

Analyzing virtual reality glasses acceptance: an empirical study in Taiwan

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Abstract

This paper identifies factors influencing consumer behavioral intentions of using virtual reality glasses. These factors including perceived enjoyment, perceived usefulness, perceived ease of use and subjective norm, are the most commonly used in research in the context of consumer behavior and new technology products. Partial Least Square (PLS), path analysis, principle component analysis, together with a survey of 203 participants in Taiwan were used to build the model. The results show that perceived usefulness has a positive effect on attitude, perceived ease of use has a positive effect on attitude, perceived enjoyment has a positive effect on attitude, attitude has a positive effect on behavioral intention, and subjective norm plays a negative role on behavioral intention to use. In the moderate effect test, we find that individuals aged from 18 to 24 care the most about a product's usefulness. Perceived ease of use and subjective norm are positively related to gender. Our results and recommendations are of interest to both scholars and virtual reality developers and retailers.

Keywords: behavioral intention, perceived enjoyment, wearable technology, virtual reality glasses

1. Introduction

Wearable technology has become a popular topic recently. With technology rapidly developing, many technology giants have been enthusiastically developing virtual reality, such as Samsung Gear VR, Oculus Rift, HTC Vive, and Sony PSVR. With high-speed computing ability, virtual reality creates three-dimensional computer graphics with stereo sound to create an immersive simulated environment. Because

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hardware equipment capabilities have increased dramatically in recent years, virtual reality technology substantially enhances the potential of relevant applications, including games, map, teaching, and website context.

With increasing consumer awareness of life quality, technology devices that offer entertainment has been an important topic for both academics and practitioners. However, research on consumer intentions towards virtual reality remains sparse. Therefore, we undertake this study of consumer intentions toward virtual reality to provide virtual reality developers and retailers with suggestions and indicate directions for future research.

This paper explores consumer willingness to use virtual reality (VR) glasses. Based on the research framework and research hypotheses, the empirical results should be useful to VR developers and retailers for more understanding of consumers' intention to use such devices. This study consists of three parts. First, for researchers, this study proposes a research framework to explore virtual reality adoption. In past technology acceptance literature, two streams of theoretical frameworks are widely used: the Theory of Planned Behavior Theory and the Technology Acceptance Theory (TAM). This paper combines the two theories and make modifications to fit in the VR glasses context. Second, we analyze users' behavioral intention to use VR glasses in Taiwan. Third, we identify the key factors that affect consumer intention to use VR glasses in Taiwan. For developers, this model proposed in this paper could serve as a reference to design products that better meet customers' needs. Furthermore, we have added the moderating effects of gender and age to explore their effects on consumer intention to use VR glasses.

2. Literature review

2.1 Overview of wearable technology device and reality

2.1.1 Wearable technology device

Wearable technology devices have become popular in the recent decade. This concept refers to clothing and accessories with cross-device or Internet connectivity that generate customizable and interactive responses (Li et al., 2016). Examples include Google glasses, Apple watches, and cheaper MiUi Intelligent devices. Unlike existing popular information technology products, wearable technology is usually attached to a certain part of the human body. People can usually keep their hands free when using such products.

2.1.2 Virtual reality

Virtual reality uses high-speed computing to integrate simulated three-dimensional computer graphics, stereo sound, and related technologies to create an immersive simulated experience (Schnack et al., 2019). Many technology device manufacturers are interested in developing VR devices and applications. Current headset products include Samsung Gear VR, Oculus Rift, HTC Vive, and Sony PSVR. Virtual reality techniques are useful in many applications, including games, map navigation, and classroom teaching.

