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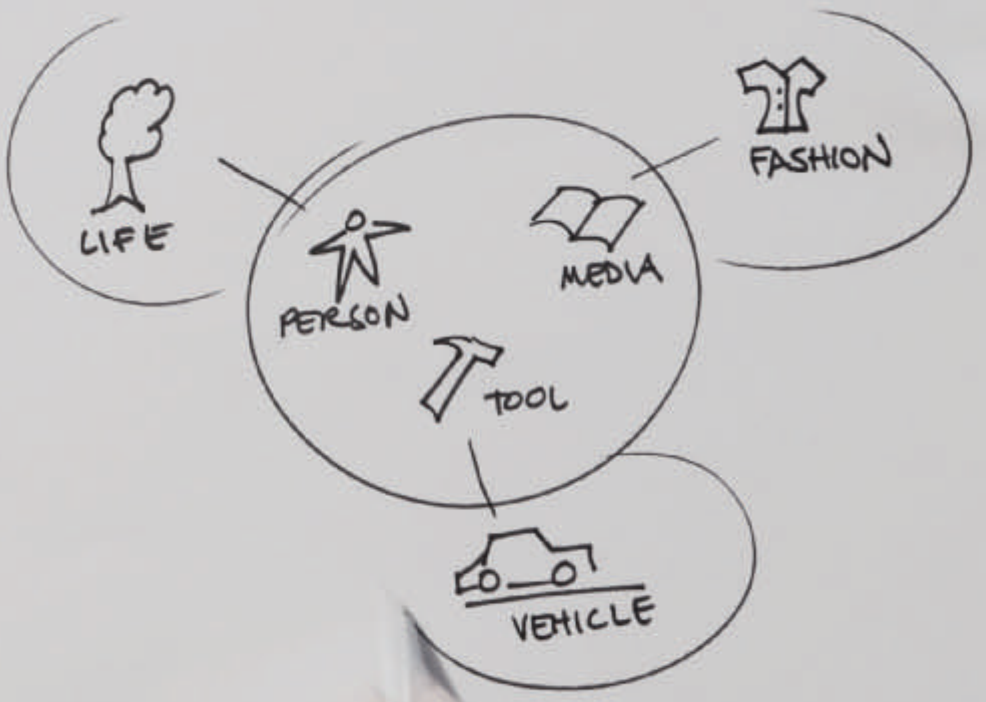
DESIGNING INTERACTIONS

BILL MOGGRIDGE



Foreword by
GILLIAN CRAMPTON SMITH

Designing Interactions

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Bill Moggridge

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Multisensory and Multimedia

Interviews with Hiroshi Ishii, Durrell Bishop, Joy Mountford, and Bill Gaver

Until recently, rendering bits into human-readable form has been restricted mostly to displays and keyboards—sensory deprived and physically limited. By contrast, "tangible bits" allow us to interact with them with our muscles as well as our minds and memory.

Nicholas Negroponte, a founder of MIT's Media Lab

■ The drummer surrounds himself with stimulants for all of the senses, and an electronic keyboard (from Yamaha)

Photo
Steven Moeder and Craig Syverson

We all have five senses; how sad that our connection to computers is "sensory deprived and physically limited," as Nicholas Negroponte so aptly phrases it. Visual displays are gradually improving, but our sense of touch is limited for most of the time to the feel of the keyboard and mouse. Sound exists as a dimension in the interface but so far has not taken the prominent place that seems possible. Smell and taste are not yet present. And then, what about dimensionality? Can we go beyond x, y, and z, and make more use of the time dimension? Although we already have some examples of animation and time-based behaviors, we could go so much further, if we think about making full use of multiple media.

This chapter explores the opportunities for interaction design to become multisensory and to take advantage of multimedia. We start with a plea to break away from the status quo and design for better use of our vision and touch. Then we look at the work of some remarkable innovators. An interview with Hiroshi Ishii, professor of the Tangible Media Group at MIT Media Lab, introduces the concept of "tangible bits." Durrell Bishop, an interaction designer based in London, talks of interfaces made up

"Visions of Japan" Exhibition at the Victoria and Albert Museum, London 1991–92

- Room 1, Cosmos—"The Realm of Cliché"
- Room 2, Chaos—"The Realm of Kitsch"

of things that are physical and connected. Joy Mountford tells the story of pioneering the use of QuickTime, when she was Head of the Human Interface Group in Advanced Technology at Apple, and her research into audio at Interval. Bill Gaver, researcher and interaction design teacher, talks about designing sound, discusses the psychology of affordances, and shows some examples of concepts that have subtle psychological relationships with the people that use them.

Vision

Why should you be chained to your computer? You sit for so many hours at a time, staring at that small rectangular display of information: it is always the same focal length, with no relief for the eyes; it makes no use of your peripheral vision; it is so dim that you have to control the surrounding lighting conditions to see it properly. Why not break away, and wander in smart environments covered in living displays, or carry a system with you as an extension of your senses, augmenting vision?

In 1991 there was a wonderful exhibition in London called "Visions of Japan,"[1] based on a concept by the architect Arata Isozaki. You moved through three large spaces, each celebrating a theme. The first was "The Realm of Cliché," which presented various entertainments. There were examples from such arts as the tea ceremony, flower arrangement, incense connoisseurship, calligraphy, martial arts, and popular and classical performing arts, to sexual pleasures, and the traditions of the underworld.

The second space was "The Realm of Kitsch," which examined the nature of competitiveness in games and sports. Competition is the basis of baseball, golf, the Japan Broadcasting Corporation singing contest, pastimes like pachinko, and the majority of other topics of daily conversations.

The third theme was "The Realm of Simulation," and this space demonstrated a dramatic expansion of the potential for visual display. The entire floor and walls of a high-ceilinged rectangular hall were completely covered with moving images. Some of the time they were separated into individual images making a collage of screens, and some of the time they were huge panoramas, stitched together to form a single image. One movie was recorded in the concourse of a mainline railway station in Tokyo at rush hour, so that as you moved through the space, you were part of a sea of Japanese commuters, hurrying in every direction to find their trains. The images on the ground were projected from the ceiling, so that the visitors to the space became part of the display screen, covered in moving images themselves, as they stood transfixed or moved slowly forward.

Here is a quote from Isozaki's description of this theme in the catalog:

> Electronic devices of innumerable kinds have spread throughout society, transforming its systems and practices from within. Television, video recording, pocket-size audio devices and giant video displays, compact computer devices, like television screen hookup game equipment and personal computers, are irreversibly altering our ways of life.
>
> The images produced by these systems are displayed on screens but they are completely separated from the real things themselves—processed, edited, and otherwise qualitatively changed, often into something completely different. That process can be manipulated, creating impressions of convincing simulation.
>
> The constant bombardment of such simulated images could cause those images to flow back into the real world, blurring the line between real and simulated. Perceptions may become completely reversed, producing the sensation that reality is only part of a world of simulation.

This idea of "blurring the line between real and simulated" was demonstrated very convincingly by the exhibition, but the audience were passive receivers of the experience, like cinema-goers; there were no interactive enhancements to their lives.

There is a considerable body of research into collaborative work making use of large electronic displays. For example, Terry Winograd has set up an interesting program called the "Stanford Interactive Workspaces" project[2] to explore new possibilities for

Room 3, Dreams—"The Realm of Simulation"
Arata Isozaki

people to work together in technology-rich spaces with computing and interaction devices on many different scales. The focus is on augmenting a dedicated meeting space with large displays and concentrating on task-oriented work such as brainstorming meetings and design reviews. The implementation of these high-technology solutions has been slow in coming. Part of this is due to the high cost of the equipment, and the immaturity of the software solutions. Perhaps there is a more basic reason based on the nature of our vision: we see clearly in a narrow focus, but we also have a powerful capability of perception with our peripheral vision. Terry Winograd describes us as spatial animals:

> There have been a variety of projects to try to take information and make it into something that feels like a real space. People are spatial animals; our brains evolved through millions of years of operating in the world, starting in the savanna or wherever it was. One direction has been to make abstract spaces, which capture the structure of information in a way that feels more like a real space.
>
> I remember some of the early demonstrations from SGI that took your file system—your ordinary hierarchical file system—and turned it into a bunch of buildings spread around on a landscape, so an area corresponded to a file directory, and you could zoom into a building to find a document. I think it was interesting, but in general did not work well, because the abstraction that was supported did not match one's intuition spatially. Your brain ended up spending a lot of time trying to figure out what all that stuff was doing, when none of it was relevant. It wasn't really a physical space, it wasn't really a tiger coming to catch you, it was just some node opening up, and you don't want to put the cognitive resources into dealing with that. So the trick—and I think it's a challenge—is to match the spatial representation with the cognitive structure of what you're doing, so that it actually makes sense and it isn't just a separate layer of window dressing on top of it.

Multidisciplinary design teams at IDEO[3] have evolved a solution to this quandary called the project room. Design projects are assigned a dedicated space, which is filled with all of the information generated during collaborative work, relevant reference materials, mockups, prototypes and so on. As you enter one of these rooms, you are engulfed in the richness of information. Most of the vertical surfaces are made up of large foam-board surfaces, covered in printouts, images, articles, handwritten notes from brainstorms, and multicolored "stickies" embellished with sketches and notes. Horizontal surfaces are stacked high with reports, magazines, books, and lots of the objects that inform the context of the project. If you are a member of the design team, you will probably have spent much of your time working in that space with your colleagues. If you are away from it for a while and then return, it is amazing how you can just stand there for a few minutes, and find that all your memories and insights about the project come flooding back. Perhaps that is because of the nature of our peripheral vision combined with the way our brains work, but we have not yet found ways to make good use of these abilities when we are using visual display technology.

When it comes to the technology that you can carry with you, the concept of "augmented reality" has replaced the expectation of "virtual reality" that was so popular for a time. Moving into a completely separated virtual world may still be attractive for entertainment or fantasy, but to ignore the real world is giving up too much for many applications. The heads-up display for fighter pilots has been augmenting vision with additional information for decades, but the versions of that concept that have been tried for the windscreens on cars, or the equivalent for eyeglasses, have not yet been designed well enough to attract a significant audience.

Our eyes are so important to us, promising a lot of opportunities to improve what we see and the way that we see it.

Members of a design team work in a project room at IDEO, full of visual reminders of information

The cockpit of an F2 fighter (1999), with heads-up display

Touch

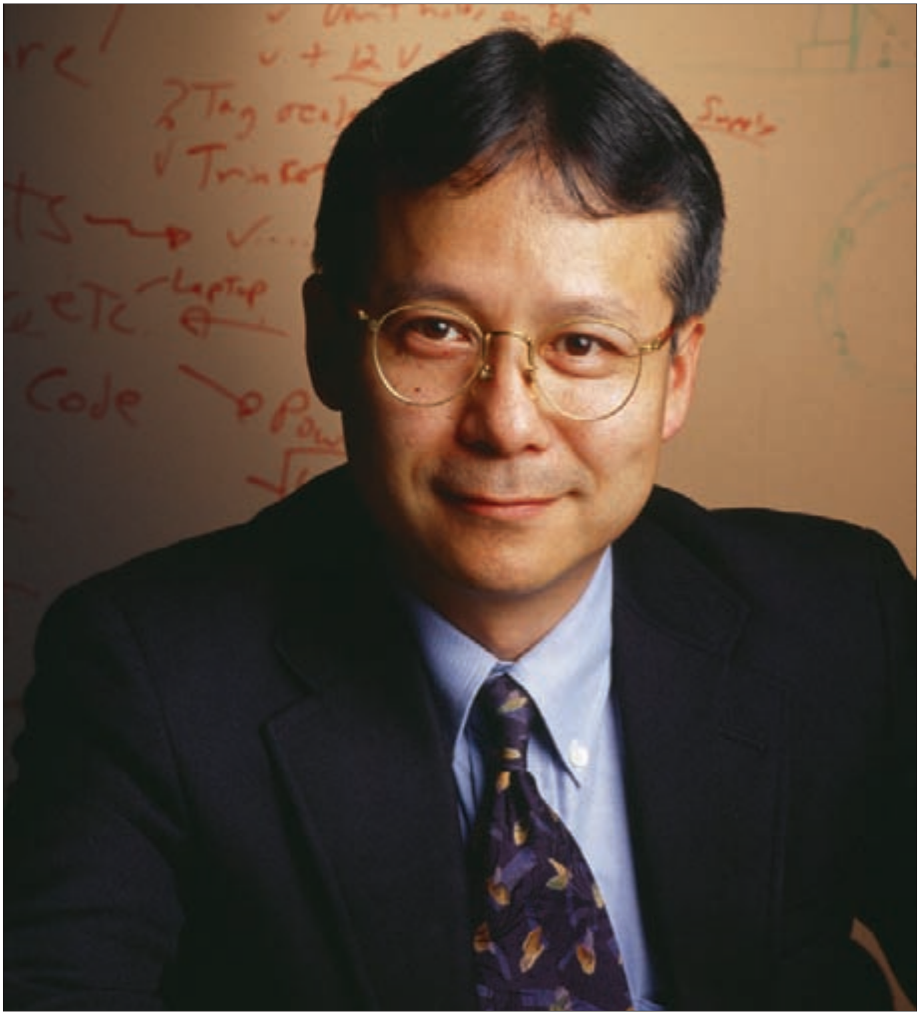
CONSIDER THE TACTILE qualities inherent in the design of a spoon. An elegant shape may be the first thing that appeals to you when you are looking at cutlery on a table or in a store, but the difference between a spoon that you enjoy using repeatedly and one that you come to ignore is much more than love at first sight. Touch and feel means a lot with a spoon—the way that the edges of the handle feel when you pick it up, the weight and balance in the hand, the feel of the bowl as it touches your lips, the way it slides into your mouth, plus the quality and surface texture of the material. The tactile qualities of an object mean a lot to us.

A telephone handset has a similar level of tactile intimacy as a spoon. You feel it in your hand, pick it up and put it against your face, pressing the earpiece over your ear to hear the strongest sound. A cell phone also has the interactive complexity of lots of keys for input—too small to operate accurately without a good snap-action tactile feedback. Turn off the ringer to avoid interrupting others, and you can feel the vibrator telling you that a call has come in. The cell phone is an example of the convergence of digital and physical interaction; in one product the design for sight, sound, and touch are all crucial.

■ The touch of a spoon compared to the touch of a handset

Photos
Nicolas Zurcher

When you are designing for generic computers, there is limited opportunity to work with touch, as the medium is normally limited to visual display and sound for output, plus keyboard and mouse for input; it is only when you are designing one of these input devices that tactile feedback and the qualities of touch are essential ingredients of the solution. Hiroshi Ishii and Durrell Bishop are both doing something about breaking the touch barrier, adding the dimensions of physical feeling to the interface. In the interview that follows, Hiroshi Ishii describes his tangible user interface (TUI) and introduces projects that are being designed by the members of his Tangible Media Group at the MIT Media Lab.



