

# Viewing versus Experiencing in Adopting Somatosensory Technology for Smart Applications

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## Abstract

*Emerging somatosensory technology offers unprecedented opportunities for researchers and industrial practitioners to design a touchless smart home system. However, existing touchless smart home systems often fail to attract a satisfying level of acceptance among home owners. The experience users have with the touchless system is key to making somatosensory technology a pervasive computing home application, yet little research has been conducted to assess the influence of direct and indirect experience on user's behavioral intention to use somatosensory technology. To address this research gap, this paper set up an experimental design to investigate the influence of direct and indirect experience in user technology acceptance. Using an in-house developed touchless system, two experimental studies (i.e., video observation versus product trial) were conducted with sixty-two participants to investigate whether the user experience has an impact on the adoption decision. Our findings indicate that direct experience has an impact on a user's acceptance of somatosensory technology. We*

*found a significant difference in the relationships between perceived complexity and usage intentions. Perceived complexity was a significant predictor of an individual's behavioral intention to use the touchless system after video observation, while its relationship to usage intention was insignificant after the user had direct experience with touchless system. Our study reveals an important implication for somatosensory technology marketers, in which product trial (direct experience) engenders more reliable inferences than does exposure to video demonstration (indirect experience). Based on this, companies should devise marketing programme involving direct experience (e.g., product trial and showroom visit) to promote new somatosensory-enabled smart home systems. The results of the study also demonstrate that user experience in research design may influence the results of the Technology Acceptance Model (TAM) studies.*

**Keywords:** Technology acceptance model, Experimental design, Direct experience, Indirect experience, Touchless system

## Introduction

Advances in somatosensory technology have increased opportunities in various industries, such as home entertainment (Leap Motion, 2014; Li et al., 2014), medical and healthcare industries (Gantenbein, 2012; Tan et al., 2013; Rosa and Elizondo, 2014). In particular, somatosensory technology has influenced the development of worldwide adoption of video games such as Nintendo Wii, Sony PS Move and Microsoft Kinect (Phonex Developers, 2014a). Taking into consideration the emerging technological landscape, many system designers and developers have tried to integrate somatosensory technology in smart home design (Bhuiyan and Picking, 2011; Mrazovac et al., 2011; Garzotto and Valoriani, 2012; Choi et al., 2012; Ben Hadj Mohamed et al., 2012; Patsadu et al., 2012). Despite this, somatosensory technology/touchless home systems have not received wide acceptance among home owners (OSRAM, 2014). Many home users accustomed to manual access to their home devices, and they perceive somatosensory technology as unnecessary mechanism to interact with their home environment (OSRAM, 2014). In some instances, home users regard new technology to be complex and it makes their life more frustrating (Intille, 2002). This issue is pertinent to somatosensory technology where users are required to learn how to control the home devices using their hand gestures.

The willingness of home users to adopt intelligent appliances is highly dependent on their perception of and their *experience* with the technology (Mert, 2008). Experience is defined as “the act of living through and observation of events and also refers to training and the subsequent knowledge and skill required” (Hock, 2002, p. 448). In marketing literature, consumers’ experience with a product can be charted on a spectrum from indirect to direct experience, depending on their level of interaction with a product (Mooy and Robben, 2002). Indirect experience is obtained through information

presented verbally or descriptions in the advertisement (Kempf and Smith, 1998; Mooy and Robben, 2002). In contrast, direct experience occurs when an individual has direct sensory contact with the product (Hoch and Ha, 1986; Mooy and Robben, 2002). Over the past decades, several marketing studies (e.g., Levin and Gaeth, 1988; Wright and Lynch, 1995; Singh et al., 2000; Kim et al., 2013) have found that direct experience had a greater impact on product judgments, attitudes, and purchase intention relative to indirect experience (Singh et al., 2000). However, little is understood about the impact of direct and indirect experience on somatosensory technology adoption.

In the somatosensory context, indirect experience arises when users view advertisements and/or video demonstrations of somatosensory technology. Direct experience occurs via product trial, in which users have physical contact with the somatosensory technology. In this paper, we assert that there are differences in factors affecting users’ behavioral intention to use somatosensory technology when they view video (indirect experience) as compared to actual experience of it (direct experience). To explicate this phenomenon, we designed a touchless system for home automation. We tested our hypothesized model (which is described later) by collecting participants’ responses after they have completed two experimental tasks (i.e., video observation of touchless system and product trial with the touchless system).

Besides the motivation to probe direct and indirect experience effect of somatosensory technology, we took cognizance that Technology Acceptance Model (TAM) research on new technology adoption is heavily steeped in non-experimental survey research. Several prior studies (Heijden, 2004; Shih, 2004; Yu et al., 2005; Walczuch et al., 2007; Ho and Huang, 2009; Ha and Stoel, 2009; Zhou, 2013) use survey designs to evaluate adoption by asking individuals to indicate adoption intention. In

the execution of these surveys, researchers assume that participants have i) seen the product or technology ii) used the product or technology, or iii) used the product or technology through their own volition. Most studies evaluate TAM and its refined models through the use of self-report surveys without actual use of the product or technology in question. However, Szajna (1996) highlights the possibility that users' experience of a product or technology influences their evaluation of TAM variables. Hence there is likely to exist differences in the evidence supporting TAM among studies that simply measure before-experience as opposed to those measuring post-experience.

In our study, we draw upon the TAM to develop a research model constituting four variables (i.e., perceived usefulness, perceived ease of use, perceived complexity and perceived enjoyment) influence on individuals' intention to use the touchless system. We conceptualized key determinants of users' behavioral intention using two constructs that are prominent in TAM: perceived usefulness and perceived ease of use. Furthermore, given that a touchless system is regarded as a hedonic system, two aspects of hedonic usage namely, perceived complexity and perceived enjoyment, are also included as the antecedents of behavioral intention. We tested our proposed model by collecting participants' responses after their direct experience (product trial) and indirect experience (video observation) with the touchless system. The goal of this paper is to examine how user's usage intention varies with direct and indirect experience. Put simply, we ask the question: Are there differences in the factors affecting a user's behavior intention to use the touchless system when they view a video (indirect experience) as compared to actual experience of it (direct experience)?

The remainder of this paper presents a literature review on somatosensory technology, TAM and user experience (direct and indirect), which provides the

foundation for our research model and hypotheses. Following this, the research methodology and the results of the two experiment studies are discussed. Our paper concludes by providing research implications, limitations and recommendations for future research.

## **Literature Review**

### ***Somatosensory Technology***

Information Systems (IS) literature provides various terms and definitions to describe somatosensory technology. In technical research, the term "somatosensory technology" is synonymous with "touchless technology/system", "natural user interface" and "Kinect-based technology" (Parziale and Chen, 2009; Boulos et al., 2011; O'Hara et al., 2014). The basic concept of somatosensory technology is that individuals can use their body movement to interact with peripheral devices or the physical environment, without the need to use any kind of controller (Phones Developers, 2014b). For example, in the smart home setting, Kinect-based Smart TV enables users to naturally interact and control the TV through gestures (Li et al., 2014). Consistent with prior studies (Parziale and Chen, 2009; Boulos et al., 2011; O'Hara et al., 2014; Li et al., 2014), we consider a touchless system as a somatosensory technology in this paper. Therefore, the terms touchless system and somatosensory technology are used interchangeably in this article.

With advances in somatosensory technology, more and more products are being incorporated in natural somatosensory interactions (Wu et al., 2014). Within the smart home setting, recent gerontechnology studies (e.g., Chiang, 2011; Chen et al., 2012; Liu et al., 2013; Ben Hadj Mohamed et al., 2013) acknowledge the application of somatosensory technology to improve independence and quality of life of elderly users (with or without disabilities) along with general users. Through an experimental

study, Liu et al. (2013) found that SVGs intervention made a positive impact on elderly people's reaction time performance, thereby improving their health and quality of life. Wu et al. (2013) also conducted an experiment to examine the influence of a somatosensory gaming device to promote learning of fine art among children. They found that children in the experimental group showed learning satisfaction, technology acceptance and learning effectiveness (Wu et al., 2013). These empirical studies point to user's experience as the key determinant of technology acceptance, and therefore provide a useful starting point to explore the impact of user's direct and indirect experience in predicting somatosensory technology acceptance/adoption.

In this paper, we designed a touchless home system to study how user's direct and indirect experience can motivate behavior change in somatosensory technology adoption. We discuss the design of our touchless system in later sections.

### ***User direct and indirect experience***

In a recent article published by *Pacific Asia Journal of the Association for Information Systems*, Hui (2013, p. 22) points out that a great deal of IS survey research asks respondents about systems/technologies that they do not have much experience in use. In most studies, introduction of the new systems/technologies is often provided before the survey is conducted, however respondents do not have direct experience or full understanding of the system/technology (Hui, 2013). Szajna (1996) in a seminal work published in *Management Science*, advocates that user experience has an impact on TAM and related research, and suggests experimental sampling should be utilized to provide evidence of experience effect. These observations lead to our research motivation to investigate whether differences exist between determinants of users' behavioral intention to use the touchless system across two experimental settings; namely direct and

indirect experiences with the touchless system.

