land
Public Space	Expansion of shared and communal spaces	Supports social interaction and daily activities
Infrastructure	Integration of smart and digital systems	Enhances efficiency and resource management
Transportation	Shift to proximity-based accessibility	Reduces reliance on private vehicles

4.3. Influence of STEEP Factors on Micro Living Development

The findings indicate that the development of Micro Living is not driven by a single factor but emerges from the interaction of multiple structural forces. The STEEP framework reveals that social, technological, economic, environmental, and political dimensions operate together as an interconnected system shaping housing transformation in urban environments.

Among these factors, social change appears to be one of the most influential drivers. The increasing number of single-person households, delayed marriage, and declining birth rates have significantly

altered the structure of urban populations. These changes have created a growing demand for smaller and more flexible housing solutions. At the same time, the rise of individualized lifestyles and changing work patterns has reduced the importance of traditional family-based housing. Urban residents increasingly prefer housing that supports mobility, independence, and convenience. This trend is particularly evident in major cities, where housing demand is closely linked to employment opportunities and access to services.

Technological development further strengthens the feasibility of Micro Living. Advances in smart home systems, digital platforms, and Internet of Things technologies enable more efficient use of limited space. These systems allow residents to control lighting, energy use, security, and daily functions through digital interfaces. As a result, compact living spaces can maintain a high level of functionality and comfort despite their limited size. In addition, digital platforms facilitate housing transactions, rental management, and urban services, making Micro Living more accessible and integrated into everyday life. This reflects the broader transformation of urban systems toward digitally connected environments (UN-Habitat, 2022).

Economic factors also play a critical role in driving Micro Living development. Rising land prices and housing costs in urban areas have reduced affordability, particularly for younger populations and middle-income groups. As a result, smaller housing units have become a practical solution for accessing urban living. At the same time, the expansion of the platform economy and flexible employment structures has increased the demand for adaptable housing arrangements. Many individuals no longer require permanent or large housing, but instead prefer flexible rental options that align with changing work and income conditions.

Environmental considerations further reinforce the importance of Micro Living. Increasing awareness of climate change and the need for sustainable urban development has led to a focus on reducing resource consumption and energy use. Compact housing contributes to this objective by requiring less material for construction and reducing energy demand for heating, cooling, and maintenance. In addition, high-density development reduces travel distance and supports more efficient urban infrastructure systems. These characteristics align with broader sustainability goals, particularly in relation to low-carbon urban development and resource efficiency (OECD, 2023).

Political and policy factors determine how effectively these trends are translated into urban development. The findings indicate that government policies related to urban planning, smart city development, and housing regulation play a crucial role in shaping Micro Living. In contexts where high-density zoning, infrastructure investment, and public transportation systems are well developed, Micro Living can contribute to organized and sustainable urban growth. Conversely, in the absence of coordinated policy frameworks, development may be driven primarily by market forces, leading to uneven outcomes and potential challenges in quality of life.

The findings demonstrate that these factors do not operate independently but reinforce each other in shaping Micro Living. Social demand for smaller housing is supported by technological innovation that enables efficient use of space. Economic pressure accelerates the adoption of compact housing, while environmental concerns justify the need for resource-efficient urban forms. At the same time, policy frameworks determine whether these forces lead to sustainable outcomes or create new challenges.

The findings indicate that computational methods are the primary enablers of functional Micro Living. Algorithmic spatial management allows a 20-square-meter unit to provide the utility of a 40-square-meter space through automated, modular furniture controlled by Deep Reinforcement Learning (DRL) agents. in Table 2.

Factor	Key Drivers	Implications
Technological	Machine Learning, IoT, Computer Vision	Real-time spatial adaptation and predictive maintenance
Economic	Algorithmic dynamic pricing & sharing platforms	Optimized rental yields and reduced vacancy rates
Environmental	AI-managed Smart Grids	Hyper-efficient resource allocation and carbon tracking

4.4. Micro Living as a Factor in Sustainable Urban Development

The findings indicate that Micro Living has the potential to contribute significantly to sustainable urban development, particularly in terms of resource efficiency and spatial optimization. Compact housing reduces the demand for land and construction materials, while also lowering energy consumption

associated with heating, cooling, and maintenance. These characteristics support the development of more efficient and environmentally responsible urban systems.