Hiroshi Ishii

"This is a small weather forecast bottle that I wanted to give to my mother on her birthday, but as she passed away in 1998, it became my tribute to her. It contains the weather forecast of Sapporo City, my hometown in Japan. Let me check what the weather is like. Now you hear the sound of the bird singing; this means tomorrow becomes a clear day. If you hear the rain sounds, tomorrow becomes a rainy day. Information is brought to you from the Internet, but it is a very different interface from using Microsoft Internet Explorer or clicking with a mouse." As he demonstrates his weather forecast bottle, Hiroshi Ishii is standing in the MIT Media Laboratory, where he is professor of the Tangible Media Group. He is surrounded by projects, prototypes, and demos, which explore the design of seamless interfaces between people, digital information, and the physical environment. With degrees in electronic and computer engineering from Hokkaido University in Japan, he came to MIT to found the Tangible Media Group. His team seeks to change the "painted bits" of GUIs to "tangible bits" by giving physical form to digital information. Ishii and his students have presented their vision of tangible bits at many academic, industrial design, and artistic venues, emphasizing that the development of tangible interfaces requires the rigor of both scientific and artistic review. Before MIT, from 1988 to 1994, he led the CSCW Research Group at the NTT Human Interface Laboratories, where his team invented TeamWorkStation and ClearBoard. His boundless enthusiasm for tangible interfaces carries him around the world to make presentations and demonstrate prototypes.

Hiroshi Ishii

At the seashore, between the land of atoms and the sea of bits, we must reconcile our dual citizenships in the physical and digital worlds. Our windows to the digital world have been confined to flat rectangular screens and pixels—"painted bits." But while our visual senses are steeped in the sea of digital information, our bodies remain in the physical world. "Tangible bits" give physical form to digital information, making bits directly manipulable and perceptible.

Hiroshi Ishii[4]

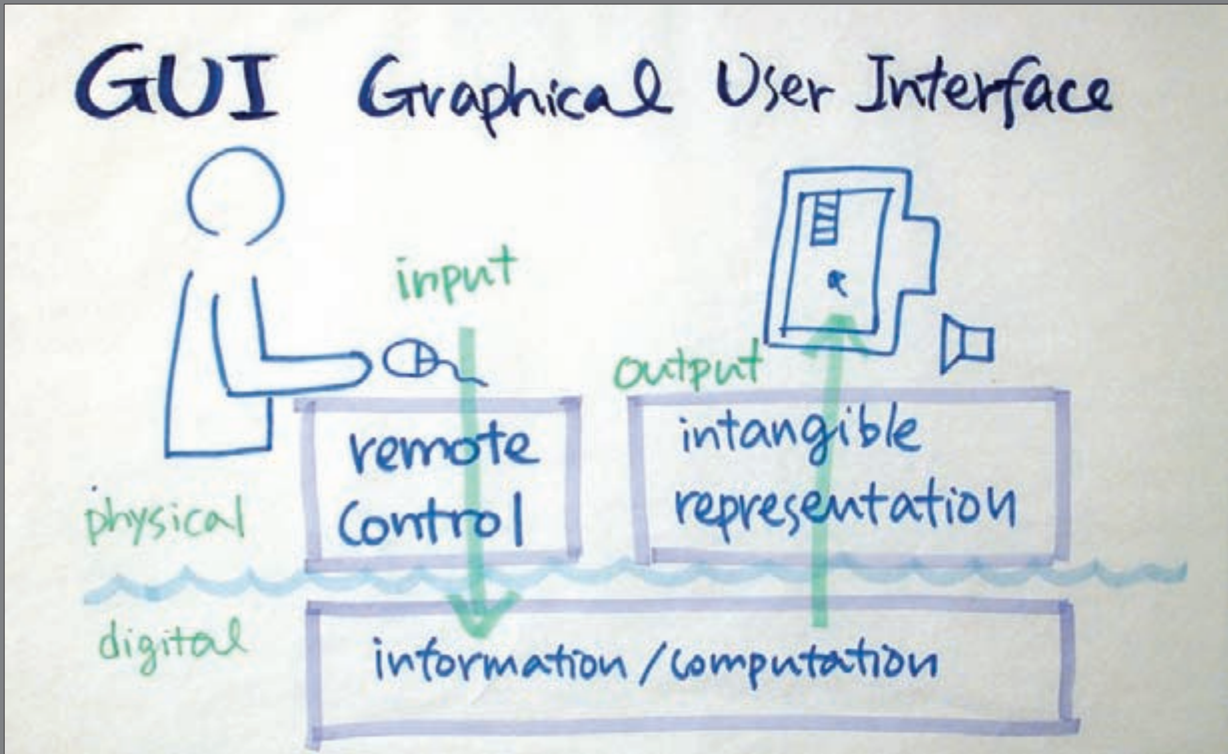
Tangible Bits

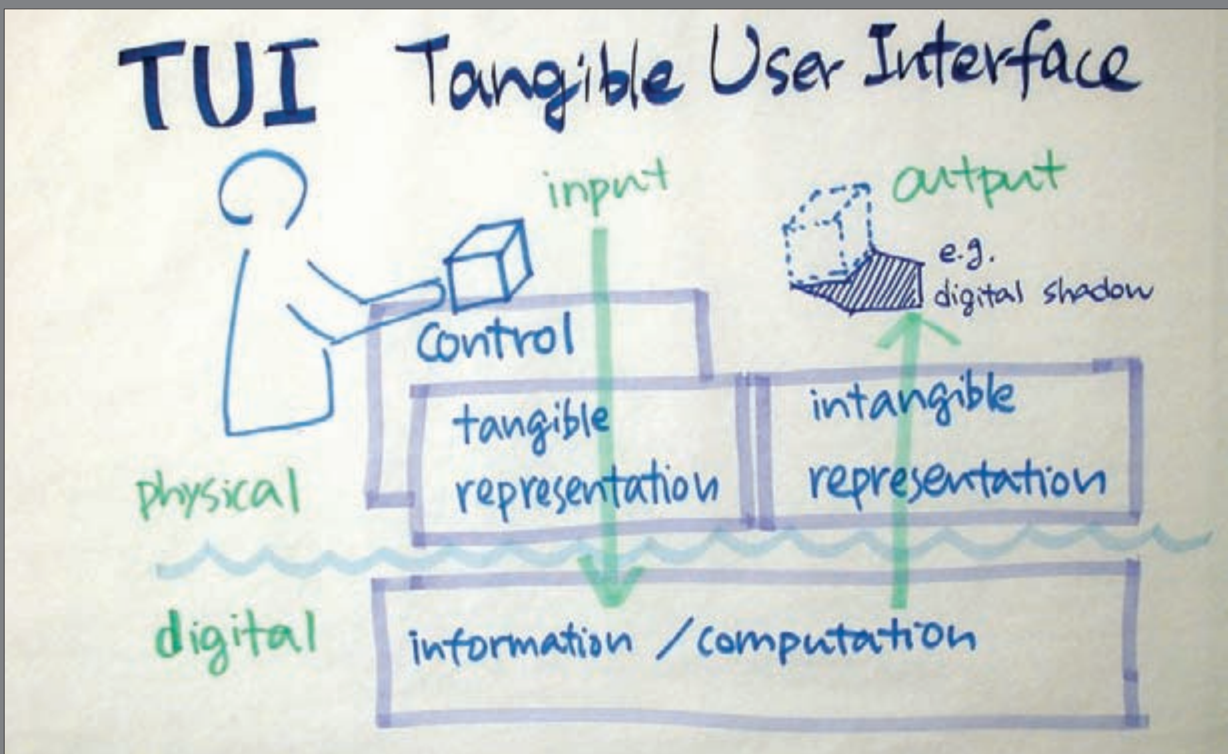
▪ "Tangible Bits" exhibition at the ICC Gallery in Tokyo

Photo
Courtesy of NTT InterCommunication Center (ICC)

Hiroshi Ishii stands in the conference room adjacent to his project space at the MIT Media Lab. He is eager to explain the concept of tangible bits, and has already prepared some hand-drawn posters to illustrate what he wants to say. He starts by talking about basic interactions, leading in to a comparison between graphical and tangible user interfaces:

> This diagram shows very simple structures. Interaction requires two key components. One is the controls, through which people can manipulate access to digital information and computations. Also, it's very important to have external representations that people can perceive, to understand the results of the computations. Today I would like to extend this model of interaction to explain first graphical user interface, then I'd like to talk about the main topics of tangible user interface.


GUI Graphical User Interface
input
output
remote control
intangible representation
physical
digital
information / computation


TUI Tangible User Interface
input
output
e.g. digital shadow
control
tangible representation
intangible representation
physical
digital
information / computation

GUI—graphical user interface

This diagram illustrates the graphical user interface that was originated by the famous Xerox Star work station in the early eighties. The graphical user interface provides a variety of components, like windows, menus, or icons, but it represents these components as intangible pixels. The basic medium of the representation is pixels on the computer screen: that is intangible. To control these representations, the graphical user interface provides generic remote controllers, like a mouse or a keyboard. One of the key features of graphical user interface is the separation of intangible representations from general purpose remote controllers, which enables flexibility and malleability.

TUI—tangible user interface

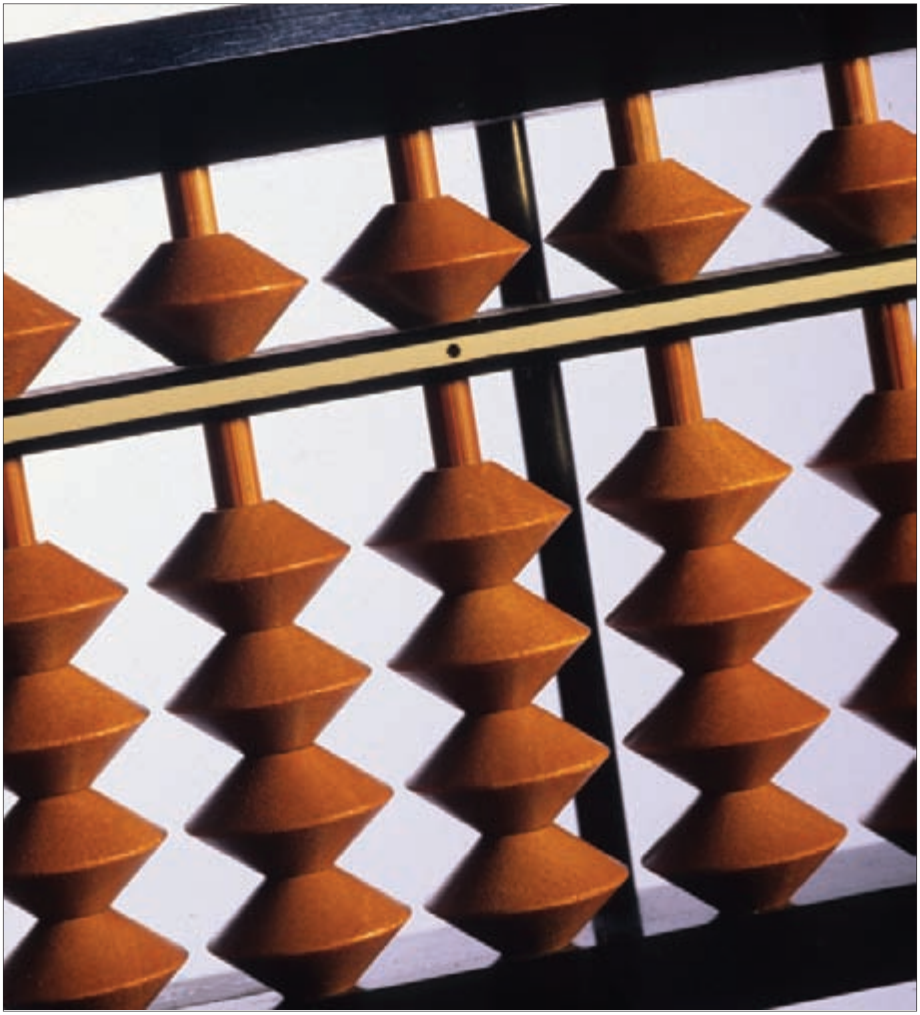
This diagram illustrates the tangible user interface, which my group has been working on for the past several years. The key idea is giving a physical form, a tangible representation, to information and computation; this differentiates our approach from the graphical user interface. The tangible representation is tightly coupled with the computation inside the computer, but the representation is physical, so that it also serves as a control mechanism, allowing people to directly grab and manipulate. By doing so, they can control the internal computation or digital information. So the coupling of tangible representation and control is one of the key features of the tangible user interface.

One of the problems of physical representation is that we cannot easily change a shape, or a color, or a form dynamically, using current technology. Therefore, we usually couple a tangible representation with an intangible representation, like a video projection or a sound. We then try to create the illusion that these two representations are coupled perceptually, so that people can get dynamic output or feedback, either video projection or sound, coupled with these tangible representations.

In short, an important key feature is to give physical form to information, so that you can have multiple forms of control of the information, especially multiplex control. This also contributes to helping people simultaneously work in collaborative situations.

