

# USING VIDEO TO PROTOTYPE USER INTERFACES

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## **Abstract:**

The Human Interface Group at Apple Computer uses video as a design tool to prototype and visualize ideas about how computers will be used in the future. This paper is for people who need to build visualizations of user interfaces that don't yet exist. It describes how to create effective interface simulations using animation and video techniques. The advantages and disadvantages of video as a user interface design and prototyping medium are also explored.

## **Deciding what interfaces to build:**

Before you can build a prototype of a user interface you have to specify what tasks the interface will enable. This specification can take many forms: a user interface ERS (an engineering requirement specification that is used to describe how the user interface will work), a list of functions or commands or even a scenario or story which describes the interface in more detail. In any event, you will end up with a collection of tasks that will be automated by a technology. The next step will be to design how a user will interact with the technology in order to accomplish the task or use the functions you've listed in your

specification. No matter how you specify your user interface you will probably need a way to illustrate your design ideas to others.

There are many techniques for simulating user interfaces. However, many of these techniques require the skills of a computer programmer and special purpose hardware or software. Until recently, user interface designers spent very little time actually *designing* user interfaces because there were no tools which enabled them to explore design alternatives. Designing often meant building.

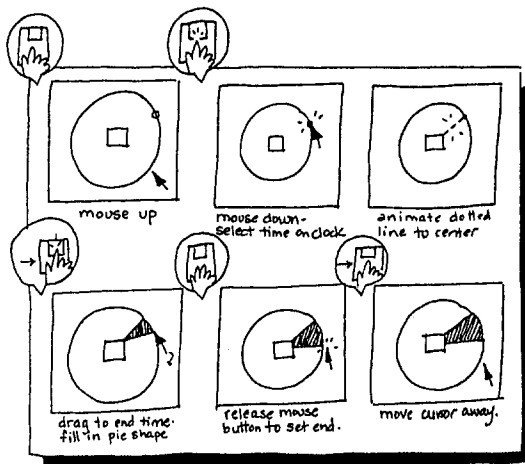
How do you prototype your user interface ideas? You could set out to actually build them, but what if people don't like your design? How do you prototype a user interface to a product that does not yet exist? Visualization and animation techniques for prototyping or simulating user interfaces without actually building them will be addressed in this paper.

## **Developing storyboards and flipbooks:**

You should have some ideas about how the eventual interface should look and 'respond' to the user. The next step is to create a storyboard or flipbook to help visualize the

user interface interactions. Storyboards and flipbooks help designers work out timing and sequencing problems and quickly record design solutions. Storyboards are used in the film industry to describe the camera shots, action, and timing events for films. There are usually eight to twelve drawings on a page with supporting text in a window below the drawing. Flipbooks are used by animators. They have one drawing per page. Animators can 'fan' the pages of the book to get a rough approximation of the motion between drawings.

The following is an example of a storyboard that illustrates an interface for marking a shared calendar.



The storyboard was intended to describe:

- what the computer screen would look like
- how the user would manipulate the interface to accomplish a task
- the response the computer would make to the user's input.

#### Visualizing the interaction:

Storyboards and flipbooks are useful tools for interaction designers but they can be difficult for others to interpret as user interface specifications because they lack continuity and transition from one drawing to the next. Once the interface techniques are described on paper, they can be visualized in a more temporal medium, such as video, to illustrate the interactivity of the design.

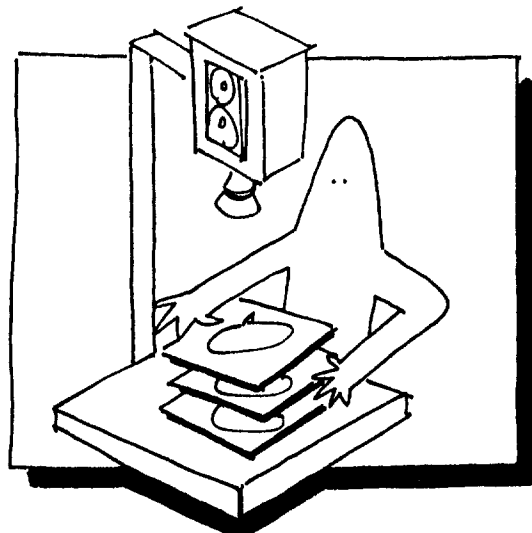
There are several techniques that can be used to illustrate interaction concepts. They vary based on the degree to which the prototype

must mimic the real product. I have used three types of prototypes: animated prototypes, computer scripted or interactive prototypes and prototypes which integrate video with other media.

