

Planning for the Things You Can't Plan for: Lessons Learned from Deployments in the Home

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Understanding how people interact with technology in their homes has long been a topic of interest for researchers. Across HCI, researchers in digital health, sustainability, education, family, and privacy are fascinated by the human routines and everyday interactions that involve technology. As these researchers have found, deploying technology (e.g., technology that monitors devices or user behavior) in the homes of participants involves both careful planning and nimble adaptivity—from securing ethical approvals, to recruiting participants, to finally setting up in their homes. Researchers in this space may face unforeseeable scenarios despite meticulous planning, which is why it is important to share our experiences with one another.

In this article, we reflect on lessons learned through our own experience of conducting more than 20 technology deployments in participants' homes within the past two years. We shed light on challenges that we have encountered, offering solutions where applicable to enable researchers who are planning to deploy technology in participants' homes. It has been 10 years since *Interactions* touched on this topic [1], and the digital home has changed a lot since then. For example, batteries were once seen as power-hungry and inefficient [2], whereas just three years later they were noted as being more reliable than wired power in some cases [3]. We believe that documenting our experiences will benefit junior researchers who are conducting home deployments for the first time, allowing them to plan and think about the potentially unexpected. Even veterans who sit on ethics committees might benefit from reading our reflections, using them to probe future researchers into considering some of the more overlooked factors of entering people's homes for research.

As “digital plumbers” themselves, Tolmie et al. [4] recognize the problems of household deployments and have presented four design solutions that may aid researchers when deploying technology in the home. These include creating tools that support deployments and maintain study knowledge as research teams evolve over time. While we see these as extremely useful takeaways, we identify problems of home deployments that go beyond their technology-focused perspective.

Doyle et al. [5] offer advice to researchers to ensure that elderly participants feel comfortable and confident in having technology deployed in their homes. For example, they discuss providing a 24-hour helpline for participants to phone in case of technical issues and breakdowns, as well as utilizing swappable systems when doing repairs or replacing equipment in participants' homes to minimize disruption. We build on this advice and also provide insight into keeping researchers safe and comfortable while conducting household deployments.

In this article, we share and detail problem scenarios from our collective experience of household deployments across two research projects. Thirteen deployments were conducted by two researchers; eight were carried out by one researcher alone. The problems to consider fall into three themes: 1) equipment issues; 2) interaction with participants; and 3) practicalities. Drawing across these, we have compiled a checklist for researchers to consider before they begin studies involving deploying technology in the home. This is not an exhaustive list; it's intended to stimulate further discussion around preparing for research in the wild.

Equipment Issues

Technology downtimes. Nobody likes other people messing with their Internet connection. If you are deploying technical equipment in the homes of participants, consider if this can interfere with existing technology or connections. For some households, losing the Internet connection even momentarily can be a big inconvenience. For example, we were conducting a deployment for a participant who ran a business from home. Temporarily disconnecting them from the Internet to install a sensor on their router left them unable to speak to customers and business partners. Additionally, it can take time for the connection to be re-established after plugging in the router. Let the participant know beforehand if possible, and ask them to plan for potential outages. Perhaps you may not be deploying equipment that can interfere with the Internet connection—but can it interfere with anything else, such as a running DVR?

Swapping sensors. Looking through an appliance electricity dataset, you might rub your eyes at the sight of the TV, for example, producing 1800 watts in a short burst, twice a day. You swore you monitored the correct device—only to collect your equipment from the household to see your TV sensor is actually on the kettle instead. How can this be? It's important to consider who may be in participants' homes for the duration of the study—grandchildren might take an interest in swapping sensors around without grandma's knowledge! In fact, anyone external to the study may switch equipment off, move it around, or tamper with it. Visually intriguing equipment, such as flashing LEDs, can pose a choking hazard for pets and children [3] and entice curious little hands (and paws!). Mishaps like this are bound to happen with research in the wild and there is little you can do to prevent them. However, it may be worth asking participants at the start of the study to note any times and dates that devices were interfered with. You should also label your sensors with the names of the devices they are monitoring to help return them to their desired place if things get swapped, particularly if your study is looking at specific devices. Finally, it can also help to do a bit of data analysis prior to the last visit with a home, so that participants can help resolve any mysteries arising from unplanned sensor reconfiguration.

