Metaverse:
A New Platform for Circular Smart Cities

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EXECUTIVE SUMMARY

The way we interact with the physical world around us is being changed rapidly by advances in technology. These new technologies are very helpful for developing smart cities with the goal of improving the quality of life considering sustainability. Technology is also at the core of the circular city vision, and we need to use the new technologies and act in a smarter way in smart cities to support the achievement of economic, environmental, and social targets that are important for sustainable development and circular economy (CE) implementation. The metaverse (which is the combination of the prefix "meta" with the word "universe") is a new concept that is known as transcending hypothetical synthetic environment linked to the physical world. In this chapter, the proposed concept will be introduced in more detail, and then the authors discuss how smart cities can use the metaverse platforms for improving themselves in five main aspects including governance, environment, mobility, economy, and quality of life dimensions.

INTRODUCTION

The metaverse is one of the most up-to-date technological developments in the rapidly transforming world in this regard. It is valuable to observe and

follow the equivalent of the discussions in this direction in the literature (Damar, 2021). Stephenson (1992) for the first time mentioned the metaverse in a piece of speculative fiction named Snow Crash defining it as a massive virtual environment parallel to the physical world, in which users interact through digital avatars. Lee et al. (2021) provided a comprehensive framework that examines the latest metaverse development under the dimensions of state-of-the-art technologies and metaverse ecosystems, and illustrates the possibility of the digital 'big bang'.

Shi et al. (2004) presented the initial design of such an end-to-end transport service for metaverse applications, along with the results of a simulation study evaluating its effectiveness. Bourlakis et al. (2009) studied the evolution of retailing, i.e. from traditional to electronic to metaverse retailing, and shed light on the ways metaverses influence that evolution considering the key challenges and opportunities faced by traditional retailers, e-retailers, and metaverse retailers. Vernaza et al. (2012) diussed the research that has been developed at the University of Panama for the use of the metaverse (virtual worlds) based on free software as virtual learning environments and their applications in e-Learning retaled to Electronics. Nevelsteen (2018) obtained a definition for a "virtual world" via sample technologies using grounded theory and compared it with related work and used it to classify advanced technologies such as a pseudo-persistent video game, a MANet, virtual and mixed reality, and metaverse. Thomason (2021) studied how the metaverse may be used in the future to change, enhance, and possibly transform health care considering collaborative working, education; clinical care, wellness, and monetization. Duan et al. (2021) provided a three-layer metaverse architecture including infrastructure, interaction, and ecosystem.

The metaverse is an immersive platform and an embodied internet where you can experience everything that you can imagine in a virtual world. In other words, users live within a digital universe via using various technologies such as telepresence, virtual reality, and augmented reality. It takes a few years before the key features of the metaverse become mainstream but already some of the high-tech companies in the world are working on platforms that can be a part of the metaverse in the near future.

Meta company (formerly Facebook) envisions a virtual world where digital avatars connect through work, travel, or entertainment using VR headsets. Acquiring Oculus (a provider of virtual reality equipment) in 2014 by this company is considered as a step toward its goal regarding metaverse in the future. To combine the real world with augmented reality and virtual reality, Microsoft company is developing mixed and extended reality (XR)