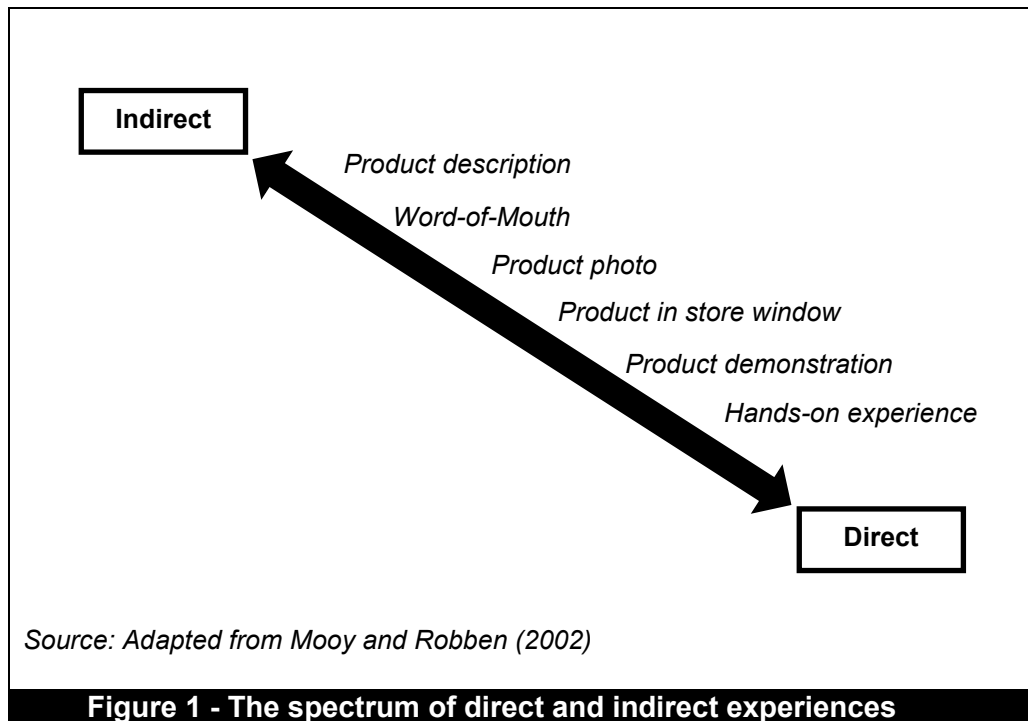
We adapted the theoretical framework on direct-indirect experience spectrum (Mooy and Robben, 2002) (see Figure 1) in the design of the two experimental settings: (1) Indirect experience is acquired by a video viewing of the touchless system; (2) Direct experience is gained by user's physical interaction with the touchless system. Both experimental designs are important to examine the effects that indirect experience (i.e., video-framed product attribute information) and direct experience (i.e., personal product experience) have on an individual's usage intention. Touchless system demonstrations in video add auditory information on how to use the technology. However, experience is indirect because users themselves have no physical access to the touchless system. The most direct form of product experience occurs when users have hands-on experience with the touchless system. Along the spectrum of direct experience, the user collects and processes more information, and this product-user interaction evokes user attention (Mooy and Robben, 2002). Given that direct experience has been reported to induce greater impact on attitude and purchase intention (Hoch and Deighton, 1989; Wright and Lynch, 1995; Mooy and Robben, 2002; Kim et al., 2013), we hypothesize that direct experience differs in its impact upon behavior intention than indirect experience within the somatosensory technology setting.

### ***TAM***

The theoretical framework for this study is built upon TAM, a simplified version of Theory of Reasoned Action (TRA) (Davis et al., 1989). TAM, introduced in 1986, has been the preeminent model to predict individuals' technology acceptance in Information Systems (IS) research (Adams et al., 1992; Straub et al., 1995; Lee et al., 2003). TAM is a parsimonious and well-suited model to study the determinants of user acceptance of technology, following a

short interaction session with the given technology (Davis et al., 1989; Lee et al., 2012). Specifically, TAM is assessed in research settings such as pre-purchase trial practice or user interaction with a technology prototype (Alavi, 1984; Davis et al., 1989). Over the years, TAM has

surfaced as useful practical tool for system designers interested to collect user comments on system features or design references (Adams et al., 1992) or take corrective actions to improve the system (Davis et al., 1989).



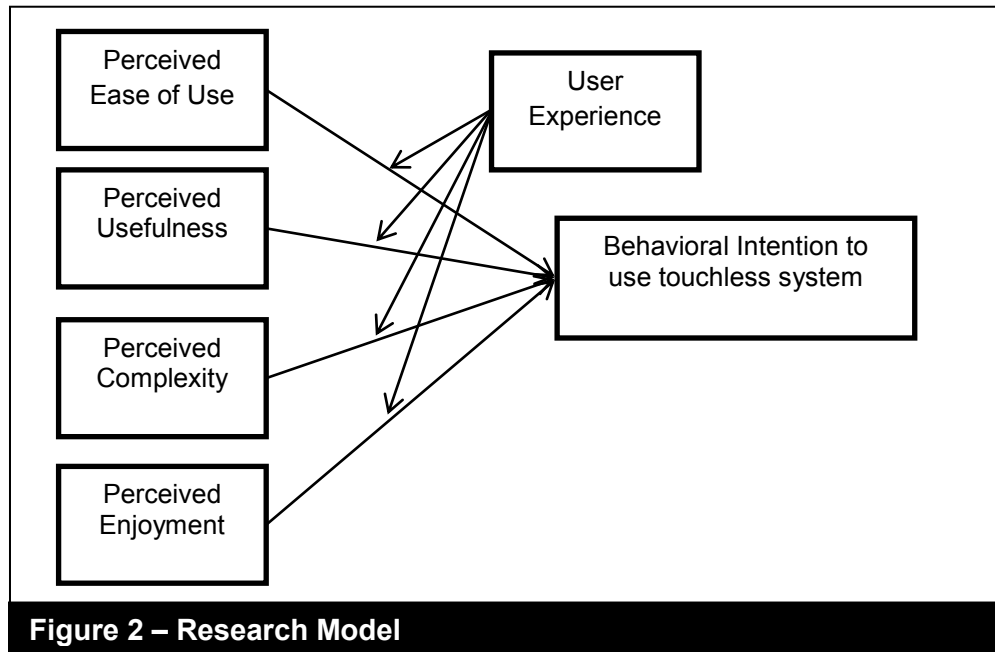
Perceived ease of use and perceived usefulness are regarded as the proximal determinants of user acceptance in TAM (Davis, 1989). Later perceived enjoyment (Davis et al. 1992) a third variable was added to TAM (Heijden, 2004). According to Wu and Lu (2013), perceived enjoyment is regarded as an intrinsic motivator in studying hedonic IS usage. Within the area of hedonic IS studies, several researchers have extended TAM with constructs such as perceived enjoyment (Davis et al., 1992; Igarria et al., 1995; Teo et al., 1999; Anandarajan et al., 2000; Childers et al., 2001; Heijden, 2004; Lee et al., 2005; Yu et al., 2005; Chen and Chen, 2011), perceived complexity (Thompson et al., 1991) and perceived playfulness (Wu and Holsapple, 2014; Jin, 2013; Moon and Kim, 2001). For

nearly three decades, there has been rich stream of multi-disciplinary research on TAM and its extended model (see: Dishaw and Strong, 1999; Lederer et al., 2000; Chen et al., 2002; Venkatesh et al., 2003; Shih, 2004; Burton-Jones and Hubona, 2006; Ha and Stoel, 2009; Wu, 2011; Ho et al., 2013; Antón et al., 2013; Ramakrishnan et al., 2014), to predict individuals' technology usage intention such as electronic book reader, and software as a service (SaaS).

We now turn to our research focus, in considering important explanatory variables in predicting somatosensory technology acceptance/adoption. The somatosensory technology studied in this article is a touchless system that enables users to control home appliances using hand

gestures. This type of system is stimulated by user's intrinsic joy and enjoyment. However, at the same time, the touchless system is perceived to be more complex than conventional systems (using remote control), and hence is less likely to be accepted by users. Building upon and

extending TAM, we propose that in addition to perceived ease of use and perceived usefulness, an individual's behavioral intention to use the touchless system is influenced by perceived complexity and perceived enjoyment. Figure 2 shows our proposed research model.



### Research hypotheses

Perceived ease of use is defined as “the degree to which a person believes that using a particular system would be free of effort” (Davis, 1989, p. 320). Davis (1989) reasons that a system perceived to be easier to use than other systems, is one that a user will accept. In the context of our study, perceived ease of use will have a positive impact on behavioral intention to use the touchless system. According to Adams et al. (1992), there is no consistent effect of ease of use or usefulness because users rationalize their perceptions in different ways, depending on time and user experience for any given system. Formalizing this perspective, the use of video allows us to assess whether the information frame affects user's perception of ease of use, compared to the effect of

personal product experience. Hence, we propose:

**H1:** The relationship between perceived ease of use and behavioral intention will be different depending on user experience (i.e., viewing video as compared to actual experience of technology).

