Research on the Role of Digital Intelligence in Empowering Smart Communities to Promote Better Living Environments

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ABSTRACT

Amid the global wave of urbanization and digital transformation, smart communities, as a crucial component of smart city development, are experiencing unprecedented growth opportunities. However, current smart community initiatives primarily focus on technological applications and efficiency improvements, often neglecting the enhancement of residents' quality of life and overall well-being, making it challenging to achieve the ultimate goal of "better living environments." This study explores the role of digital intelligence in empowering smart communities to promote better living environments. By constructing a multi-level interactive development mechanism centered on residents' happiness, this study systematically integrates four key dimensions: physical and digital infrastructure, economic governance, social services, and ecological environment. A closed-loop feedback model incorporating strategic objectives, foundational support, and core structural components is proposed. The research findings indicate that the application of advanced technologies such as big data, cloud computing, the Internet of Things (IoT), and artificial intelligence (AI) not only optimizes community resource allocation and public service efficiency but also enables real-time environmental quality monitoring and regulation through smart monitoring, green ecological design, and digital management, so as to create a safe, healthy, low-carbon and livable living space for residents. This study provides a novel theoretical perspective and practical pathway for smart community development and offers scientific insights and policy recommendations for governments and community managers in advancing digital transformation, enhancing residents' well-being, and achieving sustainable development. Although this study has certain limitations in sample size and the alignment of technological demands, future research will expand empirical investigations and explore long-term mechanisms for cross-disciplinary collaborative innovation.

Keywords: Digital intelligence empowerment; smart communities; environmental design; better living environments; sustainable development; residents' well-being

Introduction

Amid the rapid global urbanization and digital transformation, smart communities, as an essential component of smart city development, are experiencing unprecedented growth opportunities. In recent years, with the rapid advancement of digital intelligence technologies such as big data, cloud computing, the Internet of Things (IoT), and artificial intelligence (AI), governments and community managers at various levels have been actively exploring ways to leverage these cutting-edge technologies to improve urban management, public services, and environmental governance. However, traditional smart community initiatives have primarily focused on technological applications and efficiency improvements, often overlooking the enhancement of residents' quality of life and overall well-being. This technology-driven approach, while optimizing

urban operations, tends to neglect the ultimate goal of creating "better living environments," which involves leveraging smart technologies to comprehensively enhance residential environments, social interactions, and ecological sustainability.

I. Research Background

With the accelerating pace of global urbanization, cities are facing multiple challenges, including management, economic development, and environmental sustainability. In response, many countries have introduced smart city initiatives, utilizing advanced information and communication technologies (ICT) to enhance urban operations, improve efficiency, and strengthen competitiveness. China has been actively implementing a digital economy strategy, driving profound transformations in production, lifestyle, and governance. Digitalization has become an inevitable path for upgrading various industries, with new-generation information technologies injecting continuous vitality into the urban construction sector. "Digital housing construction" has emerged as a key driver of industry transformation, leveraging ICT to build digital networks that range from macro-scale urban monitoring to micro-scale building and construction site management. This digital transformation is playing a crucial role in shaping more livable, resilient, and intelligent cities. The rapid development and widespread adoption of digital intelligence technologies, including big data, AI, IoT, and cloud computing, have not only provided smart communities with unprecedented technical support and development opportunities but have also introduced innovative approaches to community governance and service delivery.

In the existing research on smart cities, the concept is fundamentally centered around information and data-driven urban operational systems, which are categorized into two aspects: physical technology and human society (Batty et al., 2012; Bibri & Krogstie, 2017). This framework integrates human capital, social capital, and ICT infrastructure to achieve sustainable economic growth, improve urban well-being, and enhance quality of life (Capdevila, 2015; Coleman, 1994). The first aspect of smart city research focuses on how these advanced and innovative technologies can be applied to optimize urban functions, achieving goals of integration and efficiency enhancement. The second aspect emphasizes how smart cities contribute to improving people's lives by enhancing quality of life, promoting equality, increasing civic participation, and enriching cultural diversity.

