# Sharing Smart Home Devices: From the perspective of AirBnB hosts

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## ABSTRACT

Sharing economy is an economic model where property or services are exchanged between people through internet. With the growing popularity of sharing economy, Airbnb has been the most prominent medium for sharing home-space. For this sharing, the owner of the home has to give access of their house to strangers from internet in a safe and secure way. The hosts would have to make sure that the guests enter the house and use different household facilities that exists in the house. AirBnB hosts are using smart home devices to provide this access and manage their property efficiently. Which is why we need to know the perspective of the hosts in this kind of usage of smart devices. To accomplish that, in this study, we will contact AirBnB hosts through the AirBnB website and conduct a pre-screening survey. If they mention that they use two or more devices at their property then we will schedule an interview with them to investigate the current situation of using smart home devices and the benefits, concerns and demands from their unique perspective. This research will allow us to understand the status quo of smart home device use in AirBnB.

### Author Keywords

AirBnB; Sharing Economy; Smart Home Devices; Internet of Things, Smart Home Devices Sharing.

### CCS Concepts

•**Human-centered computing** → **Human computer interaction (HCI);** User studies;

## INTRODUCTION

People are using sharing economy model for sharing different types of assets or services. For example: Turo[1] for car-sharing, Uber for ride sharing, AirBnB[2], Vrbo[3], Homeaway[4], Flipkey[5] for home-space , Vertoe[6] for storage space etc. Airbnb has been the most prominent sharing economy medium for sharing properties or living space [7]. While it is only 12 years old, according to their press release, it already has more than 7 million listings worldwide, covering more than 100 thousand cities in 191 countries [8].

In AirBnB, people sign up as host on the AirBnB website and advertise their under-used home or room for renting. Guests can find out these home-spaces through the website and can opt to rent them. Here, hosts are renting their house to strangers whom they know only through the website and previous research by Daniel Guttentag [9] shows that they have trust issues for each other. But for the transaction to go through, the hosts would have to give access to their home to these strangers in a safe and secure way.

To do this, AirBnB hosts are installing smart home devices on their property, which are internet connected computing devices (e.g. Google Home, Alexa devices, Smart light, Smart Lock, Smart Doorbell etc) used at home for better maintenance of systems, monitoring or entertainment purposes. Use of these devices are getting so popular that some manufacturers are even developing products just for AirBnB hosts[10]. According to International Data Corporation (IDC), almost 833 million smart home devices have been shipped globally just this year alone [11].

From previous research, we understand how smart devices are used and shared in a close trusted circle like family members[12], visiting relatives [13], roommates [14], children [15] [16]. etc. But we need to understand how it plays out outside of the trusted circle and what requirements it has in this scenario. For example, even though AirBnB has rules for all kinds of recording devices including security cameras [17], the guest might not trust the owner with the data that he is collecting through smart home devices. On the other hand, the owner might not trust the guest with his own smart home devices. So, we aim to explore how Airbnb hosts are using smart home devices in their home. This study will provide a better understanding of the status quo of smart home device use at AirBnB and give application developers & device manufacturers design recommendations about this special use case.

Our research questions are:

- RQ1: What smart home devices are AirBnB hosts currently using on their properties and for what purpose?
- RQ2: What are the benefits and concerns of using smart home devices in AirBnB for the hosts?
- RQ3: What unique needs do AirBnB hosts have for managing and sharing access control to their smart home devices with AirBnB guests?

To answer the above questions, We will conduct a pre-screening survey and a follow up interviews. From the survey we will select hosts who have at least two smart home devices in their houses. We will interview selected hosts to know more about their use of smart home devices at their AirBnB property.

With this study, we will make the following contributions

- We will synthesize the current scenario of using smart home devices in AirBnB.
- We will know the requirements of the AirBnB hosts for using those smart home devices in their property.

## RELATED WORK

We begin by discussing the research that examines the intersection of sharing economy and AirBnB. Then we discuss research work that explores smart home access control and privacy policy. At last we talk about research that studies the smart home device use in AirBnB.

