Extended Surface: Projecting smartphone displays onto the physical world

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Abstract

Until now smartphones were designed for a limited interaction frame and for private use of a single person. In addition the combination of device and touch gestures as an operation tool for surfaces is yet rarely researched. We are working on an extended on-surface projection for mobile devices, because we want to find out how the limited size of displays can be extended by using ambient surfaces, so that people have direct access to applications and files, can interact with them in public and use their device as an additional operating tool. We developed a prototype for this scenario and used a multitouch display for simulating holographic or projected information.

Author Keywords

Extended surface, augmented surface, touchable interfaces, mobile device.

1. Introduction

Functions of mobile applications are mostly divided into several layers and frames, because the menus and possible adjustments exceed the interaction area of smartphones and tablets. Even if the operation system of the device supports a split screen, it is not feasible to have a look at more than two different information types at the same time – for example having a look at notes, upcoming calendar evets and at the task list in parallel. Therefore we identify a *need for extending the screen*. By placing the controls outside of the tablet or phone we want to maximize the screen space that can be used for actual content without turning on the device. The enhanced controls can be application-specific or general types of interactions, like sending a file to another device or creating a new document.

We also see an opportunity to *support team collaboration* by enhancing the screen and turning a private usable area into a public one. Information former stored on a lmited interaction frame, could be edited by multiple users.

In addition most interaction concepts are either based on touch-only gestures or on physical controls. *We combined both – touch and physical controls* to discover to what extent the device can be adjusted to its context and could be more integrated into its ambience as an additional tool.

In this paper we present related work, our scenario description and the technical description of the prototype. In our concept a multitouch monitor represents a touchable surface, which could be substituted to a projection in the near future or to a holographic screen.

2. Related work

The Neonode company picked the idea to enlarge the interaction area of a smartphone for more than one person by developing a case - named "**Fuffr**", that detects movements and gestures besides the device. The case was primarily intended for social gaming [2]. The miniature projector **TouchPico** makes the respective projection area (multi-)touchable [6]. The **Cicret bracelet** illustrates the vision of turning the skin into a touchable interface by projecting the contents of a smartphone onto the skin [1]. A team, formed by members of Nokia Technologies and the University of Glasgow, tested **above mentioned device interaction** to improve gestures on small displays and to enlarge the interaction sphere. With certain gestures above and besides the device selection or counting could be executed [3]. The **Portable Desktop** is a concept by the FX Palo Alto Laboratory and allow the use of a table as an extended desktop for a mobile device, while the table shows the big, but vague picture and the mobile device shows detailed information [4]. **Microsoft HoloLens** is a device announced by the Microsoft Corporation for augmented reality with a frameless appearance [5]. This is an interesting development, as displays of current smart glasses had a distracting appeal and user were likely to perceive them as foreign objects.

The novelty of the **Extended Surface** consists of a new vision of touchable surfaces and the combination of touch gestures and devices as operation tools. It also unites the need of team collaboration and is able to augment the interaction frame of mobile devices. Furthermore the concept is not restricted to a certain surface, but adaptable to a projection or holographic scenario.

3. Scenario Description

Our concept aims at three use cases, which are particularly useful for office related tasks. After laying the smartphone down on a table-like surface, elements appear around the device and show current status information like next events, notes or the time. Furthermore the user can move notes to any point on the table. We consider this second case for exchanging files between devices in further steps. The third case deals with scaling a note to make it visible to a bigger group of people and to support collaboration. We describe these use cases in more detail in the following chapters.

A) Current status overview

In our concept the current status overview shows the time, social media notifications, next events, a to-do-list, notes and music controls (see fig. 8). Thereby the user does not have to switch between different applications and has direct access to certain information, while the device's screen is on stand-by. In this scenario it is also possible to adjust status items related to a specific room or place, like programming the washing machine in the bathroom, regulating the heat sink in the living room or controlling the nearby stereo.