As smart cities continue to develop, their original intent remains to enhance urban efficiency and sustainability through technological innovation and data-driven decision-making. However, the social dimension, particularly the collective need for improved well-being, must not be overlooked. From a subjective perspective, happiness is interpreted as an individual's overall assessment of their quality of life, emphasizing personal perceptions and satisfaction (Veenhoven, 2013). The objective perspective associates happiness with well-being, incorporating social, material, and environmental factors such as living environments, income levels, healthcare, and educational infrastructure. Happiness is fundamentally linked to capturing the state of human well-being and quality of life while striving for an ideal lifestyle. Notably, in this study, the definition of happiness extends beyond the conventional concepts of life quality and well-being, taking into account the innovative changes brought about by the digital era.

Within the broader smart city framework, communities serve as the fundamental units of urban life, directly influencing residents' daily experiences and social interactions. The level of community development is closely tied to residents' happiness. Existing smart city initiatives predominantly emphasize technological advancements and economic expansion. While previous studies have explored various aspects of smart cities and quality of life, they have not sufficiently addressed the human-centered goal of "better living environments." The question of how to construct smart communities that not only feature efficient physical infrastructure but also promote economic, social, and environmental harmony remains underexplored. This gap has sparked widespread academic and practical discussions on how digital transformation can be leveraged to create more human-

centered and happiness-driven smart communities. Against this backdrop, the critical issue of how digital intelligence technologies can effectively empower smart communities to enhance residential environments, community governance, and ecological sustainability has emerged as an urgent research focus.

II. Research Framework

This study aims to explore the role of digital intelligence in empowering smart communities to promote better living environments. By establishing a multi-level interactive mechanism centered on residents' well-being, this study seeks to uncover how digital intelligence technologies drive the transformation of smart communities. The study systematically examines how these technologies contribute to improvements in environmental quality, economic vitality, social governance, and ecological sustainability, providing both theoretical insights and practical pathways for achieving high-quality urban living and better residential environments.

Smart community development requires a fundamental shift from conventional approaches, advocating for a multi-dimensional interactive development mechanism (as shown in Figure 1). As illustrated in the proposed framework, the mechanism is structured with key foundational elements at the base, core smart community features at the middle level, and the overarching objective of better living environments at the top. The framework forms a closed-loop system through strategic measures that ensure comprehensive optimization across community governance, public services, and environmental sustainability. Additionally, this study integrates theoretical insights with empirical evidence by conducting quantitative assessments and case studies of model smart communities. This approach enables the validation of how digital intelligence technologies enhance community governance, improve resident engagement, and contribute to better living environments, ultimately providing a scientific foundation and policy recommendations for future smart community development.

III. A Comprehensive Development Mechanism for Multi-Level Interactive Smart Communities

Smart cities have been widely accepted and are rapidly evolving into a global movement characterized by economic expansion and social transformation (Lu et al., 2025). Zakzak (2019), through semi-structured interviews and policy analysis, presented a case study on Dubai's smart city transformation, highlighting the challenges and driving factors for policymakers in developing human-centered smart cities. Nevado-Pena et al. (2019), based on Eurostat data, examined the relationship between ICT and quality of life at the regional level in European cities and found that digital citizens tend to be happier in cities with advanced technological capabilities. Additionally, the Organisation for Economic Co-operation and Development (OECD) has identified 39 impacts of digital transformation on 12 aspects of human life, indicating both opportunities and risks (OECD, 2019).

However, there is still no systematic approach to investigating the potential impact of smart city development on human well-being. Existing empirical studies are mainly based on limited samples, making their conclusions insufficiently robust for policymakers to develop smart city initiatives aimed at enhancing well-being.

The primary research objective of this study is to establish a comprehensive development mechanism for well-being-driven smart communities. This mechanism is structured into three levels: (1) Strategic Goal Level, which defines a multi-level interactive smart community framework and establishes fundamental strategic measures; (2) Fundamental Support Level, which identifies key factors driving well-being in smart communities; and (3) Core Components Level, which develops critical elements necessary for optimizing the core characteristics of smart communities.

