

Anticipation Approach in Designing Graphical User Interface of Augmented Reality for Shopper at Retail Center

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Abstract: Anticipation refers to an action or decision that is taken in preparation for some future event. The purpose of anticipation was to construct and implicit or explicit representations of future states or effects before the actual realization of the action that produces them. Anticipation also generally associated with the ability of looking ahead or looking forward and its open the possibility to uniquely identify the design paradigm on the basis of abstract structure. Augmented reality (AR) meanwhile, is a vision based technology where the paradigm of interaction has shifted further from the constraint of the desktop metaphor. Furthermore, the usage of AR as assistive technology for shopper at retail still poses more challenges not yet well explored. This paper therefore aims to demonstrate the application of anticipation approach in designing user interface for augmented reality application. This study has justified five (5) images that can represent expected graphical user interface (GUI) in form of text and graphic for augmented reality. The image of GUI has been derived from five (5) use case of shopping that derived from features of locating services (ATMs), navigating inside the shopping center to a specific shops, encourage user to try new things, notifications to remind user to purchase the product while nearby the product location and additional information gained by pointing the product. The expected GUI of AR such as defined in this study can be used as an image based stimuli for gathering user feedback at very early stage prior to the development of actual AR application. In addition, this anticipation GUI design approach has been seen as beneficial in context of user experience evaluation where emerging technology such as AR will involves camera which is still the forbidden input devices at retail center.

Key words: anticipation; shopping; graphical user interface; augmented reality; retail center

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1. Introduction

Augmented Reality (AR) is an emerging technologies that supplements the real world with computer generated or virtual objects that appear to co-exist in the same space as the real world (Azuma, Bailiot et al., 2001). The persons who interact with the AR system could see virtual and real object coexisted in the same space. AR

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application thus refer to a system that allow user to see the physical object has been virtually annotated (Hansen, 2006; Alzahrani, Loke, & Lu, 2011). The annotation in AR is expected to be the useful, meaningful and appealing additional or complimentary information of selected focal product (Zhu, 2006).

Anticipation, meanwhile, refers to an action or decision that is taken in preparation for some future event for the purpose to construct and implicit or explicit representations of future states or effects before the actual realisation of the action that produce them (Zamenopoulos & Alexiou, 2007). Therefore, objective of this study is to apply the anticipation principle in justifying the expected graphic elements that can be represent as user interface of AR as information appliances in shopping environment. Furthermore, the usage of AR as assistive technology for shopper at retail still poses more challenges not yet well explored. This paper therefore aims to demonstrate the application of anticipation approach in designing user interface for AR as information appliances for shopper in context of shopping and retail.

2. Literature Review

2.1 Augmented Reality as Emerging Technology in Retail

Array of technologies has been available to being used by some retailers and shopping centers in which can be categorized into different area of usage that includes information and shopping assistance. However, technology at retail stores and shopping centers has been utilized heavily in operational areas such as budgeting, report generation, energy management, security and resources conservation. Lightest usage was in customer-servicing areas such as customer tracking, data-base marketing, entertainment, shopping assistance, and on-line shopping services. The largest technology usage of shopping assistance in earlier years was to provide transportation for elderly or disabled customers once they were inside the mall. In addition, only 11% of the retailers reported on utilizing technology in providing information and directions. Computer based kiosks meanwhile was the only kind of information and shopping assistance technology that has been utilized by the malls since 1990s (Clodfelter & Overstreet, 1996).

