Chapter 8
Smart Technologies and the Augmented and Virtual in Smart Cities:
Urban Life With Smart Homes, Electric Vehicles, Robotics, and Extended Realities

ABSTRACT

The purpose of this chapter is to explore urban life and the ambient in relation to smart technologies, the augmented and virtual, electric vehicles, robotics, and extended realities. A review of the research literature is conducted in the context of smart, learning, and future cities for smart homes, electric vehicles, robotics, and extended realities. Issues, controversies, and problems emerging from the literature review are highlighted, contributing to formulation of a conceptual framework for smart technologies, the augmented, and virtual in urban life and the ambient in smart cities. Using an exploratory case study approach combined with an explanatory correlational design, variables pertaining to the exploration are identified, and the nature of their relationship is assessed. Through the lens of smart technologies in urban life, ranging from smart homes to extended realities, applications are explored in smart cities while informing directions for future research and practice.

1. INTRODUCTION

Zhang and Shenjing (2020) provide an introduction to a special issue of smart technologies and urban life that aims "to generate a comprehensive understanding of the interrelations" impacting humanity, nature, sustainability, and society where smart technologies are defined broadly and are said to include "smartphone apps, apps in other mobile devices, wearable devices such as smart watches, autonomous vehicles, intelligent transport systems, drones, robots, smart houses, and new types of data generated by smart technologies." Cugurullo (2020) employs the notion of the autonomous city in the context of

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smart cities to "stress the presence of urban artificial intelligence capable of thinking and acting in an unsupervised manner" involving "autonomous cars, robots, and city brains" that "are increasingly performing tasks and taking on roles which have traditionally been the domain of humans." Stanney, Nye, Haddad, Hale, Padron, and Cohn (2021) articulate a "virtuality continuum" consisting of the real world and extending to augmented reality to mixed reality and to virtual reality. This chapter is significant in that it builds on the research literature for such smart technologies giving rise to the motivation for an exploration of smart homes, electric vehicles, robotics, and extended realities in the context of urban life and the ambient in smart cities, learning cities, and future cities.

Objectives: The primary objectives of this chapter are to a) explore urban life and the ambient in relation to smart homes, electric vehicles (EV), and robotics in the context of smart cities; b) formulate a conceptual framework for smart technologies, the augmented, and the virtual in urban life and the ambient in smart cities; and c) explore the nature of the relationship between extended realities and smart cities in learning more about the ambient. These objectives give rise to the main research question under exploration in this chapter – *How do smart homes, electric vehicles, extended realities, and robotics contribute to urban life and the ambient in smart cities?*

2. BACKGROUND

A smart home concept is described by Marzano (2006) in terms of a system of modules that would assist people while being unobtrusive, as in, "more or less invisible, either hidden completely out of sight or incorporated into objects that have always belonged in the home" such as tables, chairs, cupboards, lamps, and the like. Soar, Livingstone, and Wang, (2009) describe the notion of ambient living in the context of a health care model of wellness in Australia. Robotics findings by Studley and Little (2021) identify "the necessity of benchmarking" to discern "the state-of-the-art in Robotics" in order to continue learning about "robot-human interactions and co-working." Celani, Falcone, and d'Alessandro (2019) describe the notion of the augmented city "where citizens and communities are the main actors of urban intelligence" and "they are encouraged to create and co-design their services" based on "the real needs of people in the city."

2.1 Definitions

Definitions from the research literature are provided for key terms used in this chapter.

- **Augmented Reality:** Hopkins, Bae, Uhr, Banić, Zheng, and Do (2021) describe augmented reality (AR) as interfaces such as "screens, glasses, head-mounted displays, projection" that "superimpose digital 3D content on the user's view of the physical world using image recognition or location tracking to overlay digital content in a real-world location in real-time."
- **Extended Reality:** Stanney et al. (2021) describe eXtended reality (XR) as "a technical capability that offers a range of computer-generated immersive experiences that mirror reality to varying degrees" and is said to have become "a common-place tool for training and education, collaborating and partnering, networking and entertaining, and other applications which have yet to be envisioned and realized."