Participant Interaction

Researcher roles. Similar to when a plumber, electrician, or other tradesperson visits your home, you the researcher are the visitor that disrupts the day-to-day routine of the participants. This attracts attention and queries from participants and requires you to have different roles throughout the deployment, two of which recurred often for us: the *technical expert* and the *entertainer*. For the former, participants often watch what you are doing and ask questions along the way. While they observe your subset of technological skills, they sometimes begin to see you as the new IT guru: “Please can you help me remove a notification on my iPhone?” “Please can you fix my CD player?” As the participant is already helping you out by participating in your research, you may feel obligated to help them. For the role of the entertainer, friendly (yet distracting) encounters and conversations may develop with participants while you are trying to concentrate on deploying the equipment. Such meetings can involve young children within the household giving you one of their toys to exclaim at every 30 seconds—ignoring them would just seem cruel. Cats, dogs, and other pets may also be interested in your presence in the home, leading them to jump at you or stand on your equipment for attention; this is a particular difficulty for researchers with allergies. Like Goulden et al.’s recommendation for ensuring that both technical and social researchers attend in-the-wild studies for interdisciplinary work [6], we suggest that two or more team members are present when possible at household studies so that one researcher can focus on deploying the equipment while another can pay attention to the householders.

Power relationships. When deploying equipment in family homes, the presence of child-parent relationships and the power conflicts embedded within them become apparent. Parents like to know what their children are doing and ask for reassurance through the data collected within deployments. One mother asked us about her daughter’s extensive device and Internet use; this created a moral dilemma. While you are obligated to protect the privacy of all your participants (including children), guardians have a duty of care and therefore their concern is understandable. It is difficult to prepare for such inquisitiveness, particularly if guardians are persistent. However, fully informing the participants at the beginning of a study that no data will be shared or discussed with other inhabitants could help manage participant expectations. This would potentially head off confrontation if one particular participant does not want to share their data with other household members.

Deploying collaboratively. Having a participant invite you into their home to conduct your research requires a mutual level of trust—despite the fact that you may not have met before. Participants are going out on a limb: without necessarily knowing you, they trust you to be ethical, knowledgeable, and professional while in their homes and in your analysis of their data. From our experience, deployments worked best when participants and researchers worked together to set up deployments. When the researchers were accompanied by participants, it was easier to navigate different rooms and collectively identify devices and areas to monitor. In some cases, participants insisted that researchers

set up the sensor equipment unsupervised, on any device, in different rooms of their home. It can be quite uncomfortable, even with explicit consent, to have such freedom in a stranger's home—to enter unfamiliar rooms and touch personal possessions (if your deployment requires this). Naturally, it is important to ensure your deployment does not disrupt too much of the participant's day, but it is equally important to feel comfortable and confident in your surroundings when carrying out the deployment. It's crucial to note that participants may lack the time or capacity to accompany researchers while deploying equipment, but it may be worth discussing with the participant the prospect of their involvement before the deployment takes place. If it's really not possible to have the participant supervise the setup, just be extra careful and ask if you're not sure of something!

Practicalities

Getting there. You've done all the difficult preparation: You've found an exciting research idea; you've designed an extensive study to facilitate the idea; you've got the project ethically approved; you've built or programmed your hardware and software for deployment; and you've lined up the first household for study participation. But have you thought about how you are going to get your deployment equipment into the participants' home, alongside any extra items (e.g., multiway mains adaptor, a laptop for debugging) that you may need just in case? Such administrative thoughts hardly seem relevant when you're in your research bubble, yet without such considerations the deployment may not happen at all. Can you get your hardware onto public transport, or do you need to take a car? If you need to return to the participants' home with little notice, can you get there easily? Can you park nearby? Will it take multiple trips between the household and the vehicle to carry all your equipment inside? Can you prevent your equipment from getting wet if it's raining? These are just some of the situations you need to prepare for when doing household deployments.

