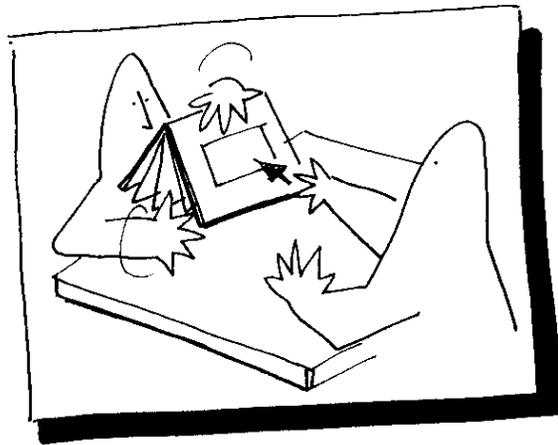


Storyboards and Sketch Prototypes for Rapid Interface Visualization



Tutorial 33

CHI '90

April 2, 1990

Seattle, Washington

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AGENDA

■ 1:30-3:00

Introduction

Overview

Techniques I

Scripts

Drawings

Screen

Shots

Storyboards

Flipbooks

Exercise 1 & 2

■ 3:00-3:30

Break

■ 3:30-5:00

Exercise 3

Techniques II

Animatics

Puppets

Computer animation

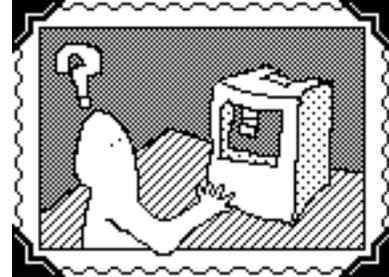
Special effects

Interactive software

Comparison of techniques

Testing tips

Summary and discussion



■ Content

The inventive leap to effective new user interfaces often requires that we visualize new applications and user scenarios long before the final technology is available. Storyboards and sketch prototypes can be powerful tools for exploring alternative design ideas and having early feedback on their usability. Features that are confusing or problematic in the design will often show up early, even with simple sketch prototypes, when brought face-to-face with real user unpredictability.

This tutorial will give an overview of media and techniques available for rapid interface visualization and will provide some tips for user testing with these sketch prototypes. Participants will have demonstrations and hands-on experience with several storyboarding and prototyping techniques.

■ Objectives

To enable you to 1) understand the value of storyboards and sketch prototypes as a means for quickly evaluating user interface ideas, 2) identify and use a wide range of media and techniques that apply to rapid interface visualization, 3) have experience with some of these prototyping techniques, and 4) understand when to use them.

■ Who should attend

Interface designers and design managers, novice to intermediate, will find this tutorial immediately useful. Implementers and researchers in the field may find the techniques valuable and the implications challenging.

INSTRUCTORS

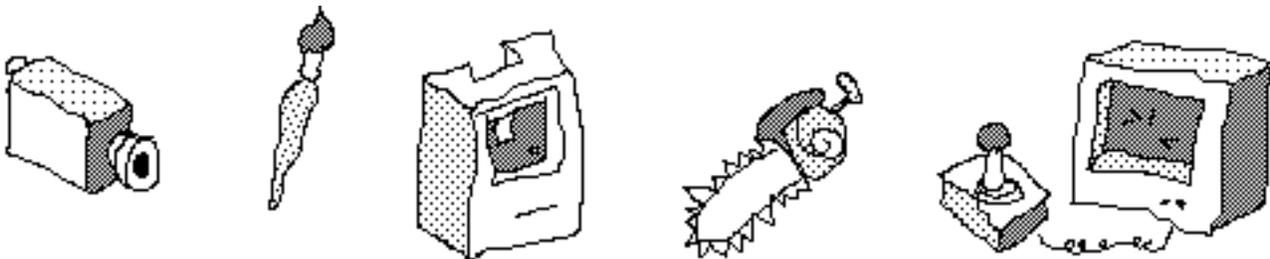
■ **Gayle Curtis** is a Biomedical Engineer at the Veterans Administration Rehabilitation Research and Development Center in Palo Alto. He works with user-interface and design issues in the development of assistive devices for disabled people. Currently he is exploring the application of virtual environment technology to hand rehabilitation and developing assistive technologies to aid disabled drivers in vehicle refueling.



Gayle also works as an independent user interface design consultant and as a lecturer at Stanford University, where he sometimes teaches the course in Visual Thinking. This course focuses on rapid visualization techniques and problem solving strategies for engineers. He holds a BA in Psychology and an MS in Engineering (Product Design) from Stanford University.

■ **Laurie Vertelney** is a User Interface Designer in the Human Interface Group at Apple Computer, Inc. She uses storytelling and video prototyping to visualize how people will use computers in the future.

During the past eight years, Laurie has designed user interfaces for such varied problems as chain saws, video game hand controllers, computer paint programs, hand held computers and software for the Macintosh personal computer. She has pioneered new techniques, taught workshops and published articles on Design Methodology, Storytelling and the Rapid Prototyping of User Interfaces. She holds a BS in Industrial Design from California State University at Long Beach.



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OVERVIEW

■ What kind of storyboards and sketch prototypes do we use for interface visualization?

