

# DEVELOPING A CONCEPTUAL MODEL OF USER ENGAGEMENT FOR MOBILE-BASED AUGMENTED REALITY GAMES

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## Article history

Received  
1 July 2015  
Received in revised form  
3 September 2015  
Accepted  
11 October 2015

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## Graphical abstract



## Abstract

This paper suggested a conceptual model of user engagement for mobile based augmented reality (AR) games. Literature revealed the importance of user engagement for defining a successful technology application such as game. However, user engagement in particular is still not clearly studied for the mobile augmented reality games area. This paper critically reviewed the relations of user engagement elements in the mobile augmented reality game and guidelines that related to engagement for such type of games. It then recommended eight attributes of user engagement conceptual model for mobile based augmented reality games that can be used by game designer to design engaging mobile AR games for the industry and future AR engagement research.

Keywords: Augmented reality, mobile game, user engagement

## Abstrak

Kertas ini mencadangkan satu model konsep penglibatan pengguna untuk mudah alih berasaskan realiti diperkukuhkan (AR) permainan. Kesusasteraan mendedahkan kepentingan penglibatan pengguna untuk menentukan aplikasi teknologi yang berjaya seperti permainan. Walau bagaimanapun, penglibatan pengguna khususnya masih tidak dikaji dengan jelas bagi kawasan permainan realiti tambahan mudah alih. Kertas kerja ini dikaji semula secara kritikal hubungan unsur-unsur penglibatan pengguna dalam mudah alih diperkukuhkan permainan realiti dan garis panduan yang berkaitan dengan penglibatan untuk apa-apa jenis permainan. Ia kemudian disyorkan lapan sifat-sifat penglibatan pengguna model konseptual untuk mudah alih berasaskan permainan realiti tambahan yang boleh digunakan oleh pereka permainan untuk mereka bentuk melibatkan diri permainan AR mudah alih untuk industri dan penyelidikan penglibatan AR masa depan.

Kata kunci: Realiti diperkukuhkan, permainan mudah alih, penglibatan pengguna

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## 1.0 INTRODUCTION

Augmented reality (AR) is defined as a technology whereby computer generated information and input is blended into our real environment view via the camera live feed in real-time [1]. Highlighted by [2] mobile AR especially should receive more attention as its progress is remarkable and potentially have millions

of users. However, they stated there are still difficulties remained thus no killer AR apps appear. Pucihar and Coulton [3] addressed the challenge in designing user experience for evaluating future AR applications. According to [4] designing AR game is a challenging task and required to look at the perspective of how to create lasting player experiences. They highlighted that it must encompass all traditional aspects,

particularly on how to combine elements from classical games with the technology of AR to enhancing player experience. There is still lack of study in user engagement criteria that specifically addressed for mobile AR game research to benefit designer in the future [5]. Moreover, there are issues along with design guideline to enhance engagement for mobile AR games [3] [5]. Therefore, the present study aims to propose a conceptual AR user engagement model within the mobile game context in order to fill the gap within AR user engagement literature.

## 2.0 REVIEW

Chapman [7] stated that engagement is something that attracts and holds our attention. Quesenbery [8] also proposed engagement as a dimension of usability that is influenced by the user's first impression of the application and enjoyment from using it. A more detailed research identified by [9] discovered aspects that lead to the engagement which are challenge, fantasy, curiosity and control [10]. Similarly, [11] conducted a study to define engagement as a quality of user experience. They categorized engagement as attributes of challenge, positive affect, aesthetic and sensory appeal, feedback, attention, endurability, interactivity, variety/novelty, and perceived user control.

Mayes and Cotton [12] defined engagement as how fun is involving and motivating a task in computer

games. Chen, Kolko, Cuddihy and Medina [13] presented their model of engagement for digital games where they stated three main factors that determine engagement namely interest, attention and immersion. Another work in engagement for video games also developed by [14] which they investigated and revised the existing work of user engagement scale by [15] to fit user engagement in video games based environment. Four factors that determined user engagement scale specifically for video games were identified i.e. focused attention, perceived usability, aesthetics and satisfaction. Rutledge and Neal [16] introduced the Positive Engagement Evaluation Model (PEEM) to incorporate holistic, qualitative experience in interactive and mobile and augmented reality applications. They presented the eight evaluation matrix to evaluate engagement using the theoretical framework into a series of evaluation prompts that may come from either the developer or the user – i.e. goal, attention, interaction, concentration, content, identity collaboration and emotional outcome of satisfaction. This matrix has been tested on AR application, and compared with several AR applications such as e-learning, e-business, e-government and AR game [5] Additionally, [17] presented mixed fantasy triad that identified virtual, real and imagination are three content aspects in achieving mixed fantasy. Imagination that blend with virtual and real content will trigger player's emotional which important in engaging player.