B) Moving a note

The user moves a note by dragging it to an optional point on the surface (see fig. 9). Even if the note is distant from the device, it is still attached to it and behaves in the same way regarding rotation and movement of the device. This is useful, if multiple devices are extended on a surface. Hence it is easy to find out, which note belongs to what device. For further work the movement case enables data exchange of two devices.

C) Scaling a note

After the note is moved away from the device, it can be scaled for a more detailed view. This can be useful for discussion in groups about detailed photography or mind maps. For scaling up the user holds down on the note with one finger and drags the smartphone away

from the it (see fig. 8). For scaling down the user holds down on the note and moves the smartphone in the direction of it. Therefore the device is turned into a physical controller.

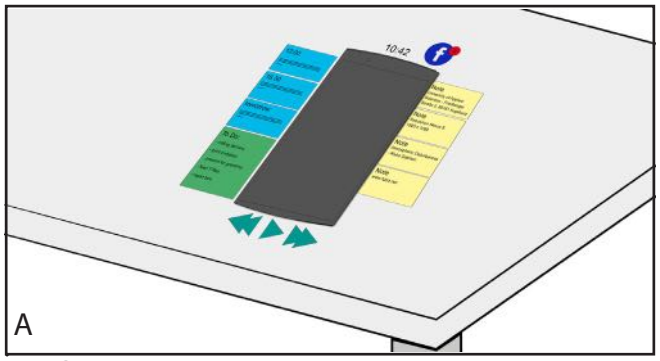

Fig.1: Current status overview.

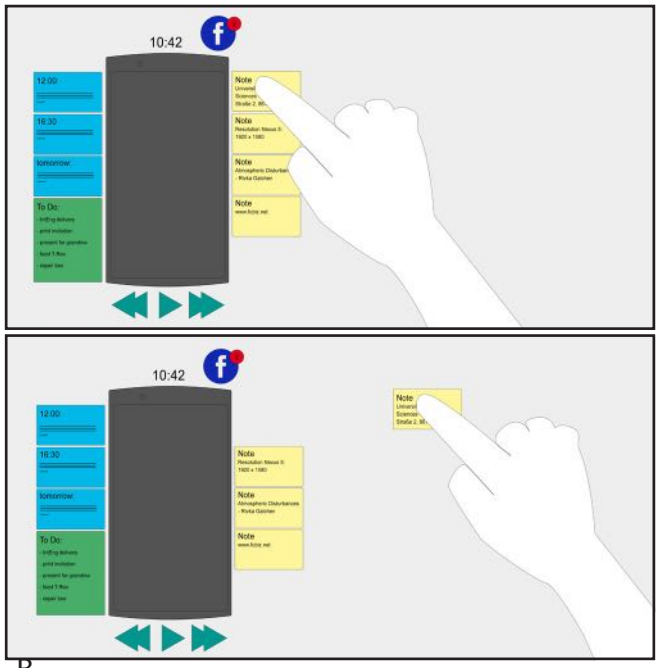

Fig.2: Drag and drop a note.

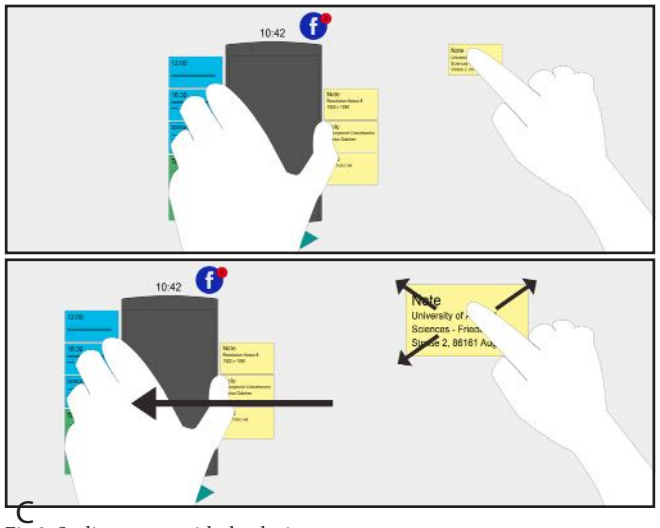

Fig.3: Scaling a note with the device.

