Artificial Intelligence for Creating a Digitized Lifestyle and Multifaceted Applications: A Case Study in the Realm of Smart Home Technology

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Abstract: Research Background: As a new generation of general-purpose technology, artificial intelligence (AI) has emerged as the core driver of the fourth industrial revolution. Its extensive application in various fields has not only reshaped the forms of traditional industries, but also spawned the rise of emerging industries. Current Situation: The application of AI in the field of intelligent home decoration has garnered significant attention both domestically and internationally. Notable progress has been made in technological research and development, product innovation, and market applications. Reasons: With the rapid development of productive forces, the contradiction between people's ever-growing demand for a better life and the lagging social productive forces has been resolved. Correspondingly, the increasing demand for improved living quality and comfort has propelled the integration of AI into homes, accelerating the construction of digital households. Purpose: This article aims to analyze the impact of artificial intelligence on smart homes, assess the feasibility of achieving digital home design, and explore how AI can facilitate human life. It hopes to contribute to the future development direction of artificial intelligence. Method: Starting from people's basic material needs, this article enumerates typical application cases in smart homes, covering various aspects of daily life such as clothing, food, shelter, and transportation. Furthermore, it delves into the research on how to create intelligent systems that enable interconnection and interoperability among various AI products.

Keywords: Smart Homes, Artificial Intelligence, Big Data, IoT, Intelligent Living

1. Overview of the Smart Home Industry Guided by Artificial Intelligence

1.1. The Concept of Smart Homes

The concept of smart homes emerged in the United States during the 1980s and gradually spread to other countries, including Canada, Australia, and Singapore. Bill Gates' visionary "Home of the Future" served as a groundbreaking prototype, exemplifying the vast potential of smart homes. Smart homes encapsulate the seamless integration of architecture, appliances, network communication, automation equipment, and management systems. Through comprehensive wiring, network

connectivity, robust security measures, automated controls, and cutting-edge audiovisual technology, these systems enable facilities to operate with efficiency and unity. This not only enhances the security and convenience of the home but also elevates the living spaces with increased comfort and aesthetic appeal, all while prioritizing energy conservation and environmental sustainability. Leveraging advanced technologies such as the Internet of Things (IoT) and mobile internet, smart homes seamlessly interconnect household appliances, enabling functionalities like security surveillance, intelligent lighting, utility management, network control, and health monitoring. This creates a home environment that is efficient, comfortable, safe, convenient, and environmentally friendly.[1]

1.2. Characteristics and Development Trends of Smart Homes

1.2.1. Challenges Faced by the Traditional Home Furnishing Industry

Traditional furniture has gradually lagged behind the times due to its technological and functional constraints.

In terms of technological innovation, smart homes significantly outperform traditional furniture, integrating cutting-edge technologies like artificial intelligence and the Internet of Things (IoT). Traditional furniture lacks intelligent elements, making it challenging to cater to the diverse demands of modern lifestyles.

Regarding functional requirements, traditional furniture often emphasizes aesthetics but frequently falls short in functionality, failing to align with the multifaceted needs of contemporary living. Smart homes, on the other hand, are designed to fulfill a wide range of practical needs.

In terms of space utilization and flexibility, smart homes demonstrate greater adaptability to the personalized needs of different users, whereas traditional furniture often appears rigid and inflexible.

Concerning environmental sustainability, smart homes prioritize energy conservation and emissions reduction, whereas traditional furniture often lacks in this aspect. Additionally, traditional furniture designers often struggle to discern market trends accurately amidst rapid changes, compounded by insufficient data collection, leading to imprecise product positioning.[2,3]

1.2.2. Big Data Serving Smart Furniture

The process of market research in the traditional furniture industry is often cumbersome and time-consuming. However, harnessing the power of big data and AI technology enables a rapid and precise capture of market changes. This technology also facilitates a deep exploration of customers' precise needs and preferences, revolutionizing the way businesses understand and cater to their target audience. Nowadays, smart homes are evolving towards advanced intelligence and interconnectedness, emphasizing not just environmental sustainability but also personalized services. This transformation is propelling the entire industry towards a green and low-carbon future, better fulfilling the diverse lifestyle needs of humanity. [4]

