SHRI VISHNU ENGINEERING COLLEGE FOR WOMEN::BHIMAVARAM (AUTONOMOUS)
DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING
HUMAN-COMPUTER INTERACTION
UNIT – V

5.1 Write Clear Text and Messages

5.1.1. Words, Sentences, Messages, and Text

Words:

- Do not use:
  - — Jargon, words, or terms:
    - Unique to the computer profession.
    - With different meanings outside of the computer profession.
    - Made up to describe special functions or conditions.
  - — Abbreviations or acronyms.
    - Unless the abbreviation or acronym is as familiar as a full word or phrase.
  - — Word contractions, suffixes, and prefixes.
- Use:
  - — Short, familiar words.
  - — Standard alphabetic characters.
  - — Complete words.
  - — Positive terms.
  - — Simple action words; avoid noun strings.
  - — The "more" dimension when comparing.
  - — Consistent words.
- Do not:
  - — Stack words.
  - — Hyphenate words.
  - — Include punctuation for abbreviations, mnemonics, and acronyms.

Table 8.1 Some Words to Forget

AVOID	USE
Abend	End, Cancel, Stop
Abort	End, Cancel, Stop
Access	Get, Ready, Display
Available	Ready
Boot	Start, Run
Error	—
Execute	Complete
Hit	Press, Depress
Implement	Do, Use, Put Into
Invalid	Not Correct, Not Good, Not Valid
Key	Type, Enter
Kill	End, Cancel
Output	Report, List, Display
Return Key	Enter, Transmit
Terminate	End, Exit

Sentences and Messages:

- Sentences and messages must be:
  — Brief and simple.
  — Directly and immediately usable.
  — An affirmative statement.
  — In an active voice.
  — In the temporal sequence of events.
  — Structured so that the main topic is near the beginning.
  — Of parallel construction.
- Sentences and messages must be of the proper tone:
  — Nonauthoritarian.
  — Nonthreatening.
  — Nonanthropomorphic.
  — Nonpatronizing.
  — Nonpunishing.
  — Cautious in the use of humor.

Messages:

- Messages are communications provided on the screen to the screen viewer.
- Several different types of messages exist, and they may be displayed in different forms and locations.
- A message should possess the proper tone and style and be consistent within itself and with other messages.
- Screen messages fall into two broad categories: system and instructional.

System messages:

- System messages are generated by the system to keep the user informed of the system's state and activities.
- System messages are of several types, each reflecting a different purpose.

Instructional messages:

- Sometimes referred to as prompting messages, are messages that tell the user how to work with, or complete, the screen displayed.

Common message types are:

1. **Status messages:**
   A status message is used for providing information concerning the progress of a lengthy operation. It usually contains a progress indicator and a short message describing the kind of operation being performed.
2. **Informational messages:**
   Informational messages, also called notification messages, provide information about the state of the system when it is not immediately obvious to the user.

Figure 8.1 Informational message box from Microsoft Windows with icon, text, and button.

3. **Warning messages:**

   Warning messages call attention to a situation that may be undesirable. They are usually identified by an "!" icon to the left of the message.

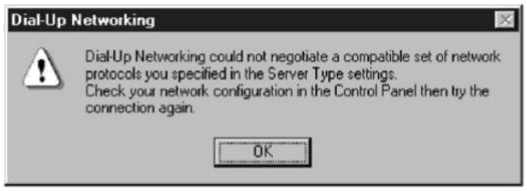

Figure 8.2 Warning message box from Microsoft Windows with icon, text, and button.

4. **Critical messages:**

   Critical messages, sometimes called action messages, call attention to conditions that require a user action before the system can proceed. A message describing an erroneous situation is usually presented as a critical message.

Figure 8.3 Critical message box from Microsoft Windows with icon, text, and button.

5. **Question messages:**

   A question message asks a question and offers a choice of options for selection. It is designated by a "?" icon preceding the message text.

