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Unify: Sharing Digital Media Content from the Cloud through Physical Interaction

Abstract
Sharing digital media in the cloud between our everyday smart devices has become an essential part of our workflows. The goal of the project was to explore new ways to share and interact with intangible media using specific devices such as smartphones and tablets. Many current commercial and research concepts are often technology-led. The concept presented in this paper, Unify, aims at envisioning how these technologies would fit in the users everyday life, moving from explorative to contextual concepts. Unify introduces specific affordances of the physical world to intangible digital objects by using the physical properties of tangible smart devices. In this way the device becomes a metaphorical physical container in which the digital objects are subject to the law of physics. This offers a different mindset for the user, releasing images of what users consider to be appropriate or standard behavior with smart devices. Through a qualitative evaluation it became apparent that users could envision the concept to be part of their daily routines and they do not need a lot of time to make this switch, which is promising for further development in this field.

Keywords
Interaction design, cloud computing, physical affordance, intangible digital objects

1. Introduction
Cloud computing offers technical benefits of saving local disk space, serving data processing and (co-) working from different locations. With a growing amount of applications such as Dropbox, Spotify and Netflix, sharing digital media in the cloud among our smart devices is becoming a part of our daily lives. Large software developers like Microsoft and Apple now also design for interoperability in their operating systems [1, 2]. Recognizing these growing systems as the next frontier of design, this work aims for physical interactions in digital cloud-based devices where artifacts from the physical environment move towards the digital world [3]. However, as cloud-based services are becoming more and more present in our daily lives and workflows, they are arguably less connected to our behavior in the physical space. This also becomes apparent through an online survey done during this project, in which the majority of respondents (n=44) indicate to prefer physical alternatives (for example an external hard disk) to digital ones (for example Dropbox) when asked what medium they would use for security-critical data. The need of an internet connection and unclear privacy issues were mostly mentioned as downsides of cloud-based services, because respondents mostly stated that they want to have a better overview of who can access their files and where they are stored.

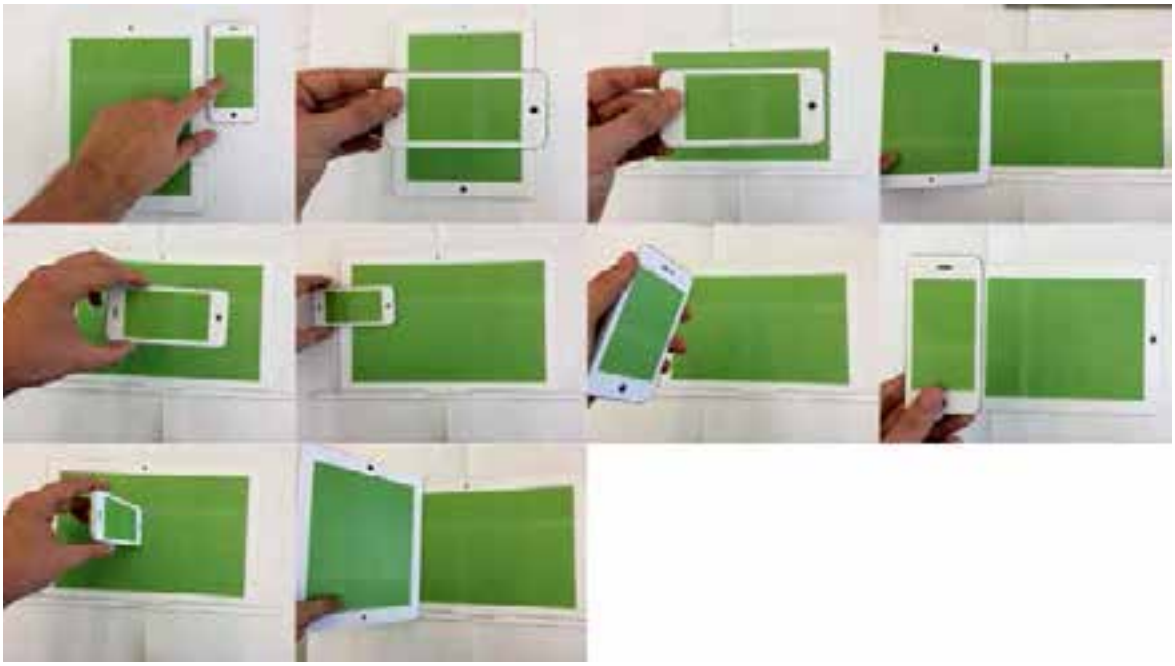

Fig. 1. Three paper prototypes were built exploring different interactions, like for instance sliding from one device to another, content can shake out, float or be pushed into another screen.

