Chapter 15
Smart Home Environment:
Artificial Intelligence–Enabled IoT Framework for Smart Living and Smart Health

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ABSTRACT

Increase in population year by year is making the living status of the urban people difficult as resource-saving and sharing become more challenging. A smart home, which is part of smart city development, provides a better way of handling available resources. Smart home also provides a better way of living with smart devices, which can monitor various activities autonomously. It is also essential to have a smart health system that monitors day to the activity of a person and provides health statistics and indicates health issues at an early stage. The home or devices become smart using artificial Intelligence to analyze the activities. Artificial intelligence provides a way to analyze the data and provide recommendations or solutions based on personalization. In this regard, developing a smart home is essential in the current urban area. This chapter identifies various challenges present in developing a smart home for smart living and smart health and also proposes an AI-based framework for realizing a system with user peronalization and autonomous decision making.

INTRODUCTION

As per current population statistics, 55% of the world's population lives in urban areas, which is expected to increase to 68% by 2050. Anticipated major challenges are fiscal problems, residential and household crowding, housing availability, homelessness, traffic and transportation, lack of quality public education, connected point-of-care solutions for healthcare delivery and increase in crime rates. Such an increase in the urban population can create a lot of stress on existing infrastructures, creating a need for smart urban ecosystems that can scale well to provide better living environments and healthcare systems. Smart cities are seen as a major technological break-through towards autonomous urban ecosystems for better living, health, and resource management in urban areas. Urban activities and operations can be automated by integrating Artificial Intelligent (AI) models for facilitating autonomous decision making and monitoring capabilities. AI-based smart city systems have the potential to improve living conditions by self-adapting to dynamic environment conditions and reducing the need for manual interventions by humans. AI based computer vision systems enable autonomous crowd monitoring and management of public workers, accidents, fires, crime, transportation, parking, etc. Emerging paradigms like the Internet of Things (IoT), cloud computing, energy-efficient LED lighting and the advancement of communication technology towards 5G can be leveraged for designing future-proof, autonomous urban systems.

Smart homes are an integral part of a Smart City Urban Ecosystem, that play a major role in improving the quality of life of city dwellers. Facilitating remote access control over home appliances, smart monitoring of children and senior citizens boosts usability and ease-of-access, while also ensuring security, and thus suits the fast-paced lifestyle of urban dwellers. Sensors deployed in each home capture environmental parameters while the collected data is further processed for enabling end-user control applications. AI-based intelligent control systems can automatically analyze data, identify anomalous patterns and perform predictive analytics to identify the situation. Based on identified anomaly type, the system is designed to initiate predefined signals to actuators to perform remedial actions. Nowadays, most families have both parents who have to go to work each morning, while children and the elderly people stay at home, without much assistance and caretaking. Hence, safety and security are essential aspects of smart living, which can automatically detect potentially hazardous events, inform the homeowner whenever there is an emergency, while also ensuring triggering of remedial actions. In a smart home, smart living can be facilitated through monitoring and controlling various devices like doors, home appliances, automatic device control, identifying any security threats, emergency situations etc. Health of residents can be monitored and analyzed using wearable sensors, user-specific activity pattern modeling along with analysis of indoor environment conditions.

The major part of the smart home development system for smart living and smart health depends on identifying the necessary smart things and associated sensors for the continuous collection of sensing data from the environment. Such smart things have several aspects associated with it, like remote accessibility, easy interaction, capability for complex decision making, etc. These smart things can be configured to use Bluetooth, Wi-Fi, GSM, etc, for communication. Identifying various issues in designing autonomous smart homes and the unified architecture required for it are critical challenges, which can be addressed by leveraging AI-based solutions with anomaly detection and predictive analytics.

Figure 1 shows the major components of a home automation system. A Smart home environment is built on a connected network of devices like RFID based resource-constrained devices, wearable devices to monitor health of a person, smart gadgets like laptop, mobile phone, remote control etc, that enables continuous interaction between components and smart appliances like washing machines, refrigerator

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