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The Effect of Motion Graphics in Mobile AR Interface on Self-efficacy and Cognitive Attitude

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Abstract

The rapid development of the mobile device has brought about a change of a new lifestyle to users based on the fusion of various IT technologies. the paradigm of digital contents was simply focused on efficiency of processing and delivery of information, today the focus has shifted toward more immediate, intuitive, real, and natural flow such as virtual reality and augmented reality. Especially the AR (Augmented Reality) naturally connected the virtual object to the real world to provide users with the effective mobile user environment. Therefore, the GUI (Graphic User Interface) of the mobile device-based augmented reality needs to be designed properly to the changed mobile environment. However, although the augmented reality is based on the video of the real world which is treated in real time, the study on the motion graphic of the virtual object organizing the user interface is not enough. Therefore, this study is aimed at empirically analyzing the effect of the motion graphic in the user interface of the mobile AR. Also, the positive effect of characteristics on improvement of Users' visual experience, self-efficacy and cognitive attitude in mobile AR motion graphics was examined. The result showed that augmented reality has a significant effect on the self-efficacy and cognitive attitude of the users' visual experience. In the future, more media research for various motion graphics of AR interface will be needed, and this study can help develop mobile AR contents.

Keywords: Graphics user Interface, Mobile Augmented Reality, Motion Graphics, Users Experience

1. Introduction

1.1 Mobile Augmented Reality

Today, Mobile devices were rapidly developed around the smart phone and tablet PC. However, the development of mobile devices is expected to accelerate. In other words, mobile devices was expanded to the wearable device area which could always be worn like a part of the user's body. And the Internet Of Things (IOT) which could share the information with surrounding objects through the network as the hardware performance developed swiftly, the central role of the future smart industry is being expected.

Also, mobile devices has high level of performance and information processing devices enabled collecting information. For example, high pixel digital camera, wireless communications (Wi-Fi, NFC, etc.), GPS and various internal sensors like, multi-touch, gyro sensor, gravity sensor, proximity sensor and motion recognition sensor, as well as generating high-resolution image and video from the display[7].

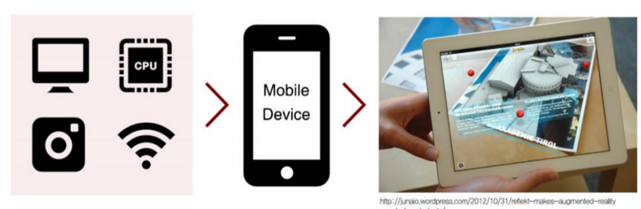

Figure 1. Augmented Reality of Mobile Device[7].

Now, users are pursuing the individualization and the change of lifestyle. And users started having much interest in the more immediate, direct, real, and natural mobile augmented reality. This change in users' needs called the mobile-based Head Mounted Display (HMD) such as Gear VR by Samsung Electronics. The augmented

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reality is a technology that provides users with more improved sense of reality by mixing the real-world and the virtual world seamlessly in real time to provide for users. the mobile augmented reality can draw a natural flow from users by letting users recognize the virtual visual information provided through the mobile device is being expressed vividly in the actually existing real world and letting them interact in real time.

Figure 2. Samsung Gear VR(http://www.samsung.com).

1.2 Motion Graphics of Grahics user Interface

The development of the mobile device enabled users to easily contact the motion graphic included in various videos regardless of the place and time but it is not easy for users to recognize that the result of the motion graphic is combined with the interface and makes the more efficient interaction possible. When loading or removing the application simply, the motion graphic is taking place on the interface and users do not know it is being used actively. However, users are clearly attracting users' attention and suggesting the use direction on the interface and endlessly providing the information through the 'movement' to recognize the current state. Especially the interface of the augmented reality contents should provide the virtual visual information to enable users to interact with contents while not disturbing the users' flow in videos of the endlessly moving real world.

Therefore, the natural motion graphic of interface elements will be a very important interface design element. The motion application effect of the digital contents interface appears when there are the continued change of the object form, change of the space and time. Also, attentiveness, especially the systematization of the motion trait which brings about the movement such as the direction, scale and speed of the object causes the motion effect on the interface. In order to use the augmented reality contents efficiently, the visual experience through the motion graphic of the user interface should induce the users' eyes. And behaviors naturally and attract the high self-efficacy and the positive cognitive attitude through it.

2. System Model and Methods

2.1 System Model

The hypotheses of this study are shown in Table 1.