**Table 1** Summary of Related Models to Develop User Engagement Conceptual Model for Mobile-based AR Games

Element from the models	Related to digital games				Related to AR technology	
	UES for Video Games [14]	Characteristics of good game [10]	UE in Games [13]	GameFlow [19]	Mixed Fantasy Triad [17]	PEEM [16]
Attention	✓		✓			✓
Goals				✓		✓
Control		✓		✓		
Concentration				✓		✓
Immersion			✓	✓		
Player skill				✓		
Challenge		✓	✓	✓		
Social Interaction				✓		✓
Feedback				✓		
Identity						✓
Perceived Usability	✓					
Aesthetics	✓					
Satisfaction	✓					✓
Novelty	✓					
Endurability	✓					
Felt Involvement	✓					
Fantasy		✓			✓	
Content					✓	✓
Interaction						✓
Interest			✓			
Curiosity		✓				

Many researchers have selected the flow theory to define engagement [11] [7]. This theory suggested that flow [20] as the state where user or person become so engaged with and really focused on an activity, then felt of lose track of time and experiencing satisfaction as being totally absorbed, well suited for game design and AR application [18]. Sweetser and Wyeth [19] for example considered this theory as their basis of developing a new model called GameFlow to identify eight elements of enjoyment namely concentration, challenge, player skill, control, clear goals, feedback, immersion, and social interaction. This paper has evaluated six related models with the elements of user engagement as presented in Table 1.

### 3.0 RESULTS

The results of the study suggested eight factors that are able to maximize the impact of user engagement for AR mobile games development. These are:

#### 3.1 Clear Goals

According to [16], the process towards the goal is the main source of the reward experience in achieving optimal engagement for AR applications. Goals are clearly as one of components should provide in games. Additionally, [19] explained overriding and intermediate goals would require players to continue playing the games to find out the answers.

#### 3.2 Satisfaction

As suggested by [14] that satisfaction in user engagement as novelty, endurability and felt involvement. Novelty is represented as the level of interest and curiosity whereby trigger from something unfamiliar or new. However, in mobile AR games, novelty for engagement is not related to the novel interaction of AR technology. As reported by [21] the wow effect on the novelty of interaction in AR technology only amazed the first time people when see it, but it quickly regressed. In actual fact, curiosity and novelty tend to be more mystery and puzzlement thus triggered people for wanting to learn more till they ensured to complete in understanding it [9]. Endurability on the other hand, pertained the concept of like hood to returns to the application and future recommendation to other users. It is explained as an overall user experience evaluation in the form of successful, rewarding and worthwhile. The third aspect, felt involvement suggested the user to have a feeling of being engaged with enjoyment in interaction process. In the context of mobile user engagement, this aspect may involve enjoyment, fun and relaxation, but depend on the specific time and places [11].

#### 3.3 Focused Attention

Focused attention is defined as the mental activity for concentrating on only one stimulus attention and ignoring all others [22]. This in fact will keep the user's attention in order to engage or immerse them in any activity of AR applications [16] and is a component of Flow [11]. The fidelity and presentation of the game's audio and graphics are affected the level of engagement during playing video game. In this context, the visual and audio need should be easier to understand [23]. In addition to this, [19] suggested that users be introduced a background story and kept the attention by providing variety of mission and feedback, high workload while still being appropriate for players and not distracted game task.

#### 3.4 Mixed Fantasy

In the mixed fantasy triad, it is important to balance between both virtual and physical content. Stapleton [17] suggested three different content to be considered i.e. virtual, real and imagination content. Other factors included the way to locate a precise virtual 3D object in real environment setting [6]. Unlike in the virtual world, objects in AR games are immersed in the real worlds. Thus, it would be a challenge to design seamless merge content between virtual and physical world. Rutledge and Neal [16] added that identity is crucial in this context to engage user imagination via integration or imaginative projection of user into experience.

#### 3.5 Perceived Usability

According to [11], usability refers to the how convenience and ease of use to everyday life situations particularly for mobile technology. Nylander, Lundquist, Brännström and Karlson [24] found that participants were more comfortable in doing simple activity such as reading on mobile device, whereas computer is for a more complex activity. A guideline in choosing marker tracking effectively, ease of use and convenience has been highlighted by [4] particularly sensor unreliability and connectivity loss [25]. For instance, [3] stated that marker-based tracking are not optimal for gaming, as users have to obtain new marker and continually carry the marker.

#### 3.6 Challenge

Challenge motivates the player to continue play the game by finishing all challenges provide inside game such as surpassing opponents, reaching desired goal, mastering skills and testing skills [19]. In this context, games should be sufficiently challenging to match the player's skill level. The level of difficulty needs to increase and vary through the game process in order to maintain the player interest and keep appropriate pace [19].

### 3.7 Interaction

Interaction in AR is slightly different than other technology for the users to interact with real physical world. Good interaction design will create more enjoyable feeling [25] [19] that significant for engagement [4]. According to [26], mobile user tends to play for negative reasons mainly due to boredom, depression and escapism or killing time [27].

