Chapter 4.

A Sculptural Perspective

Looked at from the point of view of three-dimensional visual art and design practices, much can be said about the way that today's computing objects are made, shaped, and physically transformed. Because the physical materials of computers are prefabricated and cannot be plastically reshaped, the making of computing objects today is primarily an additive process which involves the bringing together or joining various parts, including buttons, displays, chip and plastic shells. Consequently, most fields of visual artistic exploration that use the physical materials of computers, including the fine arts, physical HCI and industrial design, all use an additive processes or *assemblage*[1] to create physical computing objects. The additive manipulation of physical computing materials has led to the creation of a range of objects, from industrially designed and superficially, curvy, hand-held

[1] A more detailed discussion of sculptural assemblage is provided in Chapter 5.

devices, to successful robotic sculptures, like Tim Anderson's painting machines.[2]

But despite the range of computing objects that additive manipulation can create, this process still limits the development of computing technology as a truly sculptural medium. Absent from the artistic exploration of physical computing materials is any work that involves the hands-on, direct, plastic, manipulation of *real* and active *physical computing materials*. As a result, many types of three-dimensional, visual art and design practices simply do not work with computing technology. For instance, both the decorative arts and certain types of sculptural and artistic practices demand the hands-on, plastic manipulation of *real* physical materials. Because these practices dominate the design and creation of very specific types of objects (like fashions or house-wares), computing technology simply will not meaningfully become part of these types of objects. Moreover, the artistic development of computing technology as a three-dimensional medium is still limited. Just as assemblage transformed sculptural and artistic practices in the 20th century, so will the plastic manipulation of physical computing technology transform both artistic practices and computers. This kind of direct, hands-on plastic manipulation of *computationally active* materials will also allow artists to truly investigate the artistic relationship between physical form and computation.

[2] A more detailed description of these works is provided in Chapter 5.

This chapter looks at the design and creation of computing objects from the perspective of the visual arts. It expands on the importance of shapeablity and direct manipulation for physical computing materials, by looking at the role of these qualities in three-dimensional artistic and design practices, like industrial design, sculpture and the decorative arts.

Unshapeable, Unsculptable and Persistently Square

Throughout history, artists, designers and craftsmen have expressed their ideas and emotions in three-dimensional form through the inspired manipulation of a wonderful palette of physical materials. The results include a broad range of expressive forms, which can function aesthetically, practically and culturally. Artists, craftsmen and designers have fashioned stone into human form, clay into beautiful, yet practical vessels, and steel, rubber and glass into curvaceous, mechanical automobiles. And while the goals of these expressive activities have differed from the practical to purely aesthetic, each activity has been *sculptural* because it involved the physical shaping of materials. And in many cases, this process was highly plastic and direct one, involving the hands-on cutting, bending or molding of the material into a desired shape.

Artists seeking to reshape computing technology physically, or even sculpt computing technology face a visual medium that is both unshapeable and *persistently square*. Computing materials are prefabricated, rigid, and hard, and for reasons of

Figure 4.1 Michelangelo's *David*, 1501, carved from stone; Eva Zeisel's *Hallcraft,* 1949, slipcast clay; Detail 1920's sports car, metal and glass.

convention are usually square. They cannot be bent, shaped, or cut, which prevents them from becoming truly sculptural. In addition, because they are conventionally square, they remain strongly rooted in the pictorial, a visual arts tradition that is usually considered anti-sculptural.

The urge to break from the square in the tradition of western sculpture is strong and old. It can be traced to the history of stone carving in early Greece. The archaic stone figures in 6th century B.C. Greece were straight, linear and four sided, reflecting the block of stone they were carved from. Throughout the 5th century B.C. classical period, and into the later Hellenistic period, Greek sculptors fought to break away from these linear shapes and create fluid forms that did not reflect the square block of stone from which the figures were cut, but instead conveyed the complexity of the human body and its movement[3]. In more modern and contemporary times, the urge to break from the square and the pictorial tradition of painting can be seen in a broad sculptural tradition that includes works of assemblage, the built paintings of Frank Stella[4], installation art and site specific sculpture. In this way, getting the computer out of its box is more than a call for ubiquitous computing or new markets for chips. It reflects the artistic imperative to explore shape and form in a means that transcends the square.