2.1.3 Augmented reality

Augmented reality (AR) is a technique derived from virtual reality for taking virtual reality into the real world. Based on Kucera et al. (2018), "the purpose of AR is to produce virtual information rather than replace the real world. AR is thus an overlay of content onto the real world, but that content is not anchored to nor part of it. The real-world content and the CG content are not able to respond to each other. For example, IKEA has developed a table as part of its concept kitchen that suggests recipes based on the ingredients

2.1.4 Mixed reality

Mixed reality (MR) is also known as expansion reality. Mixed reality is an expansion of synthetic content that is anchored to the real world. The key characteristic of MR is that the synthetic content works with the real-world content simultaneously. All the above three types of reality have been studied in association with wearable technologies. Studies of wearable devices with VR technology include Choi et al. (2017) and Errichiello et al. (2019); studies of wearable AR application include Condino et al. (2019) and Nanjappan et al. (2019), and studies of wearable MR application include Incekara et al. (2018) and Li et al. (2018).

2.2 Development of the research model

To investigate a user's perceived usefulness and perceived ease of use toward an innovation, which affect the attitude toward use and behavioral intention to use, Davis (1989) proposed the information system theory to explain information technology users' behaviors, and it can serve as a theoretical ground for determination of relevant external variables (Davis et al. 1989; Venkatesh et al., 2003; Venkatesh et al., 2013).

Venkatesh (2001) argued the hypotheses about positive causal relationships, highlighted that computer self-efficacy is significant, and assumed that higher computer self-efficacy positively relates to perceived usefulness and perceived ease of use. Many studies have used revised TAM to explain the adoption of technology. Researchers have employed revised TAM to explain consumer acceptance of online shopping (Reyes-Mercado et al., 2017; Rehman et al., 2019). Revised TAM has been used to examine the intentions of prospective internet users (Mansour, 2016; Biucky and Harandi, 2017; Alalwan et al., 2018). For other examples, revised TAM has been used to explore the adoption of a website's services, e-learning, online games, mobile telecommunication, and Internet banking (Abd Ghani et al., 2017; Al-Azawei et al. 2017; Wang and Jeong 2018; Agag et al., 2019; AL-Nawafleh et al., 2019). In addition, TAM is useful in explaining the adoption of innovations (new product or service) developed from new technology. Theoretical and empirical studies have shown that TAM is a robust and parsimonious framework for understanding the adoption of technology (Tong 2010; Rese et al., 2017; Sharma and Pal, 2020). Though few studies have used revised TAM to examine consumer acceptance of virtual reality glasses, we infer from the foregoing discussion that a model that combines revised TAM along with revised Theory of Reasoned Action (TRA) is worth exploring for investigating consumer acceptance of using virtual reality glasses.

2.2.1 Perceived enjoyment

Perceived enjoyment is usually used to identify a user's emotional motivation for product use (Alalwan et al., 2018). As an important construct in the context of user emotions, perceived enjoyment has been used in many studies (Rouibah et al., 2016; Sarosa, 2019; Joe et al., 2020). The model used in this study incorporated hedonic motivation, which is conceptualized as perceived enjoyment to identify users' intrinsic perceptions more clearly.

2.2.2 Subjective norm

Subjective norm was firstly proposed by Fishbein and Ajzen (1975) based on the Theory of Reasoned Action. Subjective norm is defined as "the perceived social pressure to perform or not to perform the behavior" (Ajzen, 1991), and a user's perception about what important others believe the individual should do (Finlay, Trafimow and Moroi, 2015). The theory of reasoned action (Fishbein and Ajzen, 1975) includes subjective norms as well as attitude toward the behavior, which affects behavioral intention and further directly has influence on behavior.