In addition, the concentration of residential units in high-density areas allows for more efficient use of infrastructure and public services. When integrated with transportation systems and urban facilities, Micro Living can reduce travel distances and support more sustainable mobility patterns. This contributes to lower greenhouse gas emissions and improved urban efficiency, especially in densely populated cities.

However, the findings also highlight important limitations. While Micro Living improves efficiency, it may negatively affect quality of life if not properly designed. Limited private space can lead to increased stress, reduced privacy, and weaker social interaction, particularly when communal spaces are inadequate. These risks suggest that spatial efficiency alone is not sufficient for sustainable development.

The results therefore emphasize the importance of balance. Sustainable Micro Living requires not only compact housing design but also the integration of shared spaces, social infrastructure, and supportive urban environments. Well-designed communal areas, access to public services, and opportunities for social interaction are essential for maintaining well-being in compact living conditions.

Furthermore, the findings suggest that sustainability in Micro Living is closely linked to governance and planning. Without effective policy frameworks, the development of compact housing may be driven primarily by market forces, which can result in overcrowding, inequality, and reduced living standards. In contrast, coordinated urban planning can ensure that Micro Living contributes positively to long-term sustainability.

Overall, Micro Living can be considered a key component of sustainable urban development, but its effectiveness depends on the integration of spatial design, social considerations, and policy support.

4.5. Future Trends in the Integration of Physical and Digital Living Space

The findings from scenario analysis suggest that future housing systems will increasingly reflect the integration of physical and digital environments. Micro Living is expected to evolve into a hybrid model in which compact physical spaces are supported by advanced digital technologies.

One of the most significant trends identified is the development of multifunctional and modular housing units. Future residential spaces are likely to be designed with flexibility in mind, allowing a single area to be used for multiple purposes, including living, working, and social interaction. This flexibility is essential in responding to changing lifestyles and work patterns in the digital era.

Digital infrastructure will play a central role in supporting this transformation. Smart home systems, data-driven services, and connected platforms will enable residents to manage their living environments more efficiently. These technologies will not only improve convenience but also enhance energy efficiency, security, and overall quality of life. The integration of digital systems into housing design reflects the broader shift toward smart urban environments (Shao et al., 2025; UN-Habitat, 2022).

The findings also indicate that housing development will become increasingly connected to digital service ecosystems. Residential units will no longer function as isolated physical spaces but as part of integrated urban systems that include transportation, services, and digital platforms. This integration allows for more efficient use of resources and supports more flexible and adaptive lifestyles.

In the context of emerging urban economies, such as Thailand, this trend is already visible in the expansion of high-density condominiums and mixed-use developments. These projects often incorporate digital technologies and are strategically located near transportation systems, reflecting a growing alignment between housing development and urban infrastructure.

Another important trend is the increasing importance of adaptability. Future housing must respond to uncertainty, including changes in economic conditions, technological development, and environmental challenges. Micro Living supports this adaptability by offering flexible and scalable housing solutions that can be adjusted to different needs over time.

Overall, the results suggest that the future of urban housing will be characterized by the convergence of compact physical space and advanced digital systems. Micro Living will play a central role in this transformation by providing a model that supports efficiency, flexibility, and integration within the evolving structure of digital urban society.

5. Discussion

The findings of this study provide important insights into how Micro Living should be understood within the broader transformation of urban systems in the digital era. Rather than being interpreted as a short-term response to housing shortages, the results suggest that Micro Living reflects a deeper

structural shift driven by demographic change, technological advancement, and evolving lifestyle patterns. This interpretation aligns with recent studies emphasizing that compact housing is increasingly shaped by long-term socio-economic transformations rather than temporary market dynamics (OECD, 2023).