### 3.8 Social

According to [16] the social element in game such as multiplayer function, leader board, and social

network links are necessary include in order engaging user in interactive mobile technology. Persuasion power of social connection, competition and collaboration in design decision for game are affecting user to voluntary engage with other, it will become motivation for future use and recommendations to other. The importance explained by other study that found unique social interaction shown in same player's behavior for both normal real face to face conversations and in the collaboration augmented reality application [28].

The proposed user engagement model for mobile-based AR game is presented in Figure 1.

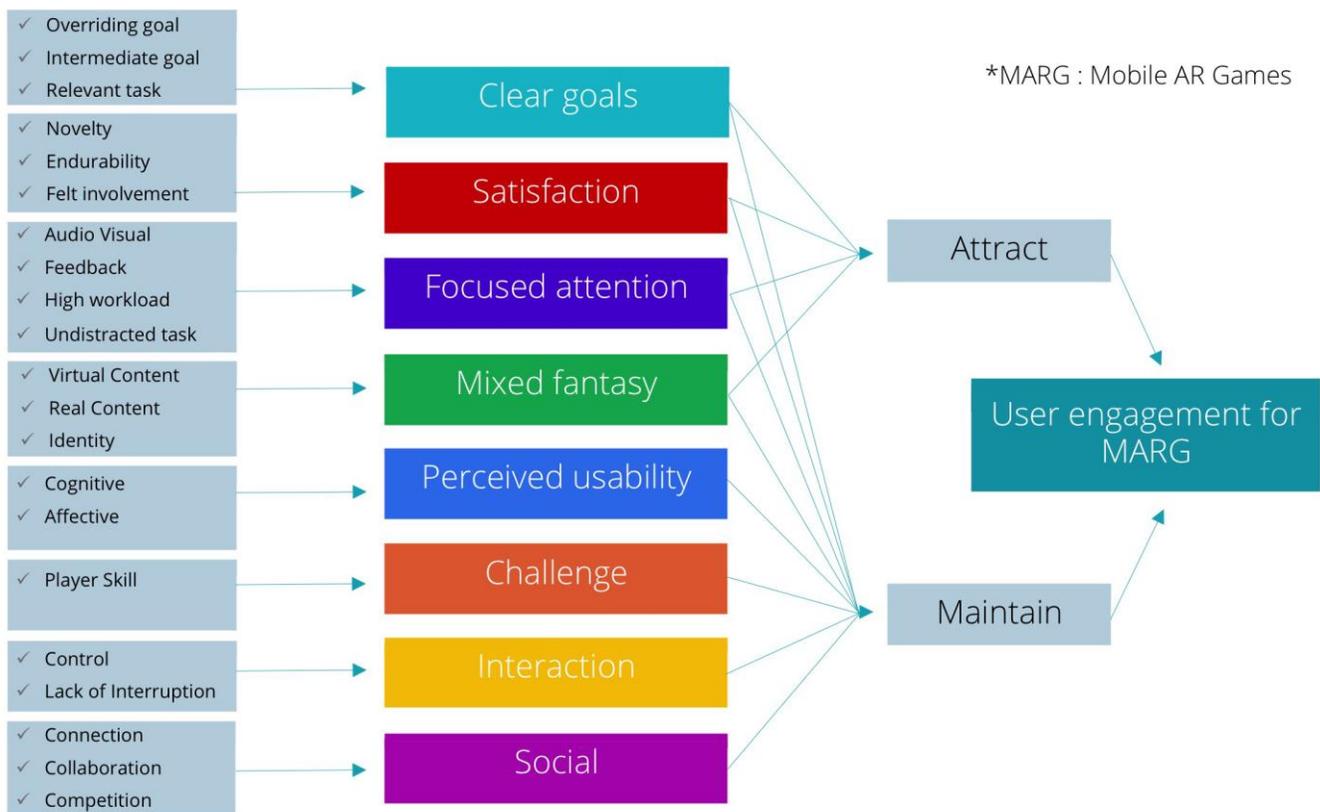


Figure 1 Proposed Conceptual User Engagement Model for Mobile-based AR Game

### 4.0 CONCLUSION

There were eight attributes have been examined based on the existing model, studies and theories of engagement as a basis to draw a conceptual model of mobile based AR game. The analysis were carefully studied the pattern of the models and tailored it to suit this type of game for better engagement of users' experience. This research finding should benefit both, industry and academic by elaborating on the theoretical understanding of the potential eight attributes that influence mobile

AR games user engagement. As for game designer, this research revealed that there are various avenues that should be explored in order to ensure an engaging experience in designing mobile AR games. Further, this conceptual model can also be extended to other AR-related application. The researchers are currently developing other studies in order to evaluate the capability of AR in enhancing the users' imagination in real physical world.

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