Interactive Displays through Mobile Projection

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Abstract
Projectors shrink in size, are embedded in some mobile devices, and the next generation of mobile projections: drone-carried or wearable projectors are graspable. The technology may be ready for a radical change in mobile interaction towards personal projected displays that are (in contrast to the milestone work of Pinhanez [7]) not limited to static setups, but the applications and interactions for such novel and exciting technologies are not designed yet. In the proposed workshop, we raise the question to what extend mobile projections will change mobile interactions. In a hands-on workshop the participants will sketch interactions with mobile projectors. The ideated interaction concepts will be structured, analyzed, and discussed regarding their potential to extend the current limitations of mobile interaction, i.e. displaying content only on the embedded screen.

Author Keywords
Mobile Projection; Personal Displays; Augmented Reality;

ACM Classification Keywords
H.5.m [Information interfaces and presentation (e.g., HCI)]: User Interfaces.

Introduction

Over the last decades technology constantly shrank and became more efficient. Nowadays smart phones are ubiquitous devices that are equipped with advanced technology. Even pico projectors are integrated to phones and are commercially available e.g. the Galaxy Beam[1]. Despite the feasibility of mobile projection, users are still deploying projectors in a very stationary way. The use of mobile projection in everyday life is still not common. Most of the commercially available systems lack of rich user interaction. Projecting content into the physical world in a mobile setup has been addressed by numerous research projects. Many technical challenges were already addressed such as distortion, contrast, and projection to uneven projection surfaces.

Even though mobile projection is not yet as pervasive as current smart phones, we do believe that it has all abilities to become in the near future. As technology will enhance, mobile projectors may become ubiquitous.

In this hands-on workshop, we will encourage the participants to think outside the box to thrive new concepts and ideas how truly mobile projection can be involved to support us in everyday life. We will provide small battery powered projectors to inspire participants' creativity to develop innovative interaction concepts and use cases.

This workshop is not limited to interaction concepts only. We also plan to identify additional ways to gain mobile projection. Combining a steerable projector with a quadcopter or adding it to smart watches are concepts we want to discuss as well.

[1] http://www.samsung.com/hk_en/support/model/GT-I8530BAATGY (last access 19-02-2015)

Related Work

Augmenting the physical world with projected content has been around for some years. In 2001, Pinhanez [7] proposed to augment physical objects with digital content by projecting on them. As distortion is a problem, it was suggested to correct the projection using a camera to enable a distortion free projection on curved surfaces. Beardsley et. al [2] used the projection-facing camera to interact with projected content. They are using a mobile camera-projector system to align the projection based on unique points in the environment. Further, they are able to use the movement of a hand-held projector as a digital cursor for interaction. With the proliferation of Kinect depth-cameras in 2010, sensing touch on projected interfaces became easily possible on arbitrary surfaces [9]. The algorithm was improved by Hardy et. al [5] using KD-trees to handle multitouch with 30 frames per seconds. While their algorithm was designed for interacting with stationary projection, Harrison et. al [6] targeted a mobile scenario by mounting a camera-projector pair on the user's shoulder. Recently, Winkler et. al [11] proposed a backpack-mounted solution for both projector and depth-sensing camera in their AMP-D project. However, interaction with projected surfaces is not limited to camera-projector setups. E.g. Surfacephone [10] uses a smart phone combined with a projector to create an projected display that becomes interactive by using the build-in camera and microphone. Further, Funk et. al [4] use everyday objects as tangible input for projected user interfaces. Wolf and Baeder [12] project texture images on plane surfaces to generate materiality illusions. Especially for interacting with mobile projectors, many areas of application have been suggested. Rukzio et al. [8] provides a comprehensive overview.

Emerging interaction possibilities

While the Everywhere Display [7] was through its stationary setup limited to turn surfaces in a room into a display, mobile projectors create a dramatic increase in interaction possibilities by allowing to turn any human or urban surface into a display. Urban displays have been mainly proposed for advertisement [1], guidance systems [13] or public gaming [3]. However, these proposals mainly consider displays that are embedded into the environment and thus are not mobile.

While, projecting in mobile situations causes many technical challenges, such as distortion, contrast, and uneven projection surfaces, there are benefits of extending mobile interaction through projectors. They provide interface properties that extend the interaction possibilities of mobile phones, such as:

- The large display size of projections enables for showing content to a greater audience. Thus, sharing media with multiple people in any situation allow spontaneous video screening, image showing or map navigation for a group of users.
- Using light as display medium instead of a screen allows for displaying content over a large distance, e.g. at architecture.
- Using the medium light result in having an ephemeral Graphical User Interfaces that does not leave content traces, and thus could be used for "clean" graffiti, moment-lasting content viewing, flash projections that rather serve as attention guidance than as content.
- Combining the advantages of projected mobile content with technology that already is embedded in mobile phones (e.g., camera, accelerometer, GPS) allows for augmenting the real world with content and also for "sticking" content to real objects or locations if analyzing the orientation and motion of the projector.
- Considering that technology is shrinking in size and suggesting that projectors will be embedded into glasses or wearable devices, the world we see could also be augmented through projections even if our hands would be too busy to carry a mobile phone.
- Finally, drone-mounted projectors would allow for hands-free everywhere displaying of content regardless of the user's position and orientation.

Workshop's goals and expected outcome

With these emerging interaction possibilities, we raise the question to what extend mobile projections will change mobile interactions. The proposed workshop aims to encourage that discussion through:

(1) ideating as radical as possible interaction ideas in a hands-on rapid prototyping session using mobile phones, pico projectors, drones, and light-weight light components, e.g. laser pointers

(2) encouraging a discussion of how mobile projectors could change mobile HCI

(3) highlighting research topics that are worth to be explored in the future and encouraging the participants to team up for collaboration after the conference

(4) viewing the mobile projection projects done by the organizers as well as by the participants and team up for a topic overview article for a magazine, book chapter or special issue.

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