4. Technical Realization

Programming Language: TUIO, processing
Hardware: 3M Multitouch Screen

To simulate a multitouch projection surface we used the 3M Multitouch Screen. The programming environment used for the project was the processing library. The signals from the 3M display are transmitted through the TUIO protocol.

Detection of each smartphone

The smartphone-prototype can be detected with three touch points. Each touch point is stored in a temporary list. As soon as the list reaches a size of three a new smartphone-object is created and the list is emptied. Although smartphone recognition could have also been done with two points only, three points are needed to recognize the rotation of the device and rotate the whole overlay accordingly. The prototype is built out of an 1st Generation iPod touch. A 3V button cell is attached to the back of the device in order to provide a constant electrical field and simulate a finger touch. Covering the back of the device and hiding the battery is a sheet of aluminium foil, with three rubber nobs attached to it, providing a conductive flow of electricity. This construction can be used to simulate a three-point-touch.

Detection of finger and smartphone movements

Every touch in the temporarily list is counted as a user touch input, since there can only be a maximum amount of two user inputs simultaneously. Since the temporarily list of touch points is emptied when three touch points are reached (creating a phone object) it is safe to assume, that all touches still in the temporary list are user touches and not corners of the smartphone.

Fig.4: Prototype of Augmented Smartphone.

5. Evaluation

Until now our concept is based on assumptions and the usefulness is not scientifically proved. Therefore a user test is outstanding. Our current prototype focuses on core functions and leaves space for adding more functionality. In relation to our in-depth literature research, our concept offers new approaches to extending surfaces. This means, that our concept is a reference point for future work. In addition it is applicable for the two scenarios of holography or projection.

6. Future Work

A following field of research is the adaptation of projected information in relation to a certain environment. Control of temperature, equipment and stereo could be shown context sensitive. The use cases could also be transferred to other devices with limited display space like smartwatches and smart glasses. In this context the surface itself could be widened to the palm of the hand, the arm or a wall.

7. Conclusion

In our concept we extended a smartphone's display to the ambient surface. We mainly wanted to solve two problems – the limited space of interaction and the design for private use, where collaboration is hindered. We depicted three use cases to explore how the interaction sphere of a user can be enriched and to what extent the user can have more direct access to information and files. By projecting information around the smartphone, moving a note and scaling it with touch and the smartphone, our concept supported collaboration and combined touch gestures with physical controls. Although the scientific approval is missing, our concept is applicable to multiple devices with limited display size and multiple environments.

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References

1. CN2P: Cicret Bracelet. *Make your skin your new touch screen*. 2015, URL: http://cicret.com/ (access: 28.1.2015).
2. Fuffr Inc.: *The Fuffr Touch Case – Multitouch Outside Your Smartphone*, Nov. 2014, URL: https://www.kickstarter.com/projects/1689453063/the-fuffr-touch-case-multitouch-outside-your-smart (access: 28.1.2015).
3. Freeman, E.; Brewster, S. und Lantz, V.: *Tactile Feedback for Above-Device Gesture Interfaces: Adding Touch to Touchless Interactions*. ICMI' 14, November 2014.
4. FX Palo Alto Laboratory: *Smart Phones as part of the Extended Desk - Scenario 1*, 23.12.2013, URL: http://vimeo.com/82567153 (access: 28.1.2015).
5. Microsoft Corporation: *Microsoft HoloLens,* 21.1.2015, URL: http://www.microsoft.com/microsoft-hololens/en-us?ocid=MSCOM_HoloLensGlobe (access: 28.1.2015)
6. Touchjet: TouchPico: *Turn Any Surface Into A Touch Screen*, URL: https://www.indiegogo.com/projects/touchpico-turn-any-surface-into-a-touch-screen (access: 28.1.2015).