Perceived usefulness represents the “instrumental value derived from use of a technology” (Karahanna et al., 2006, p. 788). For instance, users are not motivated to use the service application if it is not useful (McKenna et al., 2013). Applying this rationale in the context of touchless system, we expect a positive usefulness-intention relationship. Karahanna et al. (1999) posit that more information about the technology may be derived from direct experience than indirect experience. In our case, the role of the video is to frame the product experience,

providing indirect experience to the user. Exposure to the video influences participants' inferences drawn from information framed about usefulness of touchless system. Direct experience, which involves personal product experience of the touchless system, may result in a different judgment on usefulness dimension. Therefore, we suggest:

**H2:** The relationship between perceived usefulness and behavioral intention will be different depending on user experience (i.e., viewing video as compared to actual experience of technology).

Complexity is defined as "the degree to which a system is perceived as relatively difficult to understand and use" (Venkatesh et al., 2003, p. 451). van Mulken et al. (2010) posit a negative relationship between perceived complexity and appreciation. In other words, if a technology is perceived by users as complex and difficult to operate, users are less likely to appreciate and use the system. Along this line, Boy (2007)'s assertion on Acquired Incapacity Syndrome (AIS) has received some attention. People with AIS will convince themselves that they are unable to perform a task when they perceive a task to be too complex even without trying (Boy, 2007). In our context, users may have lower intention to use the touchless system if they perceive the system as complex even without using it. This issue can be addressed by allowing one to have a direct experience using the touchless system. When both indirect experience (video for framed product attribute information) and direct experience (experiment for personal product experience) are taken into account, we expect a different user judgment on perceived complexity. Therefore, we hypothesize:

**H3:** The relationship between perceived complexity and behavioral intention will be different depending on user experience (i.e., viewing video as compared to actual experience of technology).

Perceived enjoyment refers to "the extent to which fun can be derived from using the

system as such" (Heijden, 2004, p. 697). For example, Wu and Holsapple (2014) posit that perceived enjoyment occurs when an individual perceives his or her interaction with computers as fun. Perceived enjoyment plays an influential role in hedonic technology acceptance (Sun and Zhang, 2006). Past and recent studies of hedonic IS (Davis et al., 1992; Heijden, 2004; Lee et al., 2005; Yu et al., 2005; Wu and Holsapple, 2014) have documented that perceived enjoyment is a determinant of user's behavioral intention. In our study, we assert that an individual's behavior intention to use the touchless system is driven, to some extent, by perceived enjoyment. We hypothesize that enjoyment will explain different variances in behavioral intention in the indirect experience (i.e., video framing of product attribute information) versus direct experience (i.e., personal product experience). Therefore, we propose:

**H4:** The relationship between perceived enjoyment and behavioral intention will be different depending on user experience (i.e., viewing video as compared to actual experience of technology).

## Research methodology

### Measures

Our survey instrument primarily used validated items from well-established IS research. We also introduced new survey items in cases where no items exist in literature, and where the wordings of survey items were inappropriate for use in the context of the touchless system. Survey items of perceived ease of use were adapted from Davis (1989), Venkatesh (2000) and Chau (1996). With changes in wording to fit the touchless system, perceived usefulness was measured from three items adapted from Davis (1989), Venkatesh (2000) and Chau (1996). Perceived complexity was measured using the scale adapted from Thompson et al. (1991) and Venkatesh et al. (2003). Perceived enjoyment was operationalized using three items modified from Davis et al.



(1992) and Venkatesh (2000). Behavior intention to use the touchless system was measured using two items adapted from Venkatesh (2000) and one new item specifically developed for this study. Respondents were asked to indicate the degree to which they agreed or disagreed with each survey item, on a seven-point scale from 1 (strongly disagreed) to 7 (strongly agreed). The survey questionnaire is provided in Appendix.

### Sample

The target sample was students from a university in Malaysia. Sixty-two participants were recruited for this study. Using within-subjects design, all participants were involved in the two research settings. Voluntary consent was sought and obtained from each participant. All research procedures were in conformance with the guidelines outlined by the committee on research practices and human ethics.

Hand-width variations exist between individuals. Our designed touchless system was rather insensitive to detect very small size hand-width. This confounding effect was eliminated in this study by limiting our

choice of participants who passed the initial screening test. The initial screening test involved meeting the hand-width around the hand at the fullest part (excluding the thumb) of at least six centimeters (or 2.36 inches). Hence, each participant's hand-width was first measured and checked to meet the above measurement. None of the participants had any visual impairment and experience in using the touchless system.

Table 1 provides our sample demographic information including gender, age, and consumer types. Our participants included a balance of gender (i.e., 31 males and 31 females). The breakdown of age groups of the participants was as follows: 67.7 percent was between 18 and 24 years old, 30.6 percent were between 25 and 34 years old, and the remaining 1.6 percent was aged over 35 years old. Following the five technology adopter categories classified by Rogers (1983), our sample consisted of 11.3 percent of innovators, 11.3 percent of early adopters, 35.5 percent of early majority, 22.6 percent of late majority and 19.3 percent of laggards.

Variable	Classification	Frequency (n=62)	Percent (%)
Gender	Male	31	50
	Female	31	50
Age	18-24	42	67.7
	25-34	19	30.6
	35-44	1	1.6
Consumer Types	Laggard	12	19.3
	Late Majority	14	22.6
	Early Majority	22	35.5
	Early Adopter	7	11.3
	Innovator	7	11.3

### Data collection

Our experiential product was an in-house developed touchless system, installed in a Digital Home. This touchless system is a new technology, enabling users to access five home applications via hand gesture.

These five applications include controlling living room lights, movie on demand on the television, edutainment, kitchen e-cook book and digital photo albums. The touchless system is activated by two hand gestures (i.e., point-and-wait and palm-and-close) to control the following applications:

1. Switch on and off the living room lights;
2. Open, browse, play and close the movie on demand on the television in the living hall;
3. Open, browse, play and close the edutainment in the living hall;
4. Open, browse, play and close the kitchen e-cook book in the living hall; and
5. Open, browse, view and close the digital photo albums in the living hall.

The experimental studies were conducted in the Digital Home. There were two research settings: (1) video observation of the in-house developed touchless system; and (2) experiment of our in-house developed touchless system. In our first research setting, a 2.45-minute video was recorded to convey experiential product attributes and usage. Participants were shown the video demonstrating how to use the five home applications (i.e., controlling living room lights, movie on demand on the television, edutainment, kitchen e-cook book and digital photo albums.) via the touchless system (see Figure 3). While viewing the video, participants put on their earphones to listen to the narrator explaining procedural techniques to control the touchless system. After the video session, participants were asked to complete a survey questionnaire pertaining to the touchless system.

In our second research setting, a set of instructions describing the experimental tasks, similar to the video, was prepared for participants. After completing the survey for video observation, the participants were directed to a practice session where researchers demonstrated the hand gesture to generate commands for the five home applications. After the demonstration session, participants were given five minutes to familiarize themselves with the use of the touchless system. This was critical to ensure the participants understood the task domain and understood how to use the touchless system. To reduce any fatigue effect, participants were given another two minutes rest time before continuing the experiment. Next, participants were required to complete a formal assignment involving

use of the five home applications via the touchless system, similar to the tasks shown in the prior video. To this end, participants were asked to complete a survey questionnaire about the experiment. We used the same survey instrument as the video observation.

## Results

### **Reliability, Validity and Factor Analyses**

We used IBM SPSS predictive analytics software to check the psychometric properties of the survey instrument, and to test our hypothesized model. The psychometric properties of all scales were assessed in terms of reliability, validity and factor analysis. These assessments were systematically performed for the two models: (1) Model A: Video observation of the in-house developed touchless system; (2) Model B: Product experience of the in-house developed touchless system.

Details of reliability and validity of all variables of Model A and B are summarized in Table 2 and 3. Composite reliability of the constructs was calculated using formula  $\rho = (\sum \lambda_i)^2 / [(\sum \lambda_i)^2 + (\sum \theta_i)]$ , where  $\lambda_i$  refers to the  $i$ th factor loading and  $\theta_i$  refers to the  $i$ th random measurement error for each loading (Chau and Hu, 2001). The variables in Model A and B showed a high degree of internal consistency as all values of composite reliabilities are greater than 0.60, a desirable coefficient recommended by Bagozzi and Yi (1988). To test for the convergent validity, we followed the method set forth by Fornell and Larcker (1981). As evidenced by results in Table 2 and 3, the values of Average Variance Extracted (AVE) met the 0.50 desirable value for convergent validity. An examination of the inter-variable correlations and square root of AVE also showed that discriminant validity was established for both Model A and B. These results provided evidence of the overall reliability, convergent validity and discriminant validity of the scales.