3.1 Strategic Goals: Promoting a Better Living Environment

3.1.1 Goal Definition

This study aims to empower smart community development through digital intelligence technology, comprehensively enhancing residents' well-being,

improving quality of life, and optimizing residential environments to realize the vision of a "better living environment." The specific objectives include:

Enhancing residents' well-being by strengthening public safety, healthcare management, and education services through intelligent services and efficient governance. By implementing data-driven decision-making mechanisms, residents can receive more personalized and precise services, ensuring a fair and efficient allocation of social resources.

Optimizing the living environment by leveraging green technologies and ecological design to improve community infrastructure and the natural environment. This includes optimizing smart transportation, energy conservation, green buildings, and ecological landscaping, ensuring that community infrastructure and environmental quality meet sustainable, low-carbon, and livable standards.

Promoting economic and social harmony by fostering a digitally-driven economic ecosystem that enhances employment opportunities through online talent platforms and entrepreneurship incubation. Simultaneously, inclusive and participatory governance models can enhance social equity, cultural diversity, and resident engagement, ensuring that economic development and social progress are mutually supportive.

3.1.2 Core Issues

To promote a better living environment, this study focuses on the following key issues:

How can advanced digital intelligence technologies reshape traditional community management and service systems? This involves exploring the application of big data, AI, IoT, and cloud computing in smart communities and examining how information integration and intelligent decision-making can optimize resource allocation and public services.

How can technology-driven empowerment comprehensively enhance residents' well-being? This requires analyzing the relationship between technological applications and residents' needs, ensuring that efficiency and economic benefits do not overshadow improvements in subjective well-being and objective quality of life.

How can a multi-level, closed-loop feedback mechanism for smart community development be established? This involves creating a data-driven evaluation system, real-time monitoring, and dynamic adjustment mechanisms to ensure continuous improvement from infrastructure construction to service optimization and ultimately achieving the goal of a better living environment.

By addressing these core questions, this study provides a theoretical foundation and practical guidance for smart community development, ensuring that digital intelligence technologies play a transformative role in improving urban governance, enhancing residents' quality of life, and achieving sustainable and livable communities.

3.2 Fundamental Support Factors: Driving Mechanisms of Smart Community Characteristics

3.2.1 Infrastructure Dimension

The first key aspect is infrastructure, which involves building an efficient smart transportation system and promoting shared mobility solutions. These initiatives can alleviate traffic congestion, reduce carbon emissions, and optimize travel routes and public transportation scheduling through data analytics, ultimately providing residents with a more convenient and environmentally friendly commuting experience. A digital traffic management system can provide real-time feedback on traffic conditions, while the adoption of smart grids and advanced energy-saving technologies enhances the efficiency of energy utilization and supports low-carbon operations. This approach meets the community's daily energy demands while minimizing environmental pollution. Additionally, integrating renewable energy sources such as solar and wind power with smart energy management platforms enables real-time monitoring and regulation of energy consumption, creating a green, low-carbon living environment that promotes the well-being and sustainability of residents. A digitalized platform can also support smart water management, waste classification, and public utility services, allowing for the intelligent scheduling and efficient management of resources such as water, electricity, gas, and waste.

3.2.2 Economic and Governance Dimension

Another crucial factor is economic and governance development, which involves fostering a digital economy and expanding employment opportunities. Establishing online recruitment platforms and business incubators can facilitate the integration of digital economies with local economic activities, thereby driving employment and entrepreneurial growth within the community. Additionally, promoting smart manufacturing and a technology-driven innovation ecosystem can help transition traditional industries towards deeper integration with digital technologies. Supporting local enterprises and innovative startup initiatives enhances overall community competitiveness and industry structure, ultimately improving the quality of economic activities and services available to residents.