Writing Message Box Text:

- **Title bar:**

  — Clearly identify the source of the message.
    - The name of the object to which it refers.
    - The name of the application to which it refers.

  — Do not include an indication of message type.

  — Use mixed case in the headline style.

- **Message box:**

  — Provide a clear and concise description of the condition causing the message box to be displayed.
    - Use complete sentences with ending punctuation.
    - State the problem, it's probable cause (if known), and what the user can do about it.

- Avoid contractions.
- Avoid technical jargon and system-oriented information.
- Provide only as much background information as necessary for the message to be understood.
- Show only one message box about the cause of condition in a single message.
- Make the solution an option offered in the message.
- Avoid multistep solutions.
- Use consistent words and phrasing for similar situations.
- Use the word "please" conservatively.

— Do not exceed two or three lines.

— Include the relevant icon identifying the type of message to the left of the text.

— Center the message text in window.

Message Box Controls:

- **Command buttons:**

— If a message requires no choices to be made but only acknowledgment:

- Include an OK button.

— If a message requires a choice be made, provide a command button for each option:

- Include OK and Cancel buttons only when the user has the option of continuing or stopping the action.
- Include Yes and No buttons when the user must decide how to continue.
- If these choices are too ambiguous, label the command buttons with the names of specific actions.

— If a message allows initiation of an action to correct the situation described:

- Include a properly labeled button initiating the corrective action.

— If a message describes an interrupted process whose state cannot be restored:

- Provide a Stop button.

— If a message offers an opportunity to cancel a process as well as to perform or not perform an action:

- Provide a Cancel button.

— If more details about a message topic must be presented:

- Provide a Help button.

— Designate the most frequent or least destructive option as the default.

— Display a message box only when the window of an application is active.

— Display only one message box for a specific condition.

- **Close box:**

— Enable the title bar Close box only if the message includes a Cancel button.

Message Location:

- Use the message line for messages that must not interfere with screen information.
- Pop-up windows may be used for all kinds of messages, if available.
- Pop-up windows should always be used for critical messages.

Instructional messages:

- Instructional messages, sometimes referred to as prompting messages, are messages that tell the user how to work with, or complete, the screen displayed.
- They may be provided in messages boxes and also within the screen itself.
- Provide instructional information at the depth of detail needed by the user.
- Locate it at strategic positions on the screen.
- Display it in a manner that visually differentiates it from other screen elements.
- In writing, follow all relevant writing guidelines for words, sentences, and messages.

Table 8.2 Instructional Interaction Terms

TO INTERACT WITH THIS CONTROL:	USE THIS TERM:
For a command button, to activate.	Click
For a text box, to type or paste information.	Type
For a list box, to select an item, or items.	Select
To either type or select an option.	Enter
For a check box: To add a component. To clear a component.	 Select Clear
For a radio button.	Select
For a slider interaction.	Move
For a tab interaction.	Click

Text:

- Text, by a very general definition, is any textual element that appears on a screen, including field captions, headings, words, sentences, messages, and instructions.

Presenting Text:

- **Fonts:**
  - — Use plain and simple fonts.
  - — Choose a minimum point size of 12 to 14.
  - — Use proportional fonts.
- **Width:**
  - — Include no more than 40 to 60 characters on each line.
    - A double column of 30 to 35 characters separated by five spaces is also acceptable.
  - — Do not right-justify.
  - — Do not hyphenate words.
- **Content:**
  - — Use headings to introduce a new topic.
  - — Separate paragraphs by at least one blank line.
  - — Start a fresh topic on a new page.
  - — Use lists to present facts.
  - — Emphasize important things by:
    - Positioning.
    - Boxes.
    - Bold typefaces.
    - Indented margins.

- **Miscellaneous:**
  — Use paging (not scrolling).
  — Provide a screen design philosophy consistent with other parts of the system.

