Stop-Motion Prototyping for Tangible Interfaces

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ABSTRACT

Stop-motion animation brings the constraints of the body, space and materials into video production. Building on the tradition of video prototyping for interaction design, stop motion is an effective technique for concept development in the design of Tangible User Interfaces. This paper presents a framework for stop-motion prototyping and the results of two workshops based on stop-motion techniques including pixillation, claymation and time-lapse photography. The process of stop-motion prototyping fosters collaboration, legibility and rapid iterative design in a physical context that can be useful to the early stages of tangible interaction design.

Keywords

Stop-motion, Pixillation, Claymation, Animation, Prototyping, Tangible User Interfaces.

INTRODUCTION

Low-fidelity prototypes are useful to the interface design process because they are fast, cheap and easy to make [2]. They can be as effective as their high-fidelity counterparts for anticipating problems and evaluating design decisions [5]. Low-fidelity prototyping relies on widely available materials and skills, so it can foster collaboration within multidisciplinary groups in the design process [8].

Video can be a useful artifact for all phases of the design process, including brainstorming, prototyping and evaluation [8]. Several techniques adapted from animation, including frame-by-frame drawing and the use of clear gels, have been used to make low-fidelity prototypes of Graphical User Interfaces. Tangible User Interfaces (TUIs) can be prototyped using exploratory cardboard mock-ups with movable parts [3].

Animating existing objects through stop-motion animation can serve as inspiration for the development of novel physical interfaces. Toy designers often use stop-motion to illustrate game-play; the act of animating one construction toy inspired the design of a kinetic constructive assembly kit [1,7]. Stop-motion can also be used to explore the consequences of technologies that do not yet exist. One designer has used stop-motion animation to investigate future interaction possibilities of nano-technology [9]. Stop-motion animations make it relatively easy to speed up or reverse time and to give inanimate objects magical properties, encouraging highly imaginative work. This type of stop-motion future-telling could help to direct the development and research of future technologies.

STOP-MOTION PROTOTYPING

TUIs and Ambient Displays could benefit from a more spatial prototyping technique since they often rely on interaction with the body, movement and materials. Stop-motion animation is an easy way to sketch interaction with people and objects before investing the time and effort to build working systems. Stop-motion is made by transforming an object or a body between frames of an animation.

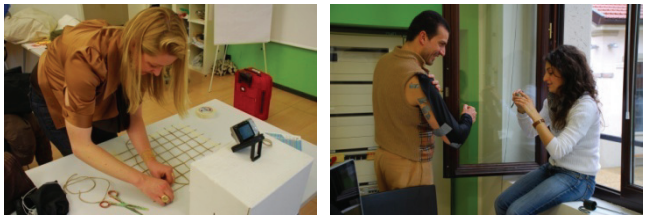

Figure 1. Using stop-motion to simulate material properties changing at a molecular scale (left) and on the body (right).

Stop-motion animations are often made using everyday objects, clay and flexible figurines (claymation), and the human body (pixillation). Animations are best made in groups, since the objects being manipulated and the camera are often a distance apart. Since the animations are shot frame-by-frame, they rely on creative material selection and rigging. For example, transformation is usually achieved by swapping an object with different items between frames. Filming liquids and smoke relies on substitute materials such as cellophane and cotton balls. Wires, fishing lines and tape can make objects seem to defy gravity, especially when animating flying or freefall. A tripod is almost always used so that the background does not seem to shift. Simple, effective animations can be made in just a few hours – in one project, novices were able to start making clay animations is a few minutes [4]. A digital camera and free movie-editing software are enough to start [6]. A soundtrack can be recorded live over the footage.

These brief animations can rapidly reveal the intuitiveness, effectiveness and legibility of specific interfaces.

WORKSHOPS

We conducted two stop-motion prototyping exercises to motivate rapid, collaborative iteration of tangible interfaces: a four-hour workshop with textile design students and a two-hour workshop with interface design students. In both, students had already developed a concept and they were encouraged to work fast. They produced short animations (5-20 seconds) using few frames (between 5 and 50).

The textile workshop was designed to explore the potential of active materials. Students worked in pairs to make animations for each individual's concept. Their projects explored ambitious themes they would have been unable to otherwise prototype. Two participants prototyped fabrics that could change material properties, one at a simulated molecular level and another on the body (See Fig. 1). One student wanted to explore applications for color-changing materials; as soon as she began to animate she realized that the critical design task was to conceive of an intuitive interaction to prompt color change – she settled on a series of gestures. Another student sought to design objects that could protect themselves from impact; she soon realized that the problem was to find a material that could expand to act as a sort of airbag (See Fig. 2). In three hours, each student shot between 2 and 5 versions of their animations, dedicating only the last half hour to compositing and editing. This workshop revealed the potential of stop-motion prototyping to break down expert-novice boundaries and to rapidly confront designers with fundamental design considerations.

Figure 2. Animating a self-cushioning wine glass (notice the fishing line used to suspend the object between frames).

In the second workshop, five groups of four graduate and undergraduate students used stop-motion to present their projects in a TUI class. They explored a wide range of interfaces, including haptic, sound-activated, wearable and ambient. The animations served as quick presentations and, in some cases, to reveal important design challenges. The exercise forced some design changes to make interaction legible on-screen, in one case the resulting design changes persisted into the final project. The large groups and social nature of several project favored the use of pixillation in the videos. Hand-drawn graphics and multi-actor scenes helped illustrate social interaction (See Fig. 3). In some cases the animation served as a presentation aid while group members narrated. In one case, the animation was so hard to make that the project had to be re-conceived. This workshop revealed that stop-motion animations are more useful at the early stages of conceptual development.

Figure 3. Using pixilation – animation of the body – to express a fantastic idea (left) or an emotion (right)

CONCLUSION

The use of stop-motion animation to produce low-fidelity prototypes of tangible interfaces can be useful to develop a concept, to refine a design and to present an interaction scenario. The technique allows rapid interaction prototyping by experts and novices alike. Stop-motion animation is especially successful to prototype interfaces having to do with the body and with hand-held or wearable objects. It can be less useful if the work is not visually self-explanatory, as with some ambient displays and haptics. Animation is an act of invention in itself, which can help to foster inventiveness in general. Stop-motion animation also brings a sense of humor to the brainstorming and design process, fostering group work and enlivening the work atmosphere.

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