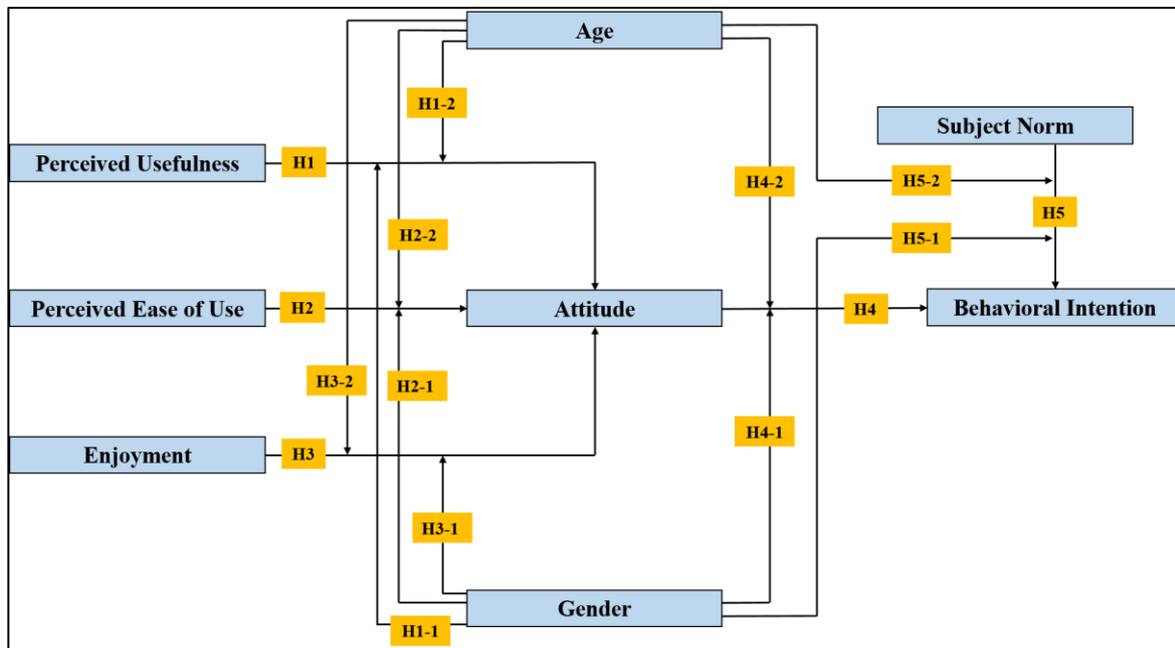
3. Methodology

3.1 Framework and hypothesis

This paper aims to explore factors that may affect consumers' intention of using VR glasses. In addition, the research direction focuses on the potential consumer intention to accept the innovative product for potential consumers. With reviewing previous research, we take variables, namely, perceived enjoyment, subjective norm and two mediation variables (gender and age) into our research model.

Based on the literature review of previous works, we propose the following hypotheses.

Figure 1. Proposed research model



H1: Consumers' attitude toward using VR glasses is positively related to perceived usefulness.

H1-1: The influence of perceived usefulness on attitude is moderated by gender.

H1-2: The influence of perceived usefulness on attitude is moderated by age.

H2: Consumers' attitude toward using VR glasses is positively related to perceived ease of use.

H2-1: The influence of perceived ease of use on attitude is moderated by gender.

H2-2: The influence of perceived ease of use on attitude is moderated by age.

H3: Consumers' attitude toward using VR glasses is positively related to perceived enjoyment.

H3-1: The influence of perceived enjoyment on attitude is moderated by gender.

H3-2: The influence of perceived enjoyment on attitude is moderated by age.

Taherdoost (2018) applied the extended technology acceptance model in their research framework. Park et al. (2012) expanded revised TAM model by adding major relevance, system accessibility, and subjective norm to understand Korean university students' behavioral intention to use mobile learning. We thus propose:

H4: Consumers' behavioral intention to use VR glasses is positively related to subjective norm.

H4-1: The influence of subjective norm on behavioral intention to use is moderated by gender.

H4-2: The influence of subjective norm on behavioral intention to use is moderated by age.

H5: The intention of using VR headset from consumers' attitude is positive.

H5-1: The influence of attitude on behavioral intention to use is moderated by gender.

H5-2: The influence of attitude on behavioral intention to use is moderated by age.

