

How to Study Home Users

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Abstract

Emerging home technologies should be directed to address latent user needs instead of mere technological pushes. The low product usability-level and unmet expectations in home environment indicate a growing need of understanding home users better. This paper surveys and discusses various methodologies of user study that would be helpful towards creating a better home networking.

In addition to describing some common characteristics of a modern home network, this paper investigates three good examples of user study in different research scenarios. As approaches for user study are usually designed according to context, requirements and limitations, this paper does not compare between the various methodologies. Instead of listing the pros and cons, this paper discusses other aspects that should be considered while devising a study approach. On the basis of this paper, constructive ideas relevant to specific home user requirement and user study can be outlined.

KEYWORDS: User Study, Home Network, Usability, User Experience

1 Introduction

The advent of broadband infrastructure has opened up the lucrative home technology market to the major Information and Communications Technology (ICT) companies. A trend of technological shifting from work to domestic environment has been observed for more than a decade from now, in [1]. Apart from broadband Internet access, today, home users are presented with sophisticated technologies ranging from online gaming and file-sharing to digital multimedia systems and the concept of the intelligent home. Rather than serving the actual need of home users, extravagance in home networks unfortunately appears to be a phenomenon of technological push and rat-race between main industrial players.

Home users often suffer from having to adapt to various home technologies which are not designed with usability considerations. Incomprehensible terminology, unattractive user manuals and complexity of system maintenance, have often left users puzzled and frustrated. In addition, a lack of ICT awareness, coupled with a great variety of similar products, causes home users to be frequently misled by advertisement or incomplete information.

On top of an absence of efficient communication between home users and technology providers, users themselves do not always understand what they need and what they are being offered with. Hence, usability studies are deemed important to communicate user requirements and expectations, to promote user-oriented design, and last but not least, to help sustaining healthy technology advancement.

To quote a security guru, Professor Eugene Spafford at Purdue University, "*Using encryption on the Internet is the equivalent of arranging an armored car to deliver credit card information from someone living in a cardboard box to someone living on a park bench*", usability is the central aspect of computer security. Similarly, sophisticated home technology may not be useful without taking usability into account.

A comprehensive study of home users is necessary to lead technological advancement based on actual user needs and requirements, rather than blind technology pushes [2]. In addition, studying home users also helps to avoid *broken expectation*, which is described as a mismatch between what a user expects and specific device capabilities, in [3].

How to study home users? It is indeed challenging knowing the complexity of human behaviours and lack of ICT knowledge among home users. This paper surveys and discusses various methodologies of user study with an objective to develop *double expertise*, a desirable skill as both an IT expert and a usability practitioner.

This paper also addresses home users from various backgrounds as conventional usability researches had mainly targeted the more affluent above average middle class. In addition, this paper is motivated to include some interesting usability concepts such as co-experience and user experience prediction, as described in [4] and [5] respectively.

After a brief introduction to address the growing need of studying home users, section 2 describes some characteristics of modern home networks in order to better understand our subject of study. Subsequently, section 3 investigates 3 example approaches used to study home users in different research scenarios. Lastly, before the conclusions, section 4 discusses some constructive ideas towards devising a better study strategy and hence creating a better home network.

2 Understanding Home Users

Prior to devising a study approach, it is necessary to have a good understanding of the subject of study in order to obtain fruitful study results. The following subsections outline some characteristics of home network from the aspects of home technology, user behaviour, expectation and experience.

2.1 Home Technology

Induced by the rapid development of ICT, complexity of home networks is ever increasing. Technological pushes have brought advanced products which once belonged to corporate, military or research institutes to the domestic environment. A lack of knowledge and training, coupled with usual low product usability, home users are often left puzzled and tired of the enormous effort involved in setting up, using and maintaining a specific system.

Home network technologies include the broadband Internet access, audio and visual system with network connectivity, home office as well as network printing and file sharing services. Concepts of advanced home network indeed represent only a small number of the more affluent households. Nevertheless, one could positively assume that the trend to embrace home technologies would continue to grow, including in the developing countries where ICT is a highly regarded economic factor.

Apart from the conventional setup, modern technologies for home networking have brought forward interesting ideas to make life easier, for example by providing the flexibility to program a video recorder via a web based television guide. Advanced technologies have also aimed to make life more efficient by delegating the daily routines to some intelligent tools, such as a remote heating control system and a fridge which keeps track of food supplies. Also described in [2] is an atmosphere controller which uses music, lighting and wall projection to enhance home experience.