### The Sharing Economy and AirBNB

Airbnb is currently the most popular marketplace for sharing home-space. Few research have showed the economic impact of AirBnB on sharing economies [18] [19] to prove the importance of AirBnB in the financial sector. On the personal experience side, Lampinen et al. shows that Airbnb facilitates not only provides monetary advantages for hosts, it also provides social interaction [20] [7] and a chance to meet new people [21]. These research work have looked at the AirBnB phenomenon itself from financial and personal experience viewpoint. But as the hosts of these properties have started using smart home devices to manage them the consumer landscape for both the financial and the personal experience has changed considerably. Which is why, in this research work, we put emphasis on knowing how the hosts of AirBnB properties are using smart home devices and what are their concerns, benefits and needs from these devices.

### Smart Home Access Control and Privacy

As smart home devices are actually made for the consumption of multiple users and to be used inside a home, many research have found that they clearly do not address the need of all the stakeholders. He at al. [22] finds that most of these devices are designed just like a personal device. Where to give someone else access to the device you will have to share your login credentials with them. You have to either share the device entirely or can not share it at all. There is no granular control of the sharing of access. They have found the need for supplementary access control options in these devices. In another research paper, Zeng et al. [23] found that smart home devices lack transparency and privacy features while most of the commercially available smart home devices provide elementary controls for security and privacy. While some systems do not provide any control at all [24]. Mazurek et al. [25] finds that even if the IoT system is designed to share in between users, the kind of access control it has is very much different from the kind of access control the user has in his/her mind. They also show that most of the time the user needs a complex access control policy and they try to achieve that by using makeshift methods. For domestic IoT devices, the access control decisions are especially complex because of the varied amount of data and the kind of trust users have between themselves [14]. Kostianinen et al. [26], tried to introduce an access control policy for smart home networks limited to family members which would pose a nominal amount of burden on the end-user by testing a few access control policies. All of this research clearly shows that, current state of smart home device access control is not suitable for multiple user scenario.

If someone still wants to share their device in a multi user scenario, Johnson et al. [13] and Kostiainen et al.[26] finds that giving guests access to your IoT device in a smart home and being specific with policies regarding the shared devices are important but can be a complex task . Few research studies [27] [23] show that the multi-user scenario can be perceived as a privacy and security concern to users. This concern exists because of the social relationships between the users and they can vary depending on the relationships such as guests [13], roommates [14], and children [15] [16]. Brush et al. [28] found that even when sharing IoT devices and sensors among neighbors can help increase the security of the neighborhood, the level of trust they have between themselves can interfere with this sharing. Providing users the information about the data being monitored by the sensors in a smart-home setting can help pacify the privacy concern and strengthen the trust they have, but at the same time it is perceived as being burdensome [29]. This collection of research clearly tells us that using a smart home device in a multi-user scenario is a complex task and the device manufacturers are not helping the cause that much.

There has been much research work done on use and sharing of smart home device inside a closed trusted circle. He et al. [22] discussed how sharing of IoT devices inside a home occurs among relationships and how they differ based on time of the day, scenarios, location of the device, etc. They also discussed ways to authenticate users so that the IoT devices stay secure while upholding the usability of the device . This work, however, does not discuss sharing and using of smart home devices with people living outside of their homes or with people the owner does not necessarily trust. An empirical study on 15 families done by Microsoft research [12] reveals that family members trust each other while keeping separate profiles on IoT devices. One of the reasons they do this is to block strangers with malicious intent. This is why it is highly desirable among users to have access-control policies based on time (for guests), special preventive measures for highly sensitive devices like cameras and locks, limiting of application's access to devices [30].

### Smart Home for AirBNB

Ur et al. [31] found that the access control system of popular IoT devices (that are used in Sharing economy), like the Kwikset door lock and Philips Hue lighting system is so isolated that it is useless in simple use cases where the user wants to share the devices with other users like the guest of the property temporarily. There is also a trust deficit for the smart home devices, because when the user is away from home, the access control of the home IoT devices has to be trustworthy enough to operate on their own [32]. This plays a major factor in deciding which smart home device to use while sharing the property with strangers.

