



Smart Home Technology: Integrating AI for Improved Living Standards

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ABSTRACT

Advanced smart home technology, enhanced by artificial intelligence, is revolutionising people's lifestyles. This review suggests that the integration of AI in smart homes has the potential to enhance convenience, security, and energy efficiency. Advanced smart home technology has evolved from basic automation to artificial intelligence (AI)-powered systems that predict human preferences and enhance household operations. The paper also addresses the topics of privacy, security, and the acceptability of AI-powered smart homes, particularly across diverse demographic segmentations. Technological breakthroughs such as predictive home automation and artificial intelligence-powered security systems are emphasised. In order to enhance adoption and living standards throughout communities, the paper proposes that privacy concerns must be effectively addressed.

Keywords: Smart home technology, Artificial intelligence, AI integration, home automation, Privacy concerns, Security systems,

INTRODUCTION

In recent years, the rise of smart technologies for appliances, energy systems, environmental controls, care of health, safety, and security systems has advanced the idea of the smart home. The seamless integration of increasingly intelligent devices and traditionally less intelligent devices within the household environment is one of the compelling visions of the future. The world of work and living is being reshaped by technological advances and the interaction of different technologies. Some of the emerging technologies directly affect the quality of living standards and facilitate the easier control of smart home appliances remotely [1]. Mansions enable smart home technology, but implementation is complex. Affordable automation brings smart homes to middle and lower class. Basic light control uses sensors and circuits. AI enables automatic control regardless of human factors [2]. AI-powered agents can customize device behavior, connect device use and activities, and offer proactive user support. Context awareness is crucial for monitoring and support, requiring dynamic interpretation of data. Real-time updates are needed to anticipate user needs and enhance the experience [3].

EVOLUTION OF SMART HOME TECHNOLOGY

Smart home technology encompasses various devices and systems that individuals utilize to monitor, manage, and control their home environment. Traditionally, homes were equipped with manual switches, knobs, and controls to manage different systems such as lighting, entertainment, security, heating, cooling, and ventilation. As technology progressed and control systems became more advanced, homes began to incorporate sophisticated electronic devices. A typical house became furnished with audio and visual entertainment devices like televisions, radios, music systems, and sound speakers. More equipment was installed to employ lighting and environmental devices across different rooms. Such basic arrangements of gadgets could be remotely operated through a remote-control console, which could be mobile [4]. Smart home technology incorporates the concept of smartness into home technology, leveraging the Internet of Things (IoT) to connect devices and sensors and manage data. This allows for the creation of a networked ecosystem of devices and controls that can be controlled through a common console or application on a smart device. This technology can deploy sensors and networking devices to control lights and environmental systems based on occupancy, automatically record and switch off

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devices when not in use, and adjust indoor temperature settings based on daily routines [5]. There is a demand for personal privacy. Devices and sensors can interfere with daily life activities. Smart home technology has become important during the pandemic. Research and development activities are focused on solving privacy issues. Smart home technology can provide a communication-free monitoring system. Advanced sensors can analyze physical parameters without communication infrastructure. Health profiles can be created for advanced automation and predictions [6].

ARTIFICIAL INTELLIGENCE IN SMART HOMES

Artificial intelligence (AI) has been incorporated into a variety of smart home technologies. AI has played a major role in home security solutions, such as night-vision cameras, motion-triggered alarms, and remote control of door locks. Additionally, front-door cameras with AI are used to recognize known faces and send alert notifications to residents if an unfamiliar face is detected. AI improves the accuracy and speed of face-assessment algorithms in camera technologies. AI also promotes energy-saving appliances and energy networks that respond to real-time social and environmental needs. These innovative solutions, however, raise privacy and data protection concerns [7]. Smart home technologies refer to appliances and devices that can operate independently through remote management or decision-making. They rely on data that can be collected and acted upon automatically, often involving cloud-based AI infrastructure revolutionizing data accessibility, affordability, integration, and cloud-based data processing capabilities. AI technologies in smart homes can be used in voice assistants, connected appliances, lighting systems, and front-door cameras [8]. Voice assistance AI allows residents to remotely manage other technologies using voice commands, such as using smart speakers to turn on heating when heading home. Connected appliances achieve automated routines but involve higher user engagement and investment. Lighting systems use image processing AI to monitor household activity and optimize energy-conserving lighting. AI in front-door cameras enhances access control through facial recognition technologies. These freshly mobile and accessible AI technologies raise questions about residents' empowerment and vulnerability. AI can empower users by relinquishing household network control and participating in unknown global networks. On the other hand, it can widen the gap between passive residents and more empowered users who understand and actively control technology [9].

