Enabling Natural Cross-Device Interaction in Personal Desktop Settings

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Abstract

This work presents an easy to use approach for cross-device interaction using the scenario of having a laptop, desktop computer and mobile device co-located on a desk. A consistent user experience is created through enabling the use of any input device to interact with all co-located devices. The user can grab data from one device and move it to another one with the currently used input device. With this approach no manual setup of connections for data exchange is necessary. Instead this setup process is automated and invisible to the user.

1 Use Case

In business as well as in private life mobile multi touch devices, laptop or desktop computers are placed beside each other for sync or exchange (see Figure 1). Furthermore users want to stay alert for notifications on a mobile device to answer a message or call while working on other devices.

Using current systems concerning these tasks, the user has to switch his present interaction device, e.g. keyboard and mouse regarding laptop or desktop computers as well as undocking and touching a respective mobile device. Thereby the user has to keep in mind or find out which keyboard or mouse is attached to which screen, thus having to interrupt the flow of interaction with his actual task at hand and to think about input devices instead.

Figure 1: Typical use case scenario including laptop, PC and smartphone on the same desk

2   Related Work

When bringing different kinds of devices physically and virtually together, several evolutionary steps of related research affect the proposed approach. These topics include controlling different desktops, coupling them, exchanging and displaying data from mobile devices on big screens.

Regarding controlling different desktops, remote desktops and virtual machines [2] are integrating the guest screen like a native window improving data exchange between the systems by drag and drop. They usually focus on a single interaction device, thus not offering a solution for multiple co-located devices.

Regarding the coupling of co-located devices current approaches are either restricted to only the same type of device having to put it physically together [4] or expert configuration is needed for setup [5]. Cross-device interaction between mobile devices and large screens or computers is realized with different approaches, including gestures [1] and proxemics interaction [3]. Concepts for natural interaction between and seamless integration of co-located mobile devices, desktop and laptop computers in existing work environments are missing.

We asked twelve users – all are using co-located devices – several questions. First we asked if they wanted to move their mouse pointer to another co-located device for data exchange and recognized that it didn't work in the past, which was the case for seven users. Current workarounds employed by all participants are to use USB-devices, cloud services or establish other network connections for exchanging pieces of texts, files or other data.

3   Preliminary Study

We asked questions to twelve users – all are using co-located devices. Current workarounds employed by all participants are to use USB-devices, cloud services or establish other network connections for exchanging pieces of texts, files or other data. These manual and

additional interactions to a task are reducing efficiency, effectiveness and satisfaction – as we found out in our questionnaire –, which are the main factors in user experience [6]. Seven users tried to move their mouse pointer to another co-located device for data exchange in the past and recognized that it didn't work.

4   Natural Cross-Device Interaction Concpet

We propose a *Natural Cross-Device Interaction* (NCDI) concept to speed up the process by enabling the use of any input device to interact with all co-located devices. Natural implies working as expected in our case. No prior manual setup is required and the devices detect their relative screen positions automatically. Thus it is not necessary to change physical input devices like keyboard or mouse. We demonstrated our concept to thirteen users and twelve found the approach easy to use and that it worked as expected. Three remarked that they find it tricky at the beginning for smartphones. One stated that it might be especially useful for all text based tasks. The new solution enables any keyboard or indirect pointing device – regardless to which computer it is attached – to be used across any computational device (see Figure 2) without manual configuration. This includes using an external keyboard or mouse on a mobile device.
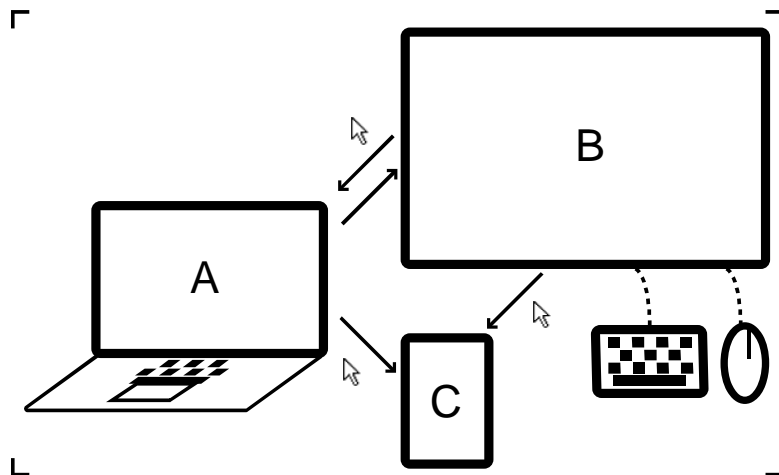

Figure 2: Any keyboard or indirect pointing device can be used across any computational device.

Figure 2 illustrates all possible interactions across co-located computational devices: Using the mouse connected to a desktop computer (B), the cursor can be moved over to the laptop screen (A) or the smartphone (C). Respectively the touchpad or pointing stick from a laptop (A) can be used to move the cursor to other device's screens (B, C). Depending on the cursor position or on an application being in focus any keyboard can be used. This way a keyboard from the laptop can be used together with the mouse from the PC or vice versa, if a mouse is attached to the laptop. Mobile devices are used additionally while working on other devices

to stay alert for notifications and to answer a message or call. Occasionally data from a mobile device is required on a PC or laptop. For example a user has taken a note from the conversation with a colleague and needs the respective information for his current work at the PC. Instead of undocking the mobile device, mailing the respective text via e-mail or other workarounds to himself, the proposed approach allows the user to directly get the text with the current mouse and keyboard at hand. The same way he can answer messages on the phone.

5   Conclusion and Future Work

We identified the need for a more natural cross-device interaction between co-located computational devices in workplace settings. With our approach users can grab data from one device and move it to another one with the currently used input device. Our work reveals another way of thinking about devices – not as isolated – but rather as part of a unified user's information space. Different devices can be seen as just different views on this information space. To make the input devices available across all coupled devices the remote desktop approach is partially used. For coupling and locating different devices as well as exchanging data between them, technologies like broadband connection, NFC and RFID are used. Our approach offers a solution for moving a cursor from a laptop or PC to a mobile touch device, but interacting the other way round is a challenge not solved by our current concept. This limitation will be addressed in future work.

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