Writing Text:

- **Sentences and paragraphs:**
  — Use short sentences composed of familiar, personal words.
    - Cut the excess words.
    - Try to keep the number of words in a sentence to 20 or less.
  — Cut the number of sentences.
  — Use separate sentences for separate ideas.
  — Keep the paragraphs short.
  — Restrict a paragraph to only one idea.
- **Style:**
  — Use the active writing style.
  — Use the personal writing style, if appropriate.
  — Write as you talk.
  — Use subjective opinion.
  — Use specific examples.
  — Read it out loud.

Window Title:

- All windows must have a title located in a centered position at the top.
  — Exception: Windows containing messages.
- Clearly and concisely describe the purpose of the window.
- Spell it out fully using an uppercase or mixed-case font.
- If title truncation is necessary, truncate it from right to left.
- If presented above a menu bar, display it with a background that contrasts with the bar.

5.1.2. Text for Web Pages

Words:

- Minimize the use of words that call attention to the Web.

Error Messages:

- Provide helpful error messages for:
  — Incomplete or incorrectly keyed, entered, or selected data.
  — Requests for documents that do not exist or cannot be found.
- Redisplay a message on the page to which it relates.
- Present them in a visually distinctive and noticeable manner.

Instructions:

- Do not use phrasing that indicates a certain page order or flow.
- Explain where "Up" leads too.
- Phrase them in a browser-independent manner.
- Minimize "Click here" instructions. — Say "Select this link."

Text:

- Web page text must be legible and properly written for the medium.

Presentation:

- Provide text that contrasts highly with the background.

Writing:

- Style:
  - — Use a style reflecting the needs of the site users.
  - — Write objectively.
  - — Use the inverted pyramid organization.
  - — Be concise, using only about half the number of words of conventional text.
  - — Each paragraph should:
    - Be short.
    - Contain only one main idea.
- Links:
  - — Minimize within-text links.
  - — Place them at the beginning or end of paragraphs or sections of text.
- Scanning:
  - — Make text scannable by using:
    - Bulleted listings.
    - Tables.
    - Headings.
    - Bold type.
- Testing:
  - — Test for legibility and readability.

Page Title:

- Provide a page title:
  - — That possesses meaningful keywords.
  - — Whose first word is its most important descriptor.
  - — That makes sense when viewed completely out of context.
  - — That is different from other page titles.
  - — Is written in mixed case using the headline style.
- Do not highlight keywords.

Headings and Headlines:

- Create meaningful headings and headlines that quickly communicate the content of what follows.
  — Make the first word an important information-carrying one.
  — Skip leading articles (the and a).
- Create meaningful subheadings to break up large blocks of text.

5.2 Create Meaningful Graphics, Icons and Images

5.2.1. Icons

- Icons are most often used to represent objects and actions with which users can interact with or that they can manipulate. These types of icons may stand alone on a desktop or in a window, or be grouped together in a toolbar. A secondary use of an icon is to reinforce important information, a warning icon in a dialog message box.

Kinds of Icons:

- The use of icons to reflect objects, ideas, and actions is not new to mankind.
- Marcus (1984) suggests icons fall into these categories:

- Rogers (1989) provided an expanded definition for icon kinds.
  Resemblance — An image that looks like what it means.
  Symbolic — An abstract image representing something.
  Exemplar — An image illustrating an example or characteristic of something.
  Arbitrary — An image completely arbitrary in appearance whose meaning must be learned.
  Analogy — An image physically or semantically associated with something.

Characteristics of Icons:

- An icon possesses the technical qualities of syntactics, semantics, and pragmatics (Marcus, 1984).
  - **Syntactics** refers to an icon's physical structure. Is it square, round, red, green, big, small?
  - **Semantics** is the icon's meaning. To what does it refer—a file, a wastebasket, or some other object? Is this clear?
  - **Pragmatics** is how the icons are physically produced and depicted. Is the screen resolution sufficient to illustrate the icon clearly?
- Syntactics, semantics, and pragmatics determine an icon's effectiveness and usability.