3.2.3 Social Services and Cultural Dimension

Smart communities leverage telemedicine platforms, health management systems, and online education services to eliminate traditional constraints on healthcare and education. Through data sharing and intelligent analysis, communities can implement early disease warning systems, personalized health management, and optimized resource allocation, leading to more equitable and inclusive public health and education services. Furthermore, deploying smart security systems, digital cultural platforms, and participatory community governance mechanisms can enhance public safety and cultural engagement. These systems use video surveillance, intelligent alarms, and online cultural activity platforms to improve security while fostering a vibrant and connected cultural environment. Digital technologies also play a crucial role in strengthening information exchange among residents, enhancing social cohesion and fostering a more inclusive and harmonious community.

3.2.4 Ecological and Environmental Dimension

Smart communities incorporate real-time environmental monitoring systems, such as sensor networks and big data platforms, to track key environmental indicators, including air quality, water quality, and noise pollution. These technologies facilitate the precise identification and continuous monitoring of pollution sources. Based on real-time data feedback, communities can implement targeted pollution control strategies to ensure continuous environmental improvements, thereby providing residents with a healthy and safe living environment that contributes to overall well-being. In addition, the development of smart green space management plans and low-carbon mobility strategies helps optimize urban ecology by increasing public green spaces and recreational areas. By integrating green building technologies with smart urban planning concepts, communities can achieve long-term environmental sustainability and foster a more livable, vibrant ecosystem.

Through the integration of key factors across these dimensions, smart communities can simultaneously enhance both physical and digital infrastructure while generating positive synergies across economic, social, and environmental domains. This comprehensive driving mechanism not only provides a strong technological foundation for community governance and services but also redefines the concept of happiness in the digital age. Ultimately, it fosters the advancement of high-quality living environments, propelling smart community development toward a more advanced and holistic future.

3.3 Core Components: Key Elements of Smart Communities

Based on extensive literature on smart cities and well-being, this study identifies smart communities as key platforms for integrating technological applications to enhance residents' quality of life and sustainability. The core components of smart communities are categorized into four interrelated and evolving dimensions, each playing a crucial role in achieving the goal of a "better living environment".

3.3.1 Efficient and Green Physical and Digital Infrastructure

Smart communities encompass intelligent transportation, smart energy management, smart water systems, and public utilities. By utilizing sensors, automated control systems, and data analytics, communities can optimize resource distribution and

reduce carbon footprints. Smart energy management system ensures the efficient and low-carbon operation of energy supply through real-time monitoring and adjustment, providing green and sustainable physical support for communities.

Digital platforms are important information hubs of smart communities, which realizes efficient integration and intelligent processing of information through cloud platforms, data centers and integrated management systems. Such platforms not only support online government affairs, community announcements, living payment and emergency management services, but also provide a basis for decision-making through data sharing, improving the transparency and response speed of community management. The construction of digital platform enables residents to obtain service information at any time, which greatly enhances the convenience and interactivity of services.

3.3.2 Resident-Friendly and Innovation-Driven Economic Systems

The application of digital technology has brought brand-new development opportunities for the internal economy of the community. By building an online talent docking, business incubation and e-commerce platform, smart communities can stimulate innovation vitality and employment potential in the region. This model not only promotes the incubation of local small and micro enterprises and entrepreneurial projects, but also provides more employment opportunities and income channels for residents, thus enhancing residents' sense of security and acquisition economically.

With the help of the smart service platform, the community has achieved seamless connection in consumption, entrepreneurship and employment. For example, intelligent payment systems and e-commerce platforms not only simplify residents' shopping processes, but also meet diverse needs through personalized recommendation and big data analysis. The convenience and transparency of economic activities make it easier for residents to participate in community economic construction, thus improving overall economic satisfaction and happiness.

3.3.3 Inclusive and Harmonious Social Environments

By building telemedicine platform, health management system and online education platform, smart community breaks the time and space limitations of traditional medical and educational services. Remote diagnosis and health monitoring not only improves the coverage and response speed of public health services, but also makes the distribution of educational resources more equitable within the community. These measures not only improve residents' health status and access to knowledge, but also build a more inclusive and harmonious social environment for the community.