Blending the digital and physical world in interaction design opens up room for opportunities. Examples can be found in both commercial concepts such as file sharing app Bump [4], game system Sifteo Cubes [5] and Google's visual design language 'Material Design' [6], as well as in research from MIT with concepts such as THAW, Smarter Objects and Swÿp [7-9]. These concepts are often technology-led: exploring what is technologically possible. The concept presented in this paper, Unify[1], aims at envisioning how these technologies would fit in the user's everyday life, moving from explorative to contextual concepts.

Through the presentation of the design concept Unify, its evaluation and a discussion, we will demonstrate new ways of interacting with cloud-based services to share digital media with others in such a way that it becomes an integral part of our daily routines.

2. Unify: A Concept for Sharing Media with Physical Interaction

When envisioning cloud-based services and technologies for blending the digital and physical world, our everyday smart devices are currently separate islands that are not aware of other devices in the environment. While technologies for quick file sharing are available (using for example USB sticks, Apple's airdrop and portable hard disks), these often have limitations, prompting the user to create their own personal workarounds for transferring files between devices.

2.1 Unify

Unify introduces affordances of the physical world to intangible digital objects using the physical properties of tangible smart devices such as smartphones and tablets. In this way the user is introduced of seeing these smart devices as a container for intangible objects, which can be handled like any container in the physical world.

The concept is aimed at linking our smart devices together using spatial relations in physical spaces or following physical laws to make them truly an extension of each other. By knowing the relative position to other devices, we are able to connect them in a more intuitive way than only enforcing digital relations in digital spaces. Unify was designed to explore how one could share media within a close environment through physical interaction, from the perspective of the physical properties of smart devices.

2.2 Interaction Exploration

While working with multiple screens is already a common practice in our daily routines and workflows, there are more possibilities where screens can be extensions of each other. Three paper prototypes were built exploring different interactions (Fig. 1). For example, files can slide from one device to another, content can shake out, float or be pushed into another screen. All these interactions treat digital media in a physical way, dealing with the laws of physics (for example, gravity).

In these prototyped concepts, a smartphone could be interpreted as an abstract block, which could be controlled by finger movements like for instance point, slide or pinch. Even when the smartphone's screen is off, one performs these finger actions intuitively on the flat surface. By extending two screens, the relative position of devices provides contextual and physical relevance to slide digital objects from one device to another.

The interfaces were aimed to provide a better understanding of the internal processes, like the data flow of music files. This is based on the Google Material Design guidelines [6], a metaphor in which digital objects become subject to the law of physics. In contrast to classic interface design, information doesn't just appear and disappear, but behaves to communicate contextual relevance and to give a better understanding of the behavior of digital files. To achieve this with Unify, the physical properties of the screen and other devices were implemented in the affordances of the digital interface (Fig. 2).

Fig. 2. To communicate the contextual relevance, the physical properties of the screen and other devices were implemented in the affordances of the digital interface with subtle visual clues, for instance a white blur.

3. Evaluation

To evaluate the concept and allow for reflection on the contextual use, an evaluation study with the envisioned user group was set up. The evaluation included a questionnaire, several given tasks, and a semi structured interview followed by an analyses. Eight Industrial Design students from Eindhoven University of Technology were asked to participate; each filled in and signed an informed consent form before the evaluation. The participants were young adults with an average age of 22.5, native users of smart devices and due to their study background, had ample imagination to interact with the prototype.

3.1 Prototype

The prototype consisted of two interfaces, one on a smartphone and the other on a desktop computer (Fig. 2). Both showed the context of a music listening application. The participant was able to scroll through a couple of songs, skip them or pause them, to mimic a real application as close as possible. If the smartphone was close enough to the notebook, the user was able to slide the current song of the smartphone to the music queue of the desktop application.