Influences on Icon Usability:

- The following factors influence an icon's usability:
  - Provide icons that are:
    - — Familiar.
    - — Clear and Legible.
    - — Simple.
    - — Consistent.
    - — Direct.
    - — Efficient.
    - — Discriminable.
  - Also consider the:
    - — Context in which the icon is used.
    - — Expectancies of users.
    - — Complexity of task.

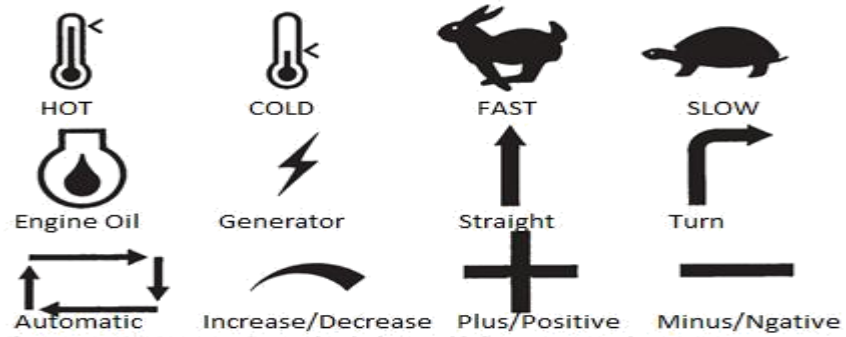

Figure 11.1 Some common icons. What do they stand for? Answers are on the next page.
From Micro Switch (1984)

Choosing Icons:

Icon design is an important process. Meaningful and recognizable icons will speed learning and recall and yield a much more effective system. Poor design will lead to errors, delays, and confusion.

A Successful Icon:

- Looks different from all other icons.
- Is obvious what it does or represents.
- Is recognizable when no larger than 16 pixels square.
- Looks as good in black and white as in color.

Size:

- Supply in all standard sizes.
  - — 16 × 16 pixels.
    - • 16- and 256-color versions.
  - — 32 × 32 pixels
    - • 16- and 256-color versions.

- Effective: 24 × 24 or 26 × 26 in 32 × 32 icon.

— 48 × 48 pixels

- 16- and 256-color versions.

- Use colors from the system palette.
- Use an odd number of pixels along each side.
  — Provides center pixel around which to focus design.
- Minimum sizes for easy selection:
  — With stylus or pen: 15 pixels square.
  — With mouse: 20 pixels square.
  — With finger: 40 pixels square.
- Provide as large a hot zone as possible.

Choosing Images:

- Use existing icons when available.
- Use images for nouns, not verbs.
- Use traditional images.
- Consider user cultural and social norms.

Creating Images:

- Create familiar and concrete shapes.
- Create visually and conceptually distinct shapes.
  — Incorporate unique features of an object.
  — Do not display within a border.
- Clearly reflect objects represented.
- Simply reflect objects represented, avoiding excessive detail.
- Create as a set, communicating relationships to one another through common shapes.
- Provide consistency in icon type.
- Create shapes of the proper emotional tone.

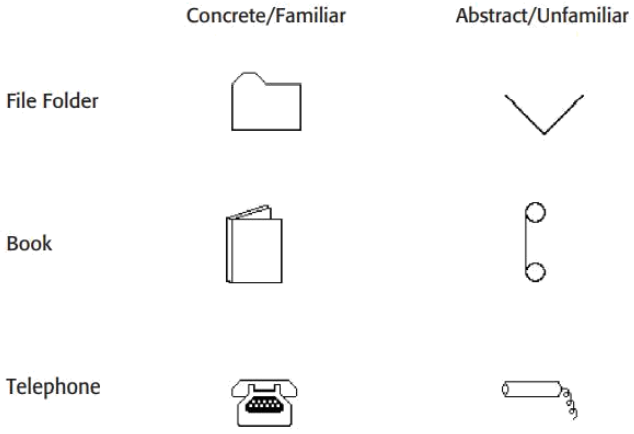

Figure 11.2 Concrete and familiar shapes.

