Impromptu Collaborative Projection for Storytelling

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ABSTRACT

Pico projectors are steadily becoming more common, but research to date has mainly investigated their usage as output devices. In this paper we consider how pico projectors might be used for *input*. We describe a concept for using projected content to create animated stories, allowing groups of people projecting photos, sketches, or even videos, to record and share the stories they tell. The concept is demonstrated by an early prototype using sensor data and a simple calibration method for device location and orientation tracking.

INTRODUCTION

In recent years the emergence of pico projectors has provided an ideal platform for ad-hoc content sharing in any location. Naturally, researchers have looked at how these new output devices might be used and further developed for user-driven public displays, or collaborative manipulation of content. However, in this research we are interested in the use of these projectors as *input* devices.

In this paper we propose the use of handheld projectors for group storytelling, recording the projected content as input for later retelling. We are particularly interested in how pico projectors might be used to help groups collaborate, both to re-live existing stories, and also to annotate and sketch with shared content to create fun, interactive narratives.

Our design aims to support this group storytelling, recording and editing behaviour by allowing ad-hoc collaborative sketches and annotations to be developed into shared video stories. We have developed a prototype that supports collaboration between a small number of users, allowing participants to project simple sketches, animating their story by moving a handheld projector. Projected interactions are then composed into a video record of the action, allowing them to later revisit and retell. Although the prototype is in its early stages, we have addressed issues in both sensor-based tracking for spontaneous projection, and in the initial device setup and calibration that is required.

BACKGROUND

Projected images have been used in play and ad-hoc storytelling throughout history. From digital shadow puppets [7] to torch-based exploration [4], researchers and artists have worked to develop digital versions of these interactions. Previous work has investigated the use of both lasers [5] and flashlights to interact with static content [6], and to play games by controlling a projected display [3].

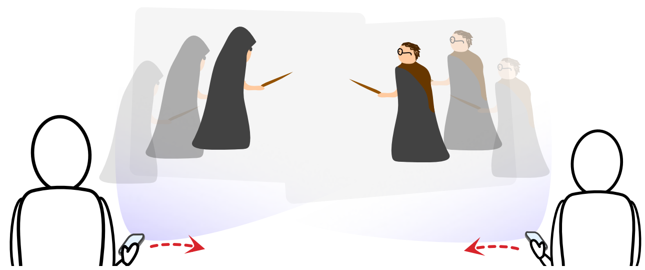

Figure 1. Creating stories by collaboratively sketching and projecting: Sam and Ben are reading the Harry Potter books, and decide to act out their own alternative Death Eaters storyline...

In our storytelling design we take a different approach, using the projector itself as the input device, allowing these types of interactions anywhere. Projector-based pointing interaction has previously been investigated (e.g. [1]), including multi-user variants, (e.g. [2]), but has usually focused on peephole-type displays. In addition, previous designs have made use of visual-based device tracking methods, mainly due to their higher accuracy. In our prototype we use a sensor-based approach, sacrificing pinpoint accuracy for the ability to project and interact spontaneously in any location.

DESIGN

Our proposed system will allow groups of people to record and annotate simple video stories to share their experiences. Fig. 1 illustrates how a group of people might tell a story using their individual projector phones.

Participants begin the storytelling by projecting a photo or video, or sketching their own scene, moving and pointing their device to animate. Others can project their own overlays, interacting with each other to create a shared event. While participants are animating the projected content, the interactions of each individual user are recorded, allowing the story to be replayed later on. Each participant's projected content and interactions are tracked separately, allowing edited versions of the event to be created if desired.

Current Prototype

We have developed an early prototype to investigate possible interactions with this projected story tool. At present our system demonstrates only the base functionality, but we also address issues in setup, synchronisation and device tracking.

