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Designing for the Computer Screen

ABSTRACT
Designing for the computer screen poses new challenges for the designer. While some of the issues are new such as time, motion, and sound, other aspects such as the readability of typography, the separation and combination of image and type, and the general issues associated with projecting the three-dimensional world onto a two-dimensional surface are part of a complex design tradition. When designing for this new medium, the designer is faced with the problem of organizing a large amount of information in a small area and must establish the most orderly arrangement of information, determine the hierarchic scale of importance, arrange the easiest accessibility of information, and design the appearance accordingly.

THE COMPUTER SCREEN AS A DELIVERY PLATFORM

While we still get a great deal of information from looking at the printed page, more frequently the computer screen is the end delivery platform for information. Computer users are not just using the computer screen as the environment on which elements are composed and created in a preview mode for later production as a printed document. The computer screen is more often the reading surface on which the interplay of images, type, and sounds is projected and intended as their final reading and listening form. Hypertext or hypermedia software is one of the first kinds of software to exploit the computer screen as a presentation platform. Hypermedia refers to kinds of linked
information and can be various media besides text. Many software systems include some hypermedia capabilities.

Display terminals are proliferating as information delivery platforms in many areas of our daily lives. This new reading surface poses its own set of unique issues and presents new challenges and opportunities for visual design. While some of the rules are similar, designing information for this picture surface is different from the printed page, sign, or billboard. The high resolution and frozen structure of the printed page are gone, and the coarse resolution of the screen, the projected rather than reflected light of the printed page, and the elements of time, motion, and the addition of sound are the qualities of the computer screen.

The medium of the computer screen and the qualities of that surface are new, but the issue of projecting a three-dimensional space onto a two-dimensional surface remains the same. Projection on a two-dimensional plane allows objects to be rendered that are impossible to build in three dimensions and are hard to conceive of without rendering (Figure 1).

What is perceived on the screen of the computer is combinations of pixels (Figure 2). One pixel represents a point; it is one-dimensional. Dragging a point forms a line. Dragging a line forms a plane, which is two-dimensional, and dragging a plane forms a volume, or the illusion of volume, which is three-dimensional.

**RULES OF THE VISUAL WORLD**

Designing information on and for the two-dimensional plane of the computer screen is a new field; however, the computer screen is a two-dimensional plane, and designing for that space is part of the graphic design tradition. Within this field, the designer is faced with using two basic strategies to project information onto the picture plane: representation and symbol.

Representation is a projection of the world as we literally see it. The understanding that we have of this image is based on the information we have stored in our memory. We identify elements in the image with the elements we remember. For example, we recognize the features of someone's face in a photograph and construct an image of the person we associate with the face in our mind.

Using symbol, the designer represents the world in the form of elements that resemble, imply, or otherwise suggest what we see. Symbol allows the designer to compress information into a small space and eliminate unnecessary detail (Figure 3). Five equally sized rings in a certain configuration become the symbol for the Olympic Games. Each
Projection on a two-dimensional plane allows objects to be rendered that are impossible to build in three dimensions and are hard to conceive of in the mind.

Figure 1. Two-dimensional projection

ring and its color represents one of the five continents. With each compression, the information that passes through our visual channel is reduced. We expand the information carried by the symbol in our mind, constructing its relationship to the world in our associative imagination.

Mixing symbol and representation (Figure 4) can be used by the designer to great effect. In this image of a Dutch treadmill crane by
Figure 2. Dimensionality on a two-dimensional picture plane
Simon Stevin, the *representation* of the figure, the building, and the barrel is integrated with the *symbolic* rendering of the wheel mechanism,
which when drawn in a representational manner would be hidden within the building.

LIMITED SPACE

The computer screen for ease of navigation and accessibility is the best place to store information, but it is also the computer's most limited resource. The amount of storage space required on the computer memory is rapidly becoming smaller, but the delivery platform, the computer screen, is increasing in both size and resolution at a much slower pace. The limited space of the computer screen and the coarseness of the resolution leave little room for embellishment and decoration.

To make simultaneous information available on the screen requires a clear and orderly structure. The reader has to be able to differentiate and retrieve in the easiest possible manner.

MULTIDIMENSIONALITY

The desire to simultaneously represent many aspects of an idea has been with us for centuries. Various projection methods have been developed that effectively allow the simultaneous display of views. This technique of simultaneously projecting views of three dimensions onto a two-dimensional surface can be used as a device by the designer of the interactive screen (Figure 5). When compared with the printed page, the resolution of the computer screen is very coarse. The density of detail possible on the printed page is many times greater than what is currently possible on most computer screens. The designer is faced with having to find alternative methods for projecting images and compressing information. These two examples demonstrate how visual techniques can be effectively used to condense information into a small area.

There are a number of projection techniques, each with its own advantages and drawbacks (Figure 6). Orthogonal or orthographic projection is when the various views of the object are projected parallel to the picture plane. The true measures are retained and can be measured.