[3] Carpenter, Rhys, Greek Sculpture: A Critical Review, Chicago, University of Chicago Press, (1960).

[4] Stella, Frank, Working Space, Cambridge, MA, Harvard University Press, (1986).

The *persistent squareness* of computing materials is complex; it is both a cultural and technical artifact[5]. Technically, it is based on the both the mechanical properties of the rigid prefabricated physical computing, and the fact that by convention, these materials are usually square. Buttons, chips, circuits, displays and speakers, are all prefabricated, rigid, bulky, and square items that simply cannot be reshaped, or cut, stretched, bent or joined. Sometimes, these materials can be specified through industrial design processes, but they are still hard an immutable once you have got them. Culturally, the conventional *squareness* of the monitor and visual displays, has kept most visual expression with computers firmly in the realm of the pictorial. This is because the virtual media of computers, (the images on the screen), have provided visual artists with such a rich and expressive medium, that they have gravitated toward the area of computer graphics, creating everything from special effects in films to photographs and computerized portraits. All these visual artworks take place on square monitors, and consequently much of the visual and artistic exploration of computers remains firmly grounded in the pictorial tradition. And monitors are square because the pictorial tradition, and the convention of displaying images on squares is so old and so strong. Painting, photographs, film, video and television all demonstrate the strength and

[5] Bishop, D., from an interview in, Abrams, R., Adventures in Tangible Computing, the Work of Interaction Designer, Durrell Bishop, in Context, *Masters Thesis for the Royal College of Art*, (1999).

development of the pictorial tradition in our culture today. So while there are strong technical reasons for the development of computer expression within the rectangle, the cultural strength of the pictorial tradition has also contributed to the acceptance of the square frame of computers.

Square Displays and the Pictorial Tradition

Until very recently, visual displays have been perhaps the most physically fixed part of the computer, (new flexible display technology and even projectors are changing this.) Monitors are simply square and rigid. That is how they are made and how they come. Their aspect ratio is even determined. When people look into a computer display, they look into this square, and consequently at art or design work firmly rooted in the pictorial traditions of painting, photography, theater and filmmaking. This is not to say that computers have not, through interactivity, created many new artistic forms. It is only to say that that these visual forms have tended to remain strongly), related to the pictorial tradition. Some of the best descriptions of what goes on inside the computer are strongly pictorial. Interface design has been famously compared, by Brenda Laurel[6], to the frame of the proscenium theater. This innovative way of looking at what goes on inside the computer is wonderful if one wishes to work in the realm of the pictorial, but also demonstrates how the materials of computers can be limiting to anyone seeking to transcend the square.

[6] Laurel, Brenda, Computers as Theater, Reading Massachusetts, Addison-Wesley Publishing Company, (1991).

Shapeabilty

Learning to shape the hard material of stone into fluid human forms that transcend the original square block took Greek artisans centuries.[7] Artists and designers wishing to explore the sculptural possibilities of computers are faced with prefabricated materials that can be even more limiting than stone. At the very least, physical force could reshape stone. Physical force used on the prefabricated materials of the computer will only destroy their electrical properties and render them useless. Thus, artists and designers working with these materials must preserve their physical integrity, rather than alter it. Usually, artists and designers attempting to transform the shape of computers have had to work around these square materials, building curvey or furry housings to hide them. And while the size of these materials can be "specified" through remote CAD and design processes, this usually does only a little to truly transform their squareness. Moreover, artists who want to work in a more direct manner than CAD, simply can do little to physical computing materials but accept them as is or cover them up with other materials. Consequently, the *persistently square* materials of computing technology have left most computational objects sculpturally superficial, a mere reflection of their square interiors.

