Informal Animation Sketching with K-Sketch

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ABSTRACT

Animation is a powerful medium that is accessible to few, because current animation tools are extremely complex. This complexity arises partially from current tools' focus on precise, often unnecessary details and partially from the difficulty of finding a small but sufficiently powerful set of tool features. We are designing K-Sketch, an informal 2D animation tool that uses sketching and demonstration to radically reduce the time needed to create an animation. Our field studies investigating the needs of current animation tool users and would-be users are helping us to minimize complexity by showing us how to prioritize the many possible tool features. Our evaluations will show how well K-Sketch meets its goal of allowing novices to create a wide range of animations quickly.

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General terms: Design, Human Factors

Keywords: Animation, sketching, pen-based user interfaces

INTRODUCTION

Animation is a popular medium for entertainment, education, and communication. It is a convenient way to express moving visual images, it can represent dynamic concepts, and it can make information more attractive and engaging [10]. Given this, it is not surprising that many people develop the desire to express their own ideas through animation, but this poses a challenge. The necessary tools are not easy to master, and one must be very dedicated in order to produce even the simplest animation.

Our research seeks to improve access to animation through a simple, intuitive interface for animating sketches [3]. By focusing on sketched objects and demonstrated movement, we hope to make creating an animation about as easy as drawing a picture. To meet this goal, we must consider all the ways that objects can move and change over time, boil them down to a small set of capabilities, and choose a set that balances expressive power and simplicity. We have done this through field studies investigating the needs of current animation tool users and would-be users. The resulting library of usage scenarios is helping us to prioritize the many possible tool features.

We begin with a quick review of related work and then describe our field studies and the conclusions we drew. Following this is a brief overview of our current design for K-Sketch: a "kinetic" sketch pad. We close with a description of our evaluation plan and conclusions.

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RELATED WORK

This research is based on the tradition of informal sketching tools. Much of the complexity of modern interfaces comes from the way they draw users' attention to details that can be deferred or ignored altogether. This philosophy has led informal interface researchers to create sketch-based tools for user interface designers [7] and web designers [9]. Noting the complexity of the animation interfaces in Macromedia Flash and Microsoft PowerPoint, we now apply this philosophy to tools for novice animators.

Current animation tool research is predominantly 3D [11], but we believe 2D animation is sufficiently powerful and much easier to work with. Also, much of the current 2D animation research is domain-specific [2], but novices need general animation tools that support a wide range of tasks. The most straightforward way to design a general, 2D animation sketching system for novices is to require users to sketch each frame individually (as in Sketchy [5]), but this is tedious and slow. A few researchers have tried to create visual languages for animation [6], but it is difficult to design a language that is both powerful and simple.

Our design for K-Sketch is closely related to Baecker's Genesys system [1], which allowed animators to demonstrate the motion of sketched objects with pen gestures. Moscovich and Hughes created a similar system with special features for skeletal structures and for coordinating the motion of objects [8]. We build on Genesys in different ways, using our field studies to direct our attention to the most important capabilities required by our target users and finding ways to provide easy access to these capabilities.

FIELD STUDIES

To guide our design of K-Sketch, we conducted field studies that investigated potential users' needs. The result of these field studies was a library of example animations, each representing a specific usage scenario for an informal animation sketching tool. Here we describe the evolution of this library and the conclusions we drew from it.

We began by interviewing seven people who currently produce 2D animation on a regular basis to see what kinds of animations they were creating and how the ability to sketch animation might affect their work practices. Four participants worked in the entertainment industry and primarily used physical media to create animation. One participant produced web sites and worked primarily in Flash. Two participants were computer science graduate students who produced animated conference presentations using a homegrown animation specification language.

Though all participants had extensive experience with animation tools, and all used these tools to produce polished, "formal" animations, five of them gave specific examples of how an informal animation tool could help them produce such animations. Most were interested in creating prototypes of longer or more complex finished works. We collected 27 specific use cases from these animators. These may be analogous to uses a novice animator might find when experimenting with an idea for an animation, before investing time in a more powerful animation tool.

One interview participant taught classes in animation to grade school and middle school students. From this participant, we collected 22 rough, student-produced animations. These animations tended to be longer, telling complete stories instead of fragments of stories. These are good example uses of an informal animation tool, because the animators understand and accept the roughness of the medium.

In addition to collecting these existing animations, we collected 16 usage examples from ten people who had never used an animation tool. These examples covered a wide range of subjects from science to dancing. Most were attempts to communicate some dynamic concept to another person (often a student), some were attempts to visualize a concept, and some sought to entertain or grab someone's attention. We supplemented this set with seven other examples from ourselves and other researchers that solved similar problems. From the resulting set of 23 animations, we produced eleven in Flash to study them more closely and to make sure they met the needs of these individuals. The time needed to build each of these examples (median 61 minutes) underscores the need for simpler animation tools.

