The Challenges of Using an Existing Cross-Device Interaction Prototype for Supporting Actual Curation Practices

Frederik Brudy[1]
f.brudy@cs.ucl.ac.uk

Nicolai Marquardt[1]
n.marquardt@ucl.ac.uk

Yvonne Rogers[1]
y.rogers@ucl.ac.uk
[1]University College London
UCL Interaction Centre
Gower Street London, UK

Abigail Sellen[2]
asellen@microsoft.com

Kenton O'Hara[2]
keohar@microsoft.com
[2]Microsoft Research
Station Road
Cambridge, UK

Abstract
Volunteer-driven organisations curating historic documents, such as societies and charities, often work within a bring-your-own-device (BYOD) practice and their meetings are in varying situations. A recurring challenge is finding lightweight ways to enable them to share and collectively work with documents using their own devices while in situ. We are working on building novel interaction techniques and applications (prototyped with a custom developer toolkit) for supporting the curation of digital collections – for example, historic documents. We discuss the pros and cons of using an existing prototype system for this purpose and points to consider when taking a prototype from the lab into the wild.

Submitted to "Cross-Surface 2016, the second international workshop on interacting with multi-device ecologies 'in the wild'", co-located with the 2016 ACM Conference on Human Factors in Computing Systems (CHI 2016), San Jose, California, USA.

Author Keywords
Cross-device interactions; in-the-wild; bring-your-own-device; using existing frameworks.

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

Introduction
Within volunteer driven organisation, such as historic societies and charities, bring-your-own-device (BYOD) is a common practice. Working collaboratively in a group can help to reveal more connections between various resources during co-located meetings, and allows to bring together people with expertise from different backgrounds. However, collecting, analysing,

Figure 2: The general flow of items in CollectionsExplorer (top): photos can be moved across devices: all tablets share a digital canvas. Middle and bottom: All photos (in this case mainly photos of street signs) are placed on a virtual canvas that can be explored by moving the iPads on the table. Items can be moved, rotated, scaled and flicked between tablets.

creatively reworking, or sharing digital content as a group across a diverse ecology of devices is difficult: most devices work in isolation, not well supporting any collaborative collection, organization, or sharing activities. In recent years, researchers have produced several different frameworks for spatial tracking of people and devices, as well as supporting cross-device interactions (e.g. [4,5,7]). These frameworks were proposed for rapid development of (research) prototypes and were often mainly used to demonstrate a proof-of-concept in the lab. However, when taking such a tool out of the lab, in order to build a system to deploy in the wild, there are several challenges which need to be addressed. In particular rigidity is one of them: even prototype systems need to be more robust in-the-wild than when tested in controlled situations. Examples are changing environments (such as changing lighting conditions, or cluttered areas), people using applications in (slightly) different ways than what they were intended for, or users using a system for entirely different activities.

In our research we are interested in how co-located curation activities can be supported through cross-device interaction techniques. We are building a specialised developer toolkit, supporting in particular novel cross-device interactions within BYOD practices, collaborative content curation, and blending digital and physical artefacts.

CollectionsExplorer for collaborative curation activities

In order to support these small group collaborations we are developing *CollectionsExplorer*, a set of hardware and software tools that enable content curation [8] tasks to be facilitated when working with multiple tablet devices. However, rather than start from scratch we chose to build *CollectionsExplorer* using an existing platform that had been used for demo purposes beforehand. *CollectionsExplorer* was built on top of *HuddleLamp* [7], which is a technology developed to spatially track devices, providing a way of combining them into a larger surface. HuddleLamp uses a hybrid approach of a depth-sensing and an RGB-camera to identify and track tablets and phones on a table. We deployed *CollectionsExplorer* during informal pilot studies and as part of a workshop to various user groups. We observed how participants approached the system, adapting it to their needs – and adapting their own behaviour in order to avoid the pitfalls of the system.

CollectionsExplorer was built to enable photographic collections to be shared across multiple devices, allowing users to explore individual pictures as well as creating new collections out of existing ones. A user can browse collections of photos, zoom in, rotate, and move and flick individual pictures between multiple devices (Figure 2 top). Figure 2 shows how a user explores multiple picture collections on an iPad. Each collection is organized in stacks of images (Figure 2 middle), which can then be spatially arranged on a digital canvas shared by all connected devices (Figure 2 bottom). In the future, *CollectionsExplorer* will be extended to support other key curation activities (e.g., duplicating current states to take home, or different ways of presenting results) and additional interaction techniques supporting these tasks.

For the spatial tracking of the devices we are using an existing system [7], which requires the tablets to lay flat on a table. When the camera's field of view is clear

and not the lighting conditions are controlled, the tracking is stable and precise. However, as soon as people try to use the system outside of a controlled lab situation, using it in an everyday task or as part of their daily routine, new problems arise, e.g. tracking gets lost because of occlusion, lighting conditions change, or people adapt tools in ways that works best for them, not how the developer might have anticipated. Thorough testing is needed, in order to get the technical issues solved and to get the interaction techniques clear enough so that they do not break outside controlled situations.

