

PREFACE

Augmenting Space: The role of immersive technologies in future cities

As digital technologies are advancing, contemporary interactions within cities are beginning to emerge. These interactions are commonly enabled through sensors to implicitly automate manual processes, such as turning on lights or walking up stairs. However, cities were not necessarily built from the ground up to be smart, rather they are gradually becoming smarter over time as technology becomes more extensible and embedded within them [1, 2]. These digital technologies create information layers that exist over the physical space, resulting in the space being filled with dynamically changing information, thus augmenting the space [3]. Augmented reality (AR) is one such technology that has recently seen a lot of development in this area and is only now starting to become more viable as hardware and computer vision algorithms have caught up. Films such as *Minority Report* (2002), *Ghost in the Shell* (2016), and *Blade Runner* (2017) have predicted AR's future emergence in public spaces and cities [4, 5, 6]. These films featured AR advertising and information holograms in public spaces, enabled by smart contact lenses and holograms. Currently however, AR has been introduced to public spaces in a number of interesting ways. For instance, *Pokemon GO* became a global phenomenon which resulted in people physically playing the game in urban spaces and caused ripple effects on the physical spaces people were playing in [7, 8, 9]. Recent work has also shown that AR can have more engaging applications, in areas such as community engagement [10], personalised digital signage [11], in-situ visualisations [12], cultural heritage [13], and remote collaboration [14, 15].

On a consumer level, AR is most common on smartphones, particularly after the release of ARKit and ARCore - improving the functionality. AR smart glasses are also becoming more accessible and bring with them the possibility of more natural integration of virtual content into our daily lives. For instance, the Microsoft HoloLens contains an array of sensor technologies giving it a sense of depth which allows it to place objects naturally in physical space. It has been successfully applied by planners to visualise underlying parts of the city in-situ [16, 17]. While AR is becoming more advanced, accessible, and has demonstrated potential, more knowledge is needed around the key benefits it will bring to cities and how it will change our interactions with the urban environment. Additionally, the use of such technologies raises the question of how the virtual and physical spaces can co-exist - creating an augmented space [3].

To address this gap in knowledge, this focus section builds on from our initial workshops [18] at Media Architecture Biennale (MAB) 2018 and IEEE International Symposium on Mixed and Augmented Reality (ISMAR) 2019 with the goal of bringing together researchers to explore the applications of AR and other immersive technologies, such as Virtual Reality (VR) and Mixed Reality (MR), within the context of enhancing architecture, public spaces and cities. In response, seven papers were selected for the focus section through a single-blinded peer-review process with at least two reviewers per paper. The papers showcase the applicability of various methods in a wide variety of different use cases, providing insights into current possibilities and

challenges for digital technologies and the ways in which they can augment cities around the world.

Callum Parker¹, Soojeong Yoo¹, Waldemar Jenek², Youngho Lee³

¹*The University of Sydney, Australia*

²*Queensland University of Technology, Australia*

³*Mokpo National University, South Korea*

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