3.2 Development of measurement

3.2.1 Perceived usefulness

According to Davis (1989), perceived usefulness is a significant construct affecting acceptance of an information system. Because the current commercial VR glasses are in nature quite entertaining devices, we defined perceived usefulness as enhancement of users' life quality via their hedonic effects (Minge and Thüring, 2018).

3.2.2 Perceived ease of use

Davis noted that perceived ease of use is a major factor in acceptance of technology. Perceived ease of use has various dimensions: easy to use (Davis, 1989), clear and understandable, easy to learn to operate, and easy to do what one wants when using the system. In this study, the operational definition of perceived ease of use is the degree to which a person using VR glasses is free of effort.

3.2.3 Perceived enjoyment

Perceived enjoyment has been employed as one of the determinants of technology acceptance to enhance understanding of consumer beliefs in happiness factors (Alalwan et al., 2018). In the literature, perceived enjoyment is often termed "hedonic motivation". This study uses the term "perceived enjoyment".

3.2.4 Subjective norm

The definition of subjective norm is "the degree to which an individual perceives that using the innovation is based on the cognition which comes from his or her social system". In this study, we define subjective norm as referencing the opinions of others when an individual considers using VR glasses.

3.2.5 Attitude

The root definition is "an individual's positive or negative feeling (evaluative affect) about performing the target behavior." In this paper, behavior intention is defined as the users' likelihood of using virtual reality glasses.

3.2.6 Behavioral intention to use

The root definition is “an individual’s attitude regardless of positive or negative feeling about performing the target behavior.” In this paper we defined behavioral intention to use as when customers’ attitude toward using VR glasses becomes more positive, the likelihood of using VR glasses will rise.

3.3. Questionnaire design

The questionnaire is divided into two parts. The first part surveys if a respondent has experiences of using VR glasses. If not, then the respondent does not proceed with the questionnaire. The first part contains demographic questions such as gender, age, occupation, and monthly income. The second part is composed of the model-related items on respondents’ experiences of using VR glasses. All items are measured on a 5-point Likert scale where 1 equals strongly disagree, 3 equals no opinion, and 5 equals strongly agree.

3.4 Data collection

In this research, the survey scope specifically covers VR glasses users in Taiwan. An online survey format was used. A pre-test was conducted with respondents who have experience of using VR glasses, some items were modified. We collected the data through Google lists and other online survey platforms and the link to the survey distributed on the social network website Facebook and on the university bulletin board system in Taiwan. A total of 242 responses to the questionnaire were returned, while 39 were eliminated as invalid.

3.5 Data analysis approach

There are two major phases of data analysis in this study, the primary data processing and the statistical analysis. We exported the data from the questionnaires to a spreadsheet file. Afterwards, we then manually collected the data from the paper-based responses and transferred it to the spreadsheet mentioned above.

3.5.1 Descriptive analysis

This study computed the means with percentages, standard deviations, and score ranges for all variables and items, including independent, dependent, and demographic variables. A frequency distribution table was created as a summary to display the data characteristics and variable distribution.

3.5.2 Reliability test

Internal consistency reliability measures the degree to which items in a questionnaire are the same as the construct they belong to (Olson et al., 2016).

4. Results

4.1 Sample demographics

Among the valid samples, 178 respondents (87.6%) were male. The proportion of respondents aged between 18 and 24 years is 40%, those below 18 (0.02%), those between 25 and 29 (0.25%), and those between 30 and 34 (0.22%) and those 35 or older (0.13 %). More than 95% had at least a four-year degree. Table 1 gives the details.