**Figure 3 - A screenshot of video clip on edutainment application**

Principal component factor analysis was performed to check the construct validity. The factor loadings, Kaiser-Meyer-Olkin (KMO), Bartlett test of sphericity, and eigenvalues of Model A and B are shown in Tables 4 and 5. Each items exhibited good factor loadings. The values of KMO ranged from 0.615 to 0.844, meeting the minimum criteria (i.e., 0.50) suggested by Hair et al. (2010). The values for the Bartlett test of sphericity were significant for all scales, with numbers ranging from 32.596 (perceived enjoyment<sub>A</sub>) to 234.847 (perceived ease of use<sub>B</sub>). All scales also attained the desirable eigenvalues of greater than 1. Taken together, all five independent and dependent variables (i.e., perceived ease of use, perceived usefulness, perceived complexity, perceived enjoyment and behavioral intention) in Model A and B were significant to be studied in this research.

There was a potential for common method bias resulting from the within-subject design, in which the same participant was used after being exposed to each treatment (i.e., video observation and product trial). We conducted both procedural and statistical remedies to address the problem of common method bias. First, we changed

the order of the items within the instrument in each treatment. This procedural remedy created psychological separation between the independent and dependent variables on the instrument (Podsakoff et al., 2003; Moody et al., 2014). Second, we conducted the Harman one-factor test (Podsakoff et al., 2003) on all the variables in Model A and Model B. Evidence for common method bias exists when either (1) a single factor emerges in the factor analysis or (2) a general factor accounts for most of the covariance (Podsakoff et al., 2003). Results from this test showed that eight factors were present and accounted for 75.40% of the variance. The factor with the greatest eigenvalue accounted for 35.36% of the variance. Because no single factor emerged as a dominant factor, our data did not show evidence of common method bias. Third, we used the correlation matrix method adapted by Pavlou et al. (2007) and Moody et al. (2014) to assess the common method bias. This approach was the examination of correlation matrix of the constructs to check if any of the values were greater than 0.90, indicating that common method bias is a serious concern (Pavlou et al., 2007; Moody et al., 2014). Table 6 shows the results of the correlation analysis of Model A and B.

All correlations were below the threshold of 0.90, indicating that common method bias was not a major concern in this study.

**Table 2. Results of reliability and validity for Model A**

	EU	UF	CP	EJ	BI
EU	<i>0.756</i>				
UF	0.588**	<i>0.854</i>			
CP	-0.485**	-0.525**	<i>0.711</i>		
EJ	0.444**	0.389**	-0.589**	<i>0.785</i>	
BI	0.519**	0.630**	-0.606**	0.511**	<i>0.946</i>
AVE	0.572	0.730	0.506	0.616	0.894
CR	0.886	0.915	0.800	0.827	0.962
SD	0.891	1.116	1.055	0.977	1.492
ME	5.059	5.093	3.464	5.038	4.720

Note: ME=Mean; SD= Standard Deviation; CR= Composite Reliability; AVE= Average Variance Extracted; EU=Perceived Ease of Use; UF= Perceived Usefulness; CP= Perceived Complexity; EJ= Perceived Enjoyment; BI= Behavioral Intention to use touchless system; \*\* All correlations are significant at the 0.01 level (2-tailed); Italicized values in the diagonal row are square roots of the AVE.

**Table 3. Results of reliability and validity for Model B**

	EU	UF	CP	EJ	BI
EU	<i>0.818</i>				
UF	0.708**	<i>0.885</i>			
CP	-0.429**	-0.359**	<i>0.758</i>		
EJ	0.685**	0.753**	-0.429**	<i>0.861</i>	
BI	0.641**	0.715**	-0.316*	0.619**	<i>0.969</i>
AVE	0.699	0.783	0.574	0.742	0.938
CR	0.924	0.935	0.843	0.896	0.979
SD	1.172	1.428	1.186	1.157	1.521
ME	4.562	4.569	3.601	4.640	4.156

Note: ME=Mean; SD= Standard Deviation; CR= Composite Reliability; AVE= Average Variance Extracted; EU=Perceived Ease of Use; UF= Perceived Usefulness; CP= Perceived Complexity; EJ= Perceived Enjoyment; BI= Behavioral Intention to use touchless system; \*\* All correlations are significant at the 0.01 level (2-tailed); Italicized values in the diagonal row are square roots of the AVE.

**Table 4. Results of factor analysis for Model A**

Variables	No. of Items	KMO	BTS	EV	Factor Loadings					
					Item 1	Item 2	Item 3	Item 4	Item 5	Item 6
EU	6	0.844	144.715***	3.432	0.777	0.797	0.843	0.477	0.754	0.828
UF	4	0.739	144.617***	2.919	0.790	0.871	0.855	0.897	Nil	Nil
CP	4	0.635	42.728***	2.025	0.525	0.770	0.820	0.695	Nil	Nil
EJ	3	0.615	32.596***	1.847	0.711	0.857	0.779	Nil	Nil	Nil
BI	3	0.746	165.633***	2.682	0.940	0.933	0.964	Nil	Nil	Nil

Note: \*\*\*  $p < 0.001$ ; KMO=Kaiser-Meyer-Olkin; BTS=Barlett's Test of Sphericity; EV=Eigen-values; EU=Perceived Ease of Use; UF= Perceived Usefulness; CP= Perceived Complexity; EJ= Perceived Enjoyment; BI= Behavioral Intention to use touchless system.

**Table 5. Results of factor analysis for Model B**

Variables	No. of Items	KMO	BTS	EV	Factor Loadings					
					Item 1	Item 2	Item 3	Item 4	Item 5	Item 6
EU	6	0.798	234.847***	4.017	0.859	0.818	0.846	0.809	0.761	0.812
UF	4	0.690	222.771***	3.131	0.931	0.886	0.841	0.879	Nil	Nil
CP	4	0.622	74.248***	2.295	0.787	0.770	0.766	0.705	Nil	Nil
EJ	3	0.715	65.880***	2.225	0.869	0.837	0.877	Nil	Nil	Nil
BI	3	0.779	222.603***	2.815	0.974	0.969	0.963	Nil	Nil	Nil

Note: \*\*\* p < 0.001; KMO=Kaiser-Meyer-Olkin; BTS=Barlett's Test of Sphericity; EV=Eigen-values; EU=Perceived Ease of Use; UF= Perceived Usefulness; CP= Perceived Complexity; EJ= Perceived Enjoyment; BI= Behavioral Intention to use touchless system.

**Table 6. Results of correlation analysis for Model A and B**

	CPA	EJA	EUA	UFA	BIA	CPB	EJB	EUB	UFB	BIB
CPA	1									
EJA	-0.589**	1								
EUA	-0.485**	0.444**	1							
UFA	-0.525**	0.389**	0.588**	1						
BIA	-0.606**	0.511**	0.519**	0.630**	1					
CPB	0.567**	-0.315*	-0.192	-0.204	-0.184	1				
EJB	-0.354**	0.351**	0.294*	0.323*	0.308*	-0.429**	1			
EUB	-0.302*	0.223	0.531**	0.326**	0.250*	-0.429**	0.685**	1		
UFB	-0.303*	0.178	0.334**	0.446**	0.412**	-0.359**	0.753**	0.708**	1	
BIB	-0.451**	0.469**	0.413**	0.344**	0.701**	-0.316*	0.619**	0.641**	0.715**	1

Note: EUA=Perceived Ease of Use in Model A; UFA= Perceived Usefulness in Model A; CPA= Perceived Complexity in Model A; EJA= Perceived Enjoyment in Model A; BIA= Behavioral Intention to use touchless system in Model A; EUB=Perceived Ease of Use in Model B; UFB= Perceived Usefulness in Model B; CPB= Perceived Complexity in Model B; EJB= Perceived Enjoyment in Model B; BIB= Behavioral Intention to use touchless system in Model B; \*\* Correlation is significant at the 0.01 level (2-tailed); \* Correlation is significant at the 0.05 level (2-tailed).