BENEFITS OF AI-INTEGRATED SMART HOMES

Smart homes use internet-connected devices to remotely monitor and control appliances through a computer or mobile device. This technology ensures safety, security, and convenience in our busy lives. Artificial intelligence advancements, like neural networks and fuzzy logic, have allowed AI to be integrated into smart appliances. This enables them to recognize and respond to voice commands. Smart homes are especially helpful for the elderly and disabled. This paper explores how AI in smart homes can enhance their quality of life [10]. AI-integrated smart home tech enables voice-controlled automation for all electrical appliances. Sensors detect motion and adjust temperature accordingly. AI smart homes enhance the standard of living for physically impaired individuals. The goal is to create a happy, comfortable, and smart living environment for all. Mobile devices monitor the home and send alerts for any unusual activity. It controls water usage and allows for emergency calls. Additionally, a gas leak detection sensor prevents explosions by shutting off the gas valve and notifying authorities [11].

CHALLENGES AND LIMITATIONS

The successful implementation of smart home technology depends on its acceptance by the community. Due to the associated concerns, such as capital and maintenance costs, and, as mentioned previously, data privacy, the level of acceptance is still low. For example, around 77% of users express concern regarding the security of their smart devices. Over 70% of users value privacy protection when using smart devices. These concerns should be addressed to increase the level of acceptance [12]. Upon investigating the acceptance of smart home technology in general mobile users, Dunn et al. identified that privacy and security concerns are significant barriers to intention to use smart home technology. Stigmatized by various risks, such as hacking or malware, persuasion attempts emphasizing security and privacy protection are more effective for potential adopters (vs. non-adopters) [13]. While different concerns have been investigated in various demographic groups, there is still a need for extensive knowledge regarding the concern of older adults about smart home technology features, as well as a comparative study between different demographic groups. As the elderly express different needs and degree of concern compared to the general population, it is essential to better understand their concern. The elderly's concern should then be compared to the general population. Such investigations can also provide crucial insights for policymakers developing services targeting a population's concern [14]. Each feature examined in the following subsections considered research findings regarding the benefit for users, concerns, and the importance of cases handling users' concerns. Moreover, relevant privacy laws including the European Union's General Data Protection Regulation (GDPR) and the United States

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Health Insurance Portability and Accountability Act (HIPAA) are discussed for each feature separately. Finally, the comparison between the general population and older adults highlights the latter's bigger need for concern handling. Regardless of the demographic group, the most important features corresponding to the biggest level of concern are location tracking and video capture [15].

FUTURE TRENDS AND INNOVATIONS

As smart home technology continues to flourish and integrate with artificial intelligence (AI), several future trends and innovations are foreseen to drive its evolution. The expansion of smart homes will generate a compounding demand for sophisticated AI systems, enabling preventative maintenance, predictive capabilities to foresee energy surges or outages, and the capacity to respond and regulate security remotely. As AI analyzes patterns, actively promoting adaptive innovation, continues to develop, anticipatory home automation will be prioritized instead of passive automation, which is presently the trend. Big data analytics will change social and behavioral patterns worldwide as resident living patterns and energy usage heighten the ability of AI and smart technologies to predict and propose optimization [16]. Moreover, artificial intelligence use in smart homes will grow, enabling enhanced home security and improved standards of living. For example, camera systems with AI-enabled recognition software will boost security and the convenience of smart home technology. When potential intrusions are detected, residents will receive alerts, and security companies, police services, and other forces can automate responses. AI visualization technology will analyze feed and objects in real time, assisting those with physical or mental impairment in smart homes. Similarly, smart home AI services will aid elderly or physically limited individuals by tracking movement and recommending actions or soothing/harmful messages [17].

CONCLUSION

The integration of artificial intelligence into smart home technology offers promising advancements in enhancing living standards by improving convenience, security, and energy efficiency. However, the widespread adoption of AI-powered smart homes is contingent on addressing significant challenges, including privacy and security concerns. As AI continues to evolve, its role in predictive and anticipatory automation will likely drive the next wave of innovations in smart homes, making them more intuitive and responsive to user needs. To fully realize the benefits of AI in smart homes, it is essential to develop technologies and policies that address user concerns, particularly among vulnerable populations such as the elderly. By doing so, smart home technology can achieve its full potential in creating safe, comfortable, and efficient living environments for all.

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CITE AS: Kibibi Muthoni L. (2024). Smart Home Technology: Integrating AI for Improved Living Standards. RESEARCH INVENTION JOURNAL OF BIOLOGICAL AND APPLIED SCIENCES 3(3):60-63.