Figure 4.2 An extreme example of the results of covering square computers with fur, and the sculpturally superficial results of such a process.

Shaping in Industrial Design

Industrial and product designers working with the physical materials of computers have been able to

[7] Carpenter, Rhys, Greek Sculpture: A Critical Review, Chicago, University of Chicago Press, (1960).

remotely and plastically, shape and design the plastic shell, boxes and peripherals of many computers and computing objects. But this operation is also often superficial, because industrial designers rarely have control over the prefabricated electronic *guts* of computing objects. These *guts* usually consist of buttons, circuits and displays that are physically rigid, bulky and square. Designers may be able to specify the size and arrangement of parts; they may even design the shape of a circuit board, but there are some parts, like displays, that they simply cannot make *unsquare.* They must work around these parts, trying to hide their squareness under a curvey shell. The direct result of this is that the objects they are designing get bigger. In Figure 4.3 the inner circle and the square contain approximately the same area. Imagine that the square is a display. To make a truly round housing for the display, without violating the its structural integrity, that housing would have to be the size of the outer circle, which is *over 50% as large in area*. Consequently, the external form, or housing, of most computing objects usually remains a rounded square, which is squished around the square interior parts.

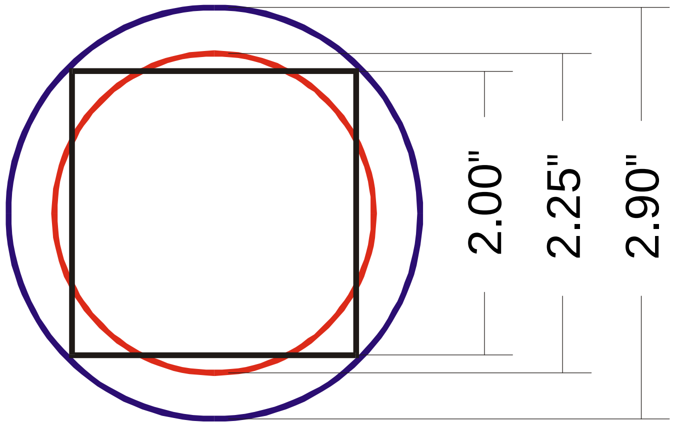

Figure 4.3 Diagram of how the housing of fundamentally square computing materials must grow in size to become curvey or round. The inner circle has the same area as the square. The outer circle, which is big enough to contain the black square, is 50% larger in area.

In addition, this form of plastic manipulation does not actively engage with computation. The plastic housing is the one material of computational objects that is non-computing. It is only structural. Consequently, reshaping it provides little opportunity to investigate physical form and computation.

Shaping in the Fine Arts

In simplistic terms, artists and sculptors who are working towards personal artistic expression with the physical materials of computers generally have little control over the shape of those materials, because they tend to work in a direct, hands-on manner with materials that are at hand; and in general, the materials of computers are shaped through industrial processes. Working additively from materials at hand as led to many successful assemblage/robotic works[8] that do not use the plastic manipulation of physical materials. It has also lead to the artistic covering square computers with unusual materials like wood or fur, or simply giving in and accepting what they've got. In no way has it let artists plastically shape active, computing materials.

For most individual artists working with the physical squareness of PC's and monitors, the transformation of these shapes has either been sculpturally superficial, or just NOT. An extreme example of how superficial the attempt to change the shape of PC's can be is the fur covered PC shown in Figure 4.2. An example of a inoffensive, kind of acceptance of square monitors is the installation of Karl Simms, *Galapagos* (Figure 4.3). While Simms valiantly works to create organic and fluid forms inside the monitor, the installation of this software is somehow contradictory, accepting the cold, square, and fixed monitors it must be shown on. This definitely shows better taste than covering it them with fur, but it outlines the limits of individual artists trying to reshape physical computing media.

[8] See Chapter 5 for a more detailed description of works in robotic assemblage.

Figure 4.3 Installation of Karl Simms *Galapagos*.