### Hypotheses Testing

Multiple regression analysis was performed to test Model A and B. Table 7, Figures 4 and 5 show the results of multiple regression analysis. The predictors

explained 49.6 percent and 52 percent of behavioral intention's variance in Model A and B, respectively. In the research setting of video observation, intention to use the touchless system was jointly determined by perceived usefulness ( $\beta_A=0.489$ ; p-value<0.01) and perceived complexity ( $\beta_A=-$

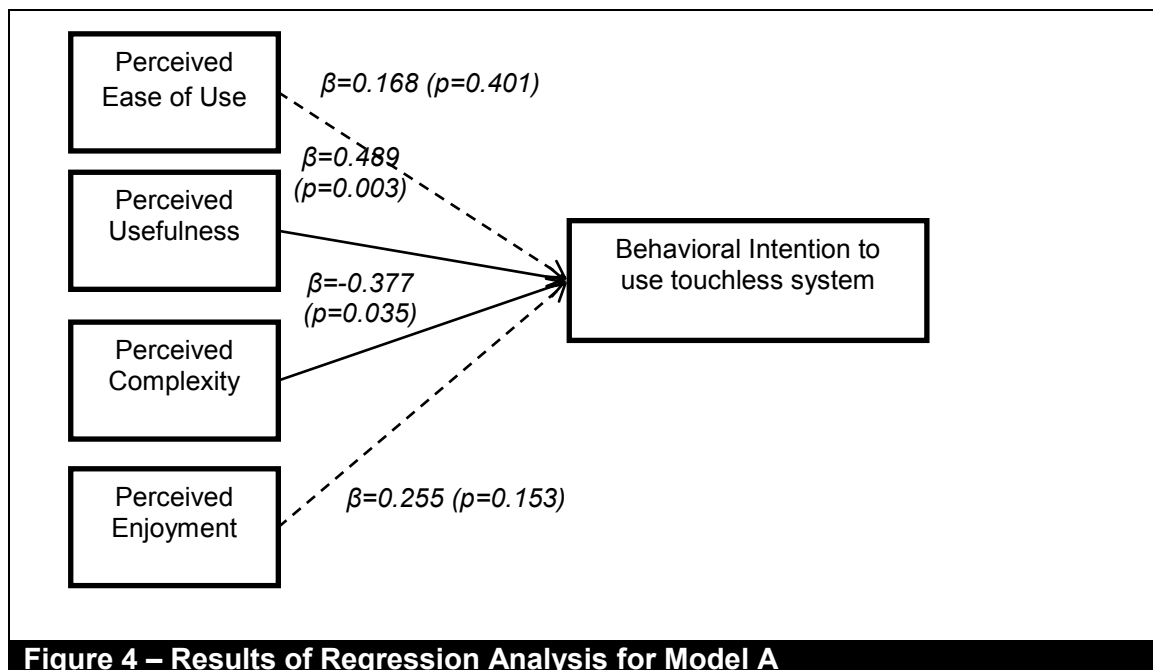
0.377;  $p$ -value $<0.05$ ). In the research setting of direct experience experiment, perceived usefulness ( $\beta_B=0.499$ ;  $p$ -value $<0.01$ ) was the dominant factor predicting individuals' usage intention. Our findings showed non-significant perceived ease of use-intention relationships ( $\beta_A=0.168$ ;  $p$ -value $>0.05$ ;  $\beta_B=0.309$ ;  $p$ -value $>0.05$ ) between the two models. In both video observation and product trial, non-significant perceived enjoyment-intention relationships ( $\beta_A=0.255$ ;  $p$ -

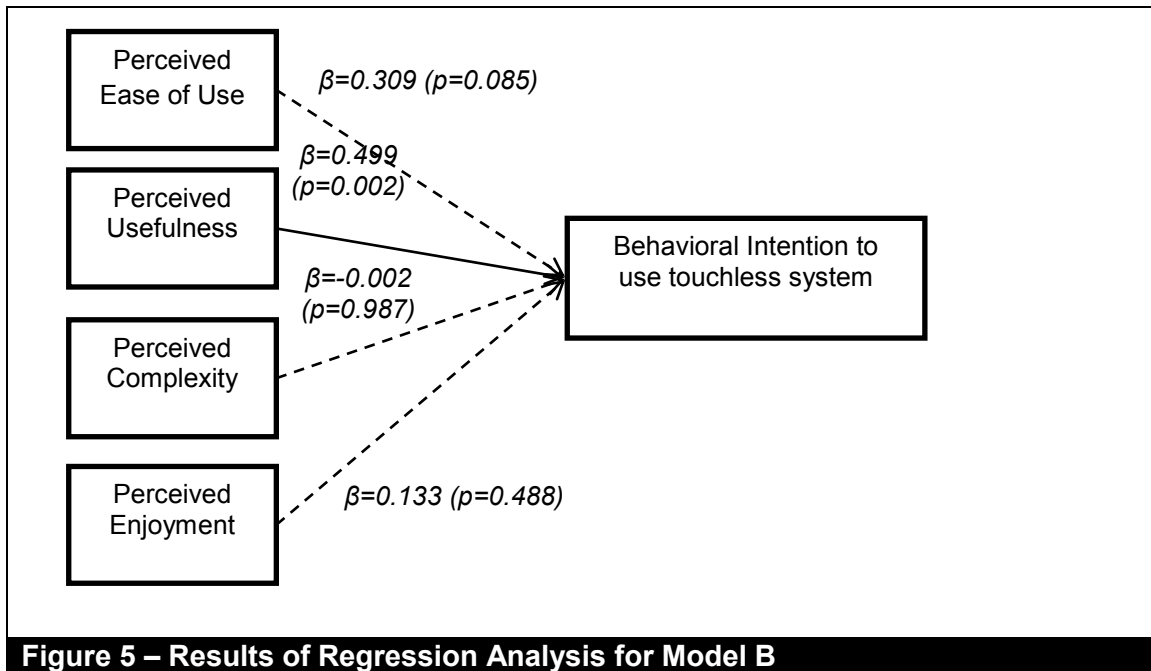
value $>0.05$ ;  $\beta_B=0.133$ ;  $p$ -value $>0.05$ ) were observed. These results lend support to hypothesis H3 but not H1, H2 and H4. Although some hypotheses were not supported, our study provides evidence to suggest that there is a difference in effect between video (i.e., framed product attribute information) versus direct experience experiment (i.e., personal product experience) on individual's behavioral intention.

**Table 7 – Results of Regression Analysis**

	Model A		Model B	
	Beta Coefficient	Std. Error	Beta Coefficient	Std. Error
(Constant)				
Perceived Ease of Use	0.168	0.199	0.309	0.176
Perceived Usefulness	0.489**	0.160	0.499**	0.157
Perceived Complexity	-0.377*	0.175	-0.002	0.129
Perceived Enjoyment	0.255	0.176	0.133	0.191
$R^2$	0.529		0.551	
Adj. $R^2$	0.496		0.520	
F	16.016		17.496	
Sig.	0.000***		0.000***	

Note: Dependent Variable = Behavioral Intention; \*  $p < 0.05$ ; \*\*  $p < 0.01$ ; \*\*\*  $p < 0.001$





## Discussion

The purpose of this study is to assess how user's usage intention varies with direct and indirect experience. We found a significant difference in the relationship between perceived complexity and behavioral intention in video observation (indirect experience) as compared to product trial (direct experience) experiment. Perceived complexity was a significant predictor of an individual's behavioral intention to use the touchless system after video observation (indirect experience), while its relationship to usage intention was insignificant after product trial (direct experience). It is clear that the inclusion of user experience shifted the significance of the complexity-intention relationship. A possible explanation is that complexity is non-significant when users have actually tried and used the system through a practice session. This is consistent with Thompson et al.'s (2005) observations that people will develop a more concrete construal of the product in their evaluations and shift product preferences after using the product, placing more attention on usability (e.g., is this

product difficult to use?), than in their evaluations without direct experience. Conceivably, users can assimilate a new technology quickly when they use it, and become familiar with its operation, and consequently do not regard the technology as complex. Support for this assertion comes from folk wisdom that says "experience is the best teacher" (Wright and Lynch, 1995, p. 708). More importantly, we found that direct experience causes participants to attend differently to the complexity evaluation dimension in touchless system/somatosensory technology.

Notably, in product trial and video observation (direct and indirect experience), perceived usefulness was found to be a significant predictor of user's behavior intention to use the touchless system. Our findings are consistent with a longitudinal research reported by Szajna (1996), indicating that perceived usefulness has a consistent positive effect on intentions at both pre-implementation and post-implementation stages of IS. From findings of two research designs (i.e., self-reported

current usage and self-predicted future usage), Davis (1989) also concludes that perceived usefulness has a more consistent positive relationship with usage behavior than other determinants. In our context, the correlation between perceived usefulness and behavioral intention is greater in the product trial (direct experience) than in the video observation (indirect experience). This result suggests that once individuals begin to actually use a touchless system, usefulness becomes more important overall in determining behavioral intention.

The non-significant relationship between perceived ease of use and behavioral intention in both video observations and product trial was not surprising. Szajna (1996) also obtained a similar result in both pre-implementation and post-implementation versions. In fact, Davis et al. (1989) reasoned that if a graphic software application creates higher quality graphs, it would likely be seen as a more useful application, despite ease of use parity. In our case, the touchless system enables users to control the home appliances using their hand gestures (instead of traditional remote control system), and the degree to which it improves users' digital lifestyle could well influence usefulness compared to easy-to-use attribute.

In this study, perceived enjoyment was found to be non-significant in both product trial and video observation (direct and indirect experience). A possible explanation for this may be as follows: somatosensory technology is a facilitator of smart home technology products. For example, hand gesture (somatosensory technology) is used to play a game. The game is enjoyed, not the gesture in of themselves. Smart home products are consumed and enjoyed, whilst the somatosensory technology is a conduit to that enjoyment. Hence, one does not experience enjoyment of somatosensory technology itself, but enjoyment relates to what is being consumed. The non-significant enjoyment-usage relationship has been observed before, in a study on computer technology by Igbaria et al. (1995).