1.3. The Current Status of Integration Development between Artificial Intelligence and Smart Home Design

1.3.1. Advancement of Furniture Products Facilitated by 5G Technology

In the era of 5G, the application of smart home technology in whole-house custom furniture design is undergoing profound revolutionary changes. 5G technology enables seamless interconnection between furniture and appliances, facilitating centralized wireless remote control, timed switching, and remote operation functionalities. The sophisticated smart control system allows users to

seamlessly transition between different living scenarios, indulging in a convenient and cozy home life. Additionally, 5G technology optimizes the layout of smart homes, expanding market development opportunities and delivering a more intelligent and personalized home experience to users. [4,5]

1.3.2. Interconnected Smart Home System with Wi-Fi Control

The intelligent home monitoring system based on STM32 chips utilizes Wi-Fi connectivity to transmit data to cloud platforms for intelligent processing. Additionally, relevant mobile applications have been designed to facilitate user-friendly operations. This system enables functions such as temperature and humidity monitoring, automatic music playback, and fire alarm alerts, offering personalized home services to users.[6]
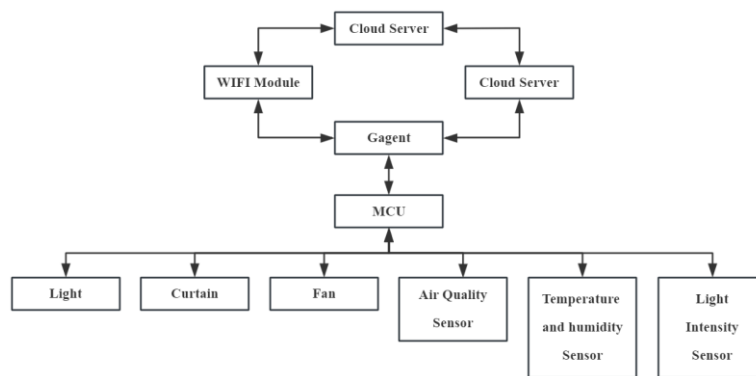

Figure 1: Interconnected Smart Home System with Wi-Fi Control

1.3.3. Transformation from Traditional Home to Smart IoT Home

The transformation of traditional furniture into smart products often encounters limitations, such as single functionality and inadequate interconnection among furniture pieces. Wired communication methods restrain the scalability and flexibility of smart homes. Nevertheless, cutting-edge technologies like 5G, big data, and artificial intelligence provide immense momentum for the rapid development of smart homes. The integration of wireless communication technologies, such as ZigBee and Bluetooth, into whole-house custom furniture design significantly boosts system stability and enhances the user experience. Technological advancements are facilitating the deep integration of artificial intelligence with whole-house custom furniture, further expanding the smart home market and laying a solid foundation for digital intelligent living.[7]

2. Application of Smart Home in Indoor Spaces

2.1. Security Intelligence

With the development of the domestic economy and society, awareness of home security has been heightened, leading to widespread adoption of smart door locks and security devices:

Biometric recognition technology, such as voice, iris, or facial recognition, is integrated with smart hosts to ensure that only authorized individuals can unlock doors.

Alarm functionality alerts users via mobile phones when the door lock is tampered with or forcefully opened, effectively deterring break-ins.

Anti-peephole unlocking feature prevents unauthorized entry through peepholes by potential intruders.

Record retrieval allows users to access and cloud backup unlocking history, enabling them to monitor usage at any time.