Researchers like Ranzini Et al. [33] talks about privacy in sharing economy not exclusive to AirBnB.

Most of the prior research focus on the importance of trust and finding the elements which are essential for building trust between hosts and guests According to Botsman and Rotgers [7], trust between strangers is one of the four principles to succeed in collaborative consumption. As hosts and guests are normally strangers to each other, it exposes some trust issues among them [9] [34]. For example, hosts can be concerned whether guests are misusing their property while being tenant at their home as well as guests can worry about the their safety or assistance for exigencies during their stay [34]. To relieve these trust issues, AirBnB hosts are using smart home devices (like smart locks, smart cameras etc) at their property to manage them while AirBnB authorities are collaborating with smart home device manufacturers to bring in more smart devices in these properties [35]. Which is why, in this research paper, we put emphasis on knowing how AirBnB hosts are using their smart home devices and for what purposes.

## METHOD

Currently US is listed as AirBnB′s largest market in the world [36] and US contributes to the revenues from smart home devices most [37]. So US households are a good sources of studying if AirBnB hosts are using smart home devices in their home and if they are using, how they are those in their home. We aim to obtain qualitative data from our participants to perceive the current situation of using smart home appliances and sharing in some cases. For that reason, we will use two research methods- online survey and follow-up interview, for the user study. Online survey will be conducted as a pre screening step. As we do not know whether hosts are currently using smart home devices or not, this survey will help us to filter out the hosts who do not use those devices in home. From survey we will select a subset of AirBnB hosts currently using smart home appliances at home in some extent and arrange them for interviews. From interviews with participants, we will collect qualitative data about hosts' experience and demand on using smart home devices. We will conduct interviews with at least 10 participants for our study. Survey and interview questions are added as supplemental documents with the draft.

### Recruitment

To recruit participants for the online survey we have gathered contact information of AirBnB hosts from AirBnB website. We are inviting them through email for participating in our study. In the invitation we have described our study and purpose to them and encouraged to participate in the online survey. We will need 5-6 days to collect and process all responses from them. We have planned to contact at least 100 hosts of AirBnB. Two researchers will send emails and

### Pre-screening Survey

Our target population for the online survey is 100+ AirBnB hosts who will agree and give consent to participate in our study. Initially, we do not know if hosts are using smart home devices in their home or not. The survey intends to select AirBnB hosts who use smart home appliances and can give us more insight into using and sharing smart home devices in their home. Through this survey, we will also have an idea of the present scenario of usage of smart home devices in AirBnB homes. We will ask them whether they are using any smart home devices in their home, if yes, how many devices and which devices they are using. We will also ask them whether they want to share their experience about using those devices with us. We have designed the survey consisting of 7 questions. As per the complexity level of the questions, it will need at most 5 minutes for the questionnaire to be completed. The survey will be conducted via a google form. We will share the link of the form with the invitation email for our study. We have chosen short online survey for pre-screening so that we can reach out to large pool of AirBnB hosts within short time and hosts can respond quickly in their convenience. We will select a subset of participants based on their response and interests in using smart home devices.

### Follow up Interview

Participants who have at least two smart home devices installed in their homes and interested to participate in interview will be contacted for follow-up session. We will conduct follow-up interviews with each participants via phone call or skype. The interview will be semi-structured. Maximum time duration for each interview will be 20 minutes and interviews will be recorded via Google Voice. Each participant of a completed interview will be awarded a $10 Amazon gift card which will be sent to their email address.

