

Chapter 9

User Perspective on the Adoption of Mobile Augmented Reality Based Applications

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ABSTRACT

Mobile augmented reality (AR) based applications enable digital content to be connected with the user's real world surroundings. To begin with, the current types of consumer-level applications are introduced. The main purpose of the chapter is to study the adoption and perceived strengths and weaknesses of mobile AR-based applications by analyzing quantitative and qualitative responses of 90 actual users. Diffusion of innovations (DOI) theory is adopted with structural equation modeling (SEM) to investigate the intention to use such applications. Perceived strengths and weaknesses, mentioned by the users, are analyzed by qualitative coding. Results indicate that the constructs of diffusion of innovations theory are able to explain 67.7% of variance for the intention to use AR-based applications. Relative advantage, ease of use, and observability are significant factors determining use intentions. The strengths and weaknesses of applications are related to content, features, ease of use, technology and hardware, enjoyment, and concept.

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INTRODUCTION

Mobile augmented reality (AR) based applications enable digital content to be connected with the user's real world contexts in real-time. Dynamic data and content feeds can be presented on the screen of the mobile phone; users are able to view through digitally enhanced camera imagery, or acquire or create digital information with the help of visual tags located e.g. in objects or products. From the technical perspective, such prototypes and pilots have been researched for almost 20 years. On the consumer or end-user level, AR-based applications can be considered as relatively new phenomenon.

Nowadays, users of smart phones are enabled to try out and use numerous AR-based applications from application marketplaces such as Android Market, iPhone App Store, Nokia Ovi Store, or BlackBerry App World. The user base on the global level has been headlined to be rising. For example, application named *Layar* has reported to reach the limit of one million users, and *Wikitude* announced millions of pre-installations to devices coming to the market. Yet, the amount of actual active users remains unknown. There might be a considerable amount of users who are just trying out the applications instead of using them regularly. Therefore, it is justifiable to study the factors affecting the intention to use such applications, as well as the actual strengths and weaknesses of the applications.

The objective of this chapter is to 1) present relevant background perspectives on AR-based applications, 2) examine the factors affecting the intention to use mobile AR-based applications, and 3) investigate further what the perceived strengths and weaknesses of the applications consists of. The background part is handled by reviewing earlier literature and presenting the two main application types with examples of current mobile applications. The factors affecting the intention to use current mobile applications are researched by applying the diffusion of innovations theory

(DOI): quantitative questionnaire answers of 90 AR-based application users are analyzed with structural equation modeling (SEM). Qualitative answers about the strengths and the weaknesses of the applications are analyzed by qualitative coding, and a set of themes is formed on the grounds of the diffusion of innovations theory and the data itself.

AUGMENTED REALITY BASED APPLICATION TYPES

The term augmented reality was coined in 1992 in the context of developing AR system for assisting aircraft manufacturing (Caudell & Mizell, 1992). Milgram, Takemura, Utsumi and Kishino (1994) have presented a widely used illustration of mixed reality on the reality-virtuality continuum (Figure 1), which describes the position of AR in relation with real and virtual environments. Fairly consistent with Milgram's continuum, in a well-known research article by Azuma (1997) AR is seen more as supplement to reality, rather than a replacement of reality. According to the definition of Azuma et al. (2001), AR system "*combines real and virtual objects in a real environment*", "*runs interactively, and in real time*", and "*registers real and virtual objects with each other*". They also suggest that AR can be related to all senses, even though the majority of the studies on AR seem to focus on the sense of sight. More recently, user-based personalizing, filtering, creating and sharing of content have been mentioned as some of the main elements of present-day AR applications (Billinghurst & Kato, 2002; Nilsson, Johansson & Jönsson, 2009; Wither, DiVerdi & Höllerer, 2009). In this chapter, AR is seen as reflecting digital information with the real world context that the user perceives, thus enhancing the physical environment with digital information in an interactive way.

Early AR applications, including "*mobile*" applications, were often prototyped with see-

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