In retrospect, Igbaria et al. (1995) elucidate that users may be placing greater priority on the functional-aspect (i.e., usefulness) of computer technology rather than the fun-aspect provided by the computer. This explanation also applies to our study. Our results in both video observation and product trial ostensibly show extrinsic motivation (i.e., perceived usefulness) consistently to be the dominant predictor of behavioral intention to use the touchless system, and underplay the effect of intrinsic motivation (i.e., perceived enjoyment). This pattern of logic implies that making a touchless system more enjoyable to use has little impact on the formation of intentions. On the contrary, a touchless system that is perceived to be useful will be accepted by users.

## **Conclusion**

In studying adoption of somatosensory technology, we find that contextual setting (viewing versus experiencing) displays difference in factors influencing it. Under the viewing setting, perceived complexity and perceived usefulness both feature as significant factors in the adoption decision. In other words, when somatosensory technology is viewed, its perceived usefulness is weighed with perceived complexity. In contrast, when somatosensory technology is experienced, the effect of perceived complexity disappears. This suggests that experience helps relieve user concern about complexity of the technology, and the key consideration in adoption is one of usefulness. This would indicate the importance of getting potential customers of somatosensory technology products/services to have direct experience. Given that somatosensory technology is operated by hand gesture, direct experience appears to remove the obstacle of the "sense of complexity" which is often a major barrier to adoption.

As somatosensory technology advances, it is increasingly being integrated in manufacturing, medical, educational, leisure



and entertainment industries. To our knowledge, there is no empirical research conducted to investigate the influence of direct and indirect experience in somatosensory technology adoption. Little is known about the importance of user's direct and indirect experience in somatosensory technology adoption. In this paper, we address this lack of knowledge by establishing and validating a research model to investigate whether direct experience (i.e. actual experience) and indirect experience (i.e. video demonstration) result in different levels of mental construal that will affect somatosensory technology adoption. Our study showed that the engaging aspect of experience removed product complexity, thereby suggesting that sensory contact (direct experience) with a somatosensory technology triggers more concrete mental construal of the product, and leads to a more extensive evaluation of the somatosensory technology.

In addition to the above, our results also provide evidence that research setting (user experience of the technology as opposed to no direct experience) may affect the results of the TAM model. This suggests that technology adoption research studies should in the future take cognizance of this in their research design.

The findings of the study also throw up intriguing questions regarding the role of experience in technology adoption and the general applicability of experience across the technology spectrum. In particular, a question can be raised as to whether the role of experience in technology adoption is generic to all technologies or only specific to touchless technology, or only to technology possessing specific types of characteristics. As such, further research is required to investigate whether direct experience of technology is equally germane across different product categories. For instance, search products (e.g., computers) versus experience products (e.g., video games) may alter the relevance of direct experience vis a vis indirect experience, since the quality of search products can be explicitly

evaluated through basic product attributes. In contrast, sensory products possess only implicit attributes that must be directly "experienced" to be evaluated.

Our study also contributes to practice. When promoting new somatosensory technology for the touchless smart home system, companies and marketers have to select appropriate marketing strategies (e.g., advertising, product trial and showroom visit) to encourage consumer's evaluation behavior. Our study shows that the direct product experience can have an important influence in consumer's perceived complexity of somatosensory technology. Given that the indirect experience such as video demonstration has little effect in developing passive product learning among consumers, direct experience of the product can be used to more effectively influence prospective consumers. Notably, product complexity barrier that often exist in new technology adoption decision can be reduced and/or removed through the experience of somatosensory technology.

Furthermore, our findings show that perceived usefulness is positively related to behavior intention in both video demonstration and product trial. This suggests marketing techniques such as visual and audio advertising and packaging information (targeting indirect experience) should be designed to highlight the usefulness of somatosensory technology, personal relevance of the technology, and efforts should be made to motivate consumers to interact with the somatosensory technology.

In today's business world, several companies and marketers have started using social networking sites to introduce and promote new technology and products offerings. For example, Leap Motion uploads product information, images and video advertisement on its Facebook website to promote its somatosensory technology (i.e., Leap Motion controller) (Leap Motion Facebook, 2014). Although video demonstration in social media

provides both visual and audio product information, consumers still lack sensory contact with the somatosensory technology. For enhanced adoption, it is necessary for companies to provide direct product experience (e.g., product trial) for potential consumers. Lack of direct experience with the somatosensory technology creates situations in which consumers perceive technology as being too complex, and subsequently refrain from buying the product. We hope that the current study serves as a catalyst for marketers and practitioners to understand that complexity attributes cannot be assessed before use, because this attribute is related to individual sensory perception. For somatosensory technology such as touchless smart home system, product trial (direct experience) engenders more reliable inferences than does exposure to advertising (indirect experience).

Although this study provides new knowledge in IS literature, it has two limitations. First, results drawn from this study were based on one distinctive somatosensory technology, namely, touchless system for home automation. In future, our model should be replicated across different somatosensory technologies such as those used in medical and office automation. This will help improve the generalizability of the findings. Second, our study used a cross-sectional data. Future research should perform longitudinal evaluation of use experiences since it may also affect the significance of adoption variable.

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## References

- Adams, D.A., Nelson, R.R. and Todd, P.A. (1992). "Perceived Usefulness, Ease of Use, and Usage of Information Technology: A Replication," *MIS Quarterly*, 16(2), pp. 227-247.
- Alavi, M. (1984). "An Assessment of the Prototyping Approach to Information Systems Development," *Communications of the ACM*, 27(6), pp. 556-563.
- Anandarajan, M., Igbaria, M. and Anakwe, U.P. (2000). "Technology Acceptance in the Banking Industry: A Perspective from A Less Developed Country," *Information Technology & People*, 13(4), pp. 298-312.
- Antón, C., Camarero, C. and Rodríguez, J. (2013). "Usefulness, Enjoyment, and Self-Image Congruence: The Adoption of E-Book Readers," *Psychology & Marketing*, 30(4), pp. 372-384.
- Bagozzi, R.P. and Yi, Y. (1988). "On the Evaluation of Structural Equation Models," *Journal of the Academy of Marketing Science*, 16(1), pp. 74-94.
- Ben Hadj Mohamed, A., Val, T., Andrieux, L. and Kachouri, A. (2012). "Using a Kinect WSN for Home Monitoring: Principle, Network and Application Evaluation," *Proceedings of the International Conference on Wireless Communications in Unusual and Confined Areas (ICWCUCA)*, pp. 1-5.
- Ben Hadj Mohamed, A., Val, T., Andrieux, L. and Kachouri, A. (2013). "Assisting People with Disabilities through Kinect Sensors into a Smart House," *Proceedings of the International Conference on Computer Medical Applications (ICCA)*, pp. 1-5.
- Bhuiyan, M. and Picking, R. (2011). "A Gesture Controlled User Interface for Inclusive Design and Evaluative Study of Its Usability." *Journal of Software Engineering and Applications*, 4, pp. 513-521.

- Boulos, M.N.K., Blanchard, B.J., Walker, C., Montero, J., Tripathy, A. and Gutierrez-Osuna, R. (2011). "Web GIS in Practice X: A Microsoft Kinect Natural User Interface For Google Earth Navigation," *International Journal of Health Geographics*, 10(45), pp. 1-14.
- Boy, G.A. (2007). "Perceived Complexity and Cognitive Stability in Human-Centered Design," in Harris, D. (ed.), *Engineering Psychology and Cognitive Ergonomics* (pp. 10-21). Berlin Heidelberg: Springer.
- Burton-Jones, A. and Hubona, G.S. (2006). "The Mediation of External Variables in the Technology Acceptance Model," *Information & Management*, 43(6), pp. 706-717.
- Chau, P.Y.K. (1996). "An Empirical Assessment of A Modified Technology Acceptance Model," *Journal of Management Information Systems*, 13(2), pp. 185-204.
- Chau, P.Y.K. and Hu, P.J.H. (2001). "Information Technology Acceptance By Individual Professionals: A Model Comparison Approach," *Decision Sciences*, 32(4), pp. 699-719.
- Chen, C.F. and Chen, P.C. (2011). "Applying the TAM to Travelers' Usage Intentions of GPS Devices," *Expert Systems with Applications*, 38(5), pp. 6217-6221.
- Chen, L., Gillenson, M.L. and Sherrell, D.L. (2002). "Enticing Online Consumers: An Extended Technology Acceptance Perspective," *Information & Management*, 39(8), pp. 705-719.
- Chen, S.T., Huang, Y.G.L. and Chiang, I.T. (2012). "Using Somatosensory Video Games to Promote Quality of Life for the Elderly with Disabilities," *Proceedings of the 2012 Fourth IEEE International Conference on Digital Game and Intelligent Toy Enhanced Learning*, pp. 258-262.
- Chiang, I. (2011). "Old Dogs can Learn New Tricks: Exploring Effective Strategies to Facilitate Somatosensory Video Games for Institutionalized Older Veterans," in Chang, M., Hwang, W.Y., Chen, M.P. and Müller, W. (eds.), *Edutainment Technologies: Educational Games and Virtual Reality/Augmented Reality Applications*, Springer-Verlag Berlin Heidelberg.
- Childers, T.L., Carr, C.L., Peck, J. and Carson, S. (2001). "Hedonic and Utilitarian Motivations for Online Retail Shopping Behavior," *Journal of Retailing*, 77(4), pp. 511-535.
- Choi, E., Kwon, S., Lee, D., Lee, H. and Chung, M.K. (2012). "Can User-Derived Gesture be Considered as the Best Gesture for a Command?: Focusing on the Commands for Smart Home System," *Proceedings of the 56<sup>th</sup> Human Factors and Ergonomics Society Annual Meeting*, pp. 1253-1257.
- Davis, F.D. (1989). "Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology," *MIS Quarterly*, 13, pp. 319-340.
- Davis, F.D., Bagozzi, R.P. and Warshaw, P.R. (1989). "User Acceptance of Computer Technology: A Comparison of Two Theoretical Models," *Management Science*, 35(8), pp. 982-1003.
- Davis, F.D., Bagozzi, R.P. and Warshaw, P.R. (1992). "Extrinsic and Intrinsic Motivation to Use Computers in the Workplace," *Journal of Applied Social Psychology*, 22(14), pp. 1111-1132.
- Dishaw, M.T. and Strong, D.M. (1999). "Extending the Technology Acceptance Model with Task-Technology Fit Constructs," *Information & Management*, 36(1), pp. 9-21.