- Scripts
- Drawings
- Screen shots
- Storyboards
- Flipbooks
- Animatics
- Puppets
- Computer animations
- Special effects
- Interactive software

■ When do we use these sketch prototypes?

Designing interfaces

- visualizing concepts
- exploring alternatives
- resolving feature details
- developing interaction scenarios

Testing interfaces

- intelligibility—can you read or interpret this?
- trackability—can you follow this?
- fumble factor—can you make this work?

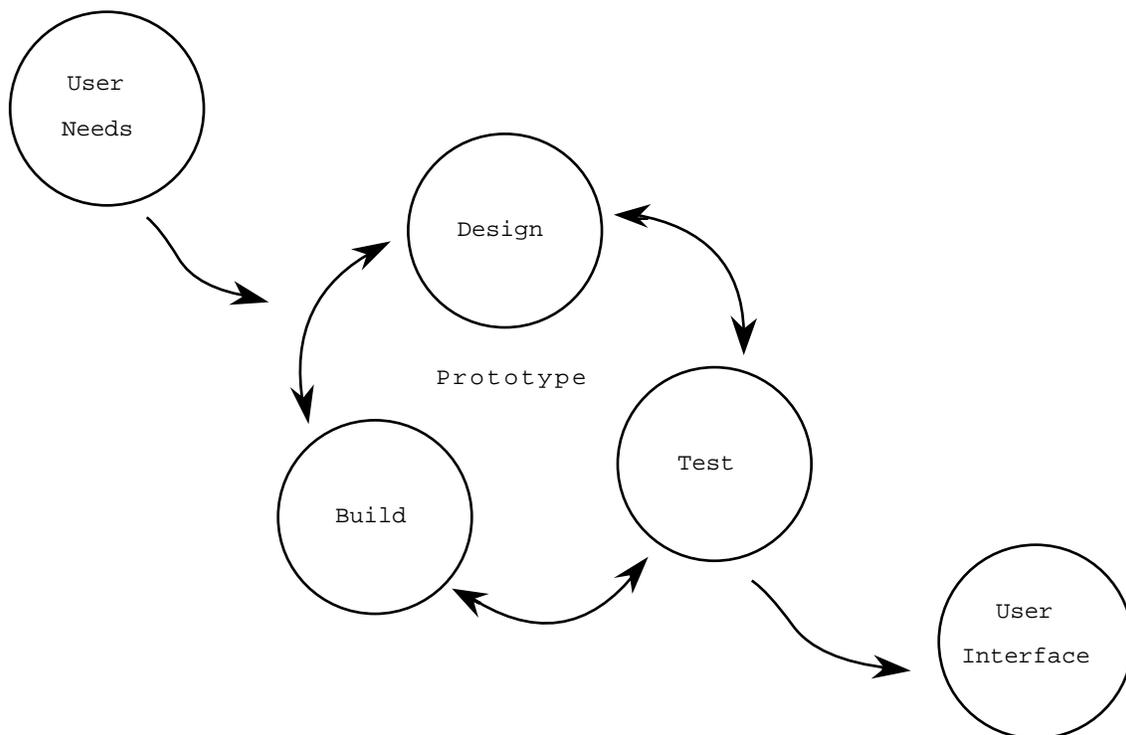
Presenting interface ideas

- to UI designers—looking at all parts of the interface
- to programmers—implementing the interface
- to marketing and management—determining application features
- to users—getting early feedback

■ How do we approach interface design?

- Get in touch with real users early in the process and get them involved in the design.
- Also include implementers and evaluators.
- Get something visible early.
- Consider first ideas expendable— use them to find out more about the problem.
- Prototype in a malleable medium.
- Try out early ideas with real users.
- Plan to iterate.

■ A model of the process...



■ Notes—



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SCRIPTS

■ What

A script is a narrative description, in written form, of the interaction between the user and the machine.

- It describes the story *action* (task)
- the *dialog* (between the user and machine)
- the *environment* where the story takes place, and
- characteristics of the *user* (physical, emotional) that may effect the user interface.

■ Why

Use a script to envision the interaction between the user and the machine—

- Identify characteristics of the user that may impact the design.
- Identify the tasks that the interface might support.

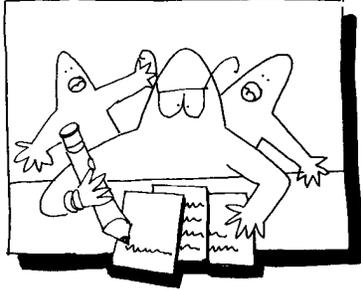
Use the script as a design tool—

- It's a basis for discussion about the interface with design team, users and implementers. Everyone can get involved.
- The detailed narrative helps identify task sequencing.
- It grounds the design in the 'real world' of the user and the task.
- It's easy to brainstorm with a script—it's quickly done and easily changed.

The written narrative serves as a basis for the storyboard and other sketch prototypes.

■ When

- Create the script early in the design cycle.
- Work through the task in verbal form first.
- Build a common understanding of the user interface before committing to implementation.



■ How to create scripts—

1. Select a scenario topic that focuses on the task or technology you are developing.
2. Develop a character profile to describe each of the users involved with the technology.
3. Set the stage by defining the context or environment where the story will take place.
4. Write a story that describes the tasks the user will accomplish using your technology.
5. Be concrete and specific wherever possible.