In interview we will ask them which smart home devices they are using in their home, who have installed those and purpose of using those devices. Furthermore, we will ask for how long they are using those devices, whether they share any smart home devices with their guests to whom they rent their house through AirBnB. If they share any smart home devices, we will intend to know which smart home devices they have shared or want to share with guests, why they have shared those. Moreover, we will ask if there is any disadvantage or challenge in using or sharing those devices. Finally, we will ask them if they wish to have any specific share control feature in smart home devices for sharing or using those in AirBnB platform, if yes which feature it is and why do they want those. At last, we will ask them whether they want to share any particular experience of using or sharing those devices. From these interviews, we will be able to know about why they are using smart home devices, benefits of using smart home devices for them, whether they have any issue regarding using or sharing smart home devices with guests.

### Ethics

We have submitted necessary documents to Institutional Review Board (IRB) of our University *anonymized for review* to get our study approved. The IRB board has decided that we do not need approval for this study and can go ahead with the recruitment process. Documents related to the IRB submission (not anonymized) will be attached to this draft as supplemental material. Participants will have to be the age of 18+ and agreed to consent to participate in our study.

### Feasibility Analysis

We have already started contacting with AirBnB hosts through the website. After getting responses from them, we will process those and select participants for follow-up interviews

and contact with them.

| Steps | Start date | End date |
|---|---|---|
| Got positive feedback from IRB | | 7 Nov |
| Inviting to take the survey | 7 Nov | 10 Nov |
| Survey response processing | 11 Nov | 12 Nov |
| Conducting interview | 13 Nov | 16 Nov |
| Data Analysis | 16 Nov | 20 Nov |
| Presentation with initial data | 21 Nov | 21 Nov |
| Final revision | 21 Nov | 4 Dec |
| Final submission | | 5 Dec |

Table 1. Project time Management

Later, to conduct interviews with the selected participants it will require 4-5 days for two researchers. Table 1 contains our time management plan for the study. We have allocated 3 days for data analysis. Overall, in our estimation, about 3 weeks will be required to complete our data collection and analysis.

### Data Analysis

Questions of the online survey have been arranged in such a way that participants need a very short time to complete. Questions are mostly yes/no questions and we also asked if participants use any smart home devices in their home. Questions are kept closed ended so that answers can be analyzed easily. If participants don't use any smart home devices at their home, they wont get text field for putting email address. If participants use any smart home device, we will ask them if they want to participate in interview later by phone call or skype. If they want, they will get a text field in survey questionnaire to put their email address. After collecting all responses we will select participants for interview session via phone call or skype. We will choose 10 AirBnB hosts who use at least two smart home devices in their home as they will be able to contribute to our study adding valuable data from their experience. If we do not get enough participants for interview, we will contact with more hosts through website. In semi-structured interview, most of the questions are open ended so that users can share their experience and thoughts freely and we can add follow up questions if necessary based on their response. Follow up interviews will be recorded and we will transcribe recorded data and classify those according to categories e.g. advantages, challenges, requirements of using smart home devices, status of sharing devices with guests etc. Analyzing the qualitative data from participants response, we will be able to know how they are currently using smart home devices and what their needs are in the case of using or sharing access control.

## RESULT

As there is no existing study on how AirBnB hosts are using smart home devices in their home, we can not anticipate the number or reasons of using those in their home. We will present the findings from our user study and general findings of participants′ desired features and use cases. We will begin by exploring the situations which have encouraged participant hosts to use smart home devices and in some cases to share with almost stranger people. We will also know that which features of smart home they want to possess in the future for the context of home-space sharing. Some hosts can handle maintenance of their property with more ease and ensure security of their home with smart appliances. Again, they can provide better care and experience to their guests during their short or long term living as a tenant using some smart home devices. Participants can also provide some ideas for design principles for the access-control to mitigate harms, introducing more transparent methods about how sensitive devices can be used or overriding protections against illegal activities and harassment.

## CONCLUSION

This user study will give us an idea about the current situation of using smart home devices in the homes of AirBnB hosts. It will also let us know whether they face any challenge or have any requirement while using those devices, whether smart home devices are being shared with guests who are almost strangers to hosts. This study will pave the path to more research on the intersection of use of smart home devices and sharing economy.


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