- GUI—graphical user interface
- TUI—tangible user interface

Illustration
Hiroshi Ishii



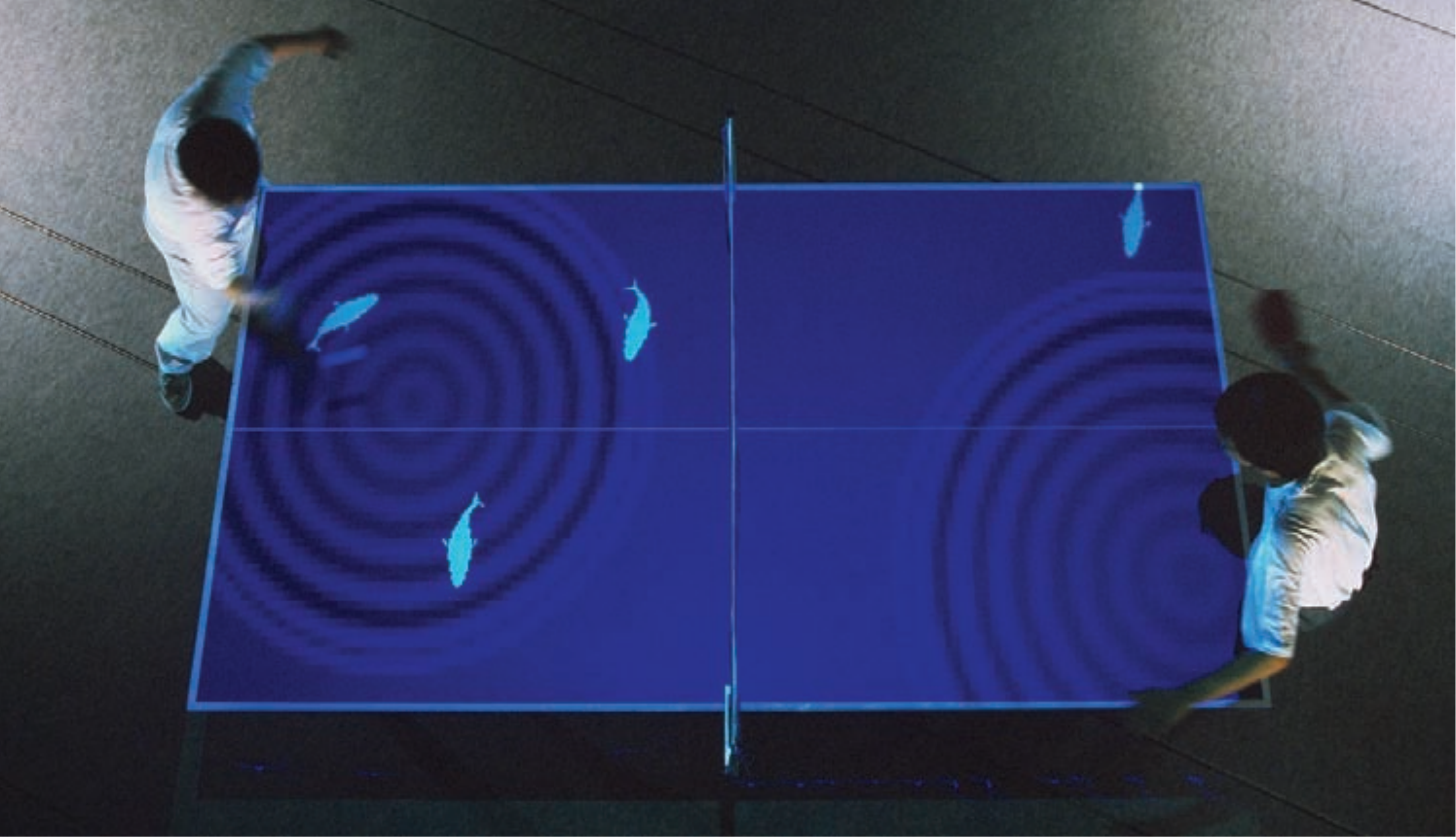
Abacus

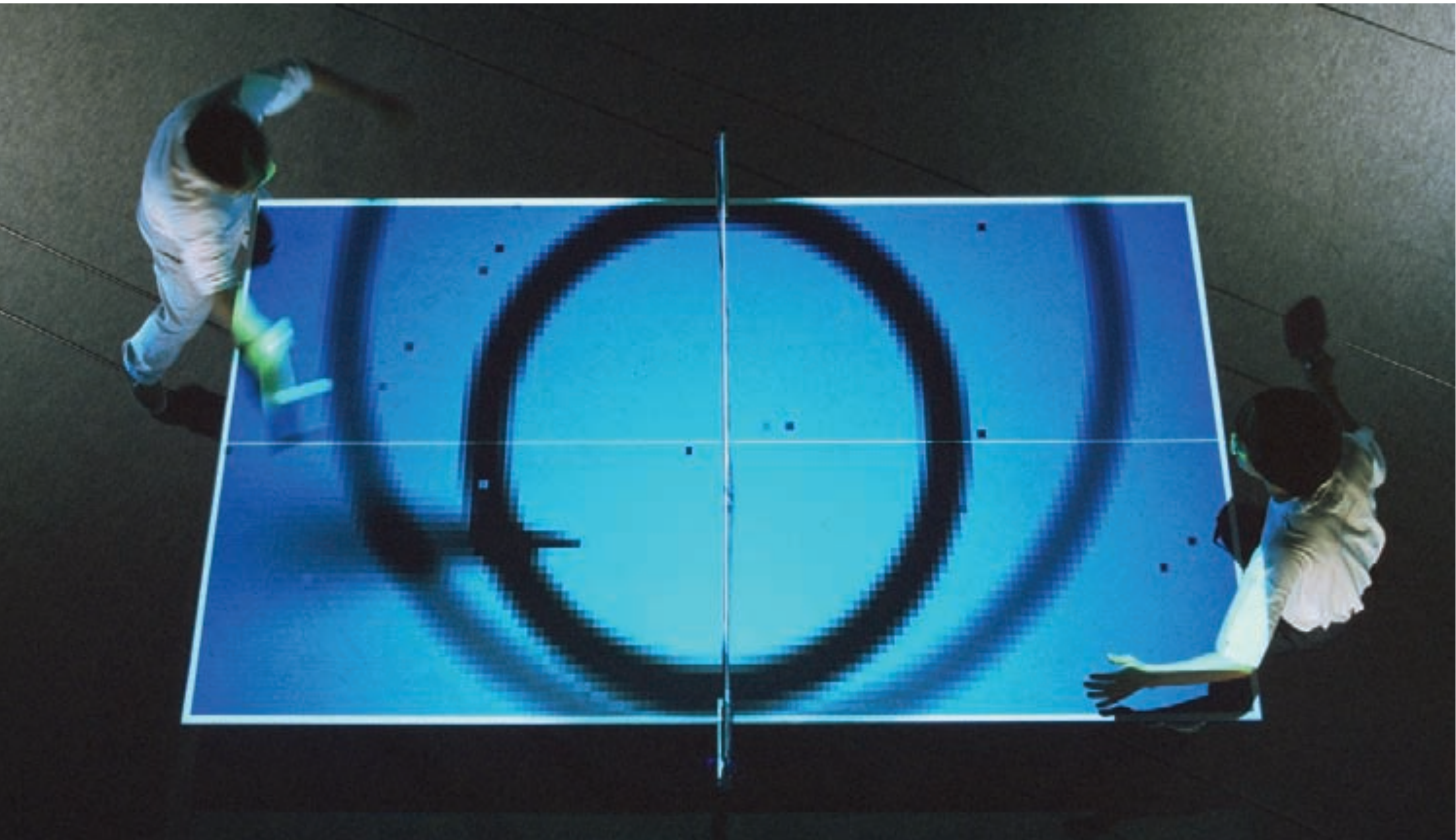
Hiroshi picks up an abacus. It is a simple and elegant design, over a foot long and about three inches wide, with a dark rectilinear frame well polished with use. The counters are simple double-cone-shaped wooden beads that slide on slim wooden dowels. He handles it with the easy familiarity of a long association and talks about the meaning it holds for him:

> Here is an abacus, the simplest form of digital computation device. All of the information is represented in the array of the beads, in a physical way, so that people can directly touch, manipulate, and feel the information. This coupling of manipulation and control is very natural in this kind of physical device, but in the digital domain, the graphical user interface introduces a big divide between the pixel representation and the controllers like the mouse.
>
> Another important feature is the affordance. This is a simple mechanical structure; by grabbing this device when I was a kid, it immediately became a musical instrument, an imaginary toy train, or a backscratcher, so I could really feel and enjoy the beads. This also serves as a medium of awareness. When my mother was busy doing the accounting in our small apartment in Tokyo, I could hear the music the abacus made, which told me that I couldn't interrupt her to ask her to play with me. Knowing other people's state through some ambient sound, such as this abacus, teaches us important directions for the next generation of user interfaces. This simple historic device taught us a lot about new directions, which we call tangible user interface.

■ Abacus

Photo
Webb Chappell





Ping Pong

His next prop is a Ping Pong paddle. It emanates an aura of antiquity almost like the steps of a medieval building, well worn to the point of deformity and covered in pock marks and scratches; when he holds it in the play position, hand and paddle suddenly become one, and it melts into his body as an extension of his arm and hand:

> Ping Pong is one of my favorite sports; that's why we designed PingPongPlus.[5] Ping Pong really allows very engaging interactions, using full body motion, speed, vision, and other kinesthesia.
>
> We can learn a lot from this Ping Pong paddle about how interaction design should be really invisible and transparent. Well-used paddles become transparent, so that the player can concentrate on the main task, playing Ping Pong, trying to hit the ball. A good fit to the body is really critical to make the interface transparent. To make a good fit, you have to choose the right form, size, and weight. This physical object changes the form after intensive use for twenty years; you can see the dent left after twenty years of playing, capturing the traces of my physical body, in this case the right hand grip. The coevolution of these physical tools changing their form seems to suggest how we can design the interface to become transparent and also to become extensions to the human body, for both digital and physical domains.

PingPongPlus using sensing, sound, and projection technologies

Photo Courtesy of NTT ICC

musicBottles[6]

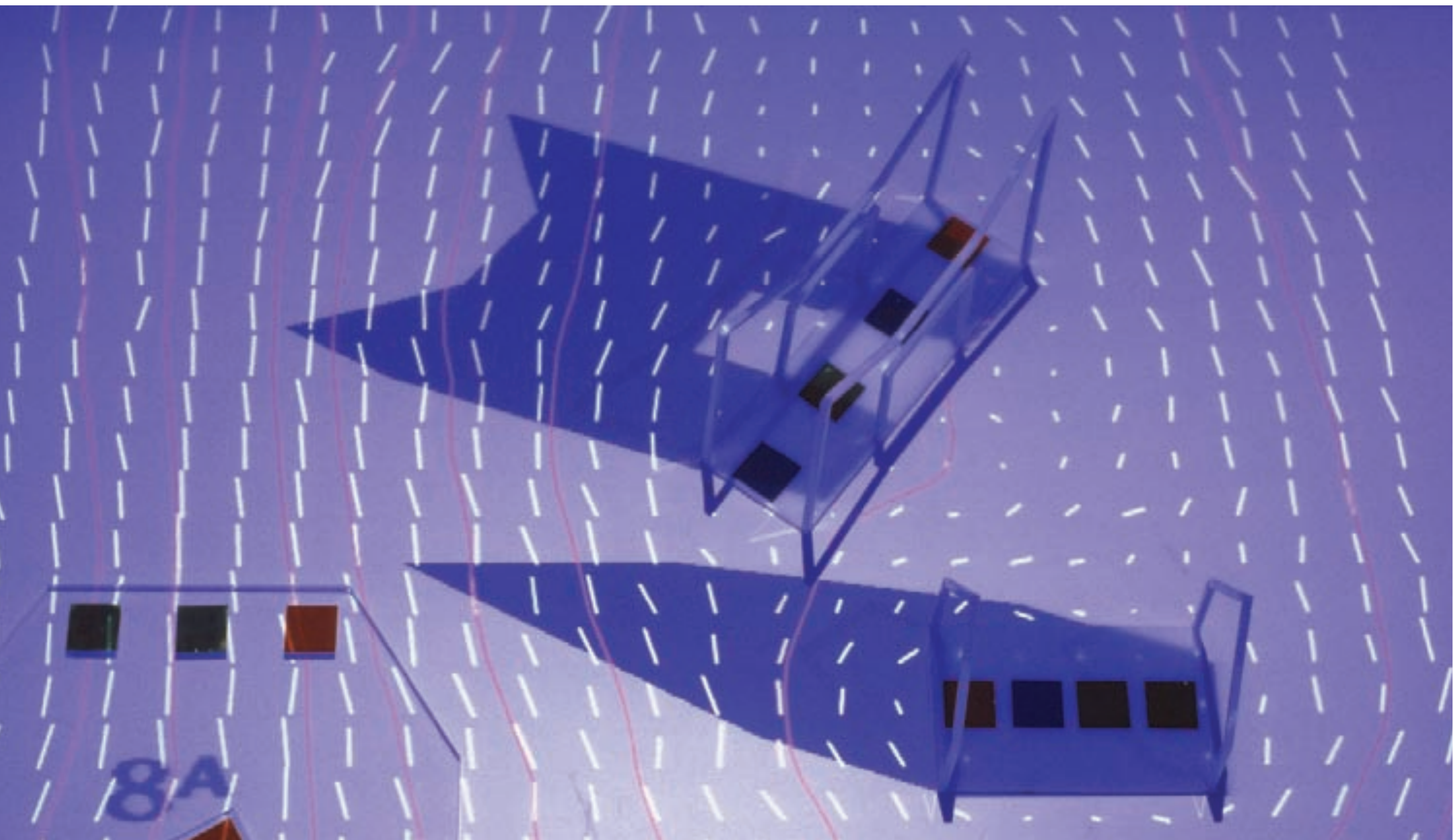
In the corner of the project space there is a shelf completely covered with transparent glass bottles. There are all sorts of shapes and sizes, but they are all attractive and interesting to look at and touch. Next to the shelf is a display consisting of a black horizontal surface, with an illuminated translucent disk set into it. On the disk there are three bottles with glass stoppers in place. Hiroshi reaches over and gently removes the stopper from one of the bottles, triggering the sound of a jazz pianist; then he does the same with the other two bottles, adding bass and drums to the trio, after a time turning off the sound by replacing the stoppers:

> Let me introduce the musicBottles project, which is using simple glass bottles as containers and conduits of online digital information. People have been using this kind of glass bottle for more than five thousand years. We extended the meaning of the container into the digital domain, and also the simple affordance of opening and closing it. This is a jazz trio. Let me play these glass bottles: she's a pianist, and bass, and drums.
>
> The importance is not the music, but the possibility that you can put anything you can imagine into any existing glass bottles in your home. You can see a variety of glass bottles behind me; some bottles contain stories, some bottles contain a genie, and you can also imagine perfume bottles that contain a chanson, or whisky bottles which contain a story of Scotland, for example.

■ musicBottles: each bottle represents an instrument, turned on by removing the stopper

Photo Courtesy of NTT ICC

With another three bottles he demonstrates a performance of a classical music trio. He then goes on to talk about the original weather forecast bottle, described in the introduction to his interview, which was inspired by his desire to communicate with his mother in Sapporo, Japan.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Tangible Media Group

Hiroshi Ishii was developing these ideas about tangible interfaces at NTT before he came to MIT as an associate professor in 1995. Since then he has been in full flow, with a team of students to help, led by a select group of graduates. This has given time for his lab to accumulate a wonderfully rich set of demonstrations and prototypes, making you feel that the whole world could be made up of magical connections between atoms and bits, with every physical object illuminated by projected information and offering controls for unseen systems.

James Patten is a graduate research assistant exploring tangible interfaces for business supply chain visualization. He shows a tangible tabletop interface covered with a projected diagram of business processes, where the little wheels on the surface act as knobs to allow you to play what-if? games with inventory control. There is a flat panel display at the back of the table, giving several different kinds of information about the process. As you rotate the wheels, you can see the parameters changing, represented by numeric values and little vertical bars, like thermometers. They are projected onto the table surface from above, so as you manipulate the wheel, the image falls onto your thumb, distorting slightly. It makes you feel that it should hurt, as the red column rises, but you can only feel the knob. Another surprise occurs when you drag the wheel away from the node on the diagram: it pulls the virtual graphic with it and then suddenly detaches itself: the graphic snaps back, and your control connects itself to another node with new parameters.

■ Urp, an application of the I/O bulb, is a digital urban planning workbench

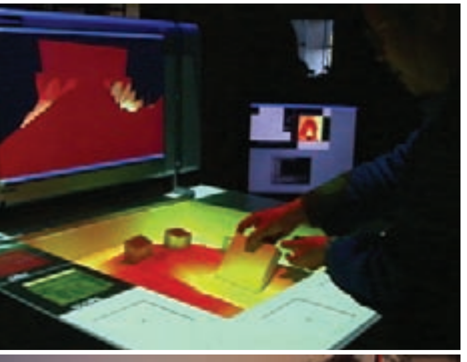
Photos top: Author

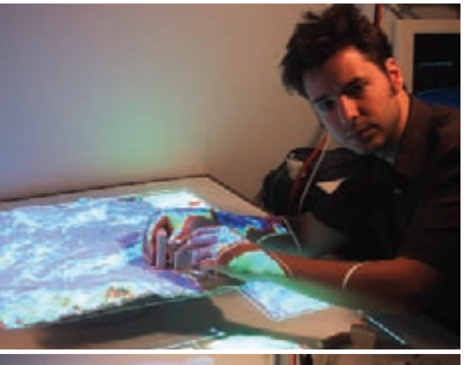
bottom: Courtesy of NTT ICC

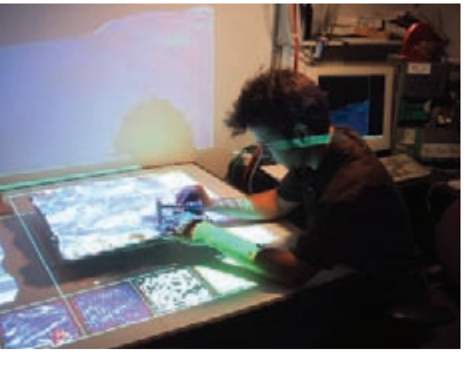
James moves on to demonstrate Urp,[7] an urban planning workbench. He positions physical architectural models on the surface of the table, and virtual shadows are cast according to a computer simulation of the time of day and season. The rotary controls to the side allow you to control a virtual clock, seeing the shadows and reflections when you adjust the time; a variation in the position of a building, or its size and shape, allow you to avoid any problems of overlap. Another simulation demonstrates air currents around the buildings in different wind conditions, so the planners can avoid those blasts of chill air that you sometimes encounter when you come round the corner of a large structure. Perhaps urban planners always feel that they have a supernatural level of control over people's lives, but there is something about using Urp to change these parameters in real time, which makes you feel power surge through your fingertips!

