3D 모바일에서의 현실감 측정 도구 개발

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Measuring Presence in Mobile 3D

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요 약

It was hypothesized that mobile 3D provide the sense of presence in different quantity and quality aspects in virtual reality. And it was supposed that the construction of presence involves various levels and dimensions. The factors of mobile 3D game are divided into 4 super-factors; condition factor, interface factor, attention factor, feedback factor that resulted into 20 sub-factors resulted from the factor analysis. Our primary goal is the development of valid Mobile 3D presence scale, and to find out the factor structure of the scale.

Keyword : Presence, Mobile 3D game.

1. Introduction

While using an advanced mobile 3D game, you can experience the sense of presence. By saying presence we mean the experience of being in virtual environment. Person who presents in a virtual environment or performs the mobile 3D game, experiences being there and focuses his attention on the virtual environment as well as experiences it as something real. Because user automatically constructs models of the space around us (Bryant, 1992) more sophisticated analyses have suggested that person simply think of presence as a form of perceptual externalization or distal attribution (Biocca, 1992). When media is involved in space construction, the energy impinging on the sense is generated from mediated stimuli rather than unmediated stimuli (Loomis, 1992).

Presence is the central goal of user interface (UI) and application in mobile 3D game. Mobile 3D game brings the sense of presence differently from the existing mobile game. The user interface in mobile 3D game is different with user interface in the existing mobile game. The goal of user interface in the existing mobile game took account only for usability, efficiency, legibility and allocation; everything but presence. However the main goal of mobile 3D game is the sense of presence. In the aspects of content validity the existing purpose of UI is not suitable for the mobile 3D game UI, because the existing UI purpose is not included in the main goal of mobile 3D game.

Also, mobile 3D game has different mechanism media with virtual environment and provides the sense of presence in a different way. It can be maintained that advanced forms of virtual reality only differ from previous media in quantity and quality of presence (Biocca, 1992). Besides, the sense of "physical reality" is "a consequence of internal processing rather then being

something that is developed only from the immediate sensory information we receive" (Ellis, 1991, P.874). Only by taking these processes into account it is possible to understand how 3D games play on a monitor without direct mapping between body movements and corresponding movements in virtual world, and even text-only VEs can elicit high degrees of presence (Schiano, 1999; Towell & Towell, 1997).

A few efforts have been reported in making mobile 3D measurements to date; however, user-centered design and user interface evaluation in mobile 3D game as a practice still lags far behind what is needed. The existing measurements of presence are adequate for the forms of virtual reality, but selected measurement are needed to create mobile 3D game.

In this study, our primary goal is to develop valid Mobile 3D presence scale, and also to identify the factor of the structure of the scale.

1. 1 Presence

Presence in mobile 3D is quite new and not well explored field of research. Presence is defined as the subjective experience of being in one place or environment, even if physically being in another (Witmer & Singer, 1998). And it is defined as the user's feeling of "being there" in a mediated environment (e.g., IJsselsteijn, deRidder, Freeman and Avons, 2000). Lombard and Ditton (1997) defined it as the illusion of non-mediation in which the user is no longer perceives the display medium. The synonym of the term presence are synthetic presence, virtual presence, ego presence and telepresence, which all refer to the same phenomenon of being in a mediated environment (Draper, Kaber & Usher, 1998).

Now, presence is not only the goal of psychology but is the center to the theorizing about advanced virtual environments such as immersive virtual reality (Barfield et al., 1995; Lombard & Ditton, 1997; Sheridan, 1992; Steuer, 1995) and mobile 3D. For example, a leading VR journal of MIT enshrines the psychological goal of presence rather than the technology of virtual reality by calling it Presence.

Some people doubt that mobile 3D can give the sense of presence. In the field of mobile Augmented Reality, presence can be observed when people interact in and with a virtual world as if they were there, when they control virtual objects or are excited about 3D graphic mobile games. Several existing studiers of presence supported the existence of mobile 3D presence. It can be maintained that advanced forms of virtual reality only differ from previous media in quantity and quality of presence (Biocca, 1992). The difference between virtual reality and other media was defined as a difference in the level of presence (e.g., Steuer, 1995). Mobile 3D is a different mechanism media with virtual environment that provides the same sense of presence but in the different degree of virtual presence.