Table 1. Demographic data for valid samples (N=203)

Type	Number	Percentage (%)	
Gender	Male	178	87.6
	Female	25	12.4
Age	18 or younger	4	2.0
	19-24	79	40.0
	25-29	50	25.0
	30-34	44	22.0
	35 or elder	70	34.0
Education	Senior high or lower	8	4.0
	College	148	73.0
	Postgraduate	47	23.0
Monthly Income (New Taiwan Dollars, NTD)*	15,000 or less	88	43.0
	15,000-30,000	30	15.0
	30,000-50,000	58	29.0
	50,000 or more	27	13.0

*The exchange rate of NTD to US dollar is 30:1

4.2 Descriptive statistics for constructs

4.2.1 Perceived usefulness

The descriptive statistical results for perceived usefulness are presented in Table 2. The construct shows a mean of 3.94 and a standard deviation of 0.575, indicating high agreement and consistency. Among the subscales, “I think using VR glasses can make my mood feel better.” has received the highest score (4.01). The second highest was “I think using VR glasses can relieve my stress.” (4.00), followed by “I think using VR glasses can improve my quality of life (3.77).

Table 2. Descriptive statistical results for perceived usefulness

Item	Mean	Std. Deviation
PU1: I think using VR glasses can improve my quality of life	3.77	0.782
PU2: I think using VR glasses can relieve my stress	4.00	0.707
PU3: I think using VR glasses allows me to have more topics with friends or family	3.99	0.811
PU4: I think using VR glasses can make my mood feel better	4.01	0.735
General	3.94	0.575

4.2.2 Perceived ease of use

The descriptive statistical results for perceived ease of use are presented in Table 3. The mean for the construct as a whole is 3.52 with a standard deviation of 0.730. Among the subscales, “I don’t think it will take much time to learn how to use VR glasses” received the highest score (3.75), followed by “I think the design of VR glasses is very easy to wear” (3.74), and “I don’t think using VR glasses will require any additional assistance or instructions” (3.11).

Table 3. Descriptive statistical results for perceived ease of use

Item	Mean	Std. Deviation
PEOU1: I think the design of VR glasses is very easy to wear	3.74	0.881
PEOU2: I don’t think it will take much time to learn how to use VR glasses	3.75	0.874
PEOU3: I don’t think using VR glasses will require and additional assistance or instructions	3.11	0.994
PEOU4: I do not think that using VR glasses will make people feel difficult	3.50	0.892
General	3.52	0.730

4.2.3 Perceived enjoyment

The descriptive statistical results for perceived enjoyment are shown in Table 4. For the construct as a whole the mean is 4.10 with a standard deviation of 0.501, indicating high agreement and consistency. Among the subscales, “I think using VR glasses can stimulate my curiosity” received the highest score (4.33), followed by “I think using VR glasses can’t make me feel bored” (4.10), and “I think using VR glasses can make me forget my troubles or unhappiness” (3.87).

Table 4. Descriptive statistical results of perceived enjoyment

Item	Mean	Std. Deviation
PEJ1: I think using VR glasses can make me forget my troubles or unhappiness	3.87	0.643
PEJ2: I think using VR glasses can stimulate my curiosity	4.33	0.601
PEJ3: I think using VR glasses can’t make me feel bored	4.10	0.640
General	4.10	0.501

4.2.4 Subjective norm

The descriptive statistical results for subjective norm are presented in Table 5. For the construct as a whole the mean is 3.13, with a standard deviation of 0.844. Among the subscales, “People who have influence on me encourage me to buy VR glasses, which will make me more involved in virtual reality applications” received the highest score (3.35), followed by “People who have influence on me feel VR glasses are a good recreation that will drive me to use them” (3.74), and “The use of VR glasses is affected by important people around me” with a low level of agreement (2.68).

Table 5. Descriptive statistical results of subjective norm

Item	Mean	Std. Deviation
SN1: The use of VR glasses is affected by important people around the me	2.68	1.025
SN2: People who have influence on me feel VR glasses is a good recreation that will drive me to use	3.34	0.985
SN3: People who have influence on me encourage me to buy VR glasses which will make me more involved in virtual reality applications	3.35	1.035
General	3.13	0.844

4.2.5 Attitude

The descriptive statistical results for attitude are presented in Table 6. For the construct as a whole, the mean is 3.98 with a standard deviation of 0.560, indicating high agreement and efficiency. Among the subscales, “For me, I would like to use VR glasses” received the highest score (4.22), followed by “Using VR glasses is a good idea” (3.99), and “Using VR glasses is a wise move” (3.97).