#### Animating interaction techniques:

##### Animated Drawings:

The simplest animation effect is an animated drawing. To illustrate how to make an animated drawing let's imagine an interface for a shared calendar. To produce an animated drawing a simple sketch of the calendar interface is drawn on a piece of paper. The drawing is then reproduced on a copier so there are multiple copies of the original sketch. The interaction events, such as the steps required to make an appointment on the calendar, are then drawn on top of the copied drawing as in-between frames for the animation. These drawings can be filled in with color if desired. The drawings are placed, in sequential order, under a video camera and shot one drawing at a time for 10 to 20 seconds. A video editor is used to assemble the final animation so that each drawing is shown for the appropriate amount of time. The drawings, edited together in this fashion give the illusion of motion. (The ideal frame rate is 24 images per second, but the motion can be illustrated even at 1 frame per second.)

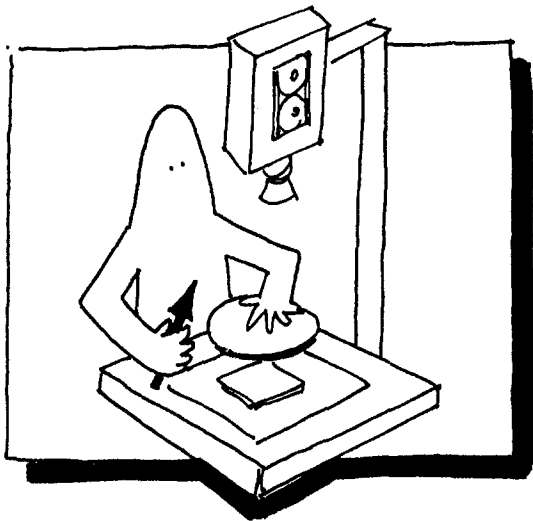


This method can produce many rough interface sketches in less than a day. The cost for materials, such as paper and pens, is minimal. And it is possible to create a crude but effective approximation of the interaction in the user interface even though

the frame rate is course. However, if a close approximation of the finished interface is what you're trying to achieve, this method will not be appropriate.

#### **Cutout animation:**

A similar technique is cut out animation. Objects such as the calendar, can be cut out of paper or cardboard and placed on top of a background. The objects are then filmed as they are moved under the video camera. Smooth transitions such as moving or rotating an object are relatively simple. The object can be moved under the camera in real time; while the video camera is recording the action. But not all computer interactions are this simple to simulate. For example, to simulate the effect of scaling a window each frame of the animation must be recorded while the object is replaced sequentially with a smaller object. The video editor must be used later to remove the time between each frame.

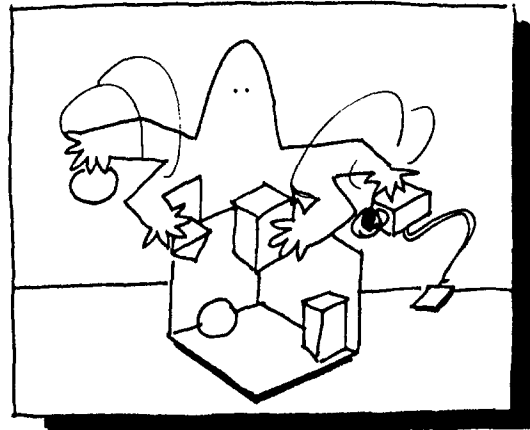


Like the animated drawing technique, cutout animation can produce many rough interface sketches in less than a day at a minimal cost. It has the added advantage that objects can be used over and over without having to recreate them. However, it is difficult to choreograph the placement of the cutout objects so retakes of the shots are often required if mistakes are made while filming. Again, this method is not appropriate for close approximations of the finished user interface.

