Chapter 2
Interacting With Augmented Reality Mirrors

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ABSTRACT

This chapter deals with the topic of Augmented Reality Mirrors (ARMs) – a kind of specular interfaces making use of Augmented Reality technology. The review presented in the chapter first analyses the current setups for the construction of ARMs. Secondly, it presents a study on their potential for inferring in human perception (e.g. behaviour and emotions) and the high interactivity potential and usability they have. In the third place, it shows their use in different areas of knowledge, namely entertainment, edutainment, clothing, arts and medical therapy. Then, the chapter presents a discussion, highlighting the current technological barriers and the need for more research. Finally, future challenges are provided.

INTRODUCTION

Rochat and Zahavi (2011) define mirrors as "peculiar objects associated with peculiar, uncanny experiences": Compared to other objects, mirrors are uncanny at a basic physical and experiential level. The natural attraction that mirrors have for human beings may be explained by cognition and neurological factors, and many studies have been carried out related to visual perception in mirrors (Dieguez, Scherer,

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& Blanke, 2011; Duñabeitia, Molinaro, & Carreiras, 2011; Jones, Collis, Watson, Foster, & Fraser, 1994; Sambo & Forster, 2011; Savardi, Bianchi, & Bertamini, 2010). Indeed, they are a source of visual enhancement as well as illusory perception. Physically, mirrors are a particular kind of surface in the environment, typically flat and polished. Any surface in the environment reflects light, but a perfectly flat and polished mirror reflects close to a 100%, depending on how it is manufactured. In simple physical terms, mirrors are obstacles to light with the particular property of abruptly inverting its direction in space while maintaining its structure, hence the structure of the optic array that we perceive.

Unlike regular mirrors, augmented reality mirrors (ARMs) can virtually change the image of the scene reflected in the mirror by means of the augmented reality (AR) technology. Overall, the AR systems are those that simultaneously (Azuma, 1997): 1) combine real and virtual objects; 2) are interactive in real time and 3) are registered in 3D. Therefore, to be considered as an ARM these characteristics have to be fulfilled. In this regard, there exist other computer-based mirror setups where image processing is applied but e.g. there isn't any kind of 3D registration, such as in (Cheng et al., 2008; Fujinami, Kawsar, & Nakajima, 2005; Jun-Ren, Chien-Lin, Jin-Kun, Jar-Ferr, & Chung-Hsien, 2008; Kim, Lee, & Kim, 2004; Morimoto, 2001; Poh, McDuff, & Picard, 2011; Shahid, Krahmer, Swerts, Melder, & Neerincx, 2009; Ushida, Tanaka, Naemura, & Harashima, 2002). These works are usually referred as digital or interactive mirrors, being ARMs a special and/or an extended case of them. – In order to highlight that an ARM follows the Azuma's definition, in some parts of the text we use the term 'pure' ARM.

The term 'AR' was first coined by Caudell and Mizell (1992) to describe a digital display used by aircraft electricians that blended virtual graphics onto a physical reality. At that time, the definition of the AR technology was linked to head-mounted displays (HMDs), as being the unique displays using this technology (Figure 1 left). It is afterwards when AR applications were related to other kind of displays, and thus the definition of AR was extended and unlinked to the display technology. However, it is not until the beginning of the new century that AR applications can be found in which a change of paradigm was introduced by changing the spatial positioning of the camera and introducing the user(s) as a part of the augmented scenario, so that ARMs were born (Figure 1 right).

Since then, the research community and also some industries have invested in the design and construction of ARMs for different purposes. Given the increasing number of such mirrors and the different

Figure 1. Change of paradigm (example of vision-based ARM)