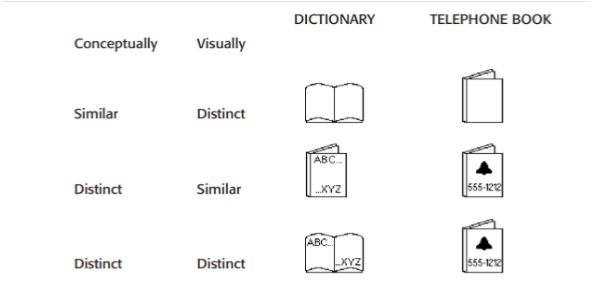

Figure 11.3 Visually and conceptually distinct shapes.

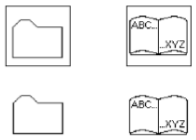

Figure 11.4 Borders degrading icon distinctiveness.

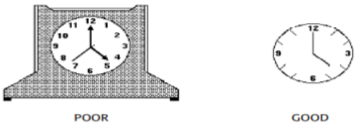

Figure 11.5 Avoid excessive detail in icon design.

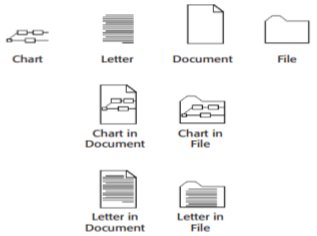

Figure 11.6 Communication relationships in icons.

Drawing Images:

- Provide consistency in shape over varying sizes.
- Do not use triangular arrows in design to avoid confusion with other system symbols.
- When icons are used to reflect varying attributes, express these attributes as meaningfully as possible.
- Provide proper scale and orientation.
- Use perspective and dimension whenever possible.
- Accompany icon with a label to assure intended meaning.

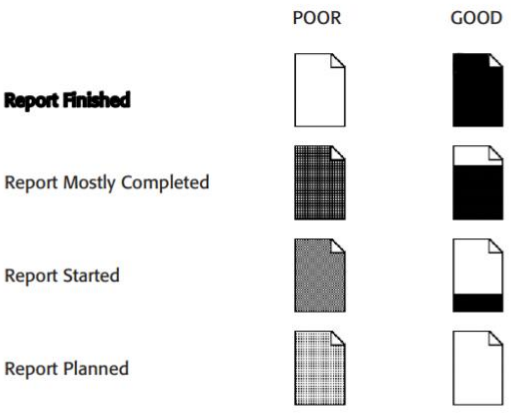

Figure 11.7 Expressing attributes in icon design.

Icon Animation and Audition:

- **Animation:**
  - — Use:
    - To provide feedback.
    - For visual interest.
  - — Make it interruptible or independent of user's primary interaction.
  - — Do not use it for decoration.
  - — Permit it to be turned off by the user.
  - — For fluid animation, present images at 16 or more frames per second.
- **Audition:**
  - — Consider auditory icons.

The Design Process:

- Define the icon's purpose and use.
- Collect, evaluate, and sketch ideas.
- Draw in black and white.
- Draw using an icon-editing utility or drawing package.
- Test for user:
  - — Expectations.
  - — Recognition.
  - — Learning.
- Test for legibility.
- Register new icons in the system's registry.

Screen Presentation:

- Follow all relevant general guidelines for screen design.
- Limit the number of symbols to 12, if possible, and at most 20.
- Arrange icons: — In a meaningful way, reflecting the organization of the real world. — To facilitate visual scanning. — Consistently.
- Place object and action icons in different groups.
- Present an interactive icon as a raised screen element.
- Ensure that a selected icon is differentiable from unselected icons.
- Permit arrangement of icons by the user.
- Permit the user to choose between iconic and text display of objects and actions.