In recent years, AR has been seen as the emerging customer-servicing technologies which promotes an exciting opportunity among retailers to drive an innovative approach of customer engagement (Bernroth, Uldall-Jorgsen, Wenstrom, & Andersson, 2014). AR has the potential to transform bricks and mortar shopping where consumers can shop directly from the printed magazine page or purchase goods virtually online instantly from the physical store (Rondon, 2012 ; Revolution, 2009). Retailers such as IKEA , Adidas and Lego has adopted AR as an interactive point of sales (POS) to stimulate the purchase intent among consumers towards their furniture, apparel and the gamification products (Spreer & Kallweit, 2014; Vrablova & Kalinic, 2015). AR interaction in context of retail is emphasized on allowing the user to quickly see the virtual metadata of a product (Valkkynen, Boyer, Urhema, & Nieminen, 2011). Figure 1 has shown list of retailers represent by its corporate logo that have started to adopt AR as part of their business. AR also has been seen as technology that can be used to overcome limitations of e-commerce in fulfilling three main tasks of shopping that includes searching and interacting with products as well in acquiring product information (Lu & Smith, 2007).

AR has been established as potential technology in context of personal information system in a form of personal wearable computing that was useful for advertisement as well as indoor or outdoor navigation system (Krevelen & Poelman, 2010), however, the challenge and potential of AR as personal information system for shopper has not yet well explored.



Figure 1 Example of Retail Companies Have Started to Adopt AR at Their POS

2.2 Related Work

Anticipation principle has been applied in several studies which aim to explore the challenge, potential and usability of AR in shopping and retail context. For instance, Olsson has anticipate people expectation for AR as a mobile services at shopping centers where the study has resulted to 28 vision statement represent expected features of AR as mobile application at shopping centers. The participants of the study have been given a plastic phone-size container as a mock-up representation of an omnipotent futuristic of mobile augmented reality devices (Olsson, Lagerstam, Karkkainen, & Mattila, 2013).

The anticipation approach also has been applied in a study conducted to develop the *Promopad* as an automated augmented-reality shopping assistant (Zhu, Owen, Li, & Lee, 2008). The study of *Promopad* however deal with the actual system implementation that includes the accuracy and robustness of in-store tracking, the positioning challenge of video see-through system and the mechanism on dynamically manage the real-time inverse lighting solve an issue of illumination but it was centered around on the pre-selected retail item to anticipate the meaningful and useful product promotion status as an effective augmented context for the shopper (Zhu, 2006). The principle of anticipation also applied in a study that aims to measure discomfort experience of stress and strain of using head mounted see-through display in a context similar to shopping which is a warehouse picking scenario within the laboratory setting (Tumler et al., 2008). Meanwhile, the virtual shop that simulates the environment of retail stores with shelves full of products has been used as a stimuli in anticipating the usability results of the AR application as physical smart space that bridge the gap between offline and online retail (Rashid, Peig, & Pous, 2015).

Table 1 Related Studies on Anticipated Approach in AR Design and Development

Source	Visual cue	Use situation	Anticipated approach
Olsson et al. (2013)	The plastic phone size container.	At shopping centers	Mock-up presentation mobile AR devices.
Zhu W. (2006)	AR application of <i>Promopad</i> .	On the retail product	Complimentary information of the pre-selected retail item
Tumler et al. (2006)	The AR system consisted of a Microvision Nomad ND2100 connected via WiFi to a Ultra Mobile PC (UMPC) carried in shoulder belt.	Warehouse picking scenario.	In the laboratory setting.
Rashid et al. (2015)	The AR system consisted of an Android devices and Wooden shelf attached to RFID system.	Handheld device pointed at the smart shelf.	The virtual shop

Related studies such as summarized in Table 1 has shown the principle of looking ahead or looking forward can be applied for several purpose that includes to discover the expected user vision, potential solutions to the technical challenges, the usability of AR as shopping application as well the possible physiological experience may occurs resulted from the long term usage of actual AR device. The virtual shop, mock-up of mobile AR devices, actual AR application or actual AR devices has been used as stimuli in order to trigger a certain actions or user feedback. However, lack of attention has been given to the usage of graphical element that based on graphics and text in a process of designing AR system or application within the context of retail and shopping.

