

# Investigating the Potential of AI-Based Automation for IoT-Enabled Smart Homes

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## ABSTRACT

With the rapid increase of population urbanization becoming more prevalent, cities often struggle to provide convenient, secure, and sustainable lifestyles due to the lack of necessary smart technologies. Using the Internet of Things (IoT) technology, smart appliances can communicate and share real time data with each other. With a broad spectrum of applications, the future of Internet of Things (IoT) looks more promising than ever before. IoT is the concept of connecting any device to the internet and other connected devices. All instruments in the network interact with each other to collect and share data. Today, IoT is being used extensively to lessen the burden on humans. To name a few, IoT is deployed for Smart homes, Wearables (watches and bracelets), Smart Cars, Smart farming, Smart Retail, Smart Grids, Smart city, and smart healthcare. Our concern in this article is on the smart city infrastructures, introducing various technologies that enhance sustainability, productivity, and comfort for urban dwellers. Even though the full capability of AI and the IoT are still in their relative infancy, these two technologies are now being combined across every industry in scenarios where information and problem-solving can improve outcomes for all stakeholders. A detailed analysis of various wireless communication technologies employed in smart home applications is presented, with extensive research conducted to determine the most appropriate communication technologies for specific use cases. The article also sheds light on different AI algorithms and their suitability for smart city applications. Furthermore, the integration of IoT and AI in smart city scenarios is discussed, emphasizing the potential contributions of 5G networks coupled with AI in advancing modern urban environments. Smart Homes use artificial intelligence (AI) and Internet of Things (IoT) technologies such as connected sensors, lighting, and meters to collect and analyze data. This data is used to optimize household infrastructure, utilities, and other services to make daily life easier and more efficient.

**Keywords**— *Smart Home; Communication technology; IoT; 5G; AI*

## I. INTRODUCTION

Artificial intelligence in home automation has completely changed how we interact with our houses in recent years. For instance, you may now enter your home and instruct your virtual assistant to start brewing coffee, switch on the lights, and adjust the temperature of the space. Home automation and smart home systems are two concepts that are interconnected. They relate to the use of AI to automate and control various systems and gadgets in a house and are frequently used interchangeably. A complete system that incorporates many technologies, such as heating, lighting, and security systems, is known as a smart house system. By managing features from either a smartphone or an audio speaker, the homeowner may take advantage of a smooth and AI-driven experience. The term "home automation" more explicitly refers to the use of technology to manage various aspects of a home. For instance, it covers actions like setting up temperature adjustments, arranging light timers, and keeping an eye on security systems from a mobile device.

Home automation and smart home systems both rely on wireless technology to carry out a variety of operations and functions. Smart home systems are essentially the idea of a centralized control hub that transmits signals to various gadgets. Home automation, on the other hand, might relate to easier-to-use, more specialized gadgets that might not need a central hub, like Amazon Alexa or Google Assistant. You must first determine whether the home automation system is built on open protocols before making your decision. This indicates that the system is not owned by a certain business and is not constrained to the goods of a single business. Open protocols offer higher security, defending your house from unauthorized entry, and enable interoperability between various gadgets from various manufacturers. In addition, the top home automation systems come with a variety of helpful functions like heating, cooling, window coverings, and so forth. Here are a few instances of several home automation programmes you may rely on whether you're at home or away on vacation.

### a. Smart Homes with AI

The use of AI in managing the infrastructure for smart homes aids in data collection from home automation devices, user behavior prediction, maintenance data provision, and data security and privacy enhancement. Its presence in home automation allows us to operate our home appliances, safeguard our houses, etc. by reducing the need for human interaction. It can do some activities automatically for the user.

The data that the devices acquired and were educated on using a range of machine learning and deep learning techniques is the primary source of this automation. Smart home linked devices offer the data, and AI learns from that data to do certain tasks automatically. For instance, Nest Thermostats from Nest Labs automatically adjust the temperature when someone is home or become more energy efficient when no one is home based on the operating habits of its customers.