In terms of technological feasibility, our smartphones, tablets and notebooks already know their absolute position on the world via GPS and the way the user holds them via gyro meters. However, these measurements are all absolute, and give no clues about their relative position to other devices in the environment. While it would be technically possible to determine relative positions of devices through RF transmitters and indoor positioning systems, other elements of the design were considered more relevant for this specific study. For the set-up of the evaluation, a mock-up of Unify was build using an absolute positioned camera outside the main setting. This camera tracked all devices' absolute positions by using the open-source computer vision framework reactTIVision [10], and the system translated this to relative data for each individual device.

3.2 Questionnaire

At the start of the session, participants were asked to complete a questionnaire. This questionnaire was meant to acquire basic information of the user group and to give an overview about their usage of smart devices in order to position acquired data.

3.3 Given Tasks

After an explanation of the motivations for the concept, participants were asked to explore the prototype without overthinking their actions and to speak out

loud their immediate reactions. This think-aloud method is valuable to explore individuals' thinking processes in a qualitative research setting [11]. Within the scenario the user got six specific tasks to perform with the music interfaces, for instance transfer a specific song from the smartphone to the notebook. The last two tasks weren't even possible, for instance pull a song out of the notebook with the smartphone, aiming for creative and new input. Every task was explained as detailed as possible, but participants were free to ask any questions immediately and to take as much time as they wanted. This procedure was video recorded for later semi-structured interviews.

3.4 Semi-structured Interview

Participants were then asked to observe the recordings of themselves interacting with the prototype. This video self-reflection method leaves extensive room for discussion and multiple interpretations, which leads to surprising input [12]. Participants were asked to explain not only what they did, but also why they performed these actions with a reference to their feelings. The interview was semi-structured on the basis of a list of predefined questions, to produce qualitative rich and honest data [13]. The semi-structured interview was audio-recorded.

3.5 Analyses

For the analyses, the audio recordings of the semi-structured interview were cut into fragments. These fragments were rearranged across the participants to look for keywords, similarities and themes.

3.6 Result

From the analyses of the audio recordings several similarities could be found. These were in the fields of the users' perception of the context, novelty and the mindset towards the system.

Perception of the Context and Novelty of the System. All participants recognized the current struggles of sharing digital files in your near environment and mostly mentioned ease-of-use and speed of action as the benefits of Unify. The concept stayed within the perception of all participants: they were continuously relating to existing services like for instance AirDrop, a service to transfer files directly between a limited selection of Apple products [14].

"I use Airdrop sometimes, but that doesn't work well for constantly sharing files with others. This works more logical, which makes it more useful for me." (Participant 4)

"I experience it as something new, but more as a logical next step in this field than a truly out of the box concept." (Participant 3)

Switching from Digital Interaction to Physical Interaction. Unify introduces an interaction whereby the smartphone becomes a metaphorical physical container in which the intangible digital objects are subject to the law of physics. The evaluation showed that it requires a different mindset when the user is introduced to this concept. Based on the video recordings, participants needed more guidance during the first interaction with the concept, but they quickly jumped to this new mindset where they were more creative and intuitive towards the system. It is essential to be aware of the fact that this intuitivity relies on the influence of the designer's skills on the affordances of the digital interface, and on the specific type of users within this evaluation (young design students). It's imaginable that slightly different results could emerge with a different group of users, which substantiates the need for more future tests to support the results.

"I was first looking for a button to send a file, but I quickly noticed the visual clues in the digital interface which suggested a real connection between the smartphone and the notebook." (Participant 6)

"However it was not possible with this prototype, I notice that it felt at the end logical to transfer a song by holding the smartphone on top of the screen of the notebook." (Participant 1)

4. Conclusions

The proposed concept, Unify, offers a way to view the cloud as an opportunity for design rather than an unwieldy and abstract existence. This comes apparent in the evaluation where participants could envision the concept to be part of their daily routines.

By introducing specific affordances of the physical world to intangible digital objects, smart devices such as smartphones and tablets become physical containers

in which digital objects can be handled like object in containers in the physical world.

This kind of interactions operates on a more metaphorical level and offers a different mindset, releasing images of what users consider to be appropriate or standard behavior with smart devices. Through the evaluation it became apparent that users do not need a lot of time to make this switch, which is promising for further development. This could offer opportunities for cloud-based services not only for ease of use, but also for assuring the user when data is security-critical.

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[1]A concept video of Unify can be found at http://www.joinunify.com