1. 2 Presence is a User Interface goal

Mobile 3D is very different with mobile 2D in the aspects of the visual, sound, tactile. Samsung Electronics introduced 3D game phones (models: SPH-G1000, SCH-G100) with vibration capability. The phone delivers realistic images and true-to-life sound, while the vibration sent to the user's hand provides an extra sense to the game experience. Mobile 3D give user much richer visual information comparing to text or 2D graphics on a single screen (Analysys, 2002). Human attention is naturally drawn to differences in visual appearance such as color, shape, texture, size, shading, location and movement. By being able to take full advantage of these factors, mobile 3D will help to attract and hold users' attention for a variety of applications.

Because of the technical supports, presence can be observed when people interact with a virtual world as if they were there, when they control virtual objects or are excited at mobile 3D. So, finding ways to provide an alternative and indirect way to assess presence is the key concept in the evaluation and design of mobile 3D.

Due to its psychological nature, presence is relevant in attempting to evaluate human experience in VEs (IJsselsteijn et al., 2000). Besides VEs, presence is also used as a global measure to explain the human experience in many other media (Freeman, Avons, Meddis, Pearson and IJsselsteijn, 2000). Compared to more traditional media such as television, radio and telephone, VR technology among all new technologies, e.g., high definition television, home theatre and video conferencing give stronger sense of presence (Lombard and Ditton, 1997; Steuer, 1992).

Beside, presence frequently becomes an issue because it is thought to correlate with improved task performance in virtual environments (Hendrix, 1994). The causality between the sense of presence and task performance has been identified that presence positivly correlates with performance (Witmer & Singer,1998). And Youngblut and Huie (2003) found a positive correlation between the learning of mission procedures and presence, by completing SUS (Slater-Usoh-Steed) presence questionnaire.

2. Factors Contribute to presence

Presence is a psychological experience. It is doubtful that sense of presence is a unitary experience (Biocca & Delaney, 1995; Kalawsky, 1998; Sheridan, 1992; Sheridan, 1996; Welch, Liu, Mellars & Stark, 1996). In addition, the construction of presence involves various levels and dimensions (Biocca & Delaney, 1995).

2. 1 Factors

The main purpose of our work is to identify factors and develop items for measuring presence. The factors from which our items were derived are conceptually based and not been tested. The factors are interacted with one another in presence. In this study the four components of the sense of presence are examined; Condition factor, Interface factor, Attention factor, Feedback factor of mobile 3D game.

Condition Factors	Interface factors	Attention factors	Feedback Factors
Degree of control	Control of event	Response delay	Sound
Immediacy of control	Interface awareness	Selective attention	Tactile
Anticipation of events	Intuitive mapping	Speed	
Mode of control	Being there		
Motion			
Connectedness & continuity			
Consistency with the objective world			
Meaning of icons			
View of field			
Resolution			
Visual display quality			

Table 1. The factors are assumed contribute to presence

3. Measuring presence

The most common approach to measure the sense of presence is the method of post-test questionnaires. AS the psychological feature of presence, such as attention and concentration, the measuring presence should be post tested. For the reason, the several existing measurements, think-aloud, observation, are lack of apply to measuring presence. The sense of presence is quite subjective. “Subject report is the essential measurement” In 1992, P.121. Sheridan mentioned. Even fewer objective measures have been identified, with none having been empirically validated (Kaber, 2002). We believe that the strength of presence experienced in a mobile 3D comes from individual differences and the character of mobile 3D. Individual differences are control of devices, characters, and degree of usability.

Different types of the character of mobile 3D provide different presence experience.

3. 1. Participants

Data were available for 60 participants who experienced 3D games. The 60 participants were recruited by advertisement in the Korea University. In the 60 participants were: 8 females and 52 males. The mean age was 25.1 years, SD=2.09, ranging 21 to 32 years.

3. 2. Procedure

Before the experiment, the experimenter explained its purpose. The subjects enjoyed the mobile 3D game about 40 min. After finishing mobile 3D game, they filled up questionnaire.