Next we move into a closetlike space that is overflowing with technology. There are projected images on two walls as well as the table and computers off to the side. This is the "Illuminating Clay"[8] project, where landscape models can be constructed using a ductile clay support. Three-dimensional geometry is captured in real time using a laser scanner, and from this information, simulations such as shadow casting, land erosion, visibility, and traveling time are calculated. The results are projected back onto the clay model, combining the advantages of physical interaction with the dynamic qualities of graphical displays. Ben Piper was another graduate student who was working on this project, and he explains:

> One of the prime aims of this interface was to allow objects from the designer's environment to enter directly into the computational simulation, rather than having to build objects digitally before adding them to a model.







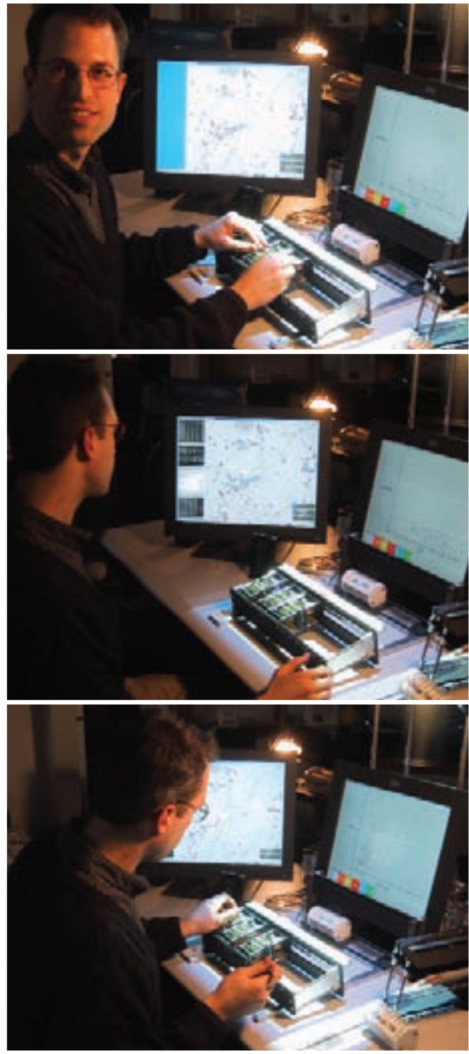
- "Sandscape" project demonstration (Sandscape is a later iteration using malleable sand)
- "Illuminating Clay" project demonstration
- "Illuminating Clay"—additional projections

The process is visually captivating, with rich colors, and multiple versions of the digital information arrayed on and around the physical model in a framework of rectangular windows. Ben demonstrates the molding of the clay to change the landscape, rotating the model to examine sections in different planes, and the addition of objects representing buildings. The real-time feedback for the experiments is so immediate that you can even use your hand to try out the impact of a large structure or a new hill.

Returning to the main area of the lab, we find Brygg Ullmer, a PhD student, sitting in front of a computer workstation with two flat screens. The surprise is that there is no keyboard or mouse on the surface in front of them; instead, there is a metal rack and a collection of bricklike modules by the side of it. Brygg explains that in this project, called "Tangible Query Interfaces," he is using physical objects to represent databases and express queries to those databases. He picks up a cylindrical object that looks as if it could be birthday cake from a bakery, until you notice that the decorative fringe is technical components rather than icing, and the words on the top say "REAL ESTATE." He explains that it represents a database of about five hundred homes in the Charlotte area of North Carolina. When he places it on the rack, it brings up the information about the homes on the screens—one as a geographical view and the other as a scatter plot view. He picks up the objects that look more like technology modules, saying that they represent parameters for the database, such as price, lot size, or square footage. Each module has a glowing indicator light, a screen on the front displaying a label and histogram, and two sliders that can be used to select a range within the displayed variable.

He puts the price module into the rack; the system recognizes it and brings up all of the houses in the system that fit within the chosen range. He moves the sliders to experiment with the prices and see their location in town. There seems to be a strong cluster of expensive houses in one area, but the inexpensive ones are more randomly scattered. He then adds another module containing lot size and demonstrates "AND" as well as "OR" relationships, depending whether the modules are touching each other or not. He adds a third parameter (the square footage) and experiments with the values and the order, which define the axis on the graphical representation. Soon he's reduced his list to a small number of houses that might be really interesting to him. He can extend the complexity of the manipulation of the database by adding a second rack, more query modules, and by moving the whole system back and forth on the table surface to change the values. You get the feeling that he can play his house hunt like a musical instrument or a construction toy, with the tangible quality of the interface adding a richness to the interaction that could make you feel more deeply connected to the information.

Hiroshi Ishii and the valiant band of graduate students in his Tangible Media Group are building connections between media and adding tactile qualities to the interface between people and computer systems, demonstrating that multisensory and multimedia interactions can be fun and help us do things better. Durrell Bishop wants things to be themselves, whether they are in the physical or digital world. In the interview that follows, he explains how he wants to design affordances to communicate potential behaviors, so we can express what interface elements are by designing them as physical objects that have digital properties.



"Tangible Query Interfaces" demonstration, allowing queries to be posed to a database of information about real estate

Photo Durrell Bishop

Durrell Bishop

Durrell designed the game Tea Diving for a CD-ROM included in an issue of the design magazine *ID*, keeping it compact, at less than 2MB. The first screen shows a box with a diving figure and a mug of tea, plus the description of the diving kit. Next is the "easy to assemble electronics," a screen with a printed circuit board and components that you have to drag and drop into place before it will "work." Once the task is complete, you are in the game. Little clothed figures fall from the sky and splat on the ground if left unattended. There is a large cookie that you can use as a paddle to rescue them, and you can bounce them into the huge tomato ketchup bottle: they emerge from the sugar pourer in swimming trunks ready to dive, and if you can bat them into the tea mug before they hit the ground, the side of the mug scrolls a message to the sound of cheering. The game exemplifies the impish humor that Durrell brings to his designs. He originally studied industrial design in London, and after a period of freelance design and photography, joined IDEO. In 1991 he returned to the Royal College of Art in London for a master's in interaction design and stayed on to continue research at RCA and with Interval Research in California. Later he designed games with Dancing Dog and then set up "itch" in partnership with Andrew Hirniak. After another spell with IDEO in London, Durrell branched out on his own again in 2004, helping his clients get the most out of highly interactive products and media.


TABLE TOP
DIVING KIT
INCLUDES :
full instructions
easy to assemble electronics
sample programme
adjustable variables
interactive postcard
COMPETITION DIVING IN YOUR OWN HOME
STEP 1. ASSEMBLE CIRCUIT BOARD
Congratulations
Part No.
1. Select components
Made in England
score...16

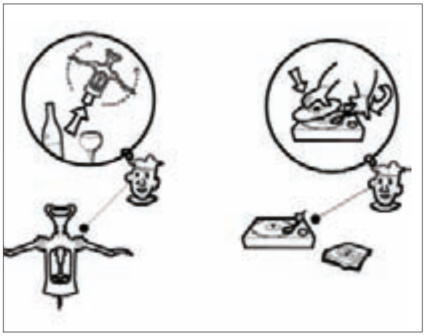
Durrell Bishop

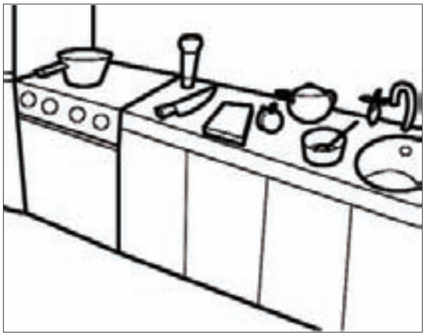
Things Should Be Themselves!

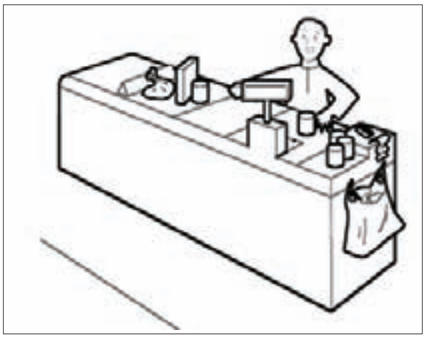
Tea Diving game by Durrell Bishop, designed for the Web site for *ID* magazine, size 231KB

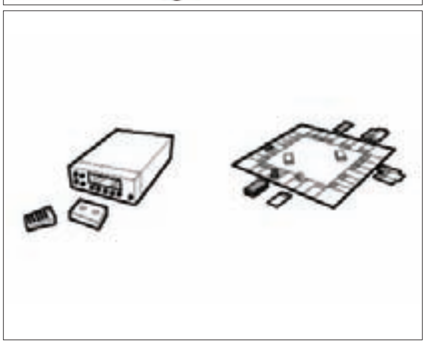
DURRELL BISHOP WANTS to design objects that are self-evident, whether they are physical or virtual. He looks at electronics and notices that the shape of the objects does little to describe what they are actually doing; it is hard to see the difference between a radio and calculator by their design. Consumer electronics modules are almost universally black boxes of a standard size, so that you can only tell the difference between them by the graphics that label the product and designate the buttons, and the buttons themselves are part of a text-based language; the legend above the button tells you what it is, and the button is no more than an action on a word. Perhaps the product has an instruction manual, but that is also text-based, so the conceptual model that establishes itself in your head is a series of instructions to help you manipulate labels.

What a contrast there is between these objects, which are supposed to be interactive, and the real world around us, which is full of self-evident things, like knives and glasses and gloves. These









- Corkscrew and record player
- Kitchen implements
- Supermarket checkout
- VCR compared to Monopoly

are objects that we immediately recognize and understand through the mechanical properties that they display by their shape:

> The mechanical world has got a lovely solution to this. Mechanical objects are usually descriptive of what they do. Here we have a corkscrew just to open a bottle of wine. The idea of pulling out the cork and the shape of the corkscrew fit together; you see it in your head the same way as you do it. When you see the object, it reminds you of what it does. Also with an old record player, the physical elements have properties which you can see and perceive how to act on them: the arm moves across, the disk spins finding a track, you look for the grooves and find the spaces. The whole product forms a fairly simple and a very descriptive system.
>
> I really like the kitchen. The kitchen is full of products designed by different people. Each of them is descriptive of what it does, but they all work together. At one end you've got things grown on trees, and at the other end you've got electrical appliances. Recipes work with them; they are like the manuals on how to use all these different items together. When you walk into a kitchen for the first time, you can probably guess where things are. This is a far cry from electronic boxes; as we all know, networking between different devices is one of the great nightmares!

The game of Monopoly is a visual description of a system that seems about as complex as a videotape recorder, but the VCR is the most frequently mentioned scarecrow of interaction design difficulty—so few people get past the play function and actually record successfully. Monopoly does a good job of making the functions of the game self-evident. The graphics lay out the possibilities clearly, and the physicality of the players' pieces and the dice let you know what is happening at a glance. As the game progresses, the houses express ownership for one player and risk for the others. There is a physical representation of the different elements of the software of the game. That is exactly what you would love to have in a VCR. You want to know what is on the tape, where things are, how much space there is left, whether it is recording, and who else in the family is using it. What would happen if the design principles of Monopoly were applied to an electronic product?

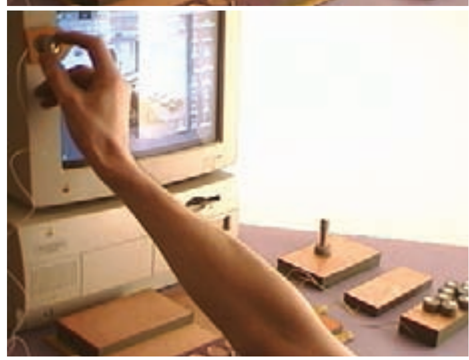
Durrell uses money as another example of physical objects that represent meaning:

> Here is a coin. Yes, mechanically it has certain properties. It's hard to copy; it fits in your pocket. But it has three other interesting properties; they are pretty much social properties. It has value; yes, it's written on it what the value is, and its size and shape denote that to some extent, but the real idea of value is not a physical thing. It also has country; it belongs to a nation. But most of all, and strangest of all, it has ownership; the ownership isn't represented on it at all, but we totally accept it, and it's mostly defined by the distance it is from you. If I'm holding it, it's mine; if it's in my pocket, it's mine. If I place it far enough away, we start questioning whose it is, but we don't think about this as a pointer to money; it's not a tag for money—it is money.