- Fornell, C. and Larcker, D.F. (1981). "Evaluating Structural Equation Models with Unobservable Variables and Measurement Error," *Journal of Marketing Research*, 18(1), pp. 39-50.
- Gantenbein, D. (2012). "Kinect Launches a Surgical Revolution," Microsoft Research. Retrieved from <http://research.microsoft.com/en-us/news/features/touchlessurgery-060712.aspx> on August 30, 2014.
- Garzotto, F. and Valoriani, M. (2012). " 'Don't Touch the Oven': Motion-based Touchless Interaction with Household Appliances," *Proceedings of the International Working Conference on Advanced Visual Interfaces, ACM*, Capri Island, Italy, pp. 721-724.
- Ha, S. and Stoel, L. (2009). "Consumer e-shopping Acceptance: Antecedents in a Technology Acceptance Model," *Journal of Business Research*, 62(5), pp. 565-571.
- Hair, J.F.Jr., Black, W.C., Babin, B.J. and Anderson, R.E. (2010). *Multivariate Data Analysis: A Global Perspective*. (7th ed.). New Jersey: Pearson Education Inc.
- Heijden, H. v. d. (2004). "User Acceptance of Hedonic Information Systems," *MIS Quarterly*, 28(4), pp. 695-704.
- Ho, L.H., Hung, C.L. and Chen, H.C. (2013). "Using Theoretical Models to Examine the Acceptance Behavior of Mobile Phone Messaging to Enhance Parent-Teacher Interactions," *Computers & Education*, 61, pp. 105-114.
- Ho, S.H. and Huang, C.H. (2009). "Exploring Success Factors of Video Game Communities in Hierarchical Linear Modeling: The Perspectives of Members and Leaders," *Computers in Human Behavior*, 25(3), pp. 761-769.
- Hoch, S.J. (2002). "Product Experience is Seductive," *Journal of Consumer Research*, 29(3), pp. 448-454.
- Hoch, S.J. and Deighton, J. (1989). "Managing What Consumers Learn from Experience," *Journal of Marketing*, 53(2), pp. 1-20.
- Hoch, S.J. and Ha, Y.W. (1986). "Consumer Learning: Advertising and the Ambiguity of Product Experience," *Journal of Consumer Research*, 13(2), pp. 221-233.
- Hui, W. (2013). "Item Context Effects in IS Survey Research," *Pacific Asia Journal of the Association for Information Systems*, 4(4), pp. 21-42.
- Igbaria, M., Iivari, J. and Maragahh, H. (1995). "Why Do Individuals Use Computer Technology? A Finnish Case Study," *Information & Management*, 29(5), pp. 227-238.
- Intille, S.S. (2002). "Designing a home of the future," *Pervasive Computing, IEEE*, pp. 76-82.
- Jin, C. (2013). "The Perspective of a Revised TRAM on Social Capital Building: The Case of Facebook Usage," *Information & Management*, 50(4), pp. 162-168.
- Karahanna, E., Agarwal, R. and Angst, C.M. (2006). "Reconceptualizing Compatibility Beliefs in Technology Acceptance Research," *MIS Quarterly*, 30(4), pp. 781-804.
- Karahanna, E., Straub, D.W. and Chervany, N.L. (1999). "Information Technology Adoption Across Time: A Cross-Sectional Comparison of Pre-Adoption and Post-Adoption Beliefs," *MIS Quarterly*, 23(2), pp. 183-213.
- Kempf, D.S. and Smith, R.E. (1998). "Consumer Processing of Product Trial and The Influence of Prior Advertising: A Structural Modeling Approach," *Journal Marketing Research*, 35(3), pp. 325-338.
- Kim, J., Lee, K.H. and Taylor, C.R. (2013). "Effects of Mobile Direct Experience on Perceived Interactivity and Attitude

- toward Smartphone Applications," *Journal of Global Scholars of Marketing Science: Bridging Asia and the World*, 23(3), pp. 282-296.
- Leap Motion (2014). "The Leap Motion Controller," Retrieved from <https://www.leapmotion.com/> on August 30, 2014.
- Leap Motion Facebook (2014). "Leap Motion Product/Service," Retrieved from <https://www.facebook.com/LeapMotion> on August 30, 2014.
- Lederer, A.L., Maupin, D.J., Sena, M.P. and Zhuang, Y. (2000). "The Technology Acceptance Model and the World Wide Web," *Decision Support Systems*, 29(3), pp. 269-282.
- Lee, D., Son, I., Yoo, M.H. and Lee, J.H. (2012). "Understanding the Adoption of Convergent Services: The Case of IPTV," *Pacific Asia Journal of the Association for Information Systems*, 4(1), pp. 19-48.
- Lee, M.K.O., Cheung, C.M.K. and Chen, Z. (2005). "Acceptance of Internet-Based Learning Medium: The Role of Extrinsic and Intrinsic Motivation," *Information & Management*, 42(8), pp. 1095-1104.
- Lee, Y., Kozar, K.A. and Larsen, K.R.T. (2003). "The Technology Acceptance Model: Past, Present, and Future," *Communications of the Association for Information Systems*, 12, pp. 752-780.
- Levin, I.P. and Gaeth, G.J. (1988). "How Consumers Are Affected by the Framing of Attribute Information Before and After Consuming the Product," *Journal of Consumer Research*, 15(3), pp. 374-378.
- Li, H., Qiu, J. and Gao, L. (2014). "A Study of Kinect-based Smart TV Control Mode," in Rau, P.L.P. (ed.), *Cross-Cultural Design/HCI 2014*, Springer International Publishing Switzerland: Lecture Notes in Computer Science 8528, pp. 174-183.
- Liu, M., Lee, A.J.Y., Chang, C.Y., Wu, H.C., Fu, H.C., Chen, S.T. and Chiang, I.T. (2013). "Impacts of a One-Month Somatosensory Game Intervention on Reaction and Health-Related Quality of Life on Elderly," *Proceedings of the 21st International Conference on Computers in Education (ICCE 2013)*, Grand Inna Bali Beach Hotel, Denpasar Bali, Indonesia.
- McKenna, B., Tuunanen, T. and Gardner, L. (2013). "Consumers' adoption of information services," *Information & Management*, 50(5), pp. 248-257.
- Mert, W. (2008). "Consumer Acceptance of Smart Appliances," Retrieved from [http://www.smart-a.org/WP5\\_5\\_Consumer\\_acceptance\\_18\\_12\\_08.pdf](http://www.smart-a.org/WP5_5_Consumer_acceptance_18_12_08.pdf) on August 30, 2014.
- Moody, G.D., Galletta, D.F. and Lowry, P.B. (2014). "When Trust and Distrust Collide Online: The Engenderment and Role of Consumer Ambivalence in Online Consumer Behavior," *Electronic Commerce Research and Applications*, 13(4), pp. 221-294.
- Moon, J.W. and Kim, Y.G. (2001). "Extending the TAM for a World-Wide-Web Context," *Information & Management*, 38(4), pp. 217-230.
- Mooy, S.C. and Robben, H.S.J. (2002). "Managing Consumers' Product Evaluations through Direct Product Experience," *The Journal of Product and Brand Management*, 11(6/7), pp. 432-446.
- Mrazovac, B., Bjelica, M. Z., Papp, I. and Teslic, N. (2011). "Smart Audio/Video Playback Control Based on Presence Detection and User Localization in Home Environment," *Proceedings of the Second Eastern European Regional Conference on the Engineering of Computer Based Systems, ECBS-EERC*.

