MagicPAPER:

Tabletop Interactive Projection Device Based on Tangible Interaction

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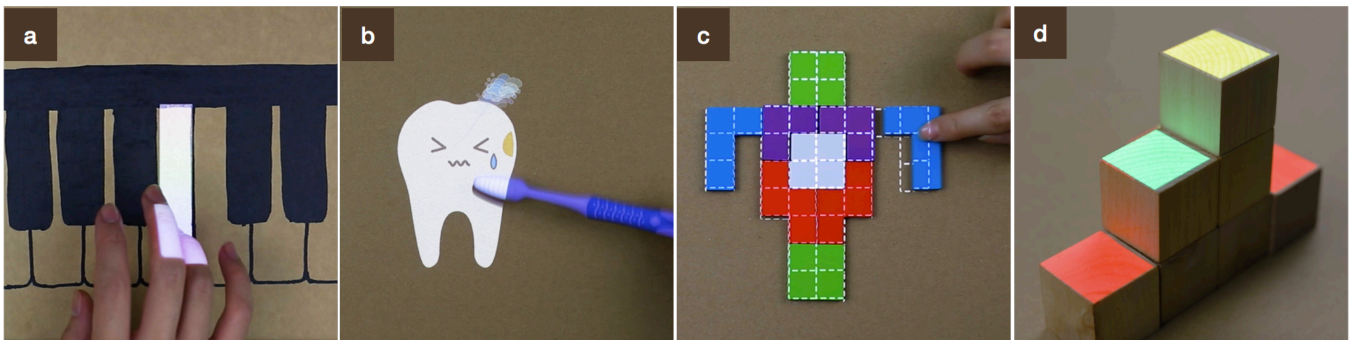

Figure 1: The interactive scene of MagicPAPER: (a) using the interaction between stick figures and projections, (b) using a toothbrush to brush the teeth on the projection, (c) matching the colored Tetris bricks with the projection, and (d) projecting the interaction on square wooden blocks.

ABSTRACT

This study proposes a tabletop projection device that can be implemented by combining physical objects with interactive projections. Users can interact on kraft papers using daily tools, such as marker pens, toothbrushes, colored blocks, and square wooden blocks. The input of the proposed device is a multifunction sensor, and the output is a tabletop projector. Using MagicPAPER, four types of interactions are implemented, namely drawing, gesture recognition, brushing, and building blocks. The abstract and poster discuss the design motivations and system descriptions of MagicPAPER.

CCS CONCEPTS

• Computing methodologies → Computer graphics; • Applied computing → Media arts; • Human-centered computing → Haptic devices;

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KEYWORDS

Media Art, Embodied Interaction, Projected Reality, Gesture Recognition.

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1 INTRODUCTION

As mobile devices are becoming more intelligent, novel touch technologies and interactive methods have also been explored and discovered. However, these interactions are limited to small electronic screens. In this project, we introduced MagicPAPER, which is a low-cost, versatile, and large desktop interactive projection device. MagicPAPER combines tangible interaction with tabletop projection and can be applied to a wider range of scenarios. To enrich the interest in and feasibility of this device, we have developed a series of applications (Figure 1).

Many different approaches to tabletop interactive projection on large surfaces have been employed. Bonfire integrates a laptop system and a desktop system to project an interactive display space on both sides of the laptop keyboard for presentation

[Robert et al. 2016]. DIRECT Combines a depth camera with a projector to turn almost any reasonable plane into a touch display [Shaun K et al. 2009]. However, the design motivation for this project is to demonstrate more possibilities for augmented reality projection technology through physical interactions on a kraft paper. The matte projection on the tabletop kraft paper reduces damage to the user's eyes and expands the user's range of operation.

MagicPAPER's interaction methods mainly include five types: In the first type, the user directly performs touch or air-touch operation on a kraft paper (Figure 2a). In the second type, the user creates a stick figure using a marker pen and interacts with the physical painting and projection (Figure 2b). In the third type, the user uses a toothbrush to brush the teeth shown in the projection (Figure 2c). In the fourth type, users can piece together colored Tetris bricks to interact with the projections (Figure 2d). In the fifth type, users can interact with projections by placing square wooden blocks in different positions (Figures 1e and 2e).

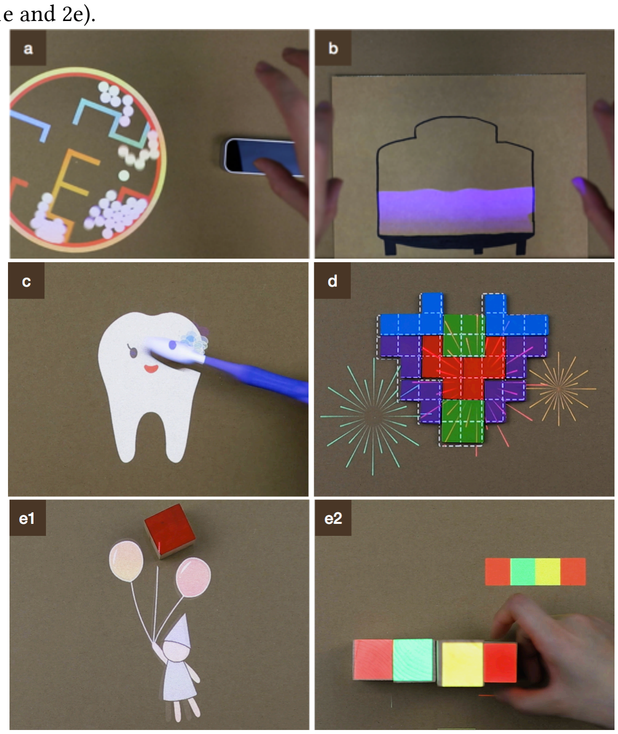

Figure 2: Five main interactions on kraft paper.

2 SYSTEM DESCRIPTION

The MagicPAPER device mainly comprises the input, which is a multifunction sensor, and the output, which is a high-precision projector (Figure 3). The software used to develop our system is Unity3D and OpenCV. For height and distance recognition of building blocks, we use an algorithm that performs the hierarchical calculation on the tabletop based on depth information. For gesture recognition, the ToF-camera-based fingertip search algorithm is mainly used; this camera can accurately track the position of the finger. To ensure the smoothness of signal transmission and the stability of the system, we have built a socket-based data exchange platform to ensure the normal operation of our system.

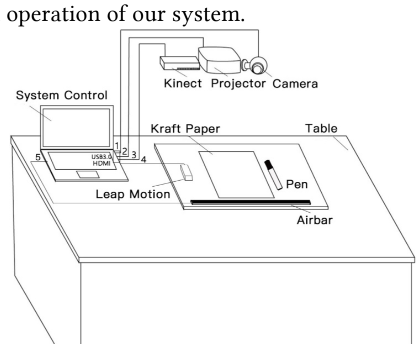

Figure 3: System diagram of MagicPAPER.

3 EXHIBITION

Our device is easy to use, and users can experience the projection using gestures on the tabletop. We showcased the MagicPAPER device in various exhibitions, and many viewers experienced this new physical interactive projection device. Visitors and practitioners who participated in the experience were impressed with our installation and provided positive comments to promote our project to the next step.

Figure 4: Visitors experience the MagicPAPER exhibition.

4 CONCLUSION

In this paper, we introduced the design motivation and interaction methods of MagicPAPER. MagicPAPER combines tangible interaction with tabletop projection and creates a series of scenes like "magic" that inspired the participants' interest. We have developed more than 10 applications in total and have been actively involved in the exhibition. We believe that this project can inspire more researchers to explore innovative interactions.

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