#### **Animated objects:**

I have recently discovered some techniques to accommodate prototyping user interfaces for three dimensional objects, such as interfaces for computer aided design. I built

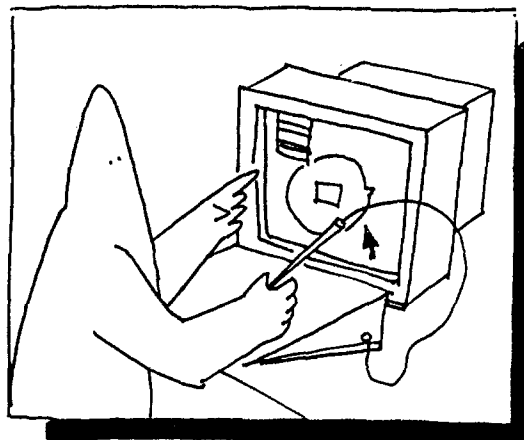
a foam core model of the objects, then used fishing line (which is transparent) to translate and rotate the objects in space. A small camera, suspended above the objects, can be moved through the space to give the illusion of walking through the model. Magnets, hidden from the camera's view, can be used to manipulate objects as if they are moving by themselves. I've also found magnets useful for moving cursors over flat planes.



One of the advantages of this method is that objects can be reused. Unfortunately, it is difficult to prototype manipulations that could not occur in real physical space such as scaling objects or changing an object's shape. But it can be faster and less expensive than creating and animating a computer generated model.

#### **Computer animation:**

Another prototyping technique is computer animation. Simple cell animation or flipcard animation can be accomplished with programs such as VideoWorks or HyperCard. Let's use our calendar interface as an example. The calendar can either be



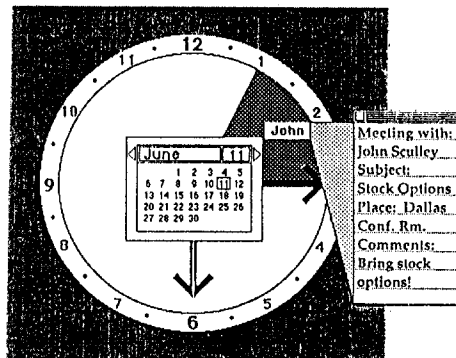
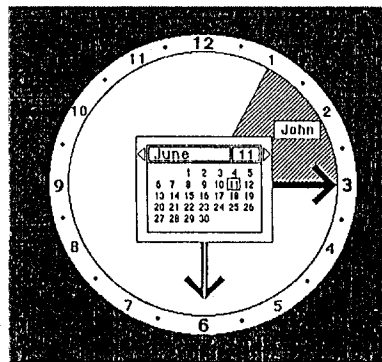
drawn with a paint program or scanned into the computer from a sketch. Each frame of the animation must be drawn and placed as a cell on top of the background sketch. Reusable objects, such as the cursor, can be moved around on top of the calendar. Their positions are recorded for playback later.

This technique can produce results that closely resemble what the finished interface might look like. When our ideas become more concrete our paper sketches are converted to computer based prototypes. These computer animation tools are used most often to prototype interfaces for Macintosh. Computer generated animations are much easier to modify than the previous animation techniques. Unfortunately, not all computer animation programs are easy to use for prototyping user interfaces and special purpose hardware is required to get video out of the computer. Filming directly off of the computer screen produces poor quality scanning effects.

### Computer scripting interactive prototypes:

An extension to computer animated prototypes are computer scripted prototypes. Animated prototypes simply play out a linear sequence of frames and are not interactive. Computer scripted prototypes are tightly confined to a series of interaction events. Some of the tools that we have used to make our prototypes somewhat interactive are VideoWorks Interactive, Prototyper and HyperCard.

The drawing below illustrates how HyperCard can be used to prototype an interface. I used the HyperCard paint tools to create a drawing of what the calendar would look like in it's normal rest state. Then I created a drawing of what the calendar would look like if the user had opened an appointment window. To simulate the effect of actually opening the appointment window, I connected or linked the two screens together with a button. When pressed, the button would flip from the illustration of the calendar in the rest state (figure A) to the illustration of the calendar with the appointment window opened (figure B). This gave the illusion that the calendar prototype actually worked, even through it was merely a user controlled animation.