DRAWINGS

■ What

A drawing is a free hand sketch or simple visual representation in any medium.

- It conveys the ‘look’ of the user interface.
- It describes in graphic form the visible features of the interface, their character and spatial relationships.

■ Why

- Drawings help the design team to develop a shared representation of what the interface will look like.
- They are the first step toward making the interface visible.
- Anyone involved in the design can comment on and modify them.
- Drawings help communicate ideas quickly and flexibly.

■ When

- Drawings should be made as soon as you’ve identified the tasks that the interface will support.
- Use them throughout the design cycle as medium for discussing changes.



■ How to use drawings—

1. Develop and use a vocabulary of user interface symbols. (see Sibbet, 1981)
2. Build on the events described in the script.
3. Use shortcuts when ever possible—photocopy or trace other drawings, reuse old drawings, etc. (see Hanks & Belliston, 1977)
4. Look on your sketches as a simple communication medium. Don't judge them as works of art. They are expendable.
5. Bring drawings into every discussion of the design. Encourage others to mark them up.
6. Make them a collaborative medium of the design in process.
7. Refine the drawings as details become resolved.

■ What

Screen shots are a static snap shot of the display screen, either on paper or on the screen itself.

- They are like drawings in that they are static, graphic representations of the user interface.
- They differ from drawings in that they are a translation of the interface ideas to the final presentation medium—the computer display.

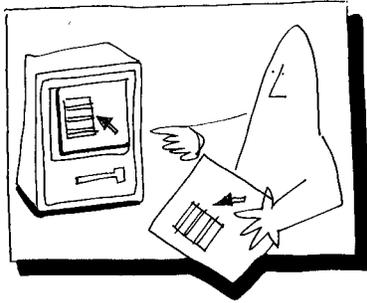
■ Why

The screen shot provides the first glimpse of what the design will look like on the computer.

- Constraints and limitations of the display medium become apparent, e.g., pixel size, character size and shape, line quality, screen size and resolution.
- The screen-based image can give the look of the ‘real’ interface even if the interface does not yet function.
- Use them as a presentation medium, when you need to communicate interface ideas more clearly and accurately than with drawings.
- Use them to test the clarity, legibility and intelligibility of the screen layouts.

■ When

- Use screen shots as a design tool after concepts are worked out on paper.
- Work with them when you want to get into the final display medium early in the design cycle.



■ How to make screen shots—

1. Determine what computer to use.
 - Develop images on the final display or a close approximation.
 - Have custom development tools made if none exist for your machine.
2. Decide what programs to use.
 - Paint if you need to illustrate.
 - Draw if you need to construct.
3. Incorporate other images.
 - Use clip art.
 - Scan hand-drawn sketches or photos.
 - Grab images from other interfaces.
4. Decide on a medium for showing screen shots to others. •
Computer display—if you need to see the interface in context.
 - Print—if you can't transport the hardware, if you need to present in print, e.g., in a report, paper or proposal.
 - Slides—if you want to present to large audiences, or in color.
 - Video—if you want to carry something small, present in color, and resolution is not an issue.
5. Some tools...
 - Mac—SuperPaint, MacPaint & MacDraw for b/w
PixelPaint, Studio 8 for color
 - PC—Deluxe Paint, PC Paintbrush

STORYBOARDS

■ What

A storyboard is a sequence of single images, each of which represents a distinct event or narrative element.

- It is a visual representation of the script and illustrates the interaction between the user and the machine.
- Imagine it as a film in visual-outline form.

■ Why

Use storyboards in two ways—

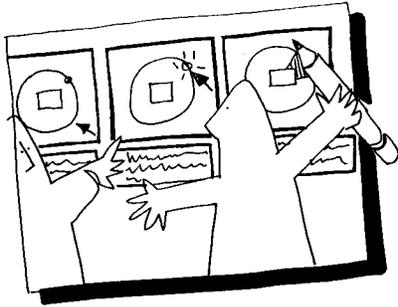
- Describe the *task* with a series of images, showing the user, the environment, and the computer.
- Describe the *interface* with a series of screen images, indicating the user's representation and the computer's response.

In addition...

- Many interaction details are worked out as you keep asking “what happens next?”
- Storyboards can show, at a glance, the sequence of interaction between the user and the computer.
- Use them to develop usage scenarios and to help define the tasks and tools.

■ When

- Develop storyboards after the task description or script writing phase.
- Storyboard the task and take it back to the user.
Do you have the story right?



■ How to make storyboards—

1. Construct a visual and verbal sequence that illustrates the interaction. Some things to consider are...
 - environment—where the system is used
 - visual cues—what the user can see
 - audible cues—what the user can hear
 - tactile cues—what the user can touch
 - user input—how the user communicates to the computer
 - computer output—how the computer responds to the user •
 - user's emotions—how the user perceives and responds to the interaction
 - technology—what technology is involved in performing the task
 - quality of experience—what benefit is perceived.
2. Use a grid that puts the graphic representation above and the verbal description below.
3. Begin with loose thumbnail sketches and drawings for early design concepts. Refine with tighter drawings and screen shots for presentation and testing.
4. Describe interaction details and emotional responses verbally when no visual representation is effective.
5. Keep the medium loose and flexible in the conceptual design phase.