3. 3. Material

The items came from previously published questionnaires in the field of VR and from the experience of mobile 3D developers. And user's view were included. We also added our concept factors. We included the Presence Questionnaire by Witmer and Singer(1994), as well as Held and Durlach (1992), Fortaine (1992), McGreevy (1992), Prothro and Hoffman (1995), Steuer (1992), Barfield and Danas (1996) and others.

In this study, both 7-point rating scale and open-ended questionnaire were used. 7-point rating scale items were correlated with the sense of presence, and consisted of 20 items (Fig. 1), anchored with 'not at all' and 'very much'. The format of 7-point rating scale was based on the semantic differential principle (Dayer, Matthews, Stulac, Wright, Yudowitch, 1976).

4. Results

Item Stems	Factor	Subscale	ITCorr
1. In the LCD. Do you know the meaning of icons?	CF	AI	.4446*
2. How much were you able to control events?	IF	DC	.4671*
3. How well could you know the interface of game?	IF	IA	.3861*
4. Could you see the process of game on the multi-angle view?	CF	MA	.5100*
5. How aware were you of the real world surroundings while moving though the game (i.e., noise, other people, room temperature, etc)?	AF	SA	.1416
6. How was your sense of "being there" in the game?	IF	BT	.3048*
7. Without menu, did you know the function of keys?	IF	IM	.3372*
8. How natural was the mechanism which controlled movement?	CF	MN	.4634*
9. How much were the vibration feedback helpful to your sense of presence?	FF	T	.2421*
10. How delaying was there between your control keys and the response in the game?	AF	IC	.2260*
11. To what extent did the sounds influence on how you performed the game?	FF	S	.0931
12. How much of your experiences in the game seemed consistent with your real world experience?	CF	CIO	.4474*
13. Could you predict what would happen next in response to the actions that you performed?	CF	A	.5297*
14. Did you feel you could reach into the virtual environment and grasp an object?	CF	O	.5766*
15. How naturally the scene moved though the next scene?	CF	CC	.6039*
16. To what extent did the field of view of the game express sufficiently?	CF	FOV	.4432*
17. How complete did the visual display quality look?	CF	C	.5232*

18. How was the resolution?	CF	R	.6034*
19. How real was the motion of objects in the game?	CF	MO	.6532*
20. During the time of the experience, was there any problem concerned with the speed of game?	AF	DS	.1686

Table 2. The factors of questionnaire

Super factors: CF=Condition Factor, IF=Interface Factor, AF=Attention Factor, FF=Feedback Factor, Sub factors: AI=Awareness of Icons, DC=Degree of Factor, IA=Interface Awareness, MA=Multi-Angle view, SA=Selection Attention, BT=Being There, IM=Intuitive Mapping, MN=Mode of Natural control, T=tactile, IC=Immediacy of Control, S=Sound, CIO=Consistency of Information with the Objective world, A=Anticipation, O=Objects, CC=Connectedness & Continuity, FOV=Field of View, C=Contents, R=Resolution, MO=Motion of Objects, DS=Degree of Speed. ITCorr=Pearson correlation coefficients between item scores and total scores. * p<.001

4. 1. Reliability

4. 1. 1. Internal reliability

The internal consistency measure of reliability (Cronbach`s Alpha) of the mobile 3D presence questionnaire yielded to 0.8312, respectively. The mean score was 5.035, with a standard deviation of 1.47.

4. 2. Validity

4. 2. 1. Content reliability

The items came from previously published questionnaires in the field of VR and from the experience of mobile 3D developers. The items include both aspects of presence such as involvement and immersion.

4. 2. 2. Construct reliability

Factor analysis was performed on the data. The data were factorized using Principal Analysis and rotated using oblique Direct Oblimin rotation. Missing values were excluded pairwise. These were replaced with mean. The scree plot suggested that 4 factors should be extracted. The 4 factors explained 51.87% of the total variance.

5. Discussion

This study is a kind of primary study for is the development of valid Mobile 3D presence scale, and to find out the factor structure of the scale. We were trying to identify what factors contribute to increasing mobile 3D presence with 60 subjects. The numbers of subjects were lack of sure to believe the statistic analyses. In further study, we have plan for extended experiment that is over 200 subjects participated. The result of experiment will be clear to show what factors contribute to increasing mobile 3D presence.

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