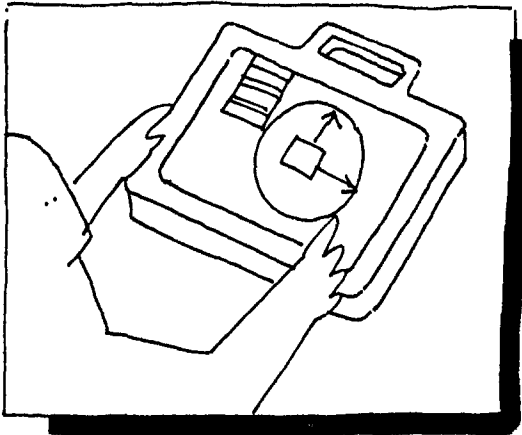
The biggest advantage to this technique is that it gives the illusion of being interactive. Tools such as these enable designers to produce quick prototypes in less than an hour or fully operational applications that require months to create. Again, there is some overhead required to learn how to use the application and to connect special adapters to convert high resolution screen images to recordable video.

### Mixing media for more complex prototypes:

Emerging technologies include the capability to show video in a window, high resolution graphics, animation and more. Simulating user interfaces to these technologies require sophisticated prototyping techniques such as special purpose video production and computer graphic tools. It may be appropriate to work with a video production facility due to the equipment cost and professional expertise required to use this equipment. It is unlikely that you will need this level of production capability in-house. (An example of this kind of prototype, which was intended for marketing purposes, is Apple Computer's, "Knowledge Navigator".)

What would a prototype using these techniques look like? Let's take our calendar one step further. Imagine that you have written a script and constructed a storyboard of a user marking a shared calendar. The prototype that you have described is quite explicit about the task of marking the calendar, the environment the user is in, and the physical packaging of the computer. To illustrate all of your ideas it would be desirable to produce a video scenario.

The prototype will be constructed in layers and assembled to give the effect of a user actually interacting with the computer and it's user interface. The first layer that is shot is a video of an actress who is playing the part of a user. She interacts with the industrial design model as if she were using it to mark her calendar. At this point model has no user interface on it's display. The second layer is a video animation of the user interface. A computer is used to animate the sequence of events that show how the computer would look when marking a calendar. Finally, the video of the user interface is matted on top of the video of the industrial design model to give the illusion that the user is actually interacting with the physical device to mark her calendar.



This technique produces an explicit representation of the user interface, both as a visual model and as an interaction model without the cost of actually implementing the user interface. Since this prototype is observed, the only thing lacking is interactivity. Unfortunately, the production costs can be very high, into the tens of thousands of dollars, and it can take months to produce.

#### Lessons learned:

Now that we've described several video prototyping techniques, let's take a look at what we have learned about video as a design tool.

#### Advantages:

- Video can provide an entire range of visual expression; from rough video sketches to highly refined and believable video productions.
- Video sketches enable designers, clients and end users to visualize interface ideas and get feedback early in the design process reducing the costs incurred by late design changes.
- Interface designers can produce many design alternatives in the same amount of time that it would take to implement just one design.
- Interface designers don't have to program computers to prototype user interfaces.
- Video is useful for specifying user interfaces for technologies which do not yet exist and can emulate the mechanics of real systems without actually having to build them.

#### Disadvantages:

- Video tools are expensive.
- Video is difficult to change or manipulate. Productions must be carefully planned ahead of time.
- It is difficult to simulate specific products with video. It is best to prototype in the target environment when possible. At Apple, HyperCard, VideoWorks and MacApp are used to prototype Macintosh user interfaces because they provide a better simulation of what the final design might look and feel like.
- Video can mislead people into believing that the prototype is the finished product. Since video can simulate reality, it is difficult to distinguish a prototype from a real working computer system.
- It is difficult to test video prototypes because they are not interactive.

#### Summary

Video is a useful design tool for prototyping user interfaces. It can provide immediate results in the form of video sketches or simulate final designs with finished video productions. Although it is not always the most appropriate design medium, video is especially useful when designing interfaces for technologies that do not yet exist.