Table 6. Descriptive statistical results for attitude

Item	Mean	Std. Deviation
ATT1: Using VR glasses is a good idea	3.99	0.675
ATT2: Using VR glasses is a wise move	3.97	0.659
ATT3: I like the idea of using VR glasses	3.75	0.723
ATT4: For me, I would like to use VR glasses	4.22	0.615
General	3.98	0.560

4.2.6 Behavioral intention

The descriptive statistical results for behavioral intention are presented in Table 7. The construct as a whole has a mean of 4.04 and a standard deviation of 0.699, indicating high agreement and consistency. Among the three of its subscales, “I will use VR glasses in the future” received the highest score (4.06), followed by “I will continue to use VR glasses in the future” (4.04), and “I would strongly recommend others to use VR glasses” (3.66) with the low level agreement.

Table 7. Descriptive statistical results for intention to use

Item	Mean	Std. Deviation
INT1: I will continue to use VR glasses in the future	4.04	0.699
INT2: I would strongly recommend others to use VR glasses	3.66	0.770
INT3: I will be using VR glasses in the future	4.06	0.687
General	3.92	0.620

4.3 Reliability and validity tests

Table 8 shows that KMO value for all items is 0.877 and the p-value of Bartlett’s test is 0.000, both are acceptable values for the factor analyses. Cronbach’s α for each variable is: perceived usefulness (0.815), perceived ease of use (0.757), enjoyment (0.839), attitude (0.858), and intention (0.715); a range of 0.715 – 0.858, which confirms the high reliability of this survey.

Table 8. KMO and Bartlett's test result

Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO)		0.877
Bartlett's Test of Sphericity	Approximate Chi-Square	2388.134
	Degree of Freedom (df)	231
	Significance (p-value)	0.000

4.3.1 Convergent validity

For construct three conditions needs to be satisfied to validate convergent validity: (1) factor loadings of all the items exceed 0.5 (Bagozzi and Yi, 1988), (2) the AVE of each construct exceeds 0.5, (3) the composite reliability(CR) of all constructs exceeds 0.6 (Bagozzi and Yi, 1988).

Table 9 shows that all items have standardized factor loadings greater than 0.6, and all constructs’ composite reliability exceeds 0.8. Convergent validity is acceptable.

Table 9. Reliability and validity test

Construct	Item	Factor Loading	Average Variance Extracted (AVE)	Composite Reliability (CR)
Perceived Usefulness	PU1	0.679	0.585	0.847
	PU2	0.832		
	PU3	0.646		
	PU4	0.877		
Perceived Ease of Use	PEOU1	0.791	0.639	0.876
	PEOU2	0.822		
	PEOU3	0.734		
	PEOU4	0.846		
Enjoyment	ENJ1	0.841	0.635	0.839
	ENJ2	0.728		
	ENJ3	0.818		
Attitude	ATT1	0.876	0.700	0.903
	ATT2	0.825		
	ATT3	0.814		
	ATT4	0.831		
Intention	INT1	0.889	0.574	0.824
	INT2	0.815		
	INT3	0.889		

4.4 Hypotheses validation

We use partial least squares (PLS) because it is a causal-predictive approach to structural equation modeling, which was developed to deal with the dichotomy between explanation and prediction (Shmueli et al., 2019). IBM SPSS 20 and SmartPLS 3.2.1 were used for the data analysis. Causal relationships among constructs were tested by path analysis using the PLS algorithm. Because PLS algorithm software does not provide a significance test, bootstrapping was used. The path coefficient for the effect of perceived usefulness

on attitude toward using the VR glasses is 0.45. The t statistic is 7.035, greater than 3.29. The p-value is thus smaller than 0.001. Therefore, H1 is supported.