Smart home especially ambient intelligence [8], which integrates itself seamlessly into user's daily life, is also an exciting development for futuristic home networking. On the other hand, ongoing research of Interconnected Broadband Home Networks (InHoNets)[14], which focuses on wireless broadband connectivity to the Internet backbone and between several home networks, in a reliable and secure manner, is an example of a more practical and user-centric project.

2.2 Behaviour at Home

Home networking is a challenging environment as home users are generally not equipped with ICT expertise. However, in many cases, teenagers have been given the responsibilities to take care of the computing systems at home as they are considered to have better exposure to modern technologies. A false assumption that most teenagers would be interested with the work of technical

setup, administration and troubleshooting has sometimes led to the scenario where teenagers become full-time unpaid tech supports at home, as mentioned in [3].

While it is unfortunately true that most home users are lack of security awareness, attitude towards trust and privacy protection is dependent on cultural background and society norms. For example, collectivism in Indian society has created a better trust among each other and therefore led to a less vigilant attitude for online privacy management [9]. Similarly, setup of wireless network without proper authentication mechanisms may not be yet another example of careless mistake or ignorance by home users. It could be a thoughtful act to share the wireless connectivity within the neighbourhood, in the name of *neighbourliness*[7].

Collaboration and individualism within the home network are also interesting aspects for further investigations. Probing into the relationship between family members and recognizing the need for individual privacy will provide a better understanding of the requirements for designing an ideal home network. By knowing the common behaviours within a family, we will be able to devise a better strategy to study the home users as a whole.

2.3 Expectation and Experience

Besides behavioural characteristics, understanding the expected of home experience is also an important corner stone to study home users. Rather than blind technology pushes, home technology should be developed by examining the latent user needs and requirements for better experience at home.

An example given in [2] clearly depicts the difference between an enhanced user experience and a suitable home experience: *"For many people who dream to visit Disneyland, there are few who would actually like to live there"*. In addition, when devising a method to study the home users, it is also necessary to consider the duration of user experience and to ask whether short laboratory tests will suffice to reflect actual day-by-day user experience.

An investigation by [3] has concluded that user disappointments against products are not usually due to broken software or broken hardware. A lack of knowledge about consumer, a lack of clarity about product literature and instruction, as well as conflicting use cases and requirements assumed by consumers are in actuality the possible factors to a *broken expectation* among home users. The mismatch between user expectation and actual product features is usually not anticipated by most out-of-box usability testing today.

Instead of individual satisfaction, model of user experience should also be expanded to fulfill *co-experience* as defined in [4]. Relevant to home environment, co-experience which is created through social interaction, creates interesting usage contexts in an impromptu and creative manner. While it is difficult to draw an exact line between individual

and social experience, co-experience should be considered when defining strategies to study home users.

3 Methodologies of Study

A good approach of usability study involves combinatory efforts from multiple disciplines including human psychology, social science, consumerism, art and design, as well as, engineering and computer science. Given a variety of techniques for usability study, the choice of a suitable combinatory strategy is indeed context-dependent. Focus on home networking, the following presents 3 interesting example approaches to study home users.

3.1 Scenario Driven Quantitative Evaluation, Structured and Open Ended Discussion

Described in [8], the authors applied a scenario-driven approach with quantitative and qualitative methods to elicit feedback on concepts of intelligent home environments. Four scenarios which envisioned ambient intelligence to assist home users seamlessly in daily activities, have been devised. The fictitious scenarios were namely "being following by multimedia content", "playing game with permission control", "home caring like automatic door opening and dishwashing" and lastly "online privacy management".

Approach:

The scenarios were designed to draw feedback from participants using quantitative and qualitative methods, in 3 phases as follow:

1. First, the participants were given a short introduction and presented with visualizations of various elements of ambient intelligence. A quantitative rating on the desirability of each element respective to each scenario was then conducted.
2. Next, the participants were further introduced to the elements of ambient intelligence through poster presentation and story telling. The authors conducted a structured-focus group discussion to address specific issues respective to each scenario.
3. Finally, the participants participated in an open-ended discussion to give feedback with regard to other user expectations and requirement on an ideal intelligent home.