The Direct Material Manipulation of *Real* Materials

As previously outlined, the most successful means for reshaping computing materials is through CAD specification, or remote design. For certain areas of three-dimensional design and artistic practice this is fine. But there are certain design and artistic practices that demand the direct, hands-on manipulation of the *real* materials of an object. For instance, architecture and industrial design often rely on model making and drawings to understand, see, sketch, and design their final products. The hands-on tactile manipulation of the materials of the object is not always essential to the design process. Designers in these areas usually use prototype materials to mimic the final result. Architects build small models of wood, cardboard and metal screen to create the final "look" of a building's *real* materials. In other words, architects usually do NOT sketch in buildings, or *real* building materials, but instead make models of them. Industrial designers and product designers often create "looks like models" from drawings. These models may be made from a variety of materials, like plaster, and then painted to look like the final material. These materials and objects are often non-functional. In fact, the final materials of such objects are usually specified by an engineer *after* the design process.

But there are certain three-dimensional artistic and design practices that *do* require the hands-on manipulation of the *real* materials of an object. Both decorative arts practices, and many more purely **A**rtistic sculptural practices often require the direct hands-on manipulation of the *real* and final materials of an object. In these practices, the objects that are created have a certain *material reality* that is the result of a process that involves sketching, exploring and creating in the materials of the final product. In more purely high **A**rt practices, (like sculpture or painting), an artist usually works with a material that is shaped directly into his or her final product. An artist takes a piece of stone and makes a sculpture, or uses paint and canvas to make a painting. Significantly, the physical presence of paint on canvas brings a material reality to a painting that a print cannot imitate. (This not to say that multiple work, like Warhol's, that explores the meaning of the individual art object, is not art, just that many forms of artistic practice rely on the hands-on manipulation of *real* materials towards the final product.) In the decorative/industrial arts practice, the hands-on manipulation of the *real* materials of an object is an essential part of the manufacturing and design process. Ceramic artists may initially make sketches on paper, but they also work and sketch directly in clay, perfecting the final shape, material and tactile properties of their products by directly manipulating the clay itself. This process can lead to the direct creation of a single hand-made, final product or to a design for a mass-produced product.

This kind of sketching and aesthetic exploration through the hands-on manipulation of physical materials, has been severely limited by the physical materials of computers. What this kind of hands-on manipulation provides artistically, is a sort of knowing through action that requires a quantitative knowledge of a material and medium, which ultimately leads to a qualitative understanding. A jewelry maker must know at some level the quantitative mechanical properties of the metals they work in, for instance how ductile a certain metal is, or what its melting point is. At the same time, the artistic and aesthetic ramifications of those quantitative properties, or the qualitative properties of that material, must be understood by the craftsmen to achieve his or her artistic and aesthetic goals. Achieving that kind of qualitative understanding, for instance what kind of curve and resolution a certain metal can have when bent in a certain process, is an aesthetic understanding of the material that can only be achieved through the direct hand-on use of the *real* material.

Of course, an artist might work in silicon, but assuming he or she could gain access to these materials, it not clear how they provide the same ability to experiment *aesthetically* that the hands-on manipulation of traditional sculptural materials provide. In many ways, this is an issue of scale. Artists and craftsmen have relied on things that they can feel and touch with their senses. The world of micro and nano-technology does not provide such *sensual* access to materials. (Of course, there are mediated ways to access and understand these materials visually, like with a microscope or a robot. these may someday be so successful that they do not fall outside of the hands-on approach I am speaking about.)

It this kind of knowing and aesthetic exploration through the direct manipulation of *real* physical computing materials, that will ultimately lead to a meaningful artistic relationship between physical form and computation.