Installation of infrared sensors and sensors on windows automatically closes them during storms, enhancing home security.[8]

2.2. Intelligent Lighting

The intelligent lighting controller integrates multiple smart technologies, including control panels, smartphones, tablets, and infrared sensing, enabling remote flexible operation and precise adjustment. Light sensitivity allows for responsive reactions to changes in environmental light and human activity, automatically dimming in bright conditions and brightening in dim conditions. Through infrared sensing and pressure-sensitive sensors, lights can intelligently switch on and off, achieving gradual illumination. Bedroom and bathroom lights support various mode settings, such as easy switching of lighting modes via voice control. Automatic light adjustment at night creates a warm and comfortable sleep atmosphere; when getting up at night, lights gently and slowly illuminate. One-touch convenience manages various scene effects, while the low-voltage system ensures usage safety and easy maintenance.

2.3. Intelligent Appliances

Smart home appliances are connected via the Internet of Things (IoT) to enable intelligent control, remote operation, and automated management. Smart TVs provide online content and voice control while automatically conserving energy. Smart air conditioners can be remotely adjusted and feature automatic energy-saving capabilities. Smart refrigerators monitor food storage and offer nutritional advice. Smart washing machines intelligently select washing programs. Smart vacuum robots automatically plan cleaning tasks. Smart door locks support various unlocking methods, enhancing security.

2.4. Smart Health and Hygiene

In home space design, smart health and hygiene have become indispensable elements:

Precise and efficient air quality monitoring enables real-time detection of indoor pollutants. Through smart devices providing instant feedback, the system promptly initiates purification procedures when air quality deteriorates, safeguarding the respiratory health of family members.

The ultraviolet germicidal system intelligently identifies harmful bacteria, allowing for easy eradication via remote control using a smartphone or tablet. This ensures a clean and safe home environment.[9]

Health management features have been comprehensively upgraded, collecting and analyzing user body data. The smart toilet monitors urine parameters in real-time, providing personalized health recommendations to help users scientifically prevent diseases and enjoy a healthy lifestyle.

2.5. Emotional Intelligence

Emotional intelligence is deeply integrated into home spaces to meet diverse smart needs:

Interaction experiences are more empathetic, where smart access control not only welcomes the homeowner but also cares attentively, actively responding to life commands.

Contextual simulations are naturally fitting, where the study's smart system provides gentle reminders and adjusts the environment according to user habits, effectively alleviating stress.

Smart home background music is personalized, combining environmental factors and homeowner preferences to cleverly mix sound sources, creating a comfortable home atmosphere and adding a strong sense of "human touch."

Health index monitoring demonstrates humanistic care, where upon detecting health abnormalities, the system promptly sends alerts and provides gentle reminders to the homeowner to pay attention to their health.[1]

3. The Contribution of Artificial Intelligence to the Construction of Digital Homes

3.1. Basic Concept of Digital Homes

A digital home refers to a comprehensive service platform that integrates the physical world within and outside the home with the digital realm. It leverages technologies such as the Internet of Things (IoT), cloud computing, big data, mobile communication, and artificial intelligence (AI) to achieve the intelligence, networking, and informatization of household products. This aims to enhance the convenience, comfort, and security of home life.
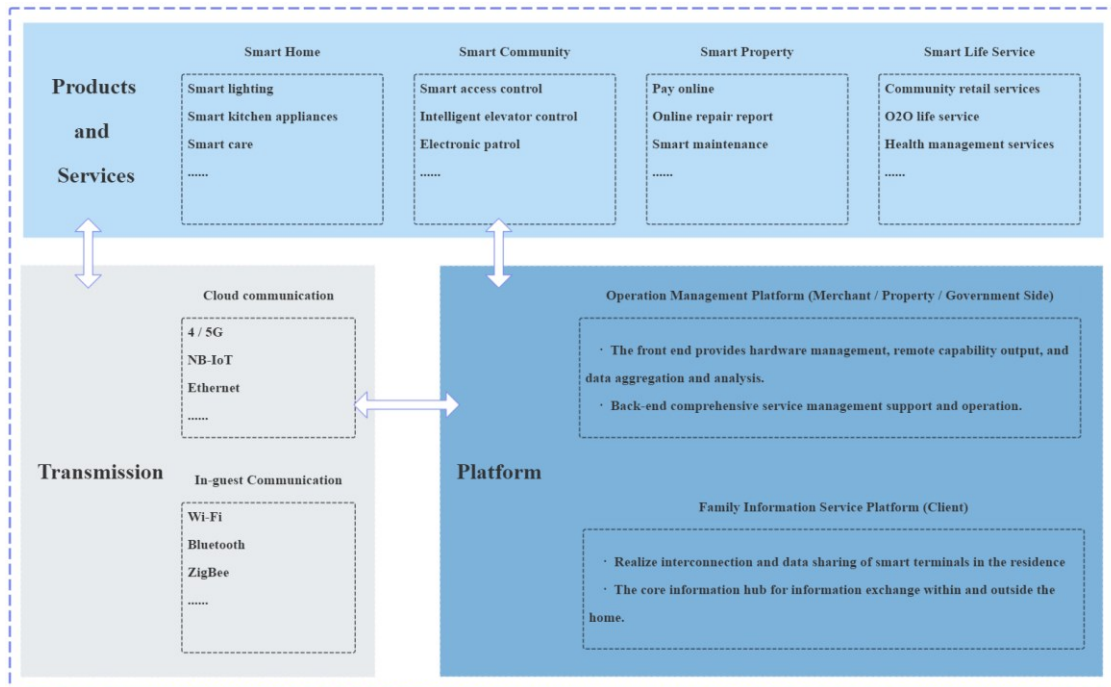