FLIPBOOKS

■ What

A flipbook is an ordered stack of separate images that, when flipped, creates the illusion of movement or transformation.

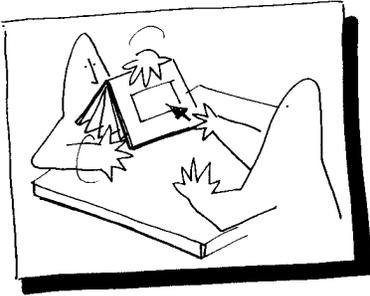
When used for interface visualization, it presents a structured, dynamic view into the interface.

■ Why

- Flipbooks build on storyboards to refine thinking about interaction sequence, since they restrict the view of the interaction to one event at a time.
- They can easily be made to ‘branch’ by hand and can simulate an interactive response long before you have working code.
- Users can select their own path through the interface and give early feedback on the interaction design.
- Flipbooks can force development of a ‘system map’, an outline of possible states and paths through the interface.
- Use them to visualize changes in the state of the interface, e.g., zooming windows, highlights, etc.
- They are simple to make, easily changed, inexpensive and portable.
- They can be a first pass at showing animation in the interface.
- Use them as a presentation tool, to walk someone through the interface.

■ When

- Make a flipbook before animating in other media to resolve interaction and sequence details.



■ How to create flipbooks—

1. Define the interaction that the flipbook will illustrate.
2. Construct a detailed task description so that you know each step of the interaction. Build on the script.
3. Build a system map—a tree chart that accounts for every possible user input and every system response—for the interaction you want to visualize.
4. Represent each step on a separate sheet of paper. Use hand drawings, computer paint or draw printouts, or screen shots on paper.
5. Stack the drawings in sequential order. Try using a binder to hold the sheets together while enabling smooth flipping.
6. Mark the branching points with tabs or post-its for easy access.
7. Flip fast when you want to give sense of animation or transformation. Flip slowly when you're walking through complex interactions.

ANIMATICS

■ What

Animatics are a form of film or video animation.

Often called moving stills (kinestasis), animatics combine camera effects such as pan and zoom with reframing of the subject to achieve a sense of motion. (see Imes, 1984)

■ Why

- Animatics add the illusion of motion to a still image.
- The motion can direct the viewer's attention, make conceptual transitions and clarify the sequence.
- The animatic adds a dimension of time to the storyboard, overcoming its static quality.
- These simple animations force resolution and refinement of transition and sequence details.

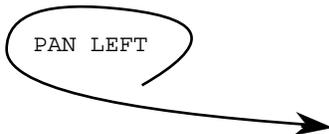
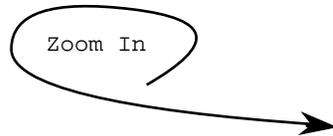
■ When

- Use animatics *after* producing drawings or storyboards of the interface
- Use them and *before* building interactive prototypes.



■ How to make animatics—

1. Pin drawings or storyboards on a wall.
2. Set up a video camera on a tripod. Use lights if needed.
3. Shoot the flat drawings or storyboards individually and in sequence.
4. Use camera techniques, such as pan, zoom, rack focus, etc. to give the illusion of motion in the image.
5. If necessary, edit the sequences together.
6. Add narration and audio effects to give realism, clarity and completeness to the sequence.



PUPPETS

■ What

The use of puppets is sometimes called direct animation.

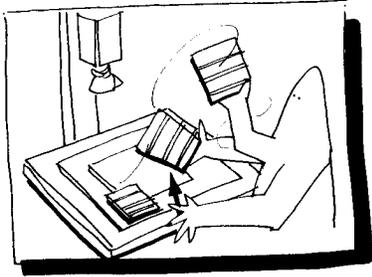
- Two and three dimensional models of interface elements are moved around in front of the camera.
- Interactions and responses are described through both real-time motion of the puppets and tightly edited sequences of single frames.

■ Why

- Puppet prototypes can be quick and easy to setup and to modify.
- They are good for spontaneous exploration and simulating real-time response factors.
- Simple skills, materials, and tools are needed to construct and use them.
- Objects (backgrounds, cursors, menus) can be reused in the animation, eliminating the task of redrawing.
- Once you build a library of puppets, they can be reused for other interface prototypes.
- It may be a quicker and cheaper alternative to computer modeling techniques, e.g., for simulating interfaces to 3D applications.
- Use them to show simple movements (translation, rotation, etc.) They're less convincing for zooming, scaling or other "magical" transitions.

■ When

- Use puppets after detail interactions have been planned in sketch or drawing form.



■ How to work with puppets—

1. Plan the interaction using storyboards or flipbooks.
2. Construct a puppet or model of the basic interface elements. (The menu bar, cursor, desktop, windows that don't change scale, menus, etc.)
3. Build special elements for effects such as inbetweens for size changes, flashing cursors or buttons, transparent overlays for ghost boxes, moving cursors.
4. Set up the puppet under a video camera that is mounted on a copy stand.
5. Film the interaction that is defined by the storyboard or flipbook. (Shoot in real time or hold for each inbetween.)
6. Edit the sequences together to simulate motion.