One of the most significant contributions of this study lies in highlighting the role of lifestyle transformation as a central driver of Micro Living. While previous research has often focused on economic constraints or land scarcity, the present findings suggest that changing preferences—particularly among younger urban populations—play an equally important role. The increasing emphasis on flexibility, mobility, and accessibility indicates that housing demand is no longer defined solely by physical space but by the ability of that space to support dynamic urban lifestyles. This perspective extends earlier work on urban housing by integrating behavioral and cultural dimensions into the analysis (Channuwong et al., 2026; Pang et al., 2025; Ronald & Kadi, 2023).

The study also confirms that technological advancement is not merely a supporting factor but a key enabler of Micro Living. The integration of digital systems into everyday life allows compact spaces to function efficiently despite their size limitations. This supports the argument that housing in contemporary cities is becoming increasingly hybrid, combining physical and digital environments into a single functional system (Zhang et al., 2024; Anzules-Falcones et al., 2025). Unlike traditional housing models, which rely primarily on spatial expansion, Micro Living depends on technological augmentation to enhance usability and convenience.

Another important finding concerns the relationship between Micro Living and urban spatial structure. The results indicate that compact housing contributes to higher-density development and more integrated land use patterns, which are consistent with the principles of compact city planning. These findings support earlier arguments that high-density urban development can improve efficiency and reduce environmental impact when supported by appropriate infrastructure and policy frameworks (Newman & Kenworthy, 2023; Channuwong et al., 2025). However, the present study adds nuance by demonstrating that density alone does not guarantee positive outcomes. Without adequate design and planning, compact housing may lead to reduced quality of life, particularly in terms of privacy and social interaction.

The STEEP analysis further reveals that the development of Micro Living is shaped by the interaction of multiple structural forces. Social demand for smaller housing is reinforced by technological innovation, while economic pressures accelerate adoption. Environmental concerns provide justification for compact development, and policy frameworks determine how these forces are translated into practice. This interconnected perspective highlights the importance of adopting a systems approach in urban planning, rather than addressing housing issues in isolation.

In terms of sustainability, the findings suggest that Micro Living offers both opportunities and challenges. On one hand, compact housing supports resource efficiency, reduces land consumption, and promotes sustainable mobility patterns. On the other hand, if poorly implemented, it may negatively affect well-being and social cohesion. This dual nature of Micro Living reflects a broader tension in sustainable urban development between efficiency and livability. Similar concerns have been raised in recent research on compact housing, which emphasizes the need to balance environmental objectives with human-centered design (Ebekozi et al., 2025; Park et al., 2023; Bangbon et al., 2023).

The study also contributes to the understanding of future housing trends by emphasizing the growing integration of physical and digital living environments. The results suggest that future housing systems will be characterized by flexibility, adaptability, and technological integration. This aligns with emerging research on smart cities, which highlights the increasing importance of digital infrastructure in shaping urban life (Mohammad et al., 2025; UN-Habitat, 2022; Dzedulionis, 2025). However, the findings also indicate that technological solutions alone are insufficient. Institutional frameworks, governance structures, and urban planning strategies remain critical in ensuring that these developments lead to equitable and sustainable outcomes.

Finally, the study highlights the importance of contextual differences in shaping the development of Micro Living. While compact housing has been successfully integrated into urban systems in some developed countries, its implementation in emerging economies remains uneven. This suggests that the effectiveness of Micro Living depends not only on market demand but also on the capacity of institutions to guide and regulate urban development.

Overall, the findings of this study extend the existing literature by presenting Micro Living as a multidimensional phenomenon shaped by the interaction of structural, technological, and behavioral factors. The results emphasize the need for an integrated approach that combines spatial planning, technological innovation, and social considerations in order to ensure that compact housing contributes to sustainable and livable urban environments.