- OSRAM (2014). "Smart Home – On the Way to Tomorrow's Intelligent Living," Retrieved from [http://www.osram.com/osram\\_com/news-and-knowledge/news/lightify/2014/smart-home--on-the-way-to-tomorrows-intelligent-living/index.jsp](http://www.osram.com/osram_com/news-and-knowledge/news/lightify/2014/smart-home--on-the-way-to-tomorrows-intelligent-living/index.jsp) on August 30, 2014.
- O'Hara, K., Gonzalez, G., Penney, G., Sellen, A., Corish, R., Mentis, H., Varnavas, A., Criminisi, A., Rouncefield, M., Dastur, N. and Carrell, T. (2014). "Interactional Order and Constructed Ways of Seeing with Touchless Imaging Systems in Surgery," *Computer Supported Cooperative Work*, 23(3), pp. 299-337.
- Parziale, G. and Chen, Y. (2009). "Advanced Technologies for Touchless Fingerprint Recognition," in Tistarelli, M., Li, S.Z. and Chellappa, R. (eds.), *Handbook of Remote Biometrics for Surveillance and Security*, Springer-Verlag London Limited, pp. 83-109.
- Patsadu, O., Nukoolkit, C. and Watanapa, B. (2012). "Human Gesture Recognition using Kinect Camera," *Proceedings of the Ninth International Joint Conference on Computer Science and Software Engineering (JCSSE)*, pp. 28-32.
- Pavlou, P.A., Liang, H. and Xue, Y. (2007). "Understanding and Mitigating Uncertainty in Online Exchange Relationships: A Principal-Agent Perspective," *MIS Quarterly*, 31(1), pp. 105-136.
- Phones Developers (2014a), "The Future, Somatosensory Technology to the Force," Retrieved from <http://www.phonesdevelopers.com/1747483/> on August 19, 2014.
- Phones Developers (2014b), "Somatosensory Technology on a Mobile Platform," Retrieved from <http://www.phonesdevelopers.com/1815102/> on August 24, 2014.
- Podsakoff, P.M., MacKenzie, S.B., Lee, J.Y. and Podsakoff, N.P. (2003). "Common Method Biases in Behavioral Research: A Critical Review of the Literature and Recommended Remedies," *Journal of Applied Psychology*, 88(5), pp. 879-903.
- Ramakrishnan, R., Ramanathan, U. and Ko, L.W.L. (2014). "Adoption of RFID Technologies in UK Logistics: Moderating Roles of Size, Barcode Experience and Government Support," *Expert Systems with Applications*, 41(1), pp. 230-236.
- Rogers, E. M. (1983). *Diffusion of Innovations*. (3rd ed.). New York: The Free Press.
- Rosa, G.M. and Elizondo, M.L. (2014). "Use of Gesture User Interface as A Touchless Image Navigation System in Dental Surgery: Case Series Report," *Imaging Science in Dentistry*, 44(2), pp. 155-160.
- Shih, H.P. (2004). "An Empirical Study on Predicting User Acceptance of e-shopping on the Web," *Information & Management*, 41(3), pp. 351-368.
- Singh, M., Balasubramanian, S.K. and Chakraborty, G. (2000). "A Comparative Analysis of Three Communication Formats: Advertising, Infomercial, and Direct Experience," *Journal of Advertising*, 29(4), pp. 59-75.
- Straub, D., Limayem, M. and Karahanna-Evaristo, E. (1995). "Measuring System Usage: Implications for IS Theory Testing," *Management Science*, 41(8), pp. 1328-1342.
- Sun, H. and Zhang, P. (2006). "Causal Relationships between Perceived Enjoyment and Perceived Ease of Use: An Alternative Approach," *Journal of the Association for Information Systems*, 7(9), pp. 618-645.

- Szajna, B. (1996). "Empirical Evaluation of the Revised Technology Acceptance Model," *Management Science*, 42(1), pp. 85-92.
- Tan, J.H., Chao, C., Zawaideh, M., Roberts, A.C. and Kinney, T.B. (2013). "Informatics in Radiology: Developing a Touchless User Interface for Intraoperative Image Control during Interventional Radiology Procedures," *RadioGraphics*, 33(2), pp. E61-E70.
- Teo, T.S.H., Lim, V.K.G. and Lai, R.Y.C. (1999). "Intrinsic and Extrinsic Motivation in Internet Usage," *Omega: The International Journal of Management Science*, 27(1), pp. 25-37.
- Thompson, D.V., Hamilton, R.W. and Rust, R.T. (2005). "Feature Fatigue: When Product Capabilities Become Too Much of a Good Thing," *Journal of Marketing Research*, 42(4), pp. 431-442.
- Thompson, R.L., Higgins, C.A. and Howell, J.M. (1991). "Personal Computing: Toward a Conceptual Model of Utilization," *MIS Quarterly*, 15(1), pp. 125-143.
- van Mulken, M., le Pair, R. and Forceville, C. (2010). "The Impact of Perceived Complexity, Deviation and Comprehension on the Appreciation of Visual Metaphor in Advertising across Three European Countries," *Journal of Pragmatics*, 42(12), pp. 3418-3430.
- Venkatesh, V. (2000). "Determinants of Perceived Ease of Use: Integrating Control, Intrinsic Motivation, and Emotion into the Technology Acceptance Model," *Information Systems Research*, 11(4), pp. 342-365.
- Venkatesh, V., Morris, M.G., Davis, G.B. and Davis, F.D. (2003). "User Acceptance of Information Technology: Toward a Unified View," *MIS Quarterly*, 27(3), pp. 425-478.
- Walczuch, R., Lemmink, J. and Streukens, S. (2007). "The effect of service employees' technology readiness on technology acceptance," *Information & Management*, 44(2), pp. 206-215.
- Wright, A.A. and Lynch, J.G.Jr. (1995). "Communication Effects of Advertising Versus Direct Experience When Both Search and Experience Attributes are Present," *Journal of Consumer Research*, 21(4), pp. 708-718.
- Wu, W.W. (2011). "Developing an Explorative Model for SaaS Adoption," *Expert Systems with Applications*, 38(12), pp. 15057-15064.
- Wu, J. and Holsapple, C. (2014). "Imaginal and Emotional Experiences in Pleasure-Oriented IT Usage: A Hedonic Consumption Perspective," *Information & Management*, 51(1), pp. 80-92.
- Wu, J. and Lu, X. (2013). "Effects of Extrinsic and Intrinsic Motivators on Using Utilitarian, Hedonic, and Dual-Purposed Information Systems: A Meta-analysis," *Journal of the Association for Information Systems*, 14(3), pp. 153-191.
- Wu, P.F., Huang, M.J. and Chang, N.W. (2013). "The Learning Experience of Fine Art by Somatosensory Game Device," *Proceedings of the Fifth International Conference on Service Science and Innovation (ICSSI)*, pp. 108-114.
- Wu, Q., Li, X.R. and Wu, G.S. (2014). "Interface Design for Somatosensory Interaction," in Marcus, A. (ed.) *DUXU*, Springer International Publishing Switzerland: Lecture Notes in Computer Science 8518, pp. 794-801.
- Yu, J., Ha, I., Choi, M. and Rho, J. (2005). "Extending the TAM for a t-commerce," *Information & Management*, 42(7), pp. 965-976.
- Zhou, T. (2013). "Understanding the Effect of Flow On User Adoption Of Mobile

Games,” *Personal Ubiquitous Computing*, 17(4), pp. 741-748.

## Appendix

1. Perceived ease of use (1=strongly disagree; 7=strongly agree)

Item 1: Learning to operate the touchless system will be easy for the users.

Item 2: User will find it easy to get the touchless system to do what they want it to do.

Item 3: Users' interaction with the touchless system will be clear and understandable.

Item 4: User will find the touchless system to be flexible to interact with.

Item 5: It will be easy for users to become skilful at using the touchless system.

Item 6: User will find the touchless system easy to use.

2. Perceived usefulness (1=strongly disagree; 7=strongly agree)

Item 1: Using the touchless system would enable users to access home edutainment more quickly.

Item 2: Using the touchless system would enable users to access home control system more quickly.

Item 3: Using the touchless system would improve users' life.

Item 4: Users would find the touchless system useful in their life.

3. Perceived complexity (1=strongly disagree; 7=strongly agree)

Item 1: The touchless system takes too much time to use.

Item 2: The touchless system is so complex, it is difficult to understand what is going on.

Item 3: Using the touchless system involves too much time doing hand movement and palm-close gestures.

Item 4: It takes too long to learn how to use the touchless system to make it worth the effort.

4. Perceived enjoyment (1=strongly disagree; 7=strongly agree)

Item 1: Users will find using the touchless system to be enjoyable.

Item 2: The actual process of using the touchless system will be pleasant.

Item 3: Users will have fun using the touchless system.

5. Behavioral intention to use touchless system (1=strongly disagree; 7=strongly agree)

If the touchless system becomes available:

Item 1: I intend to use a touchless system at home.

Item 2: It is likely that the touchless system will be the medium I use at home.

Item 3: I predict I would use a touchless system at home.

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