Table 1. Hypotheses

Classification	Description
Hypotheses 1	The motion effect in GUI will have an effect of on visual experience of augmented reality.
Hypotheses 2	The visual experience in User interface will have an effect of on self-efficacy of augmented reality.
Hypotheses 3	The self-efficacy in motion interface will have an effect of on cognitive attitude of augmented reality.

Based on these hypotheses, a research model was proposed in Figure 1.

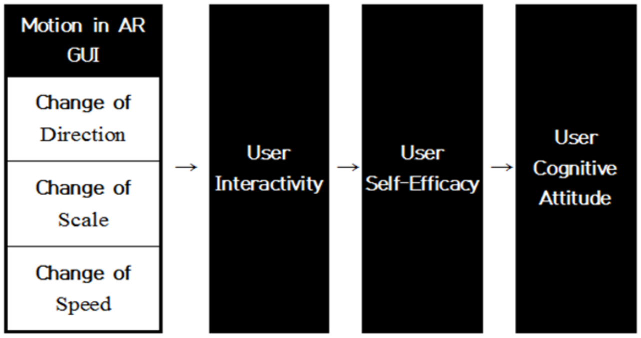

Figure 3. System Model.

2.2 Test Method

The purpose of this study is to obtain quantitative result through empirical data analysis on the influence of user experience of motion graphic user interface in augmented reality environments on the self-efficacy and cognitive attitude of mobile augmented reality user. In this test, each subject was provided with augmented-reality-based mobile contents and asked to give answers on the visual experience, self-efficacy and cognitive attitude. Therefore, in this study, a survey was conducted to collect demographic information of subjects, visual experience, self-efficacy and cognitive attitude of augmented reality based motion graphic user interface was measured.

In this experiment, each test target is instructed to experience the motion graphic expressed on the user interface of the mobile augmented reality and the degree is measured in order. To measure each variable, the items suggested in 'A Study of Media Adaptation and the User Experience of Augmented Reality' by Mi-Young Shim and Jin-Ho Lee[4] were corrected in accordance with this study and were measured through total 3 items 13 questions. (Table 2,3,4)

3. Analysis Result

3.1 Analysis Method

In this study, collected data was analyzed by using SPSS, and processed for statistics by using reliability analysis, frequency analysis, difference analysis, correlation analysis, and regression analysis.

3.2 Basic Research and Analysis

Table 5 shows the result of frequency analysis relating to demographic characteristics of the subjects. Of 130

Table 2. Measurement Visual Experience

Classification	Description
Visual Experience	The movement of components on the screen was delivered the meaning of contents effectively.
	Could feel a sense of distance to the spatial movement of the object.
	The movement of the graphic elements was harmonized with the real world properly.
	Although a lot of movements happened, the meaning was clear and was easy to cognize.
	Movements on the users' current position and direction were expressed properly.
	The movement provided the interface with the visual interest.

Table 3. Measurement Visual Self-Efficacy

Classification	Description
Self-Efficacy	Be confident of exploring the information to know arbitrarily through the augmented reality.
	It seemed like adjusting the augmented reality was done by itself as if it existed really.
	I can treat the augmented reality proficiently as my will.
	I entirely concentrated on the augmented reality.

Table 4. Measurement Cognitive Attitude

Classification	Description
Visual Experience	The augmented reality is useful to me.
	I am satisfied with using the augmented reality.
	Using the augmented reality is worthwhile.

subjects, 55 (42.3%) were male, and 75 (57.7%) female, when asked how many times they have used mobile augmented reality, 25 people answered never (19.2%), 45 people answered once or twice (34.6%), 26 people 3 or 4 times (20.0%), 21 people 5 or 6 times (16.2%), and 13 people 7 or more times (10.0%).

Table 5. Demographic Characteristics of the Subjects

Characteristics	Classification	Frequency (person)	Proportion (%)
Gender	Male	55	42.3
	Female	75	57.7
	Total	130	100
Frequency of mobile augmented reality	None	25	19.2
	1-2 times	45	34.6
	3-4 times	26	20.0
	5-6 times	21	16.2
	7 or more times	13	10.0
	Total	**130**	**100**

3.3 Reliability and Validity Analysis

Table 6 is the result of reliability analysis on the study result.

Users experience of mobile augmented reality's motion graphic interface was divided into sub-items - visual experience, self-efficacy, cognitive attitude and analyzed based on questions for each item. The result showed that visual experience, self-efficacy and cognitive attitude had a high level of reliability, with the reliability coefficient .85, .84, and .87, respectively.