■ What

Computer animated prototypes use the power of the computer to assist in the tedious aspects of animation, such as in-betweening and object repositioning.

It is based on two types of image manipulation:

- animations that flip through a sequence of pixel maps or pictures to create the illusion of motion.
- animations that rely on a mathematical model of the objects depicted. These models are used to compute each new view, as well as the intermediate positions and perspectives.

■ Why

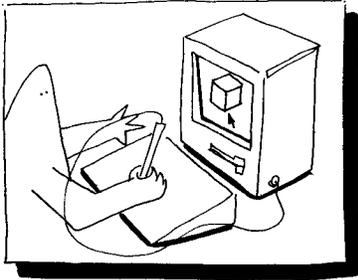
- Use computer animation to give a high degree of realism to the prototype, especially in rendering details and showing smooth motion.
- Show scaling, warps, distortions and rapid color changes more easily with this technique.
- 3D animation is most effective for prototyping interfaces to 3D applications such as CAD, visualization.
- Use it for presentation, since it can give the most realistic 'look and feel' of the interface before a real prototype is working.
- Use it when no other medium will work and you have the resources (hardware & expertise) for it.

■ Why not?

- It can be expensive, not easily portable, and difficult to learn and use.

■ When

- Construct a computer animation prototype after the design is well resolved.



■ How to make computer animations—

1. Resolve interaction events in storyboards or flipbooks first.
2. If working with pixel maps—
 - Use paint and draw tools to develop images that depict each event in the interaction (like a flipbook).
 - Use the animation program to “flip” through the images, to give the illusion of motion, interaction.
 - You direct the sequence of images.
 - Some Mac tools: HyperCard, VideoWorks, MacroMind Director, Studio1.
3. If working with mathematical models—
 - Develop models of each object to be depicted, either in the program or on paper.
 - Input the models and other parameters (e.g., light source, rendering resolution, etc).
 - You direct the movement of the objects and the view into the scene.
 - Some Mac tools: Swivel3D, DynaPerspective.
4. Good references for these techniques are Fox & Waite, 1984 and Kerlow & Rosebush, 1986.

SPECIAL EFFECTS

■ What

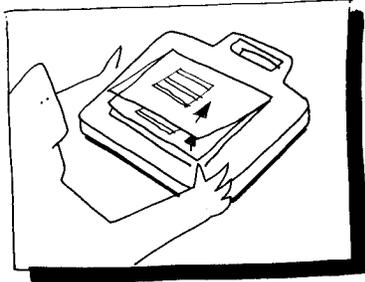
Special video effects can be created on high-end video systems to simulate effects that might be seen in the future technology. These effects include wipes, zooms, compressions, flips, twists, etc.

■ Why

- If you want to provide a compelling illustration of the product and its interface in a realistic context, combine special effects with live action.
- If you want to paint a highly believable vision of how the interface might be used and what it will look like in the final hardware package, combine video effects with industrial design models.

■ When

We recommend this for presentation purposes only.



■ How to work with special video effects—

1. Prepare a script and storyboard to work out the sequence of events and timing of the interaction.
2. Use animatics to test camera moves and timing.
3. Build industrial design (ID) models.
4. Construct computer generated elements (animations, screen simulations, etc.)
5. Record live action shots of scenes, actors, ID models.
6. Create narration, dialog and special audio effects to add realism and detail.
7. Consult a post production agency to create special video effects, or do your own if you have the resources.
8. Edit video and audio segments together..
9. (Get ready to shell out big bucks!)

■ What

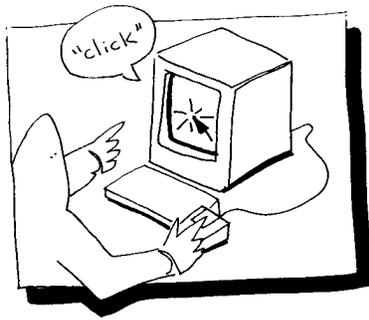
Some specialized computer applications or languages use high level scripting commands to create interactive interface events. Some examples are HyperCard, VideoWorks Interactive, Prototyper, SmallTalk, UIM's, toolkits, etc. These can be used to visualize an interface in development.

■ Why

- Use interactive software to create the most believable system response to the user.
- 'Look and feel' and real interactive response can be vividly simulated.
- Some interactive software and toolkits offer a short path from mock-up to running application code.
- A library of interface elements can be built up, so successive prototypes can be made more quickly.
- Design details become refined as subtle interactions of sequence and timing are exposed.
- Use this technique when you have the tool, the skills and want a direct path to working code.

■ When

- Interactive software prototypes are most valuable in testing, to get feedback on appropriateness and clarity of system response.



■ How to use interactive software for visualizing interfaces—

1. Pick a tool to build with. Some selection criteria are:
 - Will it run on my machine?
 - Can I use it—can I learn it?
 - Can I draw with it—can it create vivid, new screen images?
 - How easy is it to modify once it's working?
 - Can it evolve into finished code?
3. Look for user interface toolkits, drawing programs, scripting environments.
4. Put together an interdisciplinary team: graphic artist, psychologist, and programmer are a good mix.

Graphic
interface



High-level
code



DOCUMENTING PROTOTYPES

■ What

Slides and video are the most effective means for documenting and preserving your sketch prototype.