Dangerous environments. Although your own home may be a safe haven, you may find the household of a participant to be a dangerous environment. Accessing particular technology or items within participants' homes may involve tricky maneuvers, such as crawling under furniture or leaning into tight spaces, that can lead to an injury. As silly as it sounds, even just walking around in a new, unfamiliar environment while maintaining core focus on the deployment can cause havoc; for example, by banging your head on low-hanging lamps and knocking into other furniture you're not used to being around. You need to consider your own health: For example, the participant may smoke or their furniture may be dusty; therefore you may want to bring any necessary medication. This is all assuming that going to the participant's house in the first place is safe! Lone studies may put yourself at risk by meeting an unfamiliar person (or people) in their private location. Ethics departments often insist that you perform a checking-in scheme (i.e. where you inform another member of the research team that you have arrived at, and departed from, a household), yet the location of participants' homes may not permit this if the mobile phone signal is poor or even

nonexistent. You may need to visit locations in advance to see if there is a phone signal, and, for extremely remote locations, ensure you take a colleague or rethink whether you can include this household in your study.

Accessing ICT. We are all familiar with tangled wires behind a TV stand or sofa, not knowing the cables for the television from the ancient stereo system you used once in the 90s. However, this can make it extremely difficult to identify which devices you are looking to monitor in households—in one household, we unknowingly monitored the wrong device. The tangled wires make it challenging to identify individual devices, and in some instances you may not realize your mistake until the end of the study. Many times, participants themselves cannot make sense of the tangle. Alongside this, it can also be a challenge to physically access the devices you wish to monitor, and may often involve moving heavy or delicate furniture to reach sockets and cables. It may be worth asking the participant to move furniture or fish out wires for you, if they are capable, just to be on the safe side.

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Pre-deployment Checklist:

1. Seriously consider what you will be tampering with during the deployment and try to mitigate any potential downtimes you may cause, particularly if it concerns something as important as a householder's electricity supply or Internet connection.
2. Involve the participants as much as possible in the deployment: Ask them to help move their furniture or belongings when you're deploying the equipment, and ask them to maintain a log for debugging in which they note any changes or thoughts that have involved the deployed equipment (e.g. to highlight if, when, and why sensors have been swapped). These small requests can make both the deployment and the data analysis easier while also ensuring the householders feel more involved.
3. Make sure more than one researcher is present for every deployment where possible. This will spread the burden of the technical and entertainment roles needed and guarantee safety in numbers.
4. Have the awkward, inevitable conversation with participants upfront (and make note of the outcomes) so that everyone has the same understanding of the boundaries to room access and that data will not be shared between household members.
5. Ask participants before arriving at their home about transport and parking within the area, and also the presence of other life forms in their home (e.g. children or pets). This will allow you to better prepare yourself for different household dynamics and additional, admin-level stresses to the deployment.
6. Drop by deployment locations prior to the study itself to determine your phone's signal strength or uncover any other unforeseen issues associated with the area. If there are issues, politely decline the household for the study—your safety is crucial.
7. Most important: Consider yourself. Think about any mental and physical health impacts of the deployment. Prepare for potential flare-ups or additional work and travel related

stress. Leave yourself enough time to plan, to travel, and to deal with unexpected queries or problems.

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Endnotes

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Insights

- Deploying research technology in the home raises tricky and unexpected scenarios. Plan for parking, transportation, poor phone signal, allergic reactions, your safety, dodgy data, and additional stress.
- If you are disrupting participants' technology, furniture, or household relationships with your deployment, collaborate with the household to mitigate any risks.

Image Captions

Image 1. Researcher deploying energy monitoring sensor behind a television in a home.

Image 2. Researcher deploying energy monitoring sensor behind an office desk in a home.

Image 3. Researcher setting up the monitoring of a router and logging machine in a home.

Image 4. The reality of in-the-wild setups.