The application of digital technology in public safety and cultural life is equally important. The intelligent security system improves the overall security level of the community through video monitoring, intelligent early warning and real-time data analysis. The digital cultural platform, online social and leisure entertainment system provide residents with rich cultural life and social interaction opportunities. At the same time, the establishment of community co-governance and sharing mechanism encourages residents to participate in public affairs and promotes social interaction and collaborative governance, thus enhancing the cohesion of the community and residents' sense of participation.

3.3.4 Sustainable and Eco-Friendly Natural Environments

Ambient intelligence monitoring relies on the Internet of Things sensor and big data platform to realize real-time monitoring of environmental indicators such as air quality, water quality and noise. Through data-driven pollution early warning and control measures, the community can quickly respond to environmental emergencies and ensure the safety and health of the living environment. Accurate collection and real-time feedback of environmental data provide solid data support for the implementation of scientific and effective ecological governance strategies.

Green city planning is the core strategy to realize the long-term ecological sustainable development of communities. By formulating intelligent greening management scheme, promoting low-carbon travel and

ecological landscape construction, smart communities not only improve green coverage, but also create a beautiful and livable living environment for residents. This kind of planning emphasizes the harmonious symbiosis between man and nature, and through ecological restoration and green building technology, it provides the community with the ecological foundation and livability guarantee for continuous improvement.

Through the composition of the above four dimensions, smart communities has formed a system of internal coordination and mutual promotion in physical, economic, social and ecological aspects. The core composition of this multi-level interaction not only realizes the organic combination of intelligent technology and humanistic care, but also provides a solid foundation and a brand-new development path for improving residents' happiness and promoting the construction of beautiful human settlements.

IV. Conclusion and Discussion

This study aims to achieve the ultimate goal of enhancing residents' well-being and creating a better living environment by integrating digital intelligence technologies with smart community development. Through a three-tiered approach—strategic objectives, foundational support, and core components—this study proposes a closed-loop feedback and multi-dimensional coordination development mechanism. This mechanism not only emphasizes technological empowerment and efficiency improvement but also focuses on human-centered aspects such as public services, environmental optimization, and social governance, representing a breakthrough in traditional smart community development concepts in the digital era.

From the perspectives of infrastructure, economic governance, social services, and ecological environment, this study thoroughly explores the key factors driving smart community development. Measures such as intelligent transportation, energy management, smart public services, digital economy promotion, innovation-driven strategies, health and education enhancement, public safety improvements, and environmental monitoring with green planning illustrate how digital intelligence technologies specifically empower community governance and service improvement. The interplay of these factors creates a coordinated and complementary effect, providing a strong foundation for the construction of a high-quality living environment.

Despite the progress made in constructing an integrated smart community development mechanism and promoting better living environments, there are still some limitations and areas for further exploration. Firstly, the empirical data in this study is based on a limited sample size. Future research should expand its scope to validate the findings and enhance their universality and reliability. Secondly, the alignment between technological applications and residents' needs remains complex. Understanding how to balance personalized services with public interests in an ever-evolving digital landscape is a critical issue for future studies. Lastly, as technology continues to advance and social demands evolve, the development model for smart communities must also be continuously updated and refined. Future research should focus on cross-disciplinary integration, collaborative innovation, and long-term mechanisms to further advance smart communities to higher levels.

Overall, in the wave of digital transformation and green development, the environment is not merely a passive backdrop but a key driver in upgrading smart communities. By integrating intelligent monitoring, green ecological design, and digital management, smart communities can dynamically assess and regulate environmental quality, thereby creating safer, healthier, low-carbon, and livable spaces. This study provides a systematic theoretical model and practical pathway for leveraging digital intelligence technologies to advance smart community development. By positioning the environment as a core innovation element, this approach breaks away from the traditional focus on technological efficiency and economic expansion, instead achieving a multi-dimensional synergy between economic, social, and ecological development, offering a novel theoretical perspective and practical direction for improving better living environments.

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