- Videotape it in action to record its dynamics.
- Shoots slides of all static elements—drawings, screen shots, puppets, storyboards, flipbooks—to record their graphic qualities.

■ Why

- Live demos can foul up.
- Sketch prototypes can wear out.
- Slides and videos can be archived; paper mock-ups may get tossed.
- Slides and videos travel compactly and show off reliably.
- You don't have to bring along the real hardware.
- You can select the part you want to show off.

■ When

Document your prototype

- while you build it,
- when it's finished,
- before it breaks.

■ What you need...

For slides...

1. 35mm camera.
2. 50mm macro lens for copy stand work,
100mm macro to shoot from screen.
3. Lights on copy stand.
4. Hood made of mat board or foamcore to control
reflections on display screen.
5. Slide film ASA 64-100 for daylight or screen. Tungsten
balanced ASA 160 for copy stand shots.

For video...

1. Pick a format—8mm, VHS, Super VHS, 3/4" U-matic,
BetaCam. Pick a camera—tube or chip, 1 element or 3.
Consider...
 - Resolution—how much detail do you need to show?
How much post production do you intend to do?
 - Compatibility—what other formats do you have
already? What will you need to interchange with?
 - Accessibility—will they have this format where your
tape is going? Can you find support equipment?
 - Price—what's your budget? What's the cost of support
equipment & services?
2. Shoot—
 - Use portable lights and tripod for wall-mounted pieces.
 - Use copy stand for small flat artwork.
 - 3D work can be filmed with either a wall-mount or
copystand setup.
3. Edit—
 - Use time code or control-track editors if you have access
to them.
 - For minimal system, punch-and-crunch between two
decks. Use record deck or camcorder with 'backspace
edit' or 'flying erase head' feature.

COMPARISON

■ What

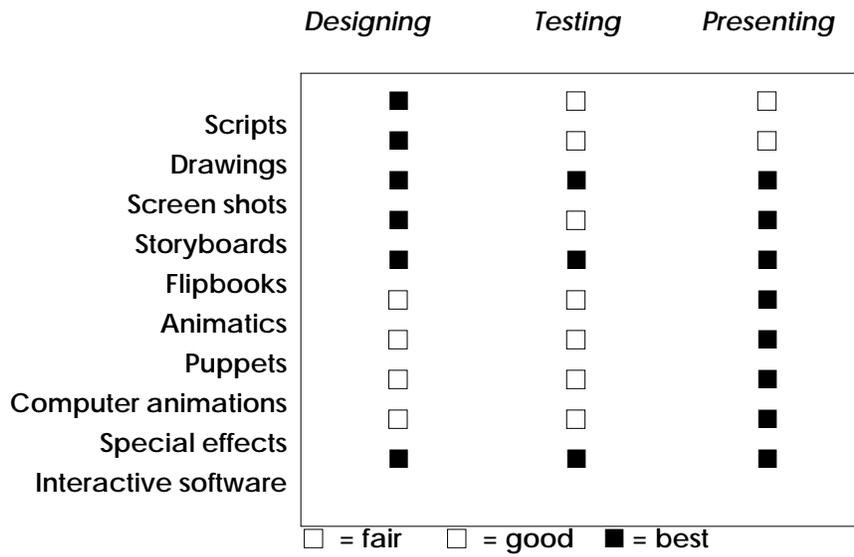
This table compares sketch prototype techniques on the dimensions of realism—how vividly and believably it depicts the interface—and engagement—how much it involves the user .

		<i>ENGAGEMENT</i>		
		Static	Narrative	Interactive
<i>Realism</i>	Sketchy	Drawings	Storyboard	Flipbook
		Paint or draw print out	Animatics	Puppets
		Screen shots on different display	Puppets	Scripted language must be ported
		Screen shots on final display	Computer animation	
	Believable		Special effect video	Scripted language becomes product
			Product demo	

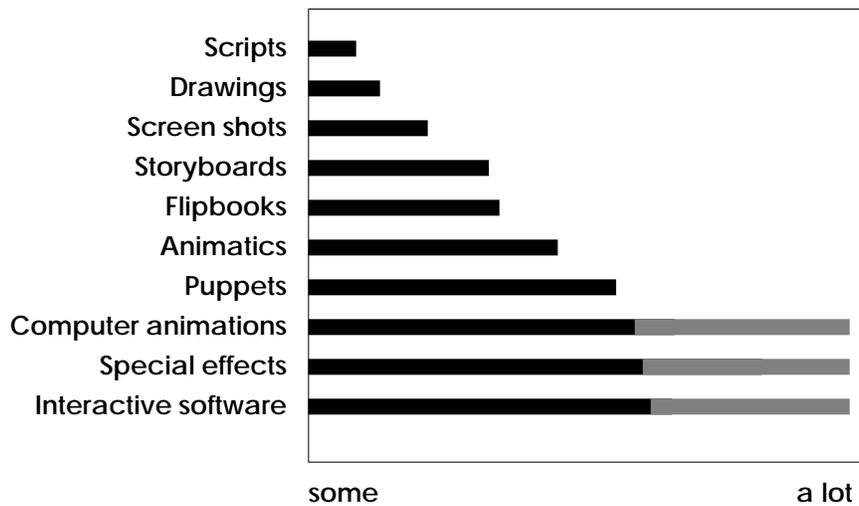
■ Why

This comparison shows alternative visualization techniques to consider, depending on your needs and where you are in the development process.

