Connected Homes and Online Retail: The Case of IoT Enabled Online Shopping

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Abstract

The emergence of the Internet of Things (IoT) is an important technology breakthrough with the potential to transform our lives. In this paper, we consider the connected home application domain of the IoT from an online retail perspective and explore factors that may affect a consumer’s behavioral intention to adopt IoT enabled online shopping (IoTOS) artifacts such as Amazon’s Dash Wand and the Google Home smart speaker. Based on the existing body of knowledge in the Information Systems (IS) field, we identify key factors including security concerns (composed of data confidentiality concerns and information privacy concerns), performance expectancy, effort expectancy, facilitating conditions, and price value, as determinants of an individual’s behavioral intention to use IoTOS artifacts. In doing so, we provide both a foundation for future research pertaining to consumer adoption of connected home innovations as well as offer insights that may help shape such innovations and their associated services.

Keywords

Internet of things (IoT), connected home, consumer, online retail, technology adoption, UTAUT2.

Introduction

The Internet of Things (IoT) promises to revolutionize various aspects of our lives and is supposed to be fundamentally different from the bulk of information technologies that we have experienced so far. Although there is as yet no universally accepted definition for the IoT, it may be thought of as the omnipresence of uniquely addressable smart things, which are able to communicate and cooperate with each other and with humans (Atzori et al., 2010; Gubbi et al., 2013; Miorandi et al., 2012).

A major application domain of the IoT is the Connected (or Smart) Home, which focusses on improving the quality of life of a home’s inhabitants by enhancing their comfort, convenience, and safety. It also includes efforts to optimize the consumption of various resources such as electricity in a home (Gubbi et al., 2013; Kellmereit and Obodovski, 2013; Miorandi et al., 2012). A survey by the World Economic Forum indicates that by 2025, connected appliances and devices would constitute over 50 percent of the Internet traffic delivered to homes (Schwab, 2016). In this scenario, we can expect almost all electrical appliances in homes to be interconnected, and in many cases, to act independently of human intervention and/or supervision (DHL, 2014; Kellmereit and Obodovski, 2013).

In this paper, we focus on the connected home application domain in general and specifically on what we classify as IoT enabled online shopping (IoTOS) artifacts, which provide consumers with an alternative to using their laptops, smartphones, or tablets when shopping online for products from their homes. The Alexa Echo, Dash Button, and Dash Wand from Amazon.com, the Google Home smart speaker, as well as the latest ‘smart’ refrigerators from LG and Samsung, all leverage existing Wi-Fi based Internet connectivity in homes to provide consumers with a new way of shopping online.
A study of behavioral intention with respect to the use of such IoTOS artifacts has the potential to provide key insights into consumer adoption of such innovations. Therefore, we seek to address the following research question:

**RQ**: What are the key factors that are likely to affect consumers’ intentions to use IoT enabled online shopping (IoTOS) artifacts?

Following this introduction, we provide a background by reviewing the relevant literature. Next, we present our conceptual model and hypotheses, followed by the proposed research methodology and conclusion sections.

**Background**

When considering the factors that may affect consumers’ adoption of IoTOS artifacts, the existing technology adoption literature in the Information Systems (IS) field becomes a useful guide. As identified by Venkatesh et al. (2007), this stream of research gained prominence after the introduction of the technology adoption model (TAM) (Davis, 1989; Davis et al., 1989) and later proliferated in various ways. This led to the introduction of a unified model, namely the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003). The diffusion of Information Technology (IT) outside the workplace coupled with its evolution from being predominantly PC based into myriad forms however, necessitated an extension of UTAUT to study the acceptance and use of technology in a consumer context. This extension, known as UTAUT2 (Venkatesh et al., 2012), added three constructs, namely hedonic motivation, price value, and habit to UTAUT.

Considered at a higher level, the IoT ecosystem may be broadly divided into three main parts (Gubbi et al., 2013; Kellmerek and Obodovski, 2013), namely data acquisition, data transport, and data analysis. In the connected home application domain, the data analysis part of the IoT ecosystem becomes very important as key insights into consumer behavior may be derived from the massive amounts of heterogeneous data collected from users of smart appliances (DHL, 2014; Kellmerek and Obodovski, 2013). This allows manufacturers and/or online retailers to engage in targeted advertising, provide better after sales service, and come up with new and innovative products and services. At the same time, this data collection raises some security concerns. Figure 1 presents an outline of the IoT ecosystem in an IoTOS context.

![Figure 1. IoT Ecosystem for Online Shopping](image)

In terms of human interaction with IoTOS artifacts, voice sensing may provide an intuitive solution (Hui et al., 2017). The Alexa Echo, Dash Wand, and Google Home smart speaker all support voice-based interaction with their respective conversational assistants (CAs). Indeed, the fact that the back-end processing of voice-based interaction with these CAs is done on the respective vendor’s cloud may increase users’ security concerns (Saffarizadeh et al., 2017).

**Conceptual Model and Hypotheses**

In preparing our conceptual model (shown in Figure 2), we modified the framework provided by UTAUT2 (Venkatesh et al., 2012). We focus on the behavioral intention of potential users since IoTOS artifacts such as the Dash Button and Dash Wand, though increasingly popular (Fortune, 2017), still represent a very small portion of (online) retail.
Although the root constructs of some factors (independent variables) in the UTAUT2 (Venkatesh et al., 2012) framework have been criticized in the past (Benbasat & Barki, 2007), we believe that when adapted to a novel context using appropriate constructs (Alaid & Zhou, 2017), the UTAUT (Venkatesh et al., 2003) and its extension UTAUT2 (Venkatesh et al., 2012) offer a robust framework for understanding (consumer) adoption of technology.