Participant Selection:

55 participants with higher education (upper-middle class) were selected to participate in the evaluation. As an empirical cross-cultural study, the evaluation took place at 6 different sites in Spain, France, Italy, Germany and the Netherlands.

Length of Study:

The evaluation process took about 4 hours at each site.

Result:

Each evaluation phase showed complementary results.

Specifically, quantitative evaluation revealed that maintaining control and responsibility, such as asking for parental permission regarding entertainment, gaming and information provision for kids, is the most desired characteristics of ambient intelligence. Meanwhile, the structured-focus and open-ended discussions identified general concerns over a loss of control, a lack of security, an increased isolation, an induction of laziness and etc. The participants also stated that a smart system should be maintenance-free, not involving programming, and at the same time, configurable.

From the wealth of suggestions and ideas, the authors have formulated a list of prioritized guidelines for designing ambient intelligence. They have also discovered that cultural differences across the sites did not affect the results of their study.

3.2 User Context Study and Laboratory User Acceptance Testing

Aimed to enhance home experience, Kuiper-Hoynig and Beusmans [2] have investigated the practicality of an atmosphere controller using music, lighting and wall projection. A main objective of their work was to find out whether an atmosphere controller will be a mere technological push or a latent user need.

Approach:

The authors devised a 2-step approach to research home experience in a living room and to study the relevance and usefulness of an atmosphere controller, as follow:

1. First, the approach started with a user context study consisting of two interviews that were conducted two weeks apart. In between the interviews, the participants were required to carry out some given homework. Knowing that people often tend to fabricate answers and are driven by the willingness to cooperate, the authors aimed to obtain honest and well-thought responses from the participants.

The authors hoped to trigger the thoughts about experiences with an atmosphere controller from the first interview. The participants were then given some homework which included keeping track of mood and changes in the living room, drawing mind maps about activities in the living room, as well as, illustrating one of the activities by making a collage from stimulus materials. The authors have employed interesting materials such as photos, magazine cuttings as well as abstract cards to represent senses of colour, smell and sound. During the two weeks, the authors have also regularly sent post cards with special assignments and creative ideas to the participants, besides reminding them about the homework.

Designing the homework with rich media content, the authors hoped to induce consciousness about participants' own behaviours and to stimulate communication of thoughts during the second interview.

- Next, using the results of contextual study, the authors constructed a prototype of atmosphere controller and invited the same participants for a laboratory user acceptance testing. The participants were asked to create a specific atmosphere without and with the prototype atmosphere controller. Half of the participants were provided with a list initial default settings, while the other half had to create an atmosphere from scratch.

Participant Selection: 6 couples participated in the study.

Length of Study: 2 weeks.

Result:

After some acquaintance with the atmosphere controller, participants appreciated the enhanced experience in their living room especially with the flexibility of personalizing the control settings. The atmosphere controller also triggered off social experience as the participants would like to impress their friends with the technology. In general, the participants have shown great interests with the controller, with minor concerns over the cost and possibility of getting bored with it later.

The combination of a stimulating user context study and laboratory acceptance testing has appeared to be a good strategy to study home users. Yet, the authors have humbly mentioned the limitations and possible improvements to their approach. They recognized however great a user experience might be, home technology should be designed to fit into daily activities according to the expected home experience. They have also suggested deploying the prototype controller in a holiday home or hotel to study the desirability of the controller over a longer period of usage.

3.3 Inventory Listing, Network Sketching and Guided Home Tour

In [7], the authors studied how usage, setup and maintenance of complex home networks including audio and visual systems have been coordinated at home. Studying such coordination have led to observations of some interesting phenomena.

Approach:

The study consisted of 4 activities, as follow:

- First, the participants were asked to produce an inventory of the technologies they have at home. Besides giving insights to the researchers, the inventory list was used to determine participants' home technological rating.
- Next, the researchers visited the participants at home for the subsequent three activities. The participants were requested to sketch three diagrams individually, i.e. the home network topology, the audio and visual system and the vision of an integrated home network.
- Then, the participants were required to give a guided home tour for visiting the locations of various compo-

nents in the home network. The tour was interrupted for discussions about purposes and possible problems of each component. The participants were also allowed to raise any questions they had concerning their assets to the researchers.