Animation Tool Feature	**Scenarios Using**	**Scenarios Requiring**
Supported		
Demonstrated Translation	75%	69%
Appearing/Disappearing Objects	53%	42%
Demonstrated Rotation	44%	36%
Repeating Motion/Event Sequences	39%	26%
Demonstrated Scaling	35%	28%
Reuse of Motion/Event Sequences	28%	4%
Demonstrated Translation + Rot.	24%	21%
Unsupported		
Animation Cels	54%	33%
Motion Hierarchies	32%	19%
Morphing/Bending	28%	7%
Keyframing	26%	10%
Physical Modeling	24%	0%
Sound	19%	11%

Table 1: Possible animation tool features and the percentage of animation scenarios that use them. Features are sometimes beneficial to a scenario, but not required. The right-most column shows how often each feature is required. Those on the top are supported by our current design for K-Sketch.

In all, 72 usage scenarios were collected, each with a single animation. We then examined every scenario to see how it might use each of about 70 design features, counting scenarios that required a feature separately from those that merely benefited from it. Table 1 shows a condensed version of these results with the percentage of scenarios that made any use of each feature and the percentage of scenarios that required each feature.

The table separates features our design currently supports from others we do not support at this time. We believe the data shows that the ability to translate objects with hand gestures and the ability to make objects appear and disappear are most important. Many other features were used frequently, and we found ways to merge some of them elegantly into our design, as shown in the following section.

Some features were used fairly frequently, but we are putting off supporting them, because they were often non-essential and they add significant complexity to the interface. For example, any time an object changed appearance (one drawing swapped for another drawing), it was a sign that the "Animation Cels" feature was useful. This happened in many animations, but over 1/3 of these could be created simply by removing the object and drawing a new object in its place. In many of the remaining cases, the ability to cycle through appearances was not essential. Full support for animation cels was required in only 33% of our scenarios. Consequently, we have chosen to add this feature later, if users call for it, in a way that does not complicate the basic interface.

A few other details bear mentioning. The "Keyframing" feature allows precise timing and coordination, but it was required only 10% of the time. Also, most animations had only a few objects that changed over time, and only 10% had more than 10 objects changing simultaneously.

We will continue to revisit this data as the project progresses to weigh the relative importance of various design ideas. Having clear numbers helps us to focus in on the most important features.

K-SKETCH USER INTERFACE DESIGN

We have designed a demonstration-based animation user interface that includes the features our field studies showed to be most important, translation and appearing & disappearing objects. The interface is most appropriate for a small number of objects, and timing is imprecise, relying on users own hand gestures for timing. Rotation, scaling, and simultaneous translation and rotation are also supported through the selection handle shown in Figure 1.

Users draw on a blank canvas that contains only a slider bar for controlling position in time and a "GO" button that runs the animation (see Figure 2a). This allows seamless transitions between drawing and animating. Objects appear at the point in time when the user draws them, and disappear at the time when they are deleted.

To define motion, the user presses "GO," and all drawings, modifications, or pauses are recorded in real time. When a drawn object is selected, the selection widget appears (Figure 2b). When the user initiates a drag operation on this widget, the animation begins to "GO" automatically. This widget has multiple control zones so that users may easily choose between a variety of motions (such as translating or scaling) and other operations (such as moving the center of rotation). By integrating many tools into one, this widget is similar to Tracking Menus [4], though it does not follow a hovering pen as Tracking Menus do.

As the user drags, the widget disappears, and visual feedback (a motion path) becomes visible (see Figure 2c). This motion path stays slightly transparent while the animation is running so that the user can focus on other moving objects. It can be deleted to erase the motion, copied to reuse it with a different object, or edited to change the path. Our current design supports editing only though translation, rotation, and scaling of motion paths, but future designs may support other forms of editing if users call for it. The user can also issue a "Repeat" command when motion paths are selected to repeat a motion any number of times.

As shown in Figures 2d-2f, another moving object can be added by rewinding, drawing a new object, and initiating another drag operation. Previously moved objects will move as the user demonstrated, and the user can coordinate the motion of new objects with her hands. This interface relies on the user's intuitive sense of timing and coordination. Timing will be imprecise, but as shown in Table 1, precise timing with key frames is needed only 10% of the time.

This design assumes the presence of a single mode switch button, which can be a barrel button, a button on the drawing tablet, or any other mode switch. By holding the button, the user indicates that a selection loop or other gesture is being drawn. Holding the button also indicates that drag operations on the selection widget should not be recorded. (Such object modifications are considered "instantaneous.")