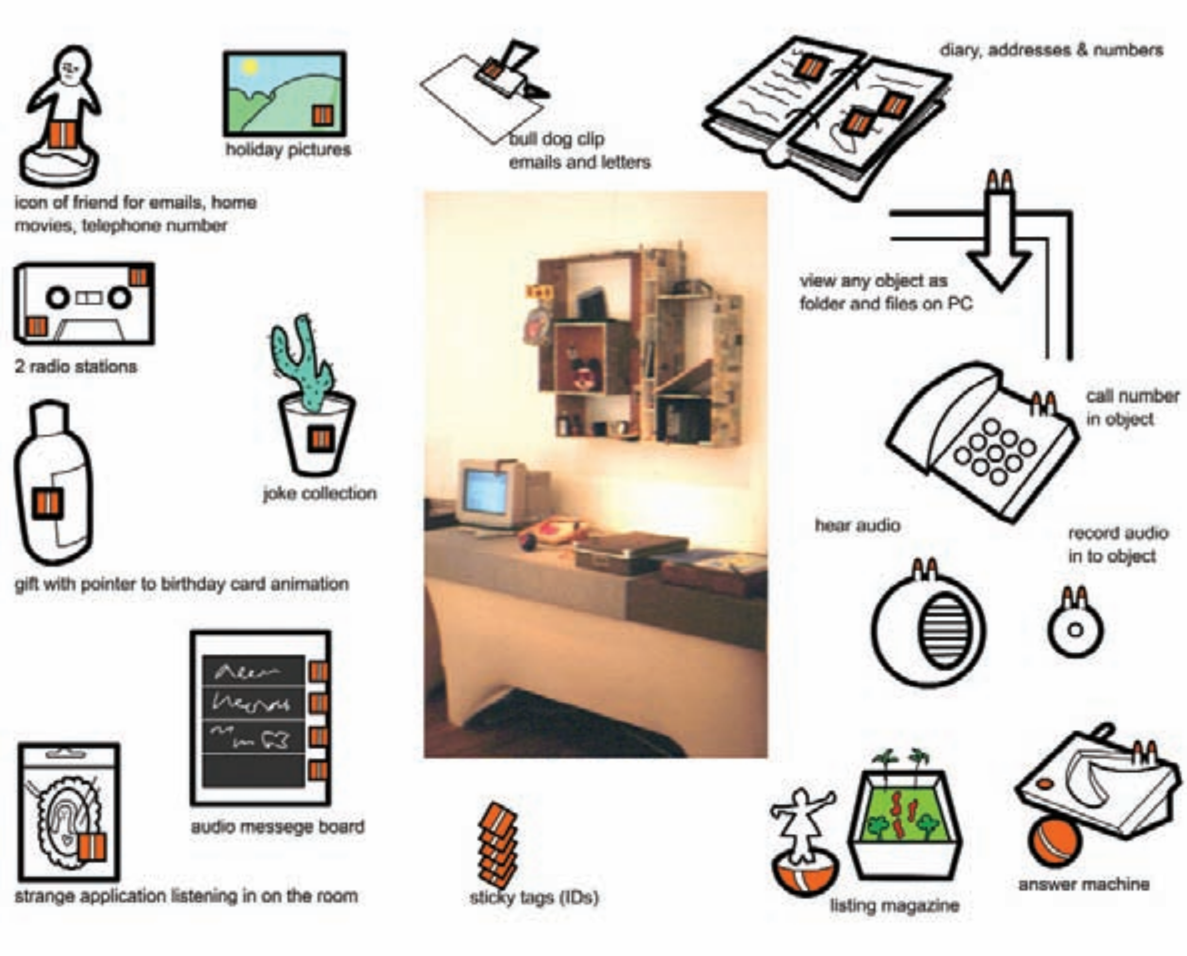
It may be possible to make virtual items, both space and objects, seem just as real as physical items by designing them to say more about themselves. If each of the items that you are designing is self-descriptive, both the environment itself and the physical objects in it, you can expand the connections between virtual and real.

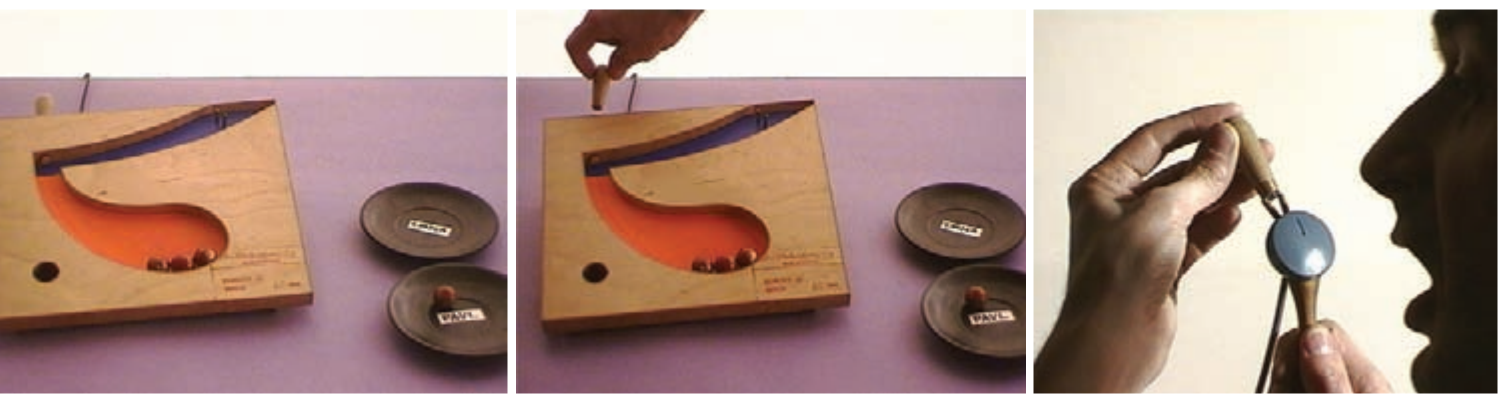
> If a recognizable physical object has a pointer to a window or folder, some form of container in a computer space, then perhaps the physical environment is just as real as the screen environment; in fact, they are one and the same thing. Any object picked up physically, which you can see has been augmented with additional information, can be taken to a tool, perhaps a reader, or to a screen, and you can see the same object in its other representation; the screen is only another representation. In this case, the objects are tagged, with the tag pointing to a file, an application, or a folder on a computer.

Durrell is constructing a physical world, which describes the computer space, using both three-dimensional objects and virtual characteristics to define the interface. A first reaction to this may be that it is artificial, but the artifice is only describing what goes on inside the computer, in the same way that the screen is only describing what is inside the computer. Folders give us pointers



One-pound coin
Video editor—augmented object reader
Video editor—augmented object to screen
Video editor—augmented object reading


icon of friend for emails, home movies, telephone number
holiday pictures
bull dog clip
emails and letters
diary, addresses & numbers
2 radio stations
joke collection
view any object as folder and files on PC
call number in object
gift with pointer to birthday card animation
hear audio
record audio in to object
audio messege board
strange application listening in on the room
sticky tags (IDs)
listing magazine
answer machine



to locations in storage, so why not use a physical object to point to the same space? A successful metaphor like the desktop is useful because it reminds us of some familiar item with equivalent behaviors and lets us operate in a way that is at best intuitive, or at least easy to learn. The physicality of objects can offer the designer many more possibilities for representations that are both familiar and exhibit relevant behaviors. The freedom from the confines of the computer screen also promises a stronger relationship to our perception of reality, just as we think that money really is money, rather than just being representations of value. Computing can break loose of the desktop and become more ubiquitous, not only in the transparent way envisaged by Mark Weiser,[9] but also in ways that present people with more-relevant and better-designed representations of the functionality and behavior available to them.

Durrell likes to build working examples to communicate his ideas, and he uses a smart telephone answering machine to illustrate his concept for physical representation:

> So let's have a look at this telephone answering machine. It's an application. As you can see in the physical version we made here, the messages drop out, but there is an extra object, that's the outgoing message. You need a way of putting audio into it, so we have another tool, that's a microphone. Any object taken to a microphone lets you put audio into that object. It just puts in an outgoing message. What sort of other objects do we have? Well, in this case, there's a speaker. When any object is taken to a speaker, [the system] looks inside that object on the computer, and plays the audio from it. There's a bulldog clip here. It's got a tag on it? What does that do? The bulldog clip is kind of an abstract thing. You need to attach it to something to have any meaning. So I put a microphone on it, I put a message in, and I put a paper on it saying, "Letters from John," and I leave it out for somebody. I started out to make my own icons and my own physical objects on the machine.
>
> A nice result of this design was the idea of friends as products. After all, you get given letters from people, you get given emails, you get given bits of video hopefully; you know about addresses and birthdays. If there is a way of collecting all these together and

■ A collection of tagged objects

Below
Telephone answering machine, showing recording of outgoing message

Photos, drawings
Durrell Bishop

representing them, then all you really need is an object, representing the person, that you keep; that then becomes the item that you pick up and take to different tools to find things.

Here we have a little plastic frog that's got a friend's name on it. If we take him to the computer, it opens up the computer representation of him, i.e., a folder. Inside that folder is a series of files. I can now pick a piece of video to send to him and drag it into the folder, and take the object off the computer. Now I put a piece of video into a small plastic object; if I take it to a camera, maybe I'll see that piece of video; if I take it to the telephone, it might dial him.

This got really exciting to me when someone asked, "Are you simply augmenting objects with new types of properties?" Do we start seeing things, and start assuming they have video in them?

Picking up tagged objects is only one possible way of describing the potential for interactions with a computer system. As technology becomes a larger part of our everyday lives, we can expect to see different kinds of interaction emerging, specifically developed for each of our activities. Durrell was given an opportunity to develop an exhibition for LG, the Korean consumer electronics giant, and he used this to create another kind of connection between physical objects and an underlying computer system—this time in the context of home entertainment. He built a wall[10] with objects representing a CD player, television, radio, door entry system and a home banking terminal. A display screen was mounted on a rolling trolley arm, so that you could slide the screen over the objects.

The screen knew where it was as it slid along a wall. Behind it we placed a series of five products, each of them working, and each of them looking at a different aspect of the relationship between the physical object and what a screen might do.

At one end was a CD player, mounted on the wall. It had three buttons: you could go up a track, down a track, or eject. By putting the CD in it, it played, so it was very limited in terms of its mechanical interface. If you slid the screen over it, it opened up an application that gave a visual description of the controls for the CD player; you could see what was on the CD and you could shuffle the tracks.

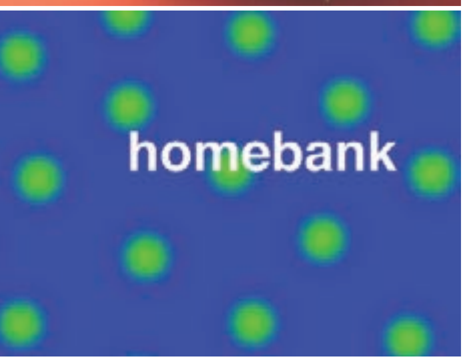
- A bulldog clip takes messages from a microphone
- The clip is labeled by a handwritten title
- A frog represents a friend
- Opening the friend's folder

> The next product on the wall was a television represented by a clothes brush, and the clothes brush simply reminded you of the fact there was a TV. When you put the screen over it, it launched television. It had four buttons on the screen, as in Britain most people only had access to four channels at that time. I liked the fact that the clothes brush became a television, just because that was how you perceived it.
>
> Next was a radio. In this case the electronic components for the radio were elsewhere, and all you were left with was a representation of the interface—a ruler, with blackboard paint on it that you could move in sixteen steps, and a pencil. By sliding the ruler down, it picked up a preset station, and you could read from the blackboard paint what it was. To set the stations up, you moved the screen in front of it, and it launched the 1950s GoldStar radio, allowing you to change that preset on the ruler.
>
> Then there was a doorbell. In this case it was pair of eyes on the wall. You slid the screen across and you got a video image from a source elsewhere in the exhibition, as if it was a video monitoring system for your entrance door.
>
> The last one was a home bank. A little display on it showed you your current account. If you slid the screen over that, it showed you your current account over time. If a little light flashed indicating that an email had come in, you could slide the screen across that particular element to read that email.

The whimsicality of this design, engaging though it is, may take away from the seriousness of the intent. Durrell is experimenting with the potential of new products that combine the properties of the environment, the Internet, and applications in a physical representation that you can perceive and that you are likely to remember. The connection between a clothes brush and a television may seem peculiar, but it engages both your spatial memory, and your associations with analogy and humor. Durrell sums it up:

> What's important to me is that there are different items, which sit in an environment, and you can remember what their properties are. You can see the potential of an action, for example, the potential of how far something might move, and it doesn't actually matter what the

LG home entertainment wall—GoldStar radio ■
Radio image distorts as it is tuned ■
Wall with screen in radio position ■
Wall with screen in TV position ■



- LG home entertainment wall—CD player position
- LG home entertainment wall—TV position
- LG home entertainment wall—banking position
- Homebank splash screen

> object looks like, as long as you can remember it easily after seeing how it behaves.

Durrell Bishop is passionate about expanding the dimensionality of interactions, adding to the two-dimensional, screen-based representations of events and behaviors a third dimension by pushing into the three-dimensional world of physical objects. His ideas of representing the potential of actions by adding twists of humor and surprise make sense in the context of the way the human brain works, as proposed by Jeff Hawkins.[11] Jeff postulates in *On Intelligence* that the brain is essentially predictive and that we remember things either because we have experienced them repeatedly or because something surprising or unusual pushes the memory out of the ordinary and makes it stick. The lateral thinking of humor can make this difference; both the representation of Durrell's friend as a plastic frog and the television as a clothes brush contain enough surprise to make them memorable, so we can easily predict their behavior next time we encounter them.

In the next interview, Joy Mountford tells of her passion for expanding the dimensions of interactions by making fuller use of media and the senses. She has achieved dramatic success in this, as she pioneered the inclusion of moving images in computer interfaces; she starts by telling the story of the development of QuickTime.

Photo Tom Gruber

Joy Mountford

“Never in my wildest dreams in England did I think I’d do anything that had to do with high-speed aircraft!” says S. Joy Mountford, as she describes her job designing displays and controls for military aircraft and the space shuttle when she was at Honeywell. It had been flight that had brought her to America in the first place, as she had won a scholarship in aviation psychology and learned how to use some flight simulators with horribly complicated control systems that pilots had to cope with. Her undergraduate degree was from University College London, and her graduate study was in engineering psychology at the University of Illinois. “We did a lot of what is now called ‘task analysis’ of man-machine systems. My professor was very methodical; I think it took us a whole semester to do a task analysis of just being able to get into your car and put the key in the ignition.” This rigorous training helped her as she gained experience in high-tech industries. She found her niche as the creator and manager of the Human Interface Group at Apple Computer, the team that invented, among other things, the initial use of QuickTime. From Apple she went on to join Interval Research, leading a series of musical development projects. Now she is founding principal of Idbias, an interaction design partnership, consulting in the development of novel and enjoyable ways for people to interact with the technology that surrounds them. Joy has been designing and managing interface design efforts for over twenty years. She frequently teaches, lectures, and presents at conferences, always delivering an inspiring performance.


Video Viewing Window
untitled Clip Grabber
Begin Frame
End Frame
Clip
36171
40449
41832
40534
40677


Moto-small30.mov
00:01:19

Joy Mountford

QuickTime

Early QuickTime compared to 2005 version

Screen capture

Before she went to Apple, Joy Mountford was working at Microelectronics Computer technology Consortium (MCC), which was sponsored by a consortium of companies developing intelligent systems to compete against the Japanese fifth-generation computer effort. She gained experience in artificial intelligence and visual displays, but she was worried that she did not know enough about graphic design. A SIGGRAPH[12] conference opened her eyes to the simulation concepts that were making displays look almost photo realistic in the seventies and early eighties. She realized that her future was not going to be limited to intelligent systems; she must include the design of how they worked with people.

> A friend of mine suggested that I look at an interesting company called Apple Computer. The only thing I'd seen about Apple Computer was in *Time* magazine, where the vice president was wearing a black leather jacket, which I thought was very cool at the time.

In preparing for my interview, I was very shocked when I used a Macintosh for the first time. It did not seem to be able to do anything with its small screen, floppy disks, a one-button mouse, and only a black-and-white display. I said, "I feel very sorry for those people. All they have is this tiny little box. And it doesn't do anything. It just does word processing and spreadsheets." I had got used to high-end Symbolics machines with very large screens. I'd always used a three-button mouse, and I'd always used high-resolution, 3-D graphics systems. My friend, thank goodness, persuaded me that there was a future for it, so I persuaded myself to go and work there.

- Joy Mountford in 1987
- Mike Mills in 1991

Joy was happy at Apple once she got there and found that the place was full of interesting and enthusiastic people. She put together the Human Interface Group, and one goal was to help release the human interface guidelines in 1986. The purpose of the guidelines was to provide helpful rules for Apple's many developers, both internal and external, so that there would be a consistent interface for all users.