More on the Decorative/Industrial Arts

When we talk about the decorative arts, we talk refer to a wide range of artistic practices that create *everyday* objects, such as jewelry, textiles, glassware, fashions and even musical instruments. While it is impossible to draw a rigid boundary between the decorative arts, industrial design, product design and even traditional sculpture, there are quite a few aspects of decorative and industrial arts practices that generally separate them from these other fields. Decorative and industrial arts are generally concerned with the creation everyday objects that have some root in the functional, but are aesthetically transformed through ornament or materials. Despite Modernist calls for a union of "form and function" the idea of transforming the everyday through ornament and materials has remained a central practice in object making throughout the 20th century and in the decorative arts today. Today's decorative arts practices also find strong roots in Post–modern ideas. They seek to "subvert the expected notions of form and challenge our traditional assumptions about the behavior of materials."[9] Thus aesthetic transformation in decorative arts practices relies heavily on the direct, hands-on, artistic exploration and manipulation of physical materials.

[9] Newman, Lenore and Spak, Jan L., *Inversion and Transformation,* Eidleberg, Martin (ed.), Designed for Delight, New York, NY, Flammarion and the Montreal Museum of Decorative Arts, (1977).

It is important to note that the hands-on relationship of decorative arts practices to physical materials does not require the final product to be a singular, hand-made item. Before the industrial revolution, the decorative arts referred clearly to the fabrication of a single, handmade “everyday” objects that ranged from jewelry to musical instruments and household items. Today’s decorative and industrial arts may produce anything from a single, individual hand-made vase to an industrially mass-produced piece of furniture. What is common to these objects is that their production or design process was not *materially abstract*. The touching or manipulating of the *real* materials of each of these objects plays an essential part in their fabrication or design. For instance, a contemporary designer making a lamp from an industrially produced translucent plastic tube must experiment with this material to determine what happens when light passes through it. Once the designer achieves an effect that is desirable, he or she can then reproduce it, either in a small series or through a larger scale industrial process. In this way, the hands-on manipulation of *real* materials in a decorative/industrial arts process can lead to either a single final object, or to a design that can then be reproduced. In contrast, an industrial designer may never have to touch the materials of his design at all. He or she may just sit at a computer and only CAD his final product.

Ramifications

Without new active, physical computing materials that are tactilely and mechanically diverse, and that allow for hands-on aesthetic and plastic exploration, computers simply cannot become part of this incredibly broad field of aesthetic practice. Practices in the decorative arts create a myriad of household objects, clothing and tools, and bring to these types of everyday objects an aesthetic transformation that is more than practical. It is cultural, symbolic and sensual. Computers are currently isolated from this type of transformation and from becoming part of the wide range of objects that decorative arts practices produce. Moreover, this kind of hands-on, plastic, investigation of computationally active physical materials is important to any visionary technology or design practice. These types of directly manipulable, plastic materials are necessary to explore a meaningful artistic relationship between form and computation. Without materials that can be directly shaped, bent and formed, and that have an effect in software, artists will not be able to understand the meaning of either shape or tactile properties, in relation to software.

While the limitations of physical computing materials do have significant artistic and aesthetic ramifications, they also have a dramatic effect on the direction of many more *practical* fields of computer development and research. Technology researchers, from visionary product designers like Durrell Bishop to nano-technology scientists, dream of computers that can cover our walls, lie in the carpets underfoot, or be worn comfortably on our backs or fingers. Technology visions like Ubiquitous computing, Tangible Media, Things-that-Think and Wearable Computing ALL call for the incorporation of computing technology into the very objects that the decorative/industrial arts are centrally concerned with. These objects are necessarily materially rich and diverse. But the same material limitations that prevent an aesthetic exploration of computing technology in such objects, are also preventing the fulfillment of these technological and design visions. For despite the shrinking size of microprocessors and the promise of wireless technology, shaping and imbedding technology into the rich material world around us remains technically difficult and elusive. No matter how small computer chips become, they must still be housed in plastic packages, and connected to in a rigid manner. Consequently, integrating computer technology into objects that are not rigid and plastic (like clothing) is still incredibly awkward and impractical. For computers to truly emerge form their plastic boxes their humanly sensed, physical materials must change.