5.2.2. Multimedia

- The graphical flexibility of the Web permits inclusion of other media on a screen, including images, photographs, video, diagrams, drawings, and spoken audio.
- Various media can be powerful communication and attention-getting techniques.
- Multimedia can hold the user's attention, add interest to a screen, entertain, and quickly convey information that is more difficult to present textually.
- It can also make the Web much more accessible to people with disabilities.

Graphics:

- Use graphics to:
  — Supplement the textual content, not as a substitute for it.
  — Convey information that can't be effectively accomplished using text.
  — Enhance navigation through:
    - Presenting a site overview
    - Identifying site pages.
    - Identifying content areas.
- Limit the use of graphics that take a long time to load.
- Coordinate the graphics with all other page elements.
- Graphics contained in Web pages serve several distinct purposes, which can be classified as follows:

  Navigational: To identify links that may be followed.

  Representational: To illustrate items mentioned in the text.

  Organizational: To depict relationships among items mentioned in text.

  Explanative: To show how things or processes work.

  Decorative: To provide visual appeal and emphasis.
- Graphics must always be used for a specific purpose.

  Supplement textual content: Use graphics to supplement text, not as a substitute for it. Never use graphics when text will do the job. If a graphic will help people understand the text they are reading, then certainly use it.

  Convey information not possible using text: Use graphics to convey information that can't be effectively conveyed using text. "A picture is worth a thousand words". Example, Photographs can be used to communicate the exact appearance of objects.

  Enhance navigation: Graphics can be used to enhance navigation. A graphical overview of a site's organizational scheme will enable the user to conceptualize and learn the site's structure faster than can be done through textual overviews.

  Limit long-loading graphics: Limit the use of graphics that take a long time to load In general, all graphics must be smaller on the Web than on the printed page. Large graphics take longer to download testing the user's patience. If a large graphic is needed, present a small version and link it to a page containing the large version. Richly colored graphics and pages containing numerous graphics are also slower to load.

  Coordinate graphics: Graphics are only one component of a Web page. The graphics must fit in with the style of typography used, the colors used, and the page layout itself.

Images:

- General:
  — Use standard images.
  — Use images consistently.
  — Produce legible images.
  — Provide descriptive text or labels with all images.
  — Distinguish navigational images from decorative images.
  — Minimize:
    - The number of presented images.
    - The size of presented images.
  — Restrict single images to 5K.
  — Restrict page images to 20K.
  — Provide thumbnail size images.
    - Image animation.
  — Avoid extraneous or gratuitous images.
- Color:
  — Minimize the number of colors in an image.
- Format:
  — Produce images in the most appropriate format.
    - GIF.
    - JPEG.
- Internationalization:
  — Provide for image internationalization.
- Screen design:
  — Reuse images on multiple pages.

Image Maps:

- Use:
  — To provide navigation links to other content.
- Advantages:
  — Can be arrayed in a meaningful and obvious structure.
  — Faster to load than separate images.
- Disadvantages:
  — Consume a significant amount of screen space.
  — "Hot spots" not always obvious.
  — One's location within image map is not always obvious.
- Guidelines:
  — Use with caution.
  — Provide effective visual cues and emphasis to make it easy to identify link boundaries.
  — Ensure image maps are accessible to the vision impaired.

Video:

- Uses:
  — To show things that move or change over time.
  — To show the proper way to perform a task.
  — To provide a personal message.
  — To grab attention.
- Disadvantages:
  — Expensive to produce.
  — Slow to download.
  — Small and difficult to discern detail.
- Guidelines:
  — Never automatically download a video into a page.
  — Create short segments.
  — Provide controls, including those for playing, pausing, and stopping.
  — Consider using:
    - Existing video.
    - Audio only.
    - A slide show with audio.

Diagrams:

- Uses:
  — To show the structure of objects.
  — To show the relationship of objects.
  — To show the flow of a process or task.
  — To reveal a temporal or spatial order.
- Guidelines:
  — Provide simple diagrams.
  — Provide cutaway diagrams or exploded views to illustrate key points.