At that time, most people were still using computers only at work, for things like spreadsheets and writing documents. The market for personal computers at home was just starting to grow. A more significant shift was taking place in the workplace, as the people buying the products were changing over from being IT professionals to the office administrators. They helped initiate a wave of change that was good for Apple, as their competitive advantage was desktop publishing. Inside the company, Joy recalls, people were looking for the next new wave of change:

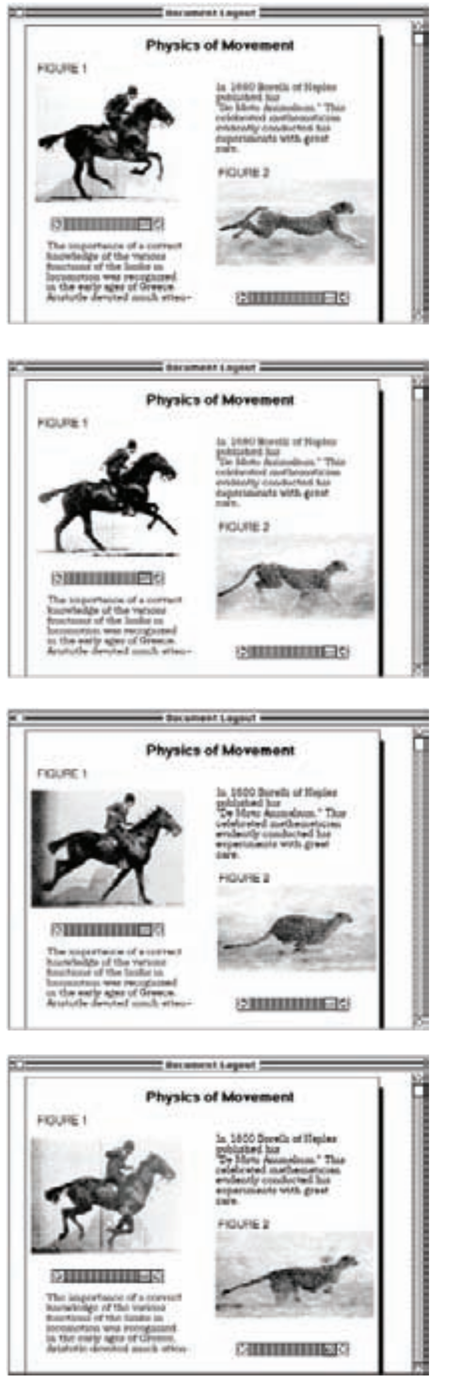
When I got to Apple, the question every week was, "So, what's beyond the desktop?" At that point, of course, we had files and folders, derived from the familiar metaphor of everyday office work. People had some familiarity with the elements of the metaphor, so they felt more comfortable beginning to use a computer that looked and behaved sort of similarly to the real world. However, based upon my past experience, I was very frustrated with that, because I thought, "Why would I want to do just paperwork on a computer?" What fascinated me was, How are you going to do something unique on a computer? Not just the replication of the real world. What would really captivate people who spend time with computers over the wonders and beauties of things like books and paper?

The idea that began to obsess me was how we might include pictures, sounds—even movies. In about 1988 I attended a conference where I heard a paper on dynamic documents presented by Professor Michael Mills. I was very intrigued. So I managed to persuade Mike to spend his sabbatical with us, starting in 1989, and he went on loan from the Interactive Telecommunications Program at New York University, where he was a professor.

Mike Mills came for his sabbatical and was soon smitten with the opportunities to put his ideas into practice.[13] He had always been interested in time-based events, particularly in how they represent spatial relationships. The challenge for the Macintosh in the late eighties was to build a toolbox that would support time-based events, so that all the different computers of varying processor speeds would play time-based media consistently. Mike ended up staying at Apple for six years and worked with Joy and her team on a wonderful series of prototypes that became the seminal work contributing to what we now know as QuickTime. Joy recalls the early work on what they were calling "dynamic icons," or Dicons:

The first thing I remember about this was that Mike managed to put together a series of illustrative prototypes using VideoWorks, which was the precursor to Director. VideoWorks enabled you to write a big score, so that you could sequence exactly the events that occurred within a transaction. This was the first time that anyone could see something occurring over time within the interface, rather like just playing back a little movie. The little movies that we put inside documents often used the original Muybridge illustrations of horses running or people running. So frame-by-frame we could play back a sequence of someone moving. This brought the document to life. Hence the team started working on dynamic documents.

I remember a day when Jean-Louis Gassée, president of the Apple Products Division at the time, was in an executive staff meeting. I knew where he was and what was going on, and when he took a break I managed to waylay him in the direction of the cube where Mike Mills was working. I persuaded him to put his head over the wall



Demonstration of QuickTime using Muybridge images

Skeletal figure animation sequence

> just long enough to see the first dynamic document. He saw a skeletal structure of a couple of movies, as it were, playing, a half inch big, with some text all around them.
>
> He stopped, and he said, "Now I know why my grandmother wants a computer!"
>
> I remember at the time thinking, "What an extraordinary thing for him to say!"
>
> I had never even thought of my grandmother using a computer, let alone why it would captivate her, and why what we had done with movies meant that. Looking back, of course, he had a lot more insight than I did. It began to change what a computer and all the documents on a computer were about. Something moved, something came to life, something played. And it showed something more than just another version of a paper document that you could read better and print. We were very excited. That began a series of four or five years of building successively on the first illustrative prototypes, to bring more and more control and playback capabilities into Simple Player to control time-based events, which we now know as QuickTime.
>
> This was the first step toward bringing video into the personal computer interface and turning the PC into a multimedia device. It also had important implications for interaction design, in that it allowed prototyping of time-based events, which is the whole point of interaction and designing for it. At that time it was very hard to demonstrate the intention of an interactive behavior. Hypercard was released in 1987. It was wonderful for click-through behaviors, and we used it for some simple animations. But we needed something more powerful to explore new metaphors. Designers were using paper animation techniques, such as flipbooks, to explain their ideas, but it was hard to convert those into the details of code. When QuickTime arrived, it was suddenly easy to generate design alternatives for behavioral animations in a medium that could also form a specification for software.

Joy remembers Mike and his team[14] working on the controller—the user interface for controlling the video player on the computer. They put together lots of illustrative samples of prototypes to show alternate ways that you could control the video:

There were many options to consider: how to control something, how to label it, how to shrink it, how to increase its size, and so on. One of the things that we now had using VideoWorks was a way of showing all of the different options that we could provide people. In addition, we could actually imagine different styles of controllers, different mechanisms, just a very subtle thing like, how would you indicate start and stop?

Would you just want to start and stop? No.

Would you like to go faster or slower?

Of course there are real-world metaphors from video players, which probably most consumers had in their homes, so we used some of those elements, but it was a different medium. If a document was dynamic, then the video was inside a document. There were many unanswered design questions.

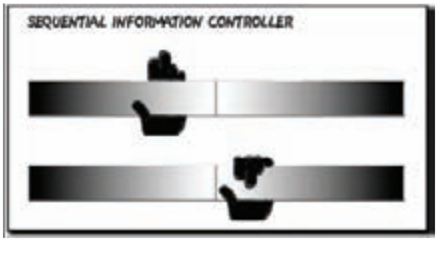
We were beginning to show people illustrations of what people might want to do with documents that included time-varying dynamic information, such as movie events. Meanwhile, there were programmers working directly within the toolbox to create enabling technologies such as 32-bit QuickDraw, which was essential to enable time-based data. They came by our offices and studied our prototypes. We began to be a place where people came to look at what a new type of document might look and behave like.

People were asking, "Well, after 32-bit color QuickDraw, what do we do? We will need that toolbox to support more events—more movie based events, with a clock that will support them across different machines."

In addition, it took a team of engineers in the Macintosh Product Development group to bring all the functionality of QuickTime together to create a viable product. We had realized to make our vision work in the way we wanted, we would need API programmers to understand how critical the interface would be for the overall product success. We also hired programmers to help build increasingly in-depth working prototypes. This allowed us to better show some of the subtleties that we were evangelizing within the interface.

At the time QuickTime was being developed, very few people were familiar with film and video-editing tools and techniques. iMovie has made video editing popular, in a similar way that word processing and laser printers brought publishing to the desktop. Now people are far more familiar with incorporating video and being able to edit clips of their children. At that time, access to a video-editing suite was expensive and daunting, and the operators of the equipment seemed to have incredible skills. Mike and his team were among this elite, coming from a film background at the Interactive Telecommunications Program at NYU. They developed what they called a "playback head" as part of the video controller interface. They were familiar with jog shuttle controllers, which are used to freeze and move forward and backward to sequence a particular segment within a movie. Joy recounts the dilemma that arose:

> They invented a graphic element called a "hand controller," which was an image of a graphical hand that appeared on the controller interface and could be grabbed to move the video, just like a jog shuttle can be spun. You could move it forward and back while it was on the controller. It had a very similar kind of feel—not a similar look, but a similar feel—to the jog shuttle. We had those hand controllers working in the lab, and we were building more capabilities borrowing from the movie-editing world. We actually patented the "hand controller." The patentable idea was that by making a vertical movement of the mouse, you could cause the open hand to "grab" onto the controller thereby locking in a frame rate, changing it from a jog shuttle to a slider. So instead of having two separate controllers, you could have both jog shuttle and fixed speed in the same controller, which was a clever kind of idea.
>
> I also had a team working in my group doing user studies, who said, "We're not too sure about this hand controller. We think we should do some user studies."
>
> We began to bring people in for studies, and we asked them to do a series of movie-editing tasks using the hand controller. I think about 80 to 90 percent of the people that we interviewed really disliked the hand controller. They felt it was like a disembodied hand that appeared from nowhere and grabbed the video. They didn't know why it was a hand. The personification—the anthropomorphizing of the interface—was not something they really enjoyed. So despite the fact that we'd taken the time to program up all of these very sophisticated controller ideas, I also spent a fair amount of time "managing them out" of the controller that actually shipped with QuickTime. The resulting Simple Player controller, indicated in the

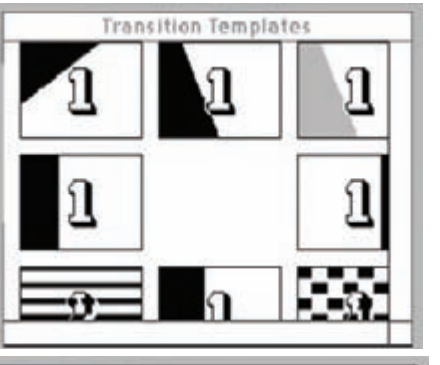


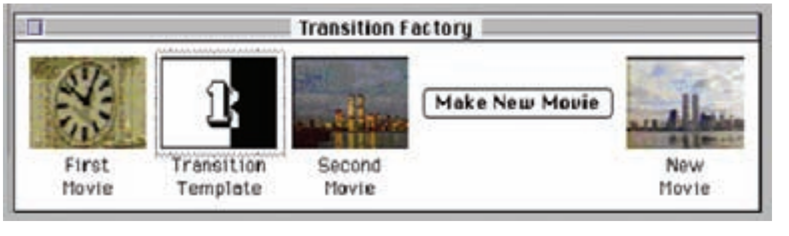
- "Hand controller" concept
- Simple QuickTime controller

drawing, really only allowed for video playback and audio level control.

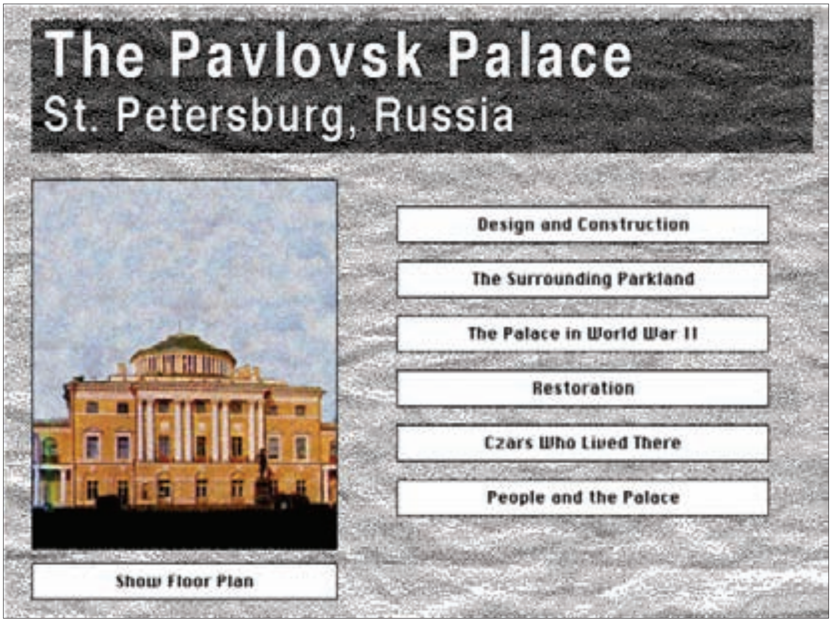
Yet again, this story emphasizes the tendency of designers just as much as engineers to design for themselves, for their own skills and familiarities, rather than for the audience for whom the product is intended. User studies might have a different result now, as many more people have engaged with the idea of video editing.

The QuickTime starter kit shipped in the fall of 1991, and Mike Mills and his team spent the year leading up to shipment working full-time with the product teams to make sure that the vision and simplicity of use were preserved. Afterward they returned to Joy's group and continued to develop the next stages of QuickTime, with projects for creating videodiscs and toolkits for transitions.





Transition templates
Transition factory


The Pavlovsk Palace
St. Petersburg, Russia
Design and Construction
The Surrounding Parkland
The Palace in World War II
Restoration
Czars Who Lived There
People and the Palace
Show Floor Plan

QuickTime VR

Joy Mountford has maintained strong connections to academia throughout her career. Every now and again she teaches a course at one of the interaction design programs around the world. She started the International Interface Design Project at Apple and continued it at Interval and now runs it for Mattel and Microsoft: this sponsored project assembles interdisciplinary teams of students to work on a project, bringing the results together for a show, critique, and celebration. She has also been a regular employer of graduate students as summer interns.

> I think it's a wonderful opportunity for both the company and also the graduate students to work together and learn different things from each other. I've always had a large number of interns coming in each summer, since they provide a whack on the side of the head! They do wild and wonderful things.

One summer she hired an intern, Dan O'Sullivan, who was also from the ITP/NYU graduate program. He started his own project without explaining to her what he was trying to do. He had a video camera pointing at an object, seemingly doing the same thing day after day.

Pavlovsk Palace, showing the menu screen, the transition from front view to floor plan, and the QuickTime VR rendering of the interior

Screen capture

> I got pretty annoyed with him because it seemed like we weren't making any progress. He was using a rotating mount from a security camera, taking images upwards, downwards, sideways and all around. He had figured out a way to take hundreds of still images, and sequentially be able to record an entire room. He was rotating the camera, taking an image, noting its position, moving the camera, taking another, and successively going all the way around and recording each image position. He had been photographing image after image after image and then referencing all the images. Simultaneously he had become friends with Michael Chen, who had developed the virtual sphere, which was a coding technique for changing the orientation of an object in 3-D space by using only a one-button mouse. So Dan decided to systematically map all his images referenced as overlapping tiles onto the virtual sphere, but from the inside looking out.