EVALUATION PLAN

Once implementation is finished, we will conduct a summative evaluation of K-Sketch. Our goals are as follows:

Low-level goals

1. Allow a wide variety of animations to be created
2. Keep the interface as simple as possible

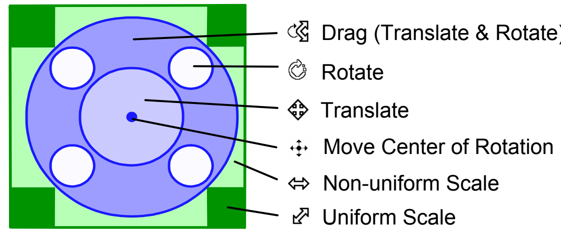
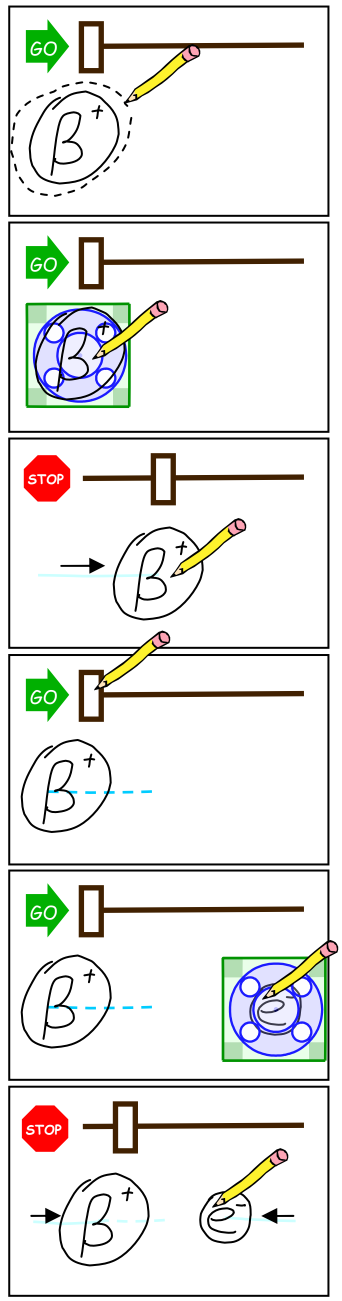


Figure 1: Selection Widget with Control Zones.



(a) Begin by drawing and selecting an object.

(b) A selection widget appears. Position pen over "Translate" region and prepare to drag.

(c) While dragging, the widget disappears, motion is recorded, and a motion path appears

(d) Drag time slider to beginning. Dashed motion path shows that motion is in the future.

(e) Draw and select another object

(f) When dragging, all objects move. Collision is timed by hand.

Figure 2: Creating a particle collision animation with K-Sketch

High-level goals

1. Allow animations to be created more easily and more quickly than with current animation tools
2. Enable animation to be used by new people in new ways and in new contexts

The low-level goals relate to K-Sketch's design. How well the design achieves these goals will influence how well the project achieves the two higher-level goals. Progress toward all these goals is hard to measure before K-Sketch reaches a wide audience, but we can draw some conclusions from laboratory studies involving users animating with K-Sketch in a controlled setting and from field tests that put K-Sketch in the hands of real users.

We propose two laboratory experiments, one focusing on low level goals and the other on high level goals. The low-level experiment will observe K-Sketch users as they animate scenes of varying complexity (as in Figure 3). By measuring the effect of scene complexity, we can get a sense of how well K-Sketch scales to support a variety of animations. By measuring learning effects, we can get a sense of how simple the interface is. The high level experiment will compare K-Sketch with existing animation tools (Flash and/or PowerPoint) as users animate scenes from our library. By asking users where they would feel comfortable creating and using these animations, we can get a sense of how well K-Sketch supports new uses of animation.

We will supplement these experiments with two field tests of K-Sketch. The first will involve novice animators in a one-day introductory animation class. After creating animations with flip-books and stop-motion photography, students will be given an opportunity to work with K-Sketch. By noting the variety of animations produced and difficulties students experience, we can get more evidence of how K-Sketch meets or does not meet its low-level goals. The second field test will involve deploying K-Sketch to educators and observing how animation gets used in their classes. By noting the relative frequency of animation use and any novel uses of animation, we can get more evidence of how K-Sketch meets its higher-level goals.

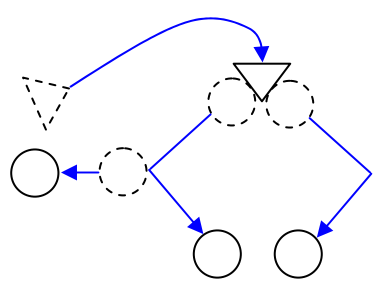


Figure 3: A complex billiard-ball scene to be animated by participants in the first laboratory experiment. Action starts with the triangle moving along the arrowed path and striking two balls. Simpler animations will involve fewer objects or will require translation with no rotation.

CONCLUSIONS

We have proposed to design, build, and evaluate a demonstration-based informal animation sketching system called K-Sketch. To choose between possible features, we collected 72 usage scenarios during field studies. Our design includes a selection widget that allows users to choose between many motion controls easily. We hope to show, through our evaluation, that the system allows a wide variety of animations to be created quickly and easily. The evaluation may also show that K-Sketch allows animations to be used in ways not possible given current tools.

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