Figure 2: Basic Concept of Digital Homes

3.2. Analysis of the Development of Digital Homes

3.2.1. Background of Digital Home Development

Phase One: Era of Traditional Homes

In the past, traditional homes were dominated by television, with particular attention to digital and network television. However, the path to intelligence was limited by hardware output ports, lacked scenario-based applications, faced challenges in interconnectivity between devices, and posed risks in stability and security. Additionally, the operation interface was cumbersome, leading to unsatisfactory user experiences.

Phase Two: Era of Smart Homes

With technological advancements, smart home systems emerged, offering features such as automatic adjustment and remote control. These systems intelligently sensed environmental factors like temperature, humidity, and brightness, and supported voice control and remote control via mobile apps. However, the focus remained on hardware connectivity, with insufficient scenario-based intelligent applications, limited device compatibility, lingering security risks, and room for improvement in user experience.

Phase Three: Era of Intelligent Homes

The era of intelligent homes arrived with the advent of technologies such as the Internet of Things, cloud computing, and big data. This facilitated intelligent device control, environmental perception, and security monitoring. At the service platform level, functions such as home entertainment and control were fully realized. However, the scope of services was confined to the household, device maintenance costs remained high, and further exploration and improvement were needed.

Phase Four: Era of Digital Homes

Today's digital homes have established digital life service systems, breaking the limitations of service radius and achieving interconnection and management of various household devices. Challenges faced in traditional smart homes have been addressed, yet challenges persist at the technological and application levels. Continuous innovation and improvement are necessary to move towards a broader future.[9]

3.2.2. Analysis of Digital Home Demands

With the rapid advancement of technology, there is a growing desire for digital homes among people. They aspire to effortlessly control lighting and air conditioning remotely through smart devices, seeking convenience in their daily lives. Simultaneously, they also expect easy access to social services such as housekeeping and healthcare online. The trend towards online government services is undeniable, enabling citizens to conveniently handle various affairs anytime, anywhere. Moreover, there is significant interest in smart security systems, as comprehensive security protection becomes essential for households. Information acquisition and entertainment are equally focal points of digital homes, as individuals anticipate accessing desired information and enjoying diverse entertainment content through digital home platforms. These demands collectively drive the increasing importance of digital homes in the future.[10]

3.3. Artificial Intelligence Empowers the Construction of Digital Households

Artificial intelligence plays a pivotal role in the digital home, with large-scale model technologies leveraging deep learning to deliver smarter and more personalized services.