At this point, I thought, "Yes, but still why would I want to do that?"

It felt a little bit like he had been obsessing about just proving that he could control the head of the camera and record the image. But what he had done is make it possible to navigate a composite image of the entire room. You could move around the camera's view of the room just like you could manipulate a 3-D view of an object with the virtual sphere.

Simultaneously the Human Interface Group had released a version of the virtual sphere code, which allowed for a one-button mouse to change orientation of a three-dimensional object. It was as if the object was encased in a translucent ball, and the user could reposition the ball in any direction, letting you to look at it from any vantage point. Joy and the team also realized that by combining the virtual sphere with Dan's large set of images, they could offer the appearance of direct manipulation in virtual space. The catch was that for Dan's images, instead of being outside looking in toward the object, you wanted to be at the center of the sphere looking outward, which they achieved by using a variation of the same basic code, but putting themselves in the center of a virtual room. They called it a "navigable movie," and Joy started thinking how to promote the concept:

Camera and HDD mounted on the elevator ascending the Golden Gate Bridge

Content, as we all know, is very key to the success of ideas like this. Sadly, Dan's first example showed his kitchen, which really wasn't that interesting, so I decided we'd try and use some interesting content that would really make people sit up and pay attention.

We did a couple of wonderful projects, which were very high risk and exciting. One was created by additional team members from the Interface Group,[15] who went up to the top of the Golden Gate Bridge. It was, I believe, the only time the Macintosh had ever gone to the top of the bridge. There's a very small elevator, which carries you all the way up the outside of the bridge support structure, and it's only big enough for one person. There was no room for the Macintosh, so it had to be strapped to the outside of the elevator.

The Macintosh, camera, and rotating camera mechanism all were on a platform because the camera had to be steady when it was recording all of the incremental images. The platform was bigger than the elevator, so it had to be mounted on the outside of the elevator while taking pictures. And, in addition, it had to have a very long power cord, which went all the way down from the elevator at the very top of the bridge to the ground.

Once the images were safely on the hard drive of the Macintosh, they used the "navigable movie" program to wrap them together into a continuous virtual space. When it was finished, you could look all around, into Marin County, over to San Francisco, and you could actually look down and see the long power cord beneath you. John Sculley demonstrated the resultant movie at MacWorld in January of 1992.[16]

The audience, mostly of developers, literally kind of drew their breath in. People had never seen something that could move around like that, and to see all those different points of view was very exciting on a window on a Macintosh.

Another project that we did to attract attention to this new capability was filmed in Russia at Pavlovsk Palace. This project explored the inverse of the navigable movies, looking at an object from every angle around it. I wanted to film a Fabergé egg to examine it from every direction. I'd gone to see Fabergé eggs in museums and had always been very disappointed because they were too far away from me, and I couldn't ever see them from any other point of view than the one they're showing me in the glass case.

When I saw a Fabergé egg in person, I felt, "Well, it's really not as compelling as I thought it was going to be. I mean, in these beautiful books I have at home, they look a lot better."

I commissioned a large structure to be built by Peace River called the "Object Maker," which was almost like a CAT scanner.[17] The camera could be positioned and moved around in three-dimensional space—well, nearly three-dimensional, as you couldn't quite get underneath, because it had to be held somehow. In any case, the camera was controlled very cleverly and gently, and it allowed us to photograph a 3-D object from viewpoints all around it. We could do the inverse of a navigable movie, to enable you to move your viewpoint around the object just as you can move the camera view within a room.

Inspired by the Fabergé egg, the team[18] built a virtual world of a Russian Palace so that the viewer could appreciate the surrounding beauty of the room in which such objects would have existed. The

Object Maker scan of cup

team went to Pavlovsk Palace and filmed Maria Feodorovna's[19] bedroom, with its beautiful painted ceilings and inlaid wood floors. These truly panoramic interesting floors and ceilings all made for an interesting rich 3-D scene. Within the room was a china case, which contained some of the things that she used and collected. The team went to work and created a magnificent virtual palace, including navigable views all around her bedroom, plus the additional special close-up view of the navigable china cup that could be viewed from all angles. It was an excellent example of two QuickTime capabilities coming together very effectively and about a place we are unlikely to be able to ever visit. The Human Interface Group distributed a navigable movie controller kit on CD to Mac developers, which was programmed and designed by Mitch Yawitz.

"Navigable movies" were the birth of what later became known as QuickTime VR. Joy and Mike and the team[20] were very successful as evangelists. Joy knew how to promote the concepts; she had the knack of choosing memorable subjects and the drive to make things happen on a large scale. Mike was inventive with his prototypes and demonstrations, and they were so compelling because they really worked, even if the scale was small, and the code was not yet robust. Meanwhile Jonathan Cohen was actually programming up a storm, creating a pioneering special effect editing tool called "Transition Factory." This enabled direct editing of audio and visual effects, which helped make the content examples work very smoothly and look good. So the audio component of media was ever present in Joy's mind, even during the early days of QuickTime.

The Bead Box

Joy was further fascinated by the possibility of expanding to other time-based media events and their uses in computers. This led her to move beyond video to its essential but undervalued cousins: audio and music. She felt that sound should be used more in interface design, integrating music, voice, and more sophisticated sound effects. People are easily attracted to moving images but often forget the evocative effect of the movie soundtrack. David Liddle offered her an opportunity to delve deeper into designing a series of audio products and projects within an innovative research environment, so she left Apple Computer to join Interval Research.

> When I got to Interval, we began to think of ways that we could extend the audio domain to more people. Needless to say, we started thinking about music, and one of the things that we also found out was that 70 percent of the population think they're amateur musicians, which is pretty high (I wonder if 70 percent think they're amateur moviemakers?), so I felt that there was a large potential audience out there. Music also blurs boundaries across gender, language, and is highly expressive. It extends from very young to quite old. People are interested in different types of music at different ages, but we all have a visceral connection to music, and sometimes a physical one, which might be to dance or play air guitar. Children often have expensive music lessons that their parents pay for, and they stop taking those lessons when they hit the teenage years, twelve or thirteen, and they often don't play music very much after that. They do, however, listen to it, but they don't necessarily play. However, currently at clubs now, people participate in DJ performances, which is an interesting genre, where they're playing samples of sounds, but also twisting and warping and playing them slightly differently each time, even though it's all preprocessed and preselected audio.

Joy led a team at Interval called Soundscapes to study the creation and use of music. She discovered that many people who want to make music, including professional musicians, are unable to read musical notation. A lot of people buy synthesizers and sit

OSCARS ATLAS
BY HENRIK DRESCHER

at home jamming without being able to read music; they communicate with others through their music but have no written language. This study led them to design the "Bead Box," a device for people who want to make music but have not mastered a conventional instrument notation or the meaning of a score.

The Bead Box had a grid of holes on its surface, five wide by four high, into which people put beads. The beads were made with resistors that tagged them uniquely, so that the box could detect their identity and location when they were put into the holes. Each bead triggered a sample. Along the horizontal axis, the density of the sounds increased as you moved a bead to the right, by adding to the richness of sampling. On the vertical axis, the pitch of the sample was higher as you moved a bead upwards. A virtual "playback head" would scan the holes and play the sounds corresponding to the beads in the plugged holes. A person could create a collage of different sound samples by placing beads and vary them dynamically by removing and repositioning the beads. Joy describes the experience:

■ Bead Box

Photo
Nicolas Zurcher

> If you had no beads, nothing happened. If you put one in, it would go "boink," and the playback head would keep moving, so there was silence until the head came back to the beginning and went "boink" again. So, it could go "boink," or "boink boink," and then you could try to move it to add to the density, so it would be "boooing, boink, boynnk."
>
> With one bead, it's not that interesting, but with multiple beads that changes. The head keeps moving, looking for and playing beads when it reaches their positions. Because of the silences and because you now have two, three, four, however many, you now trigger different sample effects, which have different overlapping decays, which all contribute to the effectiveness of the resulting music. And because you can also change the pitch, it's as if you're playing a tune while dynamically changing how it sounds. What really intrigued me was how much variation of the audio or music mix you could actually create, even with the simplest samples and changes. It was really quite addictive, and it became almost an art to see how wonderful your music could be with just three beads.

> The reason we picked a bead to represent a sound is that it is something very small, that is, a collectible, that you could hold or wear—rather like a solitaire pendant. You could see the piece that you wanted to move as a tangible object and put it somewhere and control that space. People were very keen on playing with the music box. They liked the music they created, and the box was also attractive, having embedded lights that showed through the translucent beads when the head read the sound sample for that bead. One of the most compelling illustrations of using this was actually a Yiddish recipe, said by the grandmother of one of the designers. All it said was "Take the meat. Mix into the bread." You could take each one of the beads, and make "Take the meat" more dense, less dense, higher or lower. It started to sound like a piece of music, although no one actually knew the source was her grandmother's voice saying, "Take the meat. Mix into the bread."

The initial prototypes used a translucent material for the beads, so that as the scanning head/beam went by the beads would light up. In a darkened room you could see a delicate glowing pattern of red, orange, and green shades as the scanner moved under the bead connectors and played sounds collaged together as music. By now they were confident that they had designed a captivating experience for their own ears and eyes, but Joy wanted to see if it would actually work for different age groups. They collaborated with a research firm to test the design with four-year-olds, eight-year-olds, and teenagers, both boys and girls, in three different states in the USA. For the younger children they used samples made up of body noises; for the older children they had a variety of rock and roll sounding songs, but with no lyrics:

> To our absolute amazement, all the different age groups liked it, which actually turned out to be not such a great thing, because now we didn't know who our target user or population should be. Accidentally, we had children being picked up by their parents, and then children told the parents what they had done, and the parents said, "Oh, I would like one of those." The parents suggested adding personalized samples of audio to it. They were coming up with things like, "Oh, if I could only have a bead with my child saying, 'I love

> you Mummy,' or my husband saying, 'I love you darling,' "—just a small, little, evocative personal expression that they believed could be within a bead that they could hold, or hang around their neck, or carry around in their pocket as a keepsake. We carried this sort of idea a little farther and made a particular place on the grid for a bead that you could press in and record a three second phrase. Now you could be part of this rather interesting blend of audio effects, with a personal meaningful message in the mix as well. Imagine someone saying "I love you" just at the right moment.

The research results showed a compelling product that appealed to young and old, but the challenge of evolving a successful business solution was still ahead. The design would need to be developed to allow manufacturing at the right price and focused on a specific sales channel. The team at Interval consulted experts in business and marketing for the toy retail market. This is a difficult space, where the offer has to be simple enough to be understood by a child or parent walking down the aisle of a toy store. This design was too abstract and innovative to succeed in a conventional channel and would have needed a gradual process of distribution through a marketing process that gave time for acquaintance, such as schools, or a captive audience where people could see and hear someone playing the Bead Box.

Joy Mountford had come from Apple, where the whole structure of the organization was dedicated to creating products that are launched into the real world and sold as physical products and software. She was proud of the success of such product innovations as QuickTime and found it satisfying to see it used by so many people for such a wide variety of purposes. On the other hand, Interval was set up with a main purpose of generating influential ideas from research, like Xerox PARC, but there was also a hope that the research would lead to successful new products or industries, launched to the real world by setting up spin-out companies.

The story of the Bead Box shows how difficult it is to make this happen. This wonderfully talented team of researchers came up with an engaging concept, developed prototypes through several iterations, and then validated it in extensive market research. The initial setup for the R&D team at Interval was highly interdisciplinary. The Bead Box lived in a new business area and was hard to position, given known product practices. Having more and earlier input from business or marketing folks in the retail toy space might have helped the product succeed.

It is interesting to compare this approach with the model adopted by Brendan Boyle,[21] where the concepts for new toys and games are developed in large numbers to a very rudimentary level before being offered for license to the major companies with specific distributional channels and market understanding. It is hardly surprising that research institutions like Interval or PARC have found it difficult to connect to the market, as even startup companies, or specialist invention companies, have only a small percentage of business successes. Joy had moved from Apple to Interval and had the opportunity to develop products that would be well researched, and based on a deep understanding of latent user needs and opportunities for innovation. The Bead Box project succeeded in this, but it was not particularly well positioned for retail and business issues necessary for success in the market.

Joy has always been intrigued with finding the right balance between corporate development and research environments; she sees it as an ever-evolving challenge, but believes that a symbiotic relationship can benefit both. Soon after she joined Apple, Joy went to a conference in Key West, Florida, and there met a student named Bill Gaver, who was studying with Don Norman at the University of California, San Diego. Bill had written an interesting paper outlining ideas of "auditory icons," so Joy immediately offered him a job as an intern within her group at Apple. Bill's internship resulted in the Apple Human Interface Group releasing the first ever SonicFinder (1986), which associated all Finder operations with a size-proportional and unique natural sound. After the SonicFinder was no longer supported, people complained about the quiet Finder! This early work from Joy and her team just goes to show how much all time-based media should be designed to work together to make for the most compelling interactive experiences at the user interface.

The interview with Bill Gaver that follows covers his journey from designing sounds, through research into affordances at EuroPARC, to becoming a senior research fellow at the Royal College of Art in London, where he explored the possibilities of technology in a context of aesthetics and cultural consequences.

Photo Author

Bill Gaver

In the early eighties Bill Gaver was a graduate student in psychology with Don Norman,[22] studying sound perception. When Don asked him to make a presentation about how sound might be used in computers, Bill reviewed his work so far and concluded that by thinking about the dimensions of sound-producing events, you should be able to make very simple mappings to events in the interface. That idea led to his work on auditory icons. He was studying at UC San Diego and earned his PhD in experimental psychology for work on everyday listening. He wrote a paper outlining the concept of auditory icons for a conference in Florida. There he met Joy Mountford. She liked his ideas and immediately offered him an internship at Apple, where he developed the SonicFinder. He later became interested in broader issues concerning mediated social behavior, helping to develop an audio/video communications network at Xerox EuroPARC, and also developing experimental systems that support social activities over a distance. His work as a senior research fellow, then professor of interaction research, at the Royal College of Art, London, explored the use of technologies to make aesthetic, social, and cultural interventions. He was one of the founders of the Equator Project, a six-year Interdisciplinary Research Collaboration funded by the Engineering and Physical Sciences Research Council (EPSRC), to investigate the integration of the physical and digital worlds by developing innovative systems. The initial research involved design-driven research techniques called “Cultural Probes” to uncover people’s values and activities. In 2005 he was appointed professor of design at Goldsmiths College, London.

Bill Gaver

Designing Sound

History
Tablecloth with
teapot

Photo
Andy Boucher

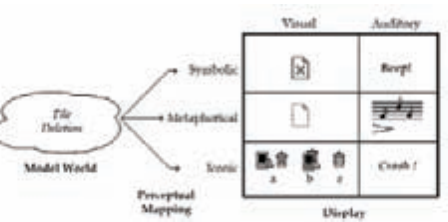
When Bill Gaver was invited to Apple as an intern in 1986, he made contact with people in the Finder software group, and started talking with them about the possibility of adding sounds to the Finder. It became a kind of underground project within Apple to make the "SonicFinder" actually work, and Bill pushed ahead with adding sounds to the real software, rather than building prototypes in HyperCard first, proving the exception to the rule that prototyping is essential to rapid progress.