2.3 Theoretical Background

The earlier definition of AR was a technology which being centered around the head-mounted see-through display (Azuma, Behringer, Feiner, Julier et al., 2001). However, AR has progressing towards interactive application which has been focused on specific information acquisition acquisition for a particular group of user in a specific context of use (Schmalstieg, Langlotz, & Billinghurst, 2011). Meanwhile, the use of image, picture or graphic as stimuli was established as an approach in eliciting emotions of people towards events or products (Desmet, Porcelijn, & van Dijk, 2007; Bradley & Lang, 1994; Isbister, Hook, Sharp et al., 2006). In addition, graphics and text also a kind of typical media used in presenting flow of information to the user (Turk & Robertson, 2000). Therefore, this study attempts to embrace the concept of information flow through text and graphic. Figure 2 thus demonstrate the design concept of virtual annotation design use in this study that showing text of information overlay on top of physical object. The virtual annotation is referring to complimentary or additional information that relates to the physical object, which is connected within the retail context.

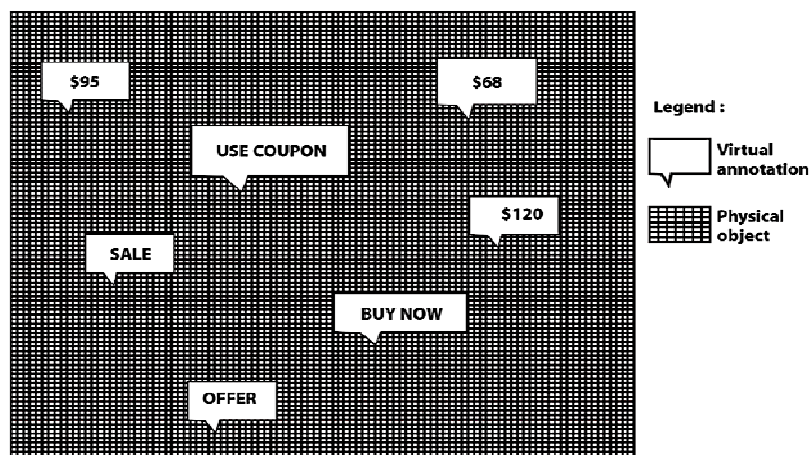


Figure 2 Design Orientation of Graphical Element of AR in Retail for Shopper

Use case in addition was a diagram that is associated with an actor and the actor's goal. Use cases focused on user goals but it emphasized on user-system interaction rather than user's task itself (Sharp, Rogers, & Preece, 2007). Therefore, this study aim to construct an expected images that represent the graphical elements of AR user interface which derived early from the use case. In general, use case is a graphical representation that consist user task and that is context dependent. The GUI design process of this study therefore define shopper as actor, actor's goal that derived from the finding of related work and shopping at retail center as context. Figure 3 shows the basic notation of use case diagram for shopper at retail center.

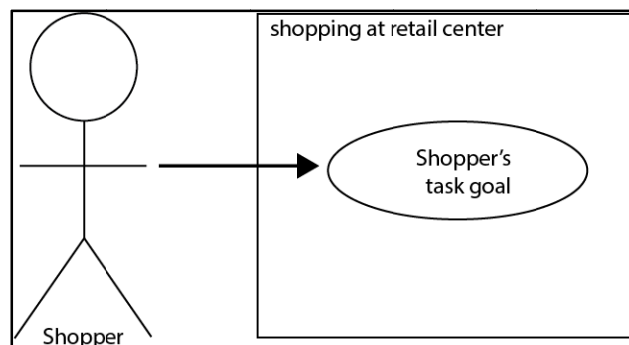


Figure 3 Use Case Diagram for Shopper

3. Designing Graphical User Interface (GUI) of AR for Shopper

3.1 Shopper's Task Goal

Several use case possible however this study will begin with the five (5) use case which has been derived from the finding of the related study particularly in Olson et al. (2013). The use case has been formed from the vision statement of user that represents the expected features of AR as mobile services at shopping center. In general, there were three (3) primary task related to AR in context of shopping which include searching for product, interacting with product and acquiring additional product information (Lu & Smith, 2007). Table 2 defines the expected features of AR and the sample use case use in this study.