The path coefficient for the effect of perceived ease of use on attitude toward using the VR glasses is 0.233. The T statistic is 5.350, greater than 3.29. The p-value is thus smaller than 0.001. Therefore, H2 is supported.

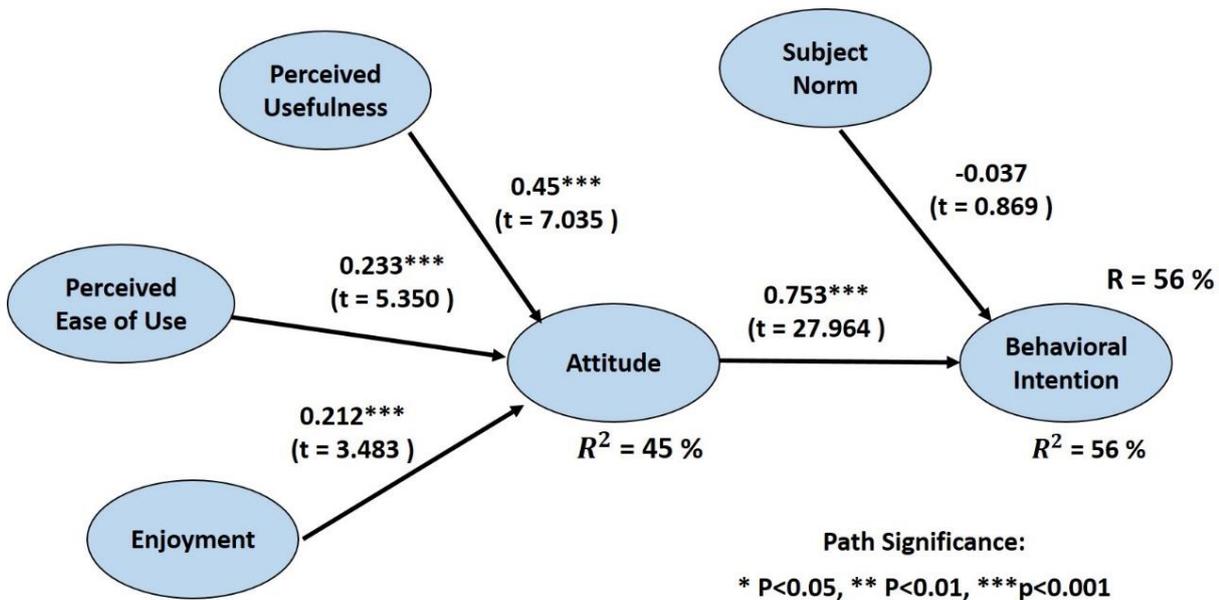
The path coefficient for the effect of enjoyment on the attitude toward using the VR glasses is 0.212. The T statistic is 3.483, greater than 3.29. The p-value is thus smaller than 0.001. Therefore, H3 is supported.

The path coefficient for the effect of subjective norm on behavioral intention toward using the VR glasses is -0.037. The T statistic is 0.869, less than 1.96. Thus, the p-value is greater than 0.05. Therefore, H4 is not supported.

4.4.1 Attitude on intention to use (H5)

The path coefficient for the effect of attitude on the behavioral intention toward using the VR glasses is -0.753. The T statistic is 27.964, greater than 3.29. Thus, the p-value is less than 0.001. Therefore, H5 is supported.

Figure 2. Structural model testing results



4.5 Test of moderating variables

The moderating effects of gender from SPSS are listed in Table 10. Most p-values are greater than 0.05, except for perceived ease of use and subjective norm. We can infer that females think that ease of use is important when they want to use VR glasses. Males are more influenced by peers than females.