Table 6. Reliability Analysis

Classification	Number of questions	Cronbach's α
Visual Experience	6	0.85
Self-Efficacy	4	0.84
Cognitive Attitude	3	0.87

In this study, exploratory factor analysis was used to validate reliability of factors of tangibility.

Table 7 is the result. In this study, 13 questions relating to visual experience, self-efficacy, and cognitive attitude were used as factors. These questions showed three factors structures, and, from the factor analysis, three factors were collected. The entire explanatory quantity was about 49.81%.

Table 7. Result of Exploratory Factor Analysis

Classification	Factor 1	Factor 2	Factor 3
Visual Experience 5	0.859		
Visual Experience 4	0.843		
Visual Experience 2	0.831		
Visual Experience 1	0.821		
Visual Experience 3	0.794		
Visual Experience 6	0.770		
Self-Efficacy 1		0.808	
Self-Efficacy 2		0.782	
Self-Efficacy 4		0.745	
Self-Efficacy 3		0.714	
Cognitive Attitude 1			0.788
Cognitive Attitude 3			0.754
Cognitive Attitude 2			0.701
Eigenvalue	2.57	2.34	2.10
Explanatory quantity	19.84	16.50	13.47

Note. Method of factor extraction :principal component analysis, Rotation method: Varimax, factor loading. Only 0.60 and above were shown.

4. Hypothesis Testing

For hypothesis testing, first, study participants had to experience motion graphics for mobile augmented reality user interface. The degree of systematization of major motion properties (orientation, size, and speed) were classified and measured sequentially. Next, the hypothesis is verified by the response for each parameter item.

In this study, three main hypotheses were tested. For empirical statistical analysis, according to characteristics of the hypotheses, each Hypothesis were tested by using correlation analysis, regression analysis and t-test.

4.1 Analysis Result of Hypothesis 1

Hypothesis 1, "The motion effect in GUI will have an effect of on visual experience of augmented reality" is to verify the effect of motion graphics(direction, scale, speed) on visual experience of mobile augmented reality user. Effect of sub-factors (direction, scale and speed) on visual experience of mobile augmented reality user were tested by using multiple regression analysis.

The result, as shown in Table 8, indicated that direction, scale and speed have a positive effect on visual experience of mobile augmented reality. In other words, visual experience of augmented reality interface increases when users perceive more motion graphics.

Table 8. Result of Multiple Regression Analysis for Testing Hypothesis 1

Classification		Non-standardized regression coefficient	Standard error	Standardized regression coefficient	t	Significance
Dependent variables	*Independent variables*					
Visual Experience	Constant	1.01	0.05		4.45	0.00**
	Direction	0.79	0.04	0.75	15.84	0.00**
	Scale	0.82	0.05	0.78	17.41	0.00**
	Speed	0.84	0.04	0.80	19.24	0.00**

Note. No. of cases =130, R-square=0.328, F=128.128, P=0.000
*p < .05, **p < .01

The explanatory power of this research model was 32.8% and statistically significant at the significance level 99%. Therefore, Hypothesis 1 was adopted.

Table 9 is the result of t-test. In comparison of visual experience between motion graphics factor(high) and motion graphics factor(low), the former induced significantly higher visual experience than the latter (t=28.45, p<.01).

Table 9. T-Test Result of Visual Experience

Classification	Motion graphics factor (high)	Motion graphics factor (low)
Average	4.45	3.28
No. of cases	130	
T	28.45	
Freedom	129	
Significance probability	0.00**	

Note. *p < .05, **p < .01

4.2 Analysis Result of Hypothesis 2

Hypothesis 2, "The visual experience in User interface will have an effect of on self-efficacy of augmented reality." is to verify the effect of visual experience on self-efficacy. Effect of visual experience on self-efficacy were tested by using simple regression analysis.

The result, as shown in Table 10, indicated that visual experience have a positive effect on self-efficacy of augmented reality user. In other words, self-efficacy of augmented reality user increases when users perceive more visual experience. The explanatory power of this research model was 29.2% and statistically significant at the significance level 99%. Therefore, Hypothesis 2 was adopted.

Table 11 is the result of t-test. In comparison of self-efficacy between motion graphics factor(high) and motion graphics factor(low), the former induced significantly higher visual experience than the latter (t=21.81, p<.01).