Drawings:

- Use:
  — When selective parts need to be emphasized or represented.
- Guidelines:
  — Provide simple drawings showing minimal detail.
  — Provide a link to a complete drawing.

Animation:

- Uses:
  — To explain ideas involving a change in:
    - Time.
    - Position.

— To illustrate the location or state of a process.
— To show continuity in transitions.
— To enrich graphical representations.
— To aid visualization of three-dimensional structures.
— To attract attention.

- Disadvantages:
  — Very distracting.
  — Slow loading.
- Guidelines:
  — Use only when an integral part of the content.
  — Create short segments.
  — Provide a freeze frame and stop mode.
  — Avoid distracting animation.

Audition:

- Uses:
  — As a supplement to text and graphics.
  — To establish atmosphere.
  — To create a sense of place.
  — To teach.
  — To sample.
- Advantages:
  — Does not obscure information on the screen.
  — Shorter downloading time than video.
- Disadvantages:
  — Is annoying to many people, including users and nonusers in the vicinity.
  — Can easily be overused, increasing the possibility that it will be ignored.
  — Is not reliable because:
    - Some people are hard of hearing.
    - If it is not heard, it may leave no permanent record of having occurred.
    - The user can turn it off.
    - Audio capability may not exist for the user.
- Guidelines:
  — When words are spoken:
    - The content should be simple.
    - The speed of narration should be about 160 words per minute.
  — When used to introduce new ideas or concepts the narration should be slowed.
  — Off-screen narration should be used rather than on-screen narration.
    - Unless the narrator is a recognized authority on the topic.
  — Create short segments.
  — Provide segments of high quality.

— Provide audio controls.

— Play background audio softly.

Combining Mediums:

- Combinations:

  — Use sensory combinations that work best together:

    - Auditory text with visual graphics.
    - Screen text with visual graphics.

- Integration:

  — Closely integrate screen text with graphics.

- Relevance:

  — Both the visual and auditory information should be totally relevant to the task being performed.

- Presentation:

  — Visual and auditory textual narrative should be presented simultaneously, or the visuals should precede the narrative by no more than 7 seconds.

  — To control attention, reveal information systematically.

    - Limit elements revealed to one item at a time and use sequential revelations for related elements.

  — Animation must show action initiation as well as the action's result.

  — Avoid animation that distracts from other more important information.

- Downloading times:

  — Consider downloading times when choosing a media.

- Testing:

  — Thoroughly test all graphics for:

    - Legibility.
    - Comprehensibility.
    - Acceptance.

5.3 Choose the Proper Colors

5.3.1. Color—What Is It?

- To describe a color, it is useful to refer to the three properties it possesses: hue, chroma or saturation, and value or intensity.

  Hue is the spectral wavelength composition of a color.

  Chroma or saturation is the purity of a color.

  Value or intensity is the relative lightness or darkness of a color in a range from black to white.

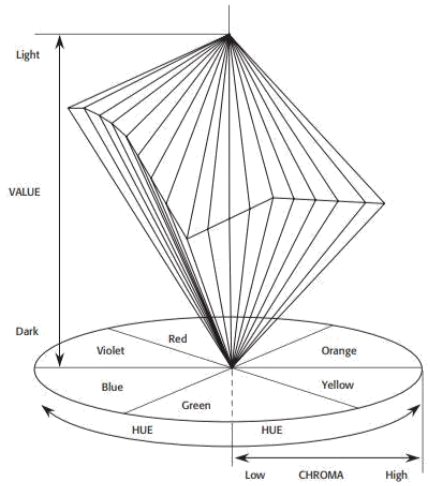

Figure 12.1 The relationship of hue, chroma, and value.