■ When to use these techniques—



■ Skills and resources needed—



TESTING TIPS

■ What can we learn with sketch prototypes?

Each sketch prototype technique described here can be used to elicit informal feedback on the design. Here are some things to ask with each type. (See Gomoll, 1990 for user observation techniques.)

■ Static

Static prototypes can tell you primarily about the intelligibility of the design. The sorts of questions that you can ask about static prototypes are:

- Can you read or interpret this?
- How does this relate to that?
- What do you think you should do first, next, last?
- What do you think this does?

■ Narrative

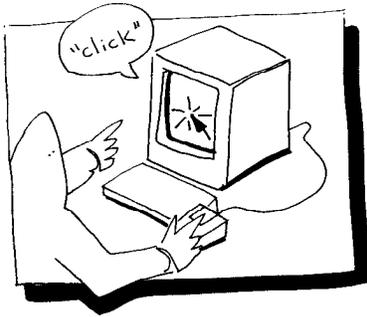
Use narrative prototypes to learn about the trackability of the interface—the ease with which changes or transformations can be understood.

- Can you follow this?
- What do you expect should happen next?
- Is something missing?
- Does it make sense to do this next?

■ Interactive

Interactive prototypes can be used to test the fumble factor of the interface—how easy it is to do the right thing. Give the user a task to do, then ask:

- What are you doing now?
- What are you thinking?
- Why did you do that?
- Did it do what you expected it to?



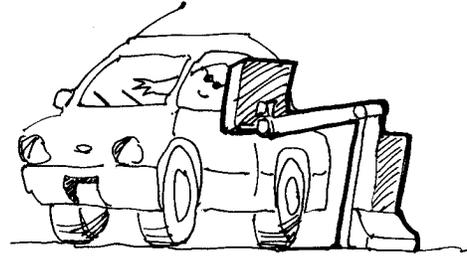
■ Summary

1. We see user interface design as a process which best involves users, evaluators, implementers, and designers from the start.
2. Rapid visualization of interface ideas can make the design more accessible to the whole team.
3. We've shown ten techniques for visualizing features of the interface at several levels of complexity, realism, and engagement.
4. There are techniques here for those with simple tools and basic skills, as well as those having sophisticated hardware and expertise.
5. These techniques can be used to facilitate the design process, get early feedback on interface ideas, and communicate concepts to everyone involved.

EXERCISES

■ The problem—

Blue Sky Petroleum is an oil company dedicated to providing the highest level of service to its customers. They see a need for better service at self-service stations, and they are developing a completely automated gas pump. Blue Sky engineering has worked out the technology to find the gas cap, connect the nozzle & regulate the fuel flow.



Our task is to design the user interface to this refueling station. The technology available for the user interface is similar to that commonly used for Automated Teller Machine (ATM) terminals: credit card reader, receipt dispenser, a small set of function keys, and a display. We have an option to use a bit-map display in place of the character displays commonly used on ATM's.

Blue Sky's idea is that the customers should be able to treat this transaction just like full service—they would simply indicate the amount and type of gas they want, hand over their credit card, and wait. Cleaning windows and checking the tires is a 'future enhancement' we don't need to consider now.

■ Exercise 1—

Invent a story about the automated gas pump, its users, and their interaction with it. Write a script that describes the action that takes place, the dialog between the users and the pump interface, their environment, and other things about the user that may affect the interface. Characterize the users—think about why they are there and what attitudes and expectations color the interaction.

■ **Keywords—**

Fill up

Regular

Unleaded

Supreme

Five gallons

Five dollars

cancel

erase

go back

Go on

start over

execute

help

Call attendant

■ **Exercise 2—**

Begin to draw a set of symbols and graphic images that communicate key features of the interface and the user's interaction with it. Working in small groups, quickly sketch the ideas with simple images that spark recognition in the group. Start with the list of keywords to the left. Draw without words. Go for recognition in 30 seconds or less.

■ **Exercise 3—**

Develop a storyboard that describes the interaction between the user and the pump terminal during a typical transaction at this new service station. Work with your group to describe in sketch form the key features of the interaction.

Put them into a sequence that enables someone to follow a complete transaction and understand what happens. Refer to the 'How' section of Storyboards in these notes.

■ **Exercise 4—(optional)**

Put your storyboard frames into a flipbook format. Have at least one set of branching alternatives described. Try out your interaction design on a member of a neighboring group. Give him or her a task, such as filling the tank with 5 gallons of unleaded gasoline.

Pick a member of your group to handle the flipping and branching. The remainder of your group should simply observe, without prompting the user. Other members of the user's group may participate in wondering "what happens next". See what you learn in this simple test of a sketch prototype.