For example in our case we have observed that when presented with *CollectionsExplorer*, people's first reaction was to pick up one of the tablets to have a closer look. However, since the camera-based tracking only works when the tablets are placed on a table, the system fails. Another issue arose, when people pointed to a specific photo, or reached for it to increase its size or to rotate it. With their arms reaching into the field of view of the camera, overhead tracking does not work properly. Both of this (not being able to pick up tablets and frequently lost tracking through occlusion) distracted participants from their main task. Instead of focusing on their primary task their main focus became how to avoid the system to fail, the technology itself got in the users' way. As a result, participants of the study refrained from further touching the tablets and relied on pointing to the tablets from afar, keeping a safe distance so that their arms did not occlude the camera. Some users reported to start thinking about the technical setup more than about their primary curation task.

Open questions for the workshop

When taking a new tool from the lab into the wild there are several challenges which need to be addressed. In the following they are split up into technical and social challenges.

Technical challenges

Setup and prerequisites. How can we enable cross-device interactions without the need for special devices or complicated setup mechanisms? In particular, for BYOD and walk-up-and-use situations the setup needs to be easy, quick, and allow people with varying technical knowledge to integrate their own and other devices. How should devices be best connected to a system? How should availability and execution of cross-device interactions be best communicated to a user?

Ubiquity and precision of spatial tracking. When employing spatial tracking, how can this tracking and the required devices be integrated in the surrounding? A precise spatial tracking often comes at a cost, e.g. the need for specialised hardware, markers, long setup procedures, etc. If less precise, these requirements could be reduced. However, this varies with the intended use case. We would like to see a discussion about the cost of precise spatial tracking vs. its benefit.

Rigidity for in-the-wild deployments. How does a research prototype need to be changed in order to be taken from the lab into the wild? For in-the-wild purposes they need to be robust, being able to be used in different scenarios than what they were intended for.

Mixed data and environment. To account for the rich nature of documents and the mixed settings of various tasks, a system should account for both, digital and non-digital content and allow to work in environments with cluttered work areas and noisy data. Deployments in the wild might happen in cluttered areas, much

unlike a controlled lab study, making possible issues unpredictable.

Social challenges

Communicating availability and ability. How are availability and interactions communicated to people in a walk-up-and-use situation? For example display blindness [6] and the honeypot effect [2] have been observed with public displays and could serve as a starting point for how those could be considered when designing cross-device interaction techniques.

Privacy and personal space. Going from the lab into the wild requires not only technical adjustments, but also careful considerations of other factors, e.g. when employing public displays, issues such as privacy [3], or personal spaces [1] and territories [9] need to be taken into account.

Control and feedback. Different social expectations and cultural backgrounds are further factors to be considered. For example, how much control should a person have over the tracking within a system and how much should the control be hidden and stay in the background?

Acknowledgments

This work is supported by Microsoft Research through its PhD Scholarship Programme.

References

[1] Altman, I. The environment and social behavior: privacy, personal space, territory, and crowding. 1975.

[2] Brignull, H. and Rogers, Y. Enticing people to interact with large public displays in public spaces. Proceedings of INTERACT, (2003).

[3] Brudy, F., Ledo, D., Greenberg, S., and Butz, A. Is Anyone Looking? Mitigating Shoulder Surfing on Public Displays through Awareness and Protection. ACM Press (2014), 1–6.

[4] Houben, S. and Marquardt, N. WatchConnect: A Toolkit for Prototyping Smartwatch-Centric Cross-Device Applications. ACM Press (2015), 1247–1256.

[5] Marquardt, N., Diaz-Marino, R., Boring, S., and Greenberg, S. The proximity toolkit: prototyping proxemic interactions in ubiquitous computing ecologies. Proceedings of the 24th annual ACM symposium on User interface software and technology, (2011), 315–326.

[6] Müller, J., Wilmsmann, D., Exeler, J., et al. Display blindness: The effect of expectations on attention towards digital signage. In Pervasive Computing. Springer, 2009, 1–8.

[7] Rädle, R., Jetter, H.-C., Marquardt, N., Reiterer, H., and Rogers, Y. HuddleLamp: Spatially-Aware Mobile Displays for Ad-hoc Around-the-Table Collaboration. Proceedings of the Ninth ACM International Conference on Interactive Tabletops and Surfaces (2014), 45–54.

[8] Rotman, D., Procita, K., Hansen, D., Sims Parr, C., and Preece, J. Supporting content curation communities: The case of the Encyclopedia of Life. Journal of the American Society for Information Science and Technology 63, 6 (2012), 1092–1107.

[9] Scott, S.D., Carpendale, M.S.T., and Inkpen, K.M. Territoriality in collaborative tabletop workspaces. Proceedings of the 2004 ACM conference on Computer supported cooperative work, ACM (2004), 294–303.