Oblique projection methods include oblique, axonometric, and isometric projection. With oblique projection, the frontal plane is drawn in orthographic projection, and the top or sides are drawn at an angle of 30° or 45°. With an angle of 30°, the true measures of the sides are retained. If an angle of 45° is used, the measures of the sides are halved in order to retain the correct optical distortion.

An axonometric drawing shows the plane view in orthographic projection and the side elevations drawn at angles of 30° and 60° or
Figure 5. Simultaneous projection of views
both at angles of 45°. The horizontal measures retain their lengths, and the verticals are foreshortened.

Isometric projection shows the lateral angles drawn at identical angles, and the true measures are retained.

Perspective that implies deep space is bound by a horizon line and one or more vanishing points. The viewer of the perspective image is outside of the picture frame looking in, his eye being drawn to the vanishing point. At this point on the plane, all the distorted parallel lines within the image converge. This image is one point in time; there is no motion in the still perspective picture.

Flat projections preserve the parallel condition of lines. Flat projection methods often give the designer more freedom to express and explain, without being faithful to a horizon line or vanishing point. They are particularly useful when designing diagrams where elements of space and time must be projected and cannot be distorted or lost because of the rules of perspective. Multiple events or processes can be projected simultaneously and understood by the viewer. These techniques often allow the designer to describe space and form from a multitude of angles and positions without being hindered by the vanishing point or horizon of the perspective image.

Excellent examples of flat projection techniques are found in pre-Renaissance and Asian art (Figures 7 and 8). Flat projection allowed the artist to create enormous spaces and project figures and continuous narrative over space and time within one image. Often a sequence of events will take place across the picture plane, and the same figures appear more than once in the same image. British painter and photographer David Hockney (1988) describes the difference between the Asian and the Renaissance approach:

The great difference between the Chinese scholar-artist and Renaissance scholar-artist is this: if the Chinese scholar-artist had a garden... he would want to walk in it, so he would make his path so that he'd have a longer walk. So he walks up the path of his garden and then goes and makes a picture of that garden, or the experience of walking in it. But the Renaissance scholar sits in a room and looks out of a window, and then makes his picture.

He is fixed there with the window picture, and therefore he thinks of perspective. The Chinese wouldn't because their experience is moving, flowing, as time is flowing. And so they both start off with very different locations; one is seated and the other is not. (p. 37)

The arrangement of windows and the layout of the computer screen are similar to the manner in which the Chinese painting is rendered, a flat projection. The screen is a flat picture plane on which rectangular windows are projected. The contents of windows scroll up and down and left to right, as if continuous in one plane. Windows appear as though they are lying one on top of the other in plain view. The windows underneath do not proportionately decrease in size as they would if
Figure 6. Projection methods
the screen were rendered in a perspective projection. The effect of placing photographic images and perspective projections within the windows is like mixing the Renaissance perspective image with the flat Chinese projection.

DESIGN FOR THE COMPUTER SCREEN

Any notion that design for the computer screen is merely decorative is a misunderstanding. Good computer screen design does not decorate; it clarifies.

In designing for the computer screen, the designer is for the first time faced with the problem of organizing such a large amount of information in such a small area that there is the chance of creating complete visual chaos. For the best and most persuasive functioning of the computer, it is necessary to establish the most orderly arrangement of information, determine the hierarchic scale of importance, arrange the easiest accessibility of information, and design the appearance accordingly.
Rudolf Arnheim (1971) has described the importance of visual order:

Order is a necessary condition for anything the human mind is to understand. Arrangements such as the layout of a city or building, a set of tools, a display of merchandise, the verbal expression of facts or ideas, or a painting or a piece of music are called orderly when an observer or listener can grasp their overall structure and the ramification of the structure in some detail. Order makes it possible to focus on what is alike and what is different, what belongs together and what is segregated. When nothing superfluous is included and nothing indispensable is left out, one can understand the interrelation of the whole to its parts, as well as the hierarchic scale of importance and power by which some structural features are dominant, others subordinate. (p. 1)

MULTIPLE WINDOWS

Maximizing the amount of information within the limited area of the computer screen has led to the use of some interesting display methods. Defining information by separating it from its surroundings has led to the development and use of a windowing system. The concept of multiwindows is not new; wonderful examples of windowing techniques can be found in Persian miniatures and manuscripts from
the Middle Ages. Windows allow their contents to be separated from their surrounding while still remaining visible.

The windows create the illusion of a slightly three-dimensional space on the picture plane of the computer screen (Figure 9a). The illusion is created by the apparent overlapping of the windows, defined by their borders. The reality is that they are all projected on the same two-dimensional picture plane (Figure 9b). By adding frames to the windows, a layering effect is produced. The windows that are only partially visible behind the top layer are often distracting to the window currently being read. While their position in the stack gives reference to the order in which they were viewed and their existence allows ease of accessibility, their continued brightness on the screen only serves as a distraction. Controlling the relative brightness of the windows and having the possibility of staggering their positions will give a sense of hierarchy to the stack while retaining accessibility and place emphasis on the current window (Figure 9c). The illusion of the third dimension on the screen is more prominent; it helps clarify a structure and gives order to the documents. Having a photograph or image or even a moving image within one of the windows can have the effect of creating a depth hole in the midst of the layer illusion (Figure 9d).