GLOSSARY

- animatic:** Often called kinestasis, an animation method that pans or zooms the camera during photography of still photographs or artwork to add motion to static images.
- animation:** The technique of creating the illusion of motion of a stationary object or drawings by means of single frame exposures.
- animation stand:** An assembly that holds the camera securely while the artwork is being shot frame by frame.
- cel animation:** The use of layered objects or drawings to create animation. When only part of a scene is to be animated and the rest of it remains still, it is unnecessary to redraw objects that remain constant from one frame to the next. (In film animation, objects were drawn on transparent acetate 'cels' so that they could be reused from one scene to the next.)
- collage/cut out animation:** The use of cutout, collaged shapes to create animation. The animation may consist of a wide variety of graphic elements, including photographs, drawings, screen printouts or abstract materials.
- computer animation:** A computer graphic tool that generates and animates graphics. A general term for sequential images produced by a computer and usually displayed on a video screen to simulate 2-D or 3-D animation effects.
- cross dissolve:** A film effect in which one image fades out as a new image fades in simultaneously. The overlapping of a fade-in and fade-out for a scene transition.
- cut:** The abrupt end of a scene or action. The following scene is abutted to the end of the previous scene.
- direct animation (under the camera):** The process of frame-by-frame animation which is achieved during the filming process. It is often known as animating "under the camera," because the creation and manipulation from frame by frame occurs as the camera is shooting frame by frame. Examples are object animation and puppet animation.
- drawings:** Drawings are free hand sketches or simple visual representations of user interface concepts. They help to develop a shared representation of what the interface will look like and are used throughout the design cycle.
- drawn animation:** Animation created from successive drawings that change minutely from one to the next.
- editing:** The sorting, assembly, synchronizing, and general preparation of various film elements into a smooth flow of picture and sound information. The activity of assembling all of the elements of the film into one animation.
- fade:** An optical transition effect of a gradual lightening of the scene from full black (fade-in) or a gradual darkening to full black (fade-out).
- flipbook:** A stack of separate images flipped by hand to create the illusion of movement and transformation. A form of camera-less animation.
- frame:** The single picture that describes an instance of an animation.

HyperCard: A computer tool for the Apple Macintosh. It uses the metaphor of a stack of cards to define relationships between pieces of information. Text and graphics can be defined by the user to create interfaces for accessing information. A high level scripting language is included for more sophisticated authoring capabilities.

in-between: The frames of the animation that fill in the action between key frames. An intermediate drawing needed to complete an action.

in-point: The first frame of a desired video shot or sequence, used for identification at edit time. The complement to this is the out-point, the last frame of the shot.

industrial design: A design discipline that focuses primarily on the design and manufacture of products and packaging.

interactive software: Computer programs used as tools for developing or modelling interactive applications. They are characterized by the use of high-level scripting languages and often provide toolkits for design of the user interface.

key frames: The start and end positions of an animated movement. The key frames, or 'extremes,' of each movement are drawn first. In-between frames are drawn secondly to fill in the motion or details between the key frames.

live action: A sequence of a film in which real objects are photographed while they are moved around, as opposed to a sequence of motion achieved by photographing a series of animated drawings.

pan: A horizontal, vertical, or diagonal camera move along the artwork.

pencil test: The test of the animation that is sketched first, then animated to preview the details of the animation before investing in the final animation.

prototype: A first implementation of a design idea in any form.

punch and crunch: A rudimentary video editing technique in which the record deck is held in pause while the play deck is rolling toward the in-point of the desired shot. When that in-point is reached, the pause is lifted (usually by punching the pause button again) and the desired shot is recorded. Works best when record deck has backspace-edit or flying-erase-head feature.

puppet animation: A stop-motion technique in which the subject matter consists of three-dimensional figures and backgrounds, which are moved incrementally for each frame of the action sequence.

rack focus: A camera technique in which the focus of the lens is noticeably shifted between foreground and background. Useful for transitions. Shifting out of focus sometimes used as an alternative to fade out.

sequence: A grouping of related scenes that are edited together in proper order and complete with respect to visual continuity.

scenario: a brief written description of a situation and the action in the situation.

scene: (1) The script action and dialog. (2) The subject being photographed by the camera.

■ Glossary *continued*

screen shot: A static reproduction of any image created or manifest on a display screen.

script: A short manuscript that fills in some of the details left out in the scenario. Often sets the context of the story as well. The written instructions that contain all dialogue, action, and camera directions used to guide the film production. Scripts are used in interface design to help define the interaction between the user and the machine.

special effects: The combination of many video and computer effects into one prototype. They are used to simulate interfaces to future technologies.

stop motion: A photographic process in which the subject matter is exposed on successive frames of film on a frame-by-frame basis rather than continuously, as in standard motion-picture photography. Between exposures, the subject matter is moved incrementally to create the illusion of movement.

storyboard: Preliminary sketches of action in sequential order. The storyboard serves as the initial description of the user interface and is necessary in discussion and planning of the production.

tilt: A camera movement caused by tipping the camera body up or down.

transitional effect: An effect, such as a cross-dissolve or wipe, designed to create a smooth flow of visual continuity between scenes. Transitional effects help

connect one scene or action to another scene or action.

user interface: Those parts of a device or system, particularly a computer system, which the human user might encounter or interact with.

video prototype: The use of video to create the illusion of a working user interface. They are often used to prototype interfaces to future technologies.

visualization: Any tangible, visible manifestation of a concept, especially a design concept.

zoom: A shift in focal length of the camera lens, between close-up and wide-angle views, giving the impression of moving toward or away from the subject.

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