3.3.1. More Personalized Multimodal Control

Multimodal interaction control is a revolutionary technology in the field of smart homes, which ingeniously integrates various sensory modalities such as visual, auditory, and tactile, bringing unprecedented convenience and intelligent experience to users. Imagine, with just a simple voice command, the smart speaker can quickly respond and complete tasks, while also providing voice feedback for smoother communication. Advanced multimodal systems combine voice, facial, and gesture recognition, enabling more intuitive and personalized interactions, making smart homes truly intelligent. This technology not only enhances user experience but also injects powerful momentum into the innovation and development of smart home technology.

3.3.2. More Efficient Home Equipment Operation and Maintenance

Although digital home devices are slightly more expensive compared to traditional ones, and maintenance and upgrades entail additional costs, they impose a certain burden on families with limited economic conditions. However, the emergence of large-scale model technology provides a solution to this problem. Through intelligent repair and maintenance of equipment, large-scale model technology can quickly identify faults and provide targeted repair solutions, greatly reducing user costs and time consumption. At the same time, its predictive and warning functions can detect potential failures in advance, extending the service life of the equipment. Additionally, large-scale model technology can optimize energy management, intelligently adjust equipment operating states, effectively reduce energy costs, and contribute to achieving a green and environmentally friendly lifestyle.

3.3.3. Enhanced Home Safety Experience

With its outstanding capabilities, large-scale model technology significantly enhances the security performance of digital homes. Leveraging deep learning and pattern recognition techniques, large-scale models can monitor and analyze various safety data in the home environment in real-time and with precision, including video surveillance and sensor data. Moreover, large-scale models can swiftly identify and alert potential intruders or other security threats, establishing a robust defense line for home security. Additionally, by deeply analyzing the behavior patterns of household members, large-scale models can effectively prevent internal safety risks in the home, such as child wandering or elderly falls, ensuring that family members enjoy a more secure and comfortable life.

3.3.4. Enhanced Smart Home Resource Integration

The digital home assistant, equipped with powerful resource integration capabilities, liberates users from the burdensome task of information search. Leveraging advanced AI technology, it provides users with personalized and accurate service recommendations, while large-scale model technology swiftly captures user demands and links to the required resources. For instance, users can effortlessly access diverse information such as property notifications, merchant discounts, and government service procedures with a simple voice command, all while enjoying personalized services delivered through intelligent analysis and push notifications. Furthermore, large-scale model technology can promptly respond to users' real-time needs by recommending music that suits their current situation, significantly enhancing convenience and efficiency in daily life.[11]

4. Conclusion

The digital home, as a crucial avenue for realizing people's aspirations for a better life, is increasingly demonstrating its intimate and intelligent qualities with the rapid development of artificial intelligence technology, bringing unprecedented convenience and comfort to countless households. Looking ahead, we should commit to the deep integration of machine logic thinking with human creative thinking, propelling the digital home from "intelligence" to "wisdom" to new heights. To this end, the following five suggestions are proposed:

Strengthen human-machine interaction design, continuously enhance the comfort and convenience of user experience, making the digital home more tailored to user needs and more intimate.[12]

Promote the bidirectional integration of machine learning and human learning, achieving knowledge sharing and complementarity, thus propelling the digital home to leap from mere "intelligence" to true "wisdom."

Deepen the intelligent processing and application of data, information, and knowledge, providing the digital home with richer and more accurate services, supporting the deep development of human-machine integration.

Enhance emotional intelligence training for machines, elevate the intelligence level of human-machine interaction, enabling machines to more accurately understand and respond to human emotional needs, enhancing the warmth and humanity of the digital home.

Actively promote the construction of a smart society, integrating the digital home into a broader social system, realizing the intelligence and efficiency of social operation, and creating a better and more livable living environment for the people.

In conclusion, the successful adoption of these five recommendations has the potential to catalyze substantial advancements in human-machine integration within the digital home ecosystem. By fostering the transition from mere "intelligence" to genuine "wisdom," these improvements can significantly contribute to the overall enhancement of residents' quality of life, bringing us closer to the realization of truly integrated and intuitive living environments.[13]

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