> What I could have done was just show images of icons and have them make sounds, but it wouldn't really have done anything. I met John Meier, who was one of the chief programmers for the Finder, and he helped me; he was incredibly patient in walking me through the Finder code and helping me add sounds. What that meant was that I had a real working Finder, so people could use it in their day-to-day lives to do their everyday work, and the thing would make noises at them.

At that time, two schools of thought dominated work on the psychology of sound. One was trying to understand more about how music works, and the other was learning some of the basic ways the ear picks up sound. The research at the time tended to focus on attributes like frequency and pitch, or amplitude and loudness, or the spectrum and timbre of sounds. The SonicFinder was based on Bill's insight that people, when they listen to sound in the world, do not listen to the dimensions that the psychologists were interested in.

> If you think about how we hear sounds in the everyday world, we listen to events in the world; we hear cars going by, we hear people walking up and down stairs, slamming a drawer, or putting a book on a table. All of those things are quite complicated from the point of view of normal psychological ways of thinking about sound. At some point I realized that we could start to build a new psychology of sound by trying to understand what the dimensions of sources are that people hear and what the acoustic information is that conveys information about those sources.
>
> You could try to understand how people hear the material of an object when it's struck, or how big something is—things like that. That sets up a new way of thinking about the dimensions of sound. When I started thinking about using sound in interfaces, it became pretty clear that if interfaces were going to have graphical representations of real-world objects, they could have auditory representations of those objects as well. In other words, if you click on a file icon, it would make a sound that a file would make if you tapped on it. If you dragged a file around the desktop, it could make a sound as if it was a physical object being scraped across a surface: that underlaid everything I did with the SonicFinder.

The SonicFinder was an auditory overlay on top of the graphical interface for the Macintosh, and Bill's strategy was to add corresponding sounds to the main interaction events. For instance, when you clicked on a file, you would hear a tapping noise, with the kind of the file being indicated by the sound of the material, and the size of the file by sound of a small or large object. The sounds were not just repeated monotonously, as they changed with the secondary properties of the objects. Scrollbars



- Diagram of SonicFinder
- Bill Gaver in 1995

made tapping sounds to indicate how far they were from the top or the bottom of the document. The sounds of windows opening and closing were slightly more imaginative, associated with events that do not exist in real life. The sound of pouring water indicated how far a copying operation had progressed, so as you copied files, you would hear a "glug, glug, glug" sound that would increase in pitch the further along it got, setting up an analogy between filling a file with information and filling a container with water.

Bill explains the qualities of sound information:

> It's important to realize that sound conveys very different information than vision does. The way vision works is that light comes from a source and bounces around off surfaces; every time it hits a surface, some bits of it are absorbed by the surface, so what's reflected back is modified, and that gives rise to information about color and texture and so forth. Our eyes pick that up, so our vision allows us to get information about surfaces laid out in space.
>
> Sound works very differently. Sound is created when objects start to vibrate, and the way they vibrate depends not just on their surfaces, but also on their internal configuration, as well as certain details about the interactions that cause them to make sound. Once a sound is created, it bounces around the environment before it reaches your ear, but it seems to convey less information about the environment than it does about the source.
>
> Once you start thinking about mapping sounds to events in the interface, you're in the business of conveying different kinds of information than you would visually.

The sound made by tapping an object can be in harmony with the visual representation of an object, but it will tell you about different things; it can communicate emotional qualities, rich with connotations. Bill was very interested in the information that sound could convey, and he remembers visiting a famous sound effects artist at Lucasfilm, who had worked on *Indiana Jones* and *Star Wars*.

> I showed him videos of some of the interfaces I'd built at the time, and he looked at me after I was done and said, "You know, a lot of these sounds seem created for humorous effects."

And I thought, "What? What do you mean, humor?"

It was a dimension that I hadn't considered for my sounds. I had never consciously thought about the sounds being humorous, or sober, or serious or what have you. Later he told me that when he created sound effects, he was less worried about the information that the sound might convey than he was about their emotional connotations. If there was a chase sequence in which two single-engine planes were flying after each other, he would work to make the engine of the good guy's plane sound confident and good and wholesome, whereas the bad guy's plane might sound a bit ominous or sinister or aggressive. All that was a foreign language to me, but it really opened my eyes to a different aspect of sound than I had been thinking about.

I don't know how to think consciously about how you create emotional tones with sounds. That's something that I believe is a sort of design and artistic thing about how you hear and how you can craft sounds. It's impossible to be neutral about these things, so the SonicFinder sounds did have emotional connotations. I think I tried to fit with the prevailing emotional tone of the Mac interface at that time, which is a bit happy, a bit jaunty, kind of friendly.

A particularly impressive sound signature in computers is the start up sound for the Mac. It was created with very little memory and processing power, but it is very elegant. Bill Gaver's SonicFinder did not stay around for very long, though it was circulated widely by informal users: it seemed to get lost in the shuffle when he finished his time at Apple. Sounds for the Macintosh remained minimal and unsophisticated until Cordell Ratzlaff set about designing a better solution for Mac OS 8.5, working with Earwax to create a set of "Finder sounds."[23] Bill was philosophical that his work took such a long time to have an effect:

I'm fairly convinced that the people who did the Finder sounds probably never saw and heard the SonicFinder, even if they had heard about it. It took about ten years from the original SonicFinder before Finder sounds were released. I think it's a good example of how the kind of research we do folds into a sort of background consciousness, and then reappears later, sometimes without people even realizing it. I take that as a hopeful sign.

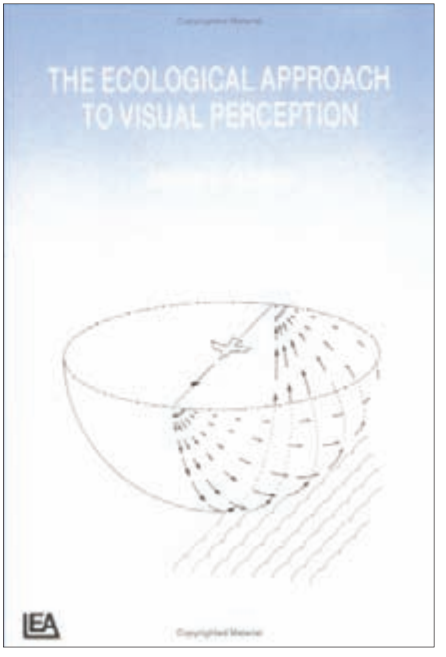
Affordances

Bill worked on the SonicFinder for a year and a half at Apple, first as an intern and then as a consultant. After that he moved to Cambridge, England, to work at Xerox EuroPARC, where he got interested in other aspects of psychology, in particular, affordances.

In 1979 the perception theorist J. J. Gibson wrote his book *The Ecological Approach to Visual Perception*,[24] which changed the way we think about how people perceive the world. He asserted that perception is designed for action, claiming that our whole evolution has been geared toward perceiving useful possibilities for action, and that rather than recognizing separate properties like length or mass, we perceive complicated combinations of these things that have validity for us to do something with or about. We see surfaces for walking, handles for pulling, space for navigation, tools for manipulating, and so on. He called the perceivable possibilities for action "affordances."

Bill explains the relationship between interaction design and the affordance offered by a flight of stairs:

> People have studied empirically the affordance for stair climbing, where it turns out that if you have a given leg length, then the depth of a stair and the riser height will be more or less optimal in terms of the biomechanical energy you spend to climb. There is an affordance for stair climbing that can't be measured just in terms of the physical dimensions of the world, or the capabilities of a person, but has to be evaluated as a complex relation between the two. That offered an interesting way to look at how interfaces convey information about what you can do with them, so that's what I turned my attention to for a number of years.
>
> I tried to peel back the notion of affordances to its real essentials. There are a lot of misunderstandings in the design community about affordances; people think of it as an expression of what you can do with an object, or simply that you can do something easily with an artifact. When you take that stance, you beg the question of whether those things are mediated by culture and whether the kinds of mappings that people are learning are arbitrary. Gibson really meant for affordances to be a statement about



J. J. Gibson's book about affordances

perception, so for something to have an affordance, you need to think more about the biophysics of a situation and combine that with fairly low-level perceptual information—in other words, information that can be conveyed through light or sound about the physics of a situation, without a lot of mediation by culture or learning.

I've tried to show that once you take a very basic metaphorical leap in the interface to thinking about the interface being a physical environment rather than being a kind of command-line-driven conversational metaphor, then all of a sudden people can start to deal with items that are shown graphically as if they are physical objects. Then they start to attend to the information being conveyed that gives them hints about what they might be able to do with those objects.

For instance, you could take the scrollbar that sits on the side of a window on most interfaces, which allows you to move the view of the window. It's difficult to understand how you would know what you might do with the scrollbar. You can start by saying that usually the handle of a scrollbar is shown as a kind of separated, bounded object within the interface, and that at least gives people some information that they might be able to interact with it in some way. The tendency might be to click on it or select it. When you do that, it's likely to move. So all of a sudden, there's perceptible information, not only about the affordance of grasping something virtual, but also about the potential for moving it. Now people can start to explore the affordance of movement. When they do that, they see the view on the window change, and now they have information that the handle moves a connected surface.

Equator Project

Bill got more and more interested in the subtleties of the subjective and qualitative relationships that people have with both digital and physical things. In 1994 he moved to the Royal College of Art in London. There he explored the use of technologies to make aesthetic, social, and cultural interventions in people's lives. He was interested in expanding the scope of the ideas and associations that people have when they think about what digital technologies can do to products. He tested the ideas by making working functional products that people can try out and live with over a period of time. He wanted to test whether the things that he thought would be interesting and valuable to them actually turn out that way.

He was involved with a large project called Equator, a six-year interdisciplinary research collaboration, funded by the Engineering and Physical Sciences Research Council (EPSRC), to investigate the integration of the physical and digital worlds by developing innovative systems. There were eight computer science, sociology, and psychology groups participating from British universities, and Bill's group looked at new technologies for the home. They built a series of prototypes to see how weight sensing could be used to get partial information about people's activities in the home. Bill describes some of these prototypes.

History Tablecloth

The History Tablecloth uses weight sensing, measuring how long things have been left on the surface. Things that have been left on it for a long time develop a kind of halo under them, which points them out and highlights them—sections of the tablecloth glow. Objects that have only been there for a short time are not highlighted.

> Ethnographers in Nottingham have done a number of studies of the home, where they've focused on the way that people use surfaces—tables and shelves and so forth—as a way of organizing flows of information. We built on that by saying that one of the problems is that you can't see the history of objects in the home, so the history tablecloth works by looking at when things are placed on certain areas of a table, and indicating how long they've been there.
>
> The way we're building it is quite interesting. We've started working with a woman who has experience with printing electroluminescent material directly onto flexible substrates, and we're working with a company to develop it. Not only do we have a very flexible display, though very low resolution, but each of the elements of the display can be quite complex and fine because it's screen-printed. The end result should look a lot like a kind of lacey

tablecloth, but segments of the tablecloth will light up to highlight things have been on it for a while.

The tablecloth appealed to us because it started to capture a kind of aesthetic for the home that we thought was particularly comfortable. Instead of having purpose-built—obviously electronic devices that you're meant to use as furniture—it becomes an accessory that you can put over your existing furniture.

Key Table and Picture Frame

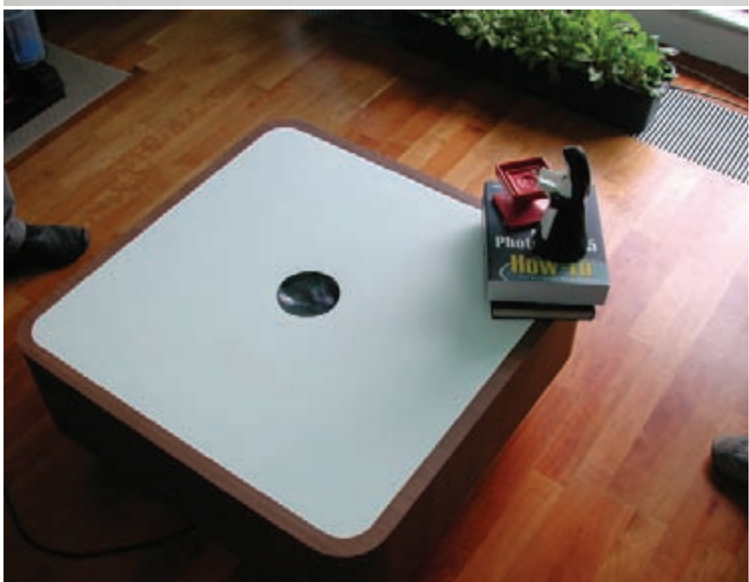
The Key Table also uses weight sensing, but to get a sense of people's emotions from the way they put things down on it, much as slamming doors are a crude measure of mental state. The table measures the energy or the force with which you throw something down, and then it maps that to your mood. If you come in through your front door in a bad mood, you are likely to throw your keys down onto the table violently, whereas if it has been a good day, you will probably place them there gently. The table triggers reactions to emotional entrances in a variety of ways; for example, a picture tilts at an angle to warn other inhabitants to tread carefully.

Key Table and Picture Frame

Photo
Sarah Pennington

The Key Table is a less well-developed design than other pieces we developed. It's much more of an experiment, more of a kind of lighthearted stab in a sort of direction. We originally wanted the Key Table to contain an automatic drinks mixer that would dispense the appropriate alcoholic beverage for your mood: if you came in and you were happy, it might give you a piña colada, but if you were in a bad mood it would give you a double whiskey. There are people in Sweden who built an automatic drinks dispenser that looked at your brainwaves and mixed you a drink, so we probably could have made that concept work, but the picture frame seemed to us to be quite a light-hearted and nice way to indicate mood.


AA



Drift Table

The Drift Table is about the size of a coffee table. It has a small round display in the middle of the top surface that looks like a kind of porthole. On the display, you see a slowly drifting view of the landscape of Britain looking from the air. It feels as if your room is floating at a height of a few hundred feet, and you are looking down through a hole in the floor. If you put things on one side of the table, the imagery starts to drift in that direction, and adding weight causes it to "descend," zooming in on the landscape below. A display on the side of the table shows the location of the aerial image.

> The table suggests a "hole" in the home connecting physical and virtual space. In the end, you can't really tell whether it's an interesting idea unless you make the thing; so we have. We've built a table now that contains a high-end PC, a bunch of hard drives, load sensors, stamp chip and so forth, all of which sits within the table. When you put the cover on, it's just an elegant object, which shows an image drifting gently by.

Drift Table, from installation to navigation

Photos
Bill Gaver, Andy Boucher, Sarah Pennington, and Brendan Walker

The Drift Table has been built, exhibited, and tried out by people extensively. It has a magically gentle entertainment value, both soothing and engaging.

Bill Gaver talks with intellectual rigor about the meaning of affordances in the context of biophysics and perception, but as you make the metaphorical leap with him toward understanding the potential for designing interactions as a complete physical environment, you are quickly drawn into the possibility of objects conveying information that is full of associations and emotional qualities. His explorations in this direction, as well as those of Hiroshi Ishii and Durrell Bishop, are closely related to the work of Tony Dunne and Fiona Raby, as they explain in the interview that follows in chapter 9, "Futures and Alternative Nows."