4.3 Analysis Result of Hypothesis 3

Hypothesis 3, "The self-efficacy in motion interface will have an effect of on cognitive attitude of augmented reality" is to verify the effect of self-efficacy on cognitive attitude. Effect of self-efficacy on cognitive attitude were tested by using simple regression analysis.

Table 10. Result of Multiple Regression Analysis for Testing Hypothesis 2

Classification		Non-standardized regression coefficient	Standard error	Standardized regression coefficient	t	Significance
Dependent variables	*Independent variables*					
Self-Efficacy	Constant	1.01	0.05		4.45	0.00**
	Visual Experience	0.79	0.04	0.75	15.84	0.00**

Note. No. of cases =130, R-square=0.292, F=120.594, P=0.000
*p < .05, **p < .01

Table 11. T-Test Result of Visual Self-Efficacy

Classification	Motion graphics factor (high)	Motion graphics factor (low)
Average	4.30	3.58
No. of cases	130	
T	21.81	
Freedom	129	
Significance probability	0.00**	

Note. *p < .05, **p < .01

Table 12. Result of Multiple Regression Analysis for Testing Hypothesis 3

Classification		Non-standardized regression coefficient	Standard error	Standardized regression coefficient	t	Significance
Dependent variables	*Independent variables*					
Cognitive Attitude	Constant	1.03	0.05		4.86	0.00**
	Self-Efficacy	0.95	0.04	0.91	21.20	0.00**

Note. No. of cases =130, R-square=0.338, F=131.770, P=0.000
*p < .05, **p < .01

The result, as shown in Table 12, indicated that self-efficacy have a positive effect on cognitive attitude of augmented reality user. In other words, cognitive attitude of augmented reality user increases when users perceive more self-efficacy. The explanatory power of this research model was 33.8% and statistically significant at the significance level 99%. Therefore, Hypothesis 3 was adopted.

Table 13 is the result of t-test. In comparison of cognitive attitude between motion graphics factor(high) and motion graphics factor(low), the former induced significantly higher visual experience than the latter (t=23.25, p<.01).

Table 13. T-Test Result of Visual Self-Efficay

Classification	Motion graphics factor (high)	Motion graphics factor (low)
Average	4.42	3.20
No. of cases	130	
T	23.25	
Freedom	129	
Significance probability	0.00**	

Note. *p < .05, **p < .01

Table 14 is the result of correlation analysis of variables used in Hypotheses. It was found that sub-factors of motion graphics of mobile augmented reality interface, visual experience, self-efficacy and cognitive attitude satisfaction were all significantly correlated.

Table 14. Verification of Correlation Among Variables

Variables	Motion Graphics	Visual Experience	Self-Efficacy	Cognitive Attitude
Motion Graphics	-			
Visual Experience	0.328**	-		
Self-Efficacy	0.304**	0.310**	-	
Cognitive Attitude	0.311**	0.284**	0.357**	-

Note. *p < .05, **p < .01

The result of testing hypotheses above can be summarized as Table 15.

Table 15. Result of Testing Hypotheses 1 to 3

Classification	Description	Adoption
Hypotheses 1	The motion effect in GUI will have an effect of on visual experience of augmented reality.	Adopted
Hypotheses 2	The visual experience in User interface will have an effect of on self-efficacy of augmented reality.	Adopted
Hypotheses 3	The self-efficacy in motion interface will have an effect of on cognitive attitude of augmented reality.	Adopted

Note. *p < .05, **p < .01

5. Conclusion

This study was aimed at obtaining the quantitative result of the effect that the motion graphic of the user interface element had on the visual experience, self-efficacy, and cognitive attitude of the mobile augmented reality users.

The empirical data analysis and to summarize the result.

First, the motion graphic on the user interface element of the mobile augmented reality had a positive effect on the users' visual experience. t shows the motion graphic of the user interface provides mobile augmented reality users with the visual interest and the understanding. Second, the visual experience by the users' motion graphic had a positive effect on the users' self-efficacy. Third, the user interface self-efficacy by the motion graphic had an effect on the users' favorable attitude on the augmented reality contents. The implications of the study which can be obtained from this study result are as follows. When approaching to the mobile augmented reality contents in the video aspect, the users' behavior and attitude by the user interface are the core of the contents success strategy. Therefore, users' positive attitude needs to be induced in developing the mobile augmented reality contents and for this, the positive experience on the motion graphic of the user interface should be provided surely.

6. Acknowledgment

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