TouchCloud: An Exploratory Study in Physically Tagging the Cloud

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Abstract

This paper introduces TouchCloud, a service that allows users to connect files stored in the cloud to physical anchors in the environment. These links are enabled via NFC stickers sensed by a bespoke application available on both PCs and mobile devices. A one-month pilot study with four participants was conducted to understand how users react to this prototype. Data collected include questionnaires and self-reported tag use. The results suggest the service was positively received and effectively merged with, and augmented, existing cloud storage services.

Author Keywords

Tangible interaction; cloud storage; Dropbox; NFC

ACM Classification Keywords

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

Introduction & Related Work

Cloud computing is a powerful new paradigm that provides access to computing infrastructure through online services [5]. File storage is one of its early successes [1], as evidenced by the popularity of applications such as Dropbox, a tool that enables users to seamlessly host and access files on the Internet. Users report the benefits of cloud storage to include

Copyright is held by the author/owner(s). TEI 2014, Feb 16 – 19, 2014, Munich, Germany. cross-device availability, ease of sharing and automation of backup and recovery [4]. Indeed, reflecting the importance of such features, a 2008 report indicates that 69% of Internet users stored data online, with experts predicting that cloud computing will soon become more relevant for users than desktop computing [4].

This paper argues that physical interfaces and tangible interaction will be a key part of future cloud services. This idea is not new: under the umbrella term of the *Internet of Things*, a wide body of research explores the connection of physical objects to digital data in domains such as diverse as tourism, healthcare, theft prevention, and smart museums [2]. However, although there is sustained research interest, there are few tangible systems that operate with recent (and widely deployed) commercial cloud services. Given this fact, this paper makes two points. Firstly, it argues this is a missed opportunity – the popularity of cloud services makes them an ideal platform to explore user behavior with connected, tangible objects. Secondly, it suggests that tangible interfaces may be able to address persistent problems with cloud systems, such as users who distrust or struggle to understand current offerings [5]. To explore these issues, this paper presents TouchCloud, a prototype system that allows users to connect physical tags to Dropbox files and describes the results of a pilot exploring how users deploy and appropriate this functionality.

TouchCloud

Inspired by the seminal work of Want et al. [6], TouchCloud is novel service that enables users to tag their physical environment with their Dropbox files. This is achieved through a set of bespoke NFC stickers (see Figure 1) and applications running on both PCs and NFC-enabled Android mobile phones. The system is simple. Firstly, users attach the stickers to, on or in objects in their environment. Secondly, they choose specific Dropbox files or folders to physically tag and select the TouchCloud command from a context menu (available via either the "Share" Dropbox menu on



Figure 1. From left to right: a tag attached to a participant's office desk; and a tag in one of the participant's wallet



Figure 2. The process of tagging a Dropbox file on a mobile device, from left to right: a user relies on the Dropbox application to "Share" a file; the user then chooses TouchCloud from the list of applications available; and finally, the user is prompted to bring a TouchCloud tag in range of their device in order to finalize the association

Android devices or on right click on the PC). The user is then prompted to bring a TouchCloud tag in range of their device in order to finalize the association (see Figure 2). After completing this stage, retrieving tagged files or folders is achieved by users simply bringing their device close to an object or location marked with a TouchCloud tag.

Physically, TouchCloud tags are NTAG203 NFC stickers. NFC was chosen as the sensing technology as tags are relatively inexpensive (approximately \$0.50/tag), unobtrusive (34 mm diameter by less than one mm thick), robust (e.g. immune to dirt or smearing), widely available (e.g. included in many recent Android and Windows-based mobile devices), and reliable - tag reading is rapid and not affected by issues such as tag or sensor alignment or precise position [6]. They can also store data: when a Dropbox file or folder is tagged in TouchCloud, a custom URL is recorded on tag. When this tag is scanned, the URL is read and sent to the TouchCloud server. The most recent version of the associated file is then downloaded (if not already present) and automatically opened on the user's device. The mobile application was developed for Android 4.0. The PC application was developed on OS X using Python 2.7 and the SCM SCL3711 contactless USB reader.

Pilot Study & Initial Results

A month-long pilot study of the TouchCloud mobile application was conducted with two male and two female participants between the ages of 19 and 34 (M= 27, SD = 7.61). The participants were Canadian, Mongolian, Korean, and Portuguese, and all reported using Dropbox on their mobile devices prior to the study. The procedures and measures were simple: at the start and end of the study participants completed short questionnaires and also self-reported on their use of the TouchCloud tags. The questionnaires were adapted from prior studies [4, 5] and asked about use of Dropbox and TouchCloud, and about safety concerns regarding these services. In terms of the self-report, users filled in a short form and took a photo of each object they tagged. Additionally, all events were logged in the TouchCloud server. Each participant was given six tags (three pairs of different colored tags) and the TouchCloud application was installed on their mobile phones. Participants were told they could keep both the tags and access to the service after the study was concluded.

The results showed that participants used a relatively small number of physical tags: between one to six tags, but with a mean of 3 (SD = 2.16). They attached them to home furniture such as desks or bookcases (four tags); office desks (three tags); wallets or handbags (three tags); and vehicles (two tags). Figure 1 shows some typical examples. On average, participants recycled each TouchCloud tag slightly less than once, tagging Dropbox files between three and seven times (M = 5.25, SD = 2.06). These digital contents included documents (14.3%), media files (19%), and folders (66.7%). Of this data, 18.2% was added to Dropbox specifically for use with TouchCloud, while 81.8% was pre-existing content. Finally, participants read their TouchCloud tags between eight and 49 times (M =23.75, SD = 19.41) in order to access documents (9.2%), media files (14.9%), and folders (75.9%).

Discussion, Future Work & Conclusion

The overarching goal of TouchCloud is to improve the user experience of cloud storage applications such as

Dropbox through providing readily available, customizable and physical mediated access to digital content. The current pilot study suggests it achieves these aims and highlights a number of trends for future exploration. Firstly, nearly one fifth of the digital content used in the study was uploaded specifically for use with TouchCloud, suggesting that physical handles can increase the types of information stored in cloud services or the contexts in which information is used. We suggest this indicates that physical handles offer valuable new usage scenarios to users and plan to conduct future studies to better understand what these are. The comments of two participants directly corroborate this notion – both reported expanding their use of Dropbox to new areas of activity (e.g. extending their usage to include either their work or leisure activities).

A second issue that emerged related to the perceived security and understandability of the system, factors that have previously been identified as strongly impacting users' experience of cloud services [5], and hampering adaptation of cloud technologies [3]. Specifically, three of the four participants reported that their cloud-stored data was safer with TouchCloud (despite TouchCloud having no influence on the security of Dropbox files). This suggests that the use of tangible tags with remote data can convey the same sense of security users feel with local data [4] – basically reinforcing the notion that they are able to limit access to digital content via simple and easy to understand physical restrictions.

Finally, in more general terms, participants reported TouchCloud to be unobtrusive and easy to use. They suggested the system would be improved if it supported additional services (e.g., Google Drive); if it allowed specific tags to be protected from public scanning; or, if certain tags could be scanned without the TouchCloud application. In sum, TouchCloud provides users with a customizable bridge between digital data and physical objects. The current study suggests it is a useful and effective tool and that studying it in practice can provide insights into what users want to do with tangible handles to data. Rather than focus on the prescribed links proposed in the past [6], this paper argues that studying user appropriation of physical handles to digital contents will be a key driver for the design of future services in this space.

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