- Finally, the home tour was concluded with a short interview designed to review the above activities. The researchers have especially made use of the interview to question about other aspects of home network that were not visible or obvious through physical tour.

Participant Selection:

The participants were selected from the above average middle-class families. Participants must satisfy a qualifier which restricted the participation pool to homes that possessed a minimum of 2 computers that are connected to each other and to the Internet.

Length of Study:

The home visit i.e. step 2, 3 and 4 were documented to last about 2 to 3 hours.

Result:

The study has revealed the complexity of modern home networks. Efforts have been made by most participants to distinguish between personal and work sub-networks. At most premises, computers were labelled to belong to an individual, while audio and visual systems were treated as common assets. However, the study has discovered competition over the usage of iPod and TiVo may cause tension over individuality and commonality. Administration and troubleshooting work was also found to be unfairly assigned to the person with most networking knowledge at home. As such, knowledge and share of work between family members could differ greatly.

The paper also addressed the issue of device invisibility (as in physically hidden for aesthetic reasons) which exacerbated the low comprehensibility of networking knowledge among some family members. While an integrated solution may appear to be capable of reducing the maintenance and troubleshooting work, the authors warned that the desirability for integrated solutions may give rise of paradoxical integration issues of the already integrated products.

The authors were aware that their study may only represent one part of community i.e. the more affluent families. They suggested their work to be used as a good starting point for a larger empirical research study. Despite the limitation, their study has successfully surfaced key coordination problems in a home network.

4 Discussion

The three detailed studies have revealed various strategies to understand home users better. They are indeed well thought and organized to exhibit their own strengths in respective

context and research requirements. Instead of discussing the pros and cons, this section will focus on providing more constructive ideas that would be helpful when designing a study approach.

In [10], the authors discussed how role playing could considerably affect the results of study. Mentioning about security may also increase test participants' secure behaviour; this may not be desirable. Designing a realistic study environment is hence of foremost importance to reflect useful results. Approaches taken in [2] including the stimulating homework, distinction between a great experience and a home experience, as well as a meticulous consideration given to the necessity of a longer test, are indeed refreshing.

While designing a realistic test environment could be difficult, one could consider studying home users from multiple aspects simultaneously. In [11], the authors mentioned how using two recording cameras could help to study their participants in a kitchen more efficiently.

Participant selection is also one important factor to perfect a user study. As developing countries like China, India and South East Asia are advancing towards achieving ICT excellence, future home user study should consider involving representatives from the massive Asian populations. Although studying a more affluent group of people may represent a future market trend, cultural difference and social collectivism, as described in [9], could have a great influence on the user behaviours.

Choice of a study approach is also dependent on the specific target home technology. For example, to study the user experience with regard to the relatively new proactive technology at home, the authors have resolved to a constructive research by first building the devices and environments exhibiting proactive features, in [13]. Meanwhile, [6] has adopted a combination of cognitive walkthrough and laboratory user testing to study the usability and privacy management in P2P file sharing.

User study can also take an active approach to predict the user experience such as in setting up a technical product at home. In [5], Booth and Sorenson have created an Initial Experience Predictor (IEP) checklist tool to predict the initial experience with a digital media adapter. However, it is important to note that predicting user experience with a checklist tool depends greatly on the cooperation by the raters. Participant selection is indeed an important step to achieve fruitful results with any study approach.

5 Conclusions

By observing other people we can figure out what they really need for a good user interface, mentioned in [12]. When devising an approach to study home users, one could start with some intuitive ideas by observing the daily activities.

This paper has first described the common character-

istics of a modern home network from the aspects of home technology, user behaviour, expectation and experience. Three example user studies have been outlined. The approaches taken in the example studies include a scenario-driven quantitative evaluation, structured and open ended discussion, a user context study with laboratory user acceptance testing, as well as, inventory listing, network sketching and a guided home tour by the participants.

As approaches for user study are usually designed according to context, requirements and limitations, this paper does not compare between the various methodologies. Instead of listing the pros and cons, this paper discusses other aspects that should be considered while devising a study approach.

On the basis of this paper, constructive ideas relevant to specific home user requirement and user study can be outlined. Another important ingredient for a good study approach is the good intention to provide a better home network with the study results. Together with an intelligent choice of technique with regard to specific context, requirements and limitations, we will arrive at a fruitful approach to study home users.

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