Mixing windows that contain images and areas of high contrast can create a problem. It is important to clearly define contrast between foreground and background elements. Understanding how to control contrast, relative brightness, and color on the screen can be effectively used to unify, layer, and separate elements (Figure 10). This series of buttons and icons demonstrates some of the spatial depth and contrast illusions created by using contrasting shades of gray and black to show foreground, background, raised, and depressed elements.

THE STRUCTURE OF TYPOGRAPHY ON THE COMPUTER SCREEN

"Typography is the art of using black to bring out the whiteness." The high resolution of the printed page allows for a much denser display of information than the stubborn resolution of the computer screen (Figure 11). Type for decent quality commercial printing is resolved between 1,000 and 2,500 lines to the inch, laser printers usually image at 300 dots to the inch, and most computer screens currently project at about 72 pixels to the inch.

Type of 8.5 points that might be quite readable on a printed page at a resolution of 1,270 lines to the inch is not acceptable in a readable form on the screen of the computer. At less than 12 points, the spaces between characters become random; some too tight, so that characters
Figure 9. The computer screen

Figure 10. Spatial depth and contrast
The bitmapped fonts are shown at about 220% of their actual size. At small point sizes, the resolution of the computer screen does not allow for the correct character forms or character spacing to be generated.

**Character spacing**

<table>
<thead>
<tr>
<th>Spacing</th>
<th>10pt Helvetica</th>
<th>10pt Times</th>
</tr>
</thead>
<tbody>
<tr>
<td>very loose</td>
<td>Library</td>
<td>Library</td>
</tr>
<tr>
<td>loose</td>
<td>Library</td>
<td>Library</td>
</tr>
<tr>
<td>normal</td>
<td>Library</td>
<td>Library</td>
</tr>
<tr>
<td>tight</td>
<td>Library</td>
<td>Library</td>
</tr>
<tr>
<td>too tight</td>
<td>Library</td>
<td>Library</td>
</tr>
</tbody>
</table>

Space that may be saved by using tight character spacing may create readability problems. Words with overlapping characters are hard to read.

**Figure 11. Pixel distortion and fonts**
appear to be overlapping, others too loose. The effect is that words bunch together or break up, and as a result readability is poor. Serif typefaces, which should be used for large areas of text, become harder to read than sans serif fonts.

Line spacing or leading should be set proportionately to both the amount of text that is being displayed and the length of the line of type. If leading is too tight, it is more difficult for the reader's eye to find the next line in the paragraph. Leading that is too loose has the effect of breaking up paragraphs into lines of text and also uses up valuable screen real estate.

Margins around text within windows are important to help readability when text windows overlap (Figure 12).

CONCLUSION

The pixel is the smallest element on the surface of the computer screen; it is the element that combines to form a line or a plane; it is the unit that combines to make up a photographic image or a single letter. It is one point on the plane of the computer screen; it indicates a position in space; it is static, centralized, and directionless.

Designing for the surface of the computer screen poses new and interesting challenges for the designer. While some of the issues are new such as time, motion, and sound, other aspects such as the readability of typography, the separation and combination of image and type, and the general issues associated with projecting the three-dimensional world onto a two-dimensional surface are part of a deep and complex tradition. When designing for this new medium, it is important to be aware of
what has already been done and what can be used and applied from the rich history of art and graphic design.

The successful designer of interactive multimedia must understand how to establish a clear visual language on the computer screen. The designer must be able to separate information into frames while separating information within the frames from the information about the frames. Devices such as the use of an overlaying grid can be effectively employed while organizing information on the screen (Figure 13). The grid can prevent random placement and create a good visual sense of structure while saving significant amounts of screen space.

This is a very basic overview of some of the issues faced by the designer of the computer screen. As the development of computer software and hardware continues to become more refined, the designer will be faced by new and varied issues, but the role of design and the goal of the designer as the clarifier of information will continue.

The example above left lacks an overall visual structure. The position of the boxes, the space between the boxes and the type within boxes is randomly spaced. The hierarchical intent of the contents is lost. The diagram is too close to the left edge of the window. The diagram above right is the same information with a more logical and hierarchical structure applied. Using weight of line and size and body weight of type can help create a clear sense of hierarchy. Using an overlaying grid while composing the structure helps to define a visual order and save valuable screen space.

Figure 13. Visual structures for the computer screen
Two-dimensional design, three-dimensional structures, the surface of the computer screen, space, and environments do not exist on their own, separate from one another. They influence each other and extend into each other's territory, and by doing so, they create the world of design.

REFERENCES