Our current prototype setup consists of a Nokia 5800 mobile phone, firmly attached to an Optoma PK101 projector and a

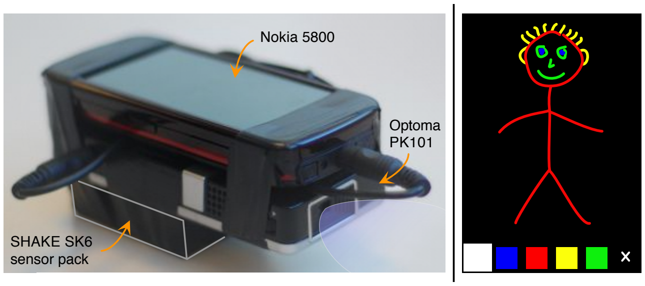

Figure 2. Our current prototype. Each user holds the device (left) in-hand, sketching on the screen (right) and moving to animate their projected story. Movements are recorded by the attached sensor pack.

SHAKE SK6 sensor pack (see Fig. 2). A Python application running on the phone allows the user to draw sketches, and the phone's screen is projected directly. Each phone is connected wirelessly to a server, which receives live sensor data in addition to the projected content. When storytelling ends, the server composes a shared video, adding the projected content in the positions indicated by the sensor data.

Projector Tracking

Previous handheld projector pointing designs have required high-resolution visual tracking of users' hand positions in order to be able to synchronise projected content with the device's movements. In our design we take a different approach, using accelerometer, magnetometer and gyroscope sensor data to detect hand movement and orientation.

The use of sensor data allows story creation in any suitable projection location, rather than just those with visual tracking capabilities. Because sensor-based tracking gives only the orientation of the device, rather than its position in 3D space, inaccuracies in tracking are inevitable. However, we address this issue by requiring users to stand reasonably still while projecting, and pre-calibrating to help account for variation in arm movements. In addition, the short distance of the projector from the projection surface also lessens the impact of imprecise tracking in the resulting story video.

A more important problem with ad-hoc projection is the issue of discovering the location of the surface that the user projects onto. While previous approaches have been able to use fixed locations, or a combination of GPS data and assumptions about the user's arm position, in our design we want to allow story creation even when precise location data is not available. To address this issue we developed a simple calibration method to allow quick estimation of the distance of the projection surface without the need for location data.

Calibration

Our calibration method relies on users' perception of short distances, using this to estimate the distance between the projector and the projection surface. The calibration procedure begins by displaying a small marker and prompting the user to point directly in front of them on the projection surface. Following this, the user is asked to point one metre to the left or right of this point. Magnetometer data from the sensor pack attached to the device allows simple estimation of this distance: $d = \frac{1}{\tan\theta}$ (see Fig. 3). Optionally,

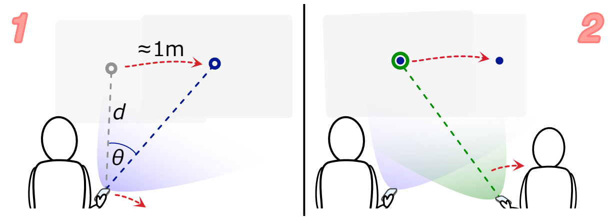

Figure 3. Estimating projection surface distance: First, one person calibrates their device by estimating 1m on the projection surface (left). Others calibrate by pointing to markers projected by the first (right).

accuracy can be improved by prompting the user to repeat the procedure with different directions or distances. Further participants can use a simpler procedure: by pointing to marks projected by the first user, their relative locations can be approximated with reasonable accuracy.

Clearly this method is prone to error when users are unable to remember where they originally pointed, or, more importantly, when their estimation of short distances is inaccurate. However, for our application – where pinpoint accuracy is not essential – this approach provides a quick way to allow projector tracking and distance estimation without the overheads and location restrictions of of visual tracking methods.

CONCLUSIONS AND FUTURE WORK

In this position paper we have discussed using a combination of mobile phones, sensor packs and pico projectors to allow ad-hoc creation of shared stories. We believe there are many possibilities not discussed here, and we welcome feedback from the research community. In our initial prototype we have shown how some of the main issues in tracking and calibration can be addressed; in future work we aim to refine these solutions, further develop the prototype to improve its interaction and remove the need for a server, and conduct a user study to investigate usability in various scenarios.

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