Table 10. Results of hypotheses test (moderating effects: gender)

Hypotheses		F Value	p-Value	If supported
H1-1	The influence of perceived usefulness on attitude is moderated by gender	0.345	0.947	No
H2-1	The influence of perceived ease of use on attitude is moderated by gender	1.707	0.082	Yes
H3-1	The influence of perceived enjoyment on attitude is moderated by gender	0.887	0.505	No
H4-1	The influence of subjective norm on behavioral intention is moderated by gender	2.232	0.034	Yes
H5-1	The influence of attitude on behavioral intention is moderated by gender	0.744	0.635	No

The moderating effects of age are shown in Table 11. Most of the alternative hypotheses are rejected, except for H1-2. We find that the 18 to 24 cohort cares about product's usefulness. For example, they care about their peers' opinions of using VR glasses.

Table 11. Results of hypotheses test (moderating effects: age)

Hypotheses		F Value	p-Value	If supported
H1-2	The influence of perceived usefulness on attitude is moderated by age	1.835	0.007	Yes
H2-2	The influence of perceived ease of use on attitude is moderated by age	0.912	0.616	No
H3-2	The influence of perceived enjoyment on attitude is moderated by age	1.131	0.314	No
H4-2	The influence of subjective norm on behavioral intention is moderated by age	1.295	0.147	No
H5-2	The influence of attitude on behavioral intention is moderated by age	1.232	0.200	No

5. Conclusions

The purpose of this research is to identify factors which affect the intention to use the VR glasses. We incorporated subjective norm and perceived enjoyment into the combined revised TAM-TRA model. We found that attitude affects the intention of using VR glasses, unlike previous studies which found that attitude is a weak indicator. Second, the most influential variable on attitude is perceived usefulness (standard

coefficient = 0.446), followed by perceived ease of use (standard coefficient = 0.233) and perceived enjoyment (standard coefficient = 0.212). Our results show that attitude is the most influential variable directly influencing the intention to use VR glasses and perceived usefulness is the most influential variable indirectly affecting attitude toward using VR glasses.

We also tested potential moderating variables, gender and age. We find that gender influences perceived ease of use and subjective norm. For women, they increase intention to use VR glasses when they are easy to use. Any variable is not influenced by age except perceived usefulness, which had the strongest effect in the 18 to 24 age group.

All hypotheses are supported in this study, except for hypothesis 4. The result shows that subjective norm has no direct influence on behavioral intention of using VR glasses, contrary to previous work (Kim and Chang, 2006). It appears that peer views are not important to respondents in forming their intention to use VR glasses.

5.1 Academic implications

This study proposed a new research model which incorporated two variables to examine the relationships. This model may also be applied in other innovative entertainment technology product fields. We showed that perceived usefulness has the most significant effect on attitude. The relationships of enjoyment on attitude, ease of use on attitude and attitude on behavioral intention were consistent with those found in previous studies. Because our findings showed subjective norm had no significant effect on attitude, a finding different from previous research, we suggest that subjective norm be explored in future research.

5.2 Managerial implications

We found that “perceived usefulness” is the most important factor affecting consumer intention to use VR glasses. Given that the 18-24 age group gave this item its highest score, we recommended that VR developers carefully listen to young people and incorporate their needs into the design as a basis for continuous improvement.

5.3 Limitations and recommendations

There are several research limitations. First, the survey respondents of this study are limited to Taiwanese users who participated via online survey in a virtual reality group on Facebook and a Sony PlayStation group on the PTT BBS system. We suggest that the future researchers explore other potential consumer groups in different countries via different survey methodologies, including qualitative methods. Second, the study used convenience sampling that cannot represent the whole population. Future study could expand the scale of the sampling and explore the effectiveness of the model. Third, gender ratio of subjects was not balanced. This could result from gender inequity for novel technology. Future studies could explore to reach more female respondents and further the phonomime and revise their model.

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