Table 2 List of Use Case Use to Design GUI of AR for This Study

Expected features of AR (Olson et al. (2013))	Sample use case
Locating services (ATMs).	Retrieve information of ATMs location.
Navigation inside the shopping center to a specific shops.	Retrieve information of shop name, opening hours and shop location.
Encourage users to try new things.	Retrieve complimentary of product information.
Notifications to remind user to purchase the product while nearby the product location.	Retrieve notification to purchase the product.
Additional information gained by pointing the products.	Retrieve complimentary of product information.

3.2 Expected GUI element of AR for Shopper at Retail Center

The user interface of AR is primarily based on vision (Woo, Lippman, & Raskar, 2012) where the visual interaction of AR has been centered around the metaphor of mixed reality display (Milgram & Kishino, 1994). Therefore, it is possible to construct expected image that represent the graphical elements of AR interface that constraints within the use case of retail and shopping. The following figure thus demonstrate the expected user interface and orientation of information design of AR for shopper at retail center that inspired by the sample use case which defined as in Table 1.

Figure 4 shows example of possible virtual annotation of information about ATMs location placed on the photo of the actual retail center. The expected GUI which demonstrate icons of ATMs varied in size represent distance of ATMs from the AR devices used by the customer.

Figure 5 shows example of possible virtual annotation of information related to shop name, shop opening hours and shop location. The expected GUI which demonstrate icons of the shop with the text caption showing shop opening hours and the shop location.



Figure 4 Expected GUI Element of AR for the Use Case of Retrieve Information of ATMs Location

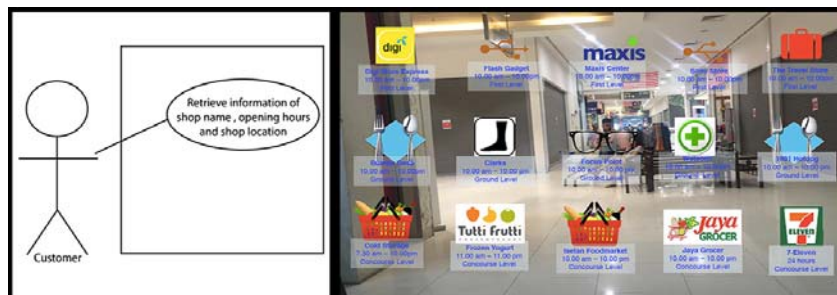


Figure 5 Expected GUI Element of AR for the Use Case of Retrieve Information of Shop Name, Shop Opening Hours and the Shop Location



Figure 6 Expected GUI Element of AR for the Use Case of Retrieve Notification of Product Purchase

Figure 4 shows example of possible virtual annotation of notification of product purchase. The expected GUI in Figure 4 has demonstrated the context of notification of grocery product purchase.



Figure 7 Expected GUI Element for AR for the Use Case of Retrieve Complimentary of Product Information

Figure 7 shows two (2) possible GUI of virtual annotation in displaying complimentary product information that for the features of encouraging users to try new things and additional information gained by pointing to the products. Expected GUI image in Figure 5 demonstrates the web link to the recipe for cooking and the list of complimentary product associate to grocery product of oranges and cabbages.

4. Conclusion

The study has justified five (5) expected GUI element of AR interface that represent five (5) use case of shopping. The expected GUI element can be a visual design examples in the evaluation of anticipated user experience at the early phase of development of AR as personal information appliances at retail center. As the key technology for AR is the camera, it is challenging for the developer or designer to evaluate the potential of AR

application in real context of shopping environment as most retail center still implement the *no camera policy*. Therefore, using anticipation approach with graphics and text can overcome the current challenge in designing and evaluation of AR application in actual setting of shopping.

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