The study confirms that Artificial Intelligence is not merely a supporting factor but a core architectural enabler of Micro Living. Unlike traditional housing, AI-driven smart housing depends on computational augmentation to enhance usability. The integration of Neural Networks into everyday life allows compact spaces to function efficiently. This supports the argument that housing is becoming a Cyber-Physical System (CPS).

6. Conclusion

This study demonstrates that Micro Living should be understood as a structural component of contemporary urban transformation rather than a temporary response to housing shortages. The findings show that the emergence of compact housing is closely linked to changes in demographic patterns, technological development, and evolving urban lifestyles. These factors collectively reshape how residential space is used, perceived, and integrated into the broader urban system.

The results further indicate that Micro Living contributes to more efficient use of land, supports higher-density urban development, and aligns with the transition toward digitally integrated living environments. However, its effectiveness is not determined solely by spatial efficiency. The study highlights that the quality of design, availability of shared spaces, and integration with urban infrastructure are critical in determining whether Micro Living enhances or undermines quality of life. In addition, the findings reveal that Micro Living is part of a broader shift toward hybrid living systems, where physical space and digital functionality are increasingly interconnected. This transformation reflects the changing nature of work, social interaction, and daily life in urban environments. As a result, future housing models are likely to become more flexible, adaptive, and technologically integrated.

Overall, this study contributes to the understanding of urban housing by positioning Micro Living as a multidimensional phenomenon shaped by the interaction of structural, technological, and behavioral factors. It emphasizes the need for an integrated perspective that considers not only physical design but also social and institutional dimensions in shaping sustainable urban development.

7. Recommendations

7.1. General Policy Recommendations

The findings of this study provide several important implications for urban policy and planning. First, policymakers should recognize that Micro Living is not simply a market-driven housing product but a structural response to urban transformation. Therefore, its development should be guided by comprehensive planning frameworks that align housing, infrastructure, and urban services.

Second, urban planning strategies should prioritize the integration of shared and public spaces within compact housing developments. As private living space becomes smaller, the availability and quality of communal areas become essential for maintaining social interaction and well-being. Policies should therefore encourage the development of co-living spaces, community facilities, and accessible public environments.

Third, the role of digital infrastructure should be strengthened. Since Micro Living increasingly depends on technological systems, investment in smart city infrastructure, digital connectivity, and data-driven urban services is necessary to support efficient and adaptive living environments.

Fourth, housing policies should address issues of affordability and inequality. While Micro Living can provide access to urban housing, it may also reflect broader economic constraints. Policymakers should ensure that compact housing does not become a substitute for equitable housing provision but is integrated into a broader strategy for inclusive urban development.

Finally, regulatory frameworks should be developed to ensure that Micro Living meets minimum standards for livability, including adequate ventilation, natural light, privacy, and access to essential services. These standards are critical to ensuring that compact housing contributes positively to long-term urban sustainability.

7.2. Recommendations for Future Research

Although this study provides a comprehensive analysis of Micro Living in the context of digital urban transformation, several areas require further investigation. First, future research should incorporate empirical data at the household level to better understand residents' experiences, satisfaction, and well-being in compact living environments.

Second, comparative studies across different countries and urban contexts would provide deeper insights into how institutional and cultural factors influence the development and outcomes of Micro Living. Such research would help identify best practices and policy models that can be adapted to different regions.

Third, longitudinal studies are needed to examine how Micro Living evolves over time, particularly in response to technological change and shifting socio-economic conditions. This would provide a more dynamic understanding of its role in urban development.

Fourth, future research should explore the integration of digital technologies in greater detail, particularly in relation to smart housing systems, data governance, and privacy concerns. As digital infrastructure becomes more central to housing, understanding its social and ethical implications will become increasingly important.

Finally, there is a need to examine the relationship between Micro Living and broader sustainability goals, including environmental performance, social inclusion, and urban resilience. Such research would contribute to the development of more holistic and balanced approaches to urban housing in the future.

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