#### Levels of Data Exchange in AI and IoT-Powered Smart Homes

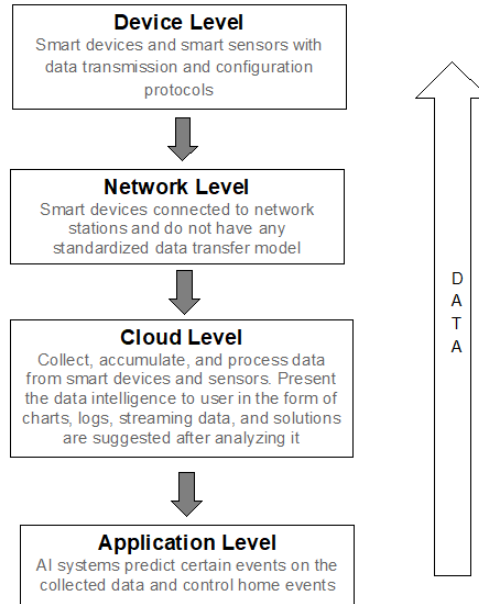


Figure-1: Levels of Data Exchange in Smart Homes

### b. Smart Homes and IoT

IoT enables linked items to interact with one another and may either be operated remotely or can convey data to a distant user via AI. These objects include automobiles, buildings, and other physical objects that are integrated with software, sensors, and the internet. With the aid of AI, these linked devices can keep track of the status of every other connected device on the same network and offer real-time data.

### c. Important Guidelines for All Smart Home Systems

1. Any AI and IoT enabled smart home should address the primary concerns of data security and privacy because every connected device tends to leave the digital traces of personal data that must be kept safe and secure.
2. Devices with proper AI and IoT integration may act more automatically and have better functionality. For instance, security cameras often detect dangers automatically, but when properly integrated with AI, they will proactively warn people to take charge of the situation if something goes wrong.
3. Any home automation technology must solve the important issue of interoperability. To enable new use-cases like energy saving, appliance diagnostics, damage avoidance during natural catastrophes, etc., smart home devices need be made interoperable.
4. Better customer service is a crucial component of every organization. People who live in smart homes could run into a variety of problems in their IoT environment, from minor issues with troubleshooting to significant problems with data protection. Businesses who offer superior customer service will always be in the lead.
5. The user will be able to save time, money, and effort by using voice commands, which will also make certain tiresome jobs easier. As delivering user-friendly services consistently produces positive effects for the company, controlling gadgets and household appliances by speech should be given emphasis.

### d. How will smart homes be affected by the confluence of AI and IoT?

Artificial intelligence (AI) in smart homes may transform unprocessed sensor data from linked smart devices into useful behaviour patterns for our daily life. AI-enabled devices can foresee the optimal experience by understanding the habits of renters. If no one is home, the heating, fan, or lights won't turn on, and the doors will lock themselves without human intervention.

The ideal situation would be for a user to cook food in a smart oven or stove while AI monitors the interior temperature of the food. The AI may reduce the cooking temperature to avoid burning the food if it reaches the optimal temperature. When the user was ready to receive the food from the machine, the AI would notify the user. Artificial intelligence (AI) could be able to pick up on and foresee consumer preferences. Before a client user arrives at home to start cooking, for instance, a smart kitchen may be set up.

The promise of IoT and AI isn't limited to brand-new houses; there are several choices that enable current items, like switches, to be updated to become Smart Switches and outdated air conditioners to become Smart Apps or AI-based on cloud servers, among other things, and give remote access.

Wireless solutions make deployment easier since they don't require much heavy lifting or manual labor to get the user to Smart Living. Almost any existing switch, air conditioner, or light may be upgraded using a variety of brand-neutral retrofit techniques.

For homes with a keen interest in technology, AI and IoT in the smart home is a winning mix. Instead of using past use, AI-enabled customization can let your home keep track of how you go about your daily activities. Automation of smart homes and AI are at a crossroads. With the development of technology and the availability of additional device integration, substantial improvements will be realized.

## II. Conclusion

Large-scale technological advancements are merging the criteria for Smart Homes. The idea of a smarter, more convenient home is gaining popularity as the number of connected gadgets surpasses the number of humans. There are countless uses for home automation. Smart Homes, which combine AI and IoT, entice the tech-savvy while reducing energy costs and boosting security. Smart houses therefore support and protect the advancement of technology.

Artificial intelligence (AI) and the Internet of Things (IoT) will significantly advance smart home automation. To make our homes comfortable and secure, AI and home automation work together. Electronics and smart home technologies are designed to simplify and streamline our lives. Through smartphone applications or voice commands, homeowners may systematize various parts of their whole home and request assistance from AI to complete manual jobs. Smart homes are becoming the new standard and will play a key role in our lives in the future, whether we like it or not.

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