Survey of Interactive Displays through Mobile Projections

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ABSTRACT

Projectors shrink in size, are embedded in some mobile devices, and with the miniaturization of projection technology truly mobile projected displays became possible. In this paper, the authors present a survey of the current state of the art on such displays. They give a holistic overview of current literature and categorize mobile projected displays based on mobility and different possible interaction techniques. This paper tries to aid fellow researchers to identify areas for future work.

KEYWORDS

Interaction, Mobile, Projected Displays, Projection

INTRODUCTION

Over the last few decades, technology constantly shrunk and became more efficient. Nowadays smart phones are ubiquitous devices that are equipped with advanced technology. Even pico projectors are integrated into phones and are commercially available e.g. the Galaxy Beam, and with the miniaturization of projection technology and the increasing capacity of batteries, truly mobile projected displays became possible. This development has spawned an ever increasing amount of research in the field of HCI that investigates multiple factors of such mobile projected displays. Besides needed interaction techniques also factors such as social implications, mobility and perception have been explored (Cowan et al., 2012; Kaufmann et al., 2012; Pouli and Subramanian, 2012). Such mobile projectors have the ability to create ad-hoc large-scale personal displays that allow for exploration of large-scale information. While Rukzio et al. (2012) presented a very comprehensive overview of the field of mobile projection, latest research and development has driven the field much further than initially expected.

We previously (Löchtefeld, 2015) presented a survey and categorization of mobile projection research. Here, we provide a more holistic overview of the current state and categorize the different works based on their mobility and provided interaction techniques. In terms of mobility, we categorize mobile projected displays into four different classes that start with fixed display and afterwards increase in their mobility.
In this paper, we extend our previous survey of mobile projections. We use six different classes to categorize interaction techniques, including Bi-Manual manipulation of Surface and Projector as well as Around the device interaction.

By using this classification, we not only give an overview on existing works, we furthermore identify less investigated areas and present opportunities for future work. Therefore, this paper can yield as a holistic overview of current research in the field of mobile projected displays.

TYPES OF PROJECTED DISPLAYS

When it comes to different projected displays, we can distinguish between four types that differ in the amount of mobility they provide: Environmental Projectors, which as the name suggests are located in the environment, e.g. projectors installed in meeting rooms; Moveable Projectors which are not fixed in the environment but need to be set up before operation; Hand-Held and Body-Worn Projectors are fully mobile projectors that are either held in the hand, e.g. a projector phone, or worn on the body; Self-actuated Projectors presents the most mobile setting, in which the projector can move through the environment on its own. This categorization is visualized in Figure 1.

Environmental Projectors

Environmental Projectors are characterized by the projection unit being immobile and therefore fixed in the environment. The most common example for this class would be projectors that are installed in e.g. meeting rooms. In this case the output – the projected display – is usually fixed as well. Thereby Environmental Projectors provide the advantage of a large undistorted projected display.

Still two subcategories exist that are a hybrid between Environmental Projectors and more mobile classes. The first class is represented by Steerable Projectors where even though the projector is fixed in the environment, the projected display can be created at different positions in the environment. This subclass represents a hybrid between the Environmental Projectors and the Hand-Held and Body-Worn Projectors. The second subclass are Object Projectors, where the projector is mounted on a moveable object but the created projected display is limited to this specific object. This subclass is a hybrid between Environmental Projectors and the Moveable Projectors class.

Steerable Projectors

Steerable Projectors allow, even though the projection unit is mounted in a fixed position in the environment, to create projected displays at nearly arbitrary positions in the environment. This
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