Data confidentiality concerns in our model are an extension of the information security construct used by Pavlou et al. (2007), who in a B2C e-commerce context had found that both information security and information privacy concerns lead to higher perceived uncertainty for buyers. Data confidentiality concerns may be defined as a consumer’s beliefs regarding an online retailer's inability and unwillingness to safeguard consumers' monetary, biometric, and other identifying information from unauthorized access and modification during transmission and storage (Miorandi et al., 2012; Pavlou et al., 2007). This leads us to our first hypothesis:

**H1a:** Data confidentiality concerns negatively influence behavioral intention to use IoTOS artifacts.

Information privacy concerns may be defined as a consumer’s beliefs regarding an online retailer's inability and unwillingness to protect his or her personal information from improper use, disclosure to third parties, and secondary use without the consumer’s consent (Pavlou et al., 2007). Here, we acknowledge the personalization privacy paradox (Awad & Krishnan, 2006) due to which firms are advised to focus on less privacy conscious consumers, who are more willing to share their personal information to access personalized services. This is perhaps not directly applicable in an IoTOS context. For instance, consumers who are comfortable sharing other personal information using a PC may not feel comfortable in sharing their voice recordings via an IoTOS artifact. Thus, we posit part two of our first hypothesis:

**H1b:** Information privacy concerns negatively influence behavioral intention to use IoTOS artifacts.

Performance expectancy is one of the strongest predictors of technology adoption (Alaid & Zhou, 2017; Venkatesh et al., 2003; Venkatesh et al., 2012). We define it here as a consumer’s beliefs that using IoTOS
artifacts will allow him or her to shop online for their favorite products much more efficiently. Thus, we posit our second hypothesis:

**H2**: Performance expectancy will positively influence behavioral intention to use IoTOS artifacts.

Effort expectancy on the other hand, relates to the ease of using a system (Venkatesh et al., 2003; Venkatesh et al., 2012) and is very important in a consumer context. We define it here as a consumer’s beliefs that using IoTOS artifacts will allow him or her to shop online for their favorite products in a convenient manner, and present our third hypothesis:

**H3**: Effort expectancy will positively influence behavioral intention to use IoTOS artifacts.

Facilitating conditions were hypothesized to predict behavioral intention by Venkatesh et al. (2012), who found that they have a positive effect on consumer technology adoption. We believe that facilitating conditions (provided by an online retailer) will be important in determining consumers’ behavioral intentions towards IoTOS artifacts, and present our fourth hypothesis:

**H4**: Facilitating conditions will positively influence behavioral intention to use IoTOS artifacts.

The price of a given technology and its ongoing financial commitments are important considerations for most consumers. Here, we consider price value for an IoTOS artifact to be positive when its benefits are perceived to be greater than its associated costs, and a positive price value has a positive influence on behavioral intention (Venkatesh et al., 2012). Thus, we reach our fifth hypothesis:

**H5**: Price value will positively influence behavioral intention to use IoTOS artifacts.

Previous technology adoption research has also shown that age and gender can play a significant role in determining behavioral intention (Venkatesh et al., 2003; Venkatesh et al., 2012). Therefore, we include age and gender as control variables in our model.

**Proposed Research Methodology**

We will begin by interviewing existing users of IoTOS artifacts who have used their device to shop online. Based on the findings from these interviews, we will refine our conceptual model, which will then be validated via an online survey. Our population of interest is all likely users of IoTOS artifacts in the United States (U.S.). As per the results of a recent Pew Research Center report (Pew Research Center, 2016) and the nature of IoTOS artifacts, we feel that this includes repeat online shoppers between the ages of 18 and 64. Accordingly, we will survey a panel of repeat online shoppers who have made at least two purchases online in the last year. We will consider two IoTOS artifacts as exemplars in this study, namely the Dash Wand and the Google Home smart speaker to allow for a comparison of results. Due to our focus on behavioral intention, we will preclude any current users of our exemplar IoTOS artifacts from this survey. The respondents will be (randomly) assigned to an exemplar IoTOS artifact and will be given a description of its capabilities. They will also be asked to click on a link and visit the webpage for their IoTOS artifact. Only when the respondent has clicked on this link will they be allowed to proceed with the survey.

**Conclusion**

The emergence of the Internet of Things (IoT) will most likely have a profound impact on our lives. In this paper, we focus on IoT enabled online shopping (IoTOS) artifacts, which allow consumers to shop online from their homes without having to use their laptops, smartphones, or tablets. A study of behavioral intention with respect to the adoption of such IoTOS artifacts can provide key insights into the factors that affect consumer adoption of such innovations. Towards this goal, we have presented a conceptual model which incorporates key factors that may affect an individual’s behavioral intention to use IoTOS artifacts.

In conclusion, we would like to reiterate the importance of studying individuals’ behavioral intention towards using IoTOS artifacts. Greater understanding in this context would not only provide a foundation for future research in this area but could also help shape such innovations and their associated services.
REFERENCES