- The primary colors of illuminated light are red, green, and blue, whose wavelengths additively combine in pairs to produce magenta, cyan, and yellow, and all the other visible colors in the spectrum. The three primary colors additively combine to produce white.
- **RGB** Many color monitors use the three primary colors of light, in various combinations, to create the many colors we see on screens. By adjusting the amounts of red, green, and blue light presented in a pixel, millions of colors can be generated. Hence, color palette editors exist with labels R, G, and B (or the words spelled out).
- Some palette editors use a convention based on the Munsell method of color notation called **HSV (hue, saturation, and lightness)**, for hue, saturation, and value.
- If pixels of different colors are placed next to each other, this tremor combines the two colors into a third color. This is referred to as **dithering**, and sometimes **texture mapping**.

5.3.2. Color Uses

- Use color to assist in formatting a screen:

  — Relating or tying elements into groupings.

  — Breaking apart separate groupings of information.

  — Associating information that is widely separated on the screen.

  — Highlighting or calling attention to important information by setting it off from the other information.

- Use color as a visual code to identify:
  — Screen components.
  — The logical structure of ideas, processes, or sequences.
  — Sources of information.
  — Status of information.
- Use color to:
  — Realistically portray natural objects.
  — Increase screen appeal.

5.3.3. Possible Problems with Color

- High Attention-Getting Capacity.
- Interference with Use of Other Screens.
- Varying Sensitivity of the Eye to Different Colors.
- Color-Viewing Deficiencies.
- Cross-Disciplinary and Cross-Cultural Differences.

High Attention-Getting Capacity:

This quality causes the screen viewer to associate, or tie together, screen elements of the same color, whether or not such an association should be made. A person might search for relationships and differences that do not exist, or that are not valid.

Interference with Use of Other Screens:

Indiscriminate or poor use of color on some screens will diminish the effectiveness of color on other screens.

Varying Sensitivity of the Eye to Different Colors:

All colors are not equal in the eye of the viewer. Some combinations of screen colors can strain the eye's accommodation mechanism.

Color-Viewing Deficiencies:

Table 12.2 Results of Color-Defective Vision

	COLOR SEEN WITH:		
ACTUAL COLOR	RED-VIEWING DEFICIENCY (2.04%)	GREEN-VIEWING DEFICIENCY (6.39%)	BLUE-VIEWING DEFICIENCY (0.003%)
Red	Brown	—	—
Yellow	Greenish-Yellow	Orange	Deeper Yellow
Purple	Dark Blue	Red	Deep Red
Green	—	Light Brown	—
Brown	—	Reddish-Brown	—
Blue	—	—	Green

From Barnett (1993); Fowler and Stanwick (1995).

Cross-Disciplinary and Cross-Cultural Differences:

Colors can have different meanings in different situations to different people. The color blue has the following quite different meanings:

For financial managers — Corporate qualities or reliability.

For health care professionals — Death.

For nuclear reactor monitors — Coolness or water.

For American movie audiences — Tenderness or pornography.

5.3.4. Choosing Colors

Choosing Colors for Categories of Information:

- Choosing colors for categories of information requires a clear understanding of how the information will be used.
- Some examples:
  — If different parts of the screen are attended to separately, color-code the different parts to focus selective attention on each in turn.
  — If decisions are made based on the status of certain types of information on the screen, color-code the types of status that the information may possess.
  — If screen searching is performed to locate information of a particular kind or quality, color-code these kinds or qualities for contrast.
  — If the sequence of information use is constrained or ordered, use color to identify the sequence.
  — If the information displayed on a screen is packed or crowded, use color to provide visual groupings.
- Use color as a redundant screen code.

5.3.5. Choosing Colors for Textual Graphic Screens

For displaying data, text, and symbols on a textual graphical screen colors selected should have adequate visibility, meaning, contrast, and harmony.

- Use effective foreground/background combinations.
- Use effective foreground combinations.
- Choose the background color first.
- Display no more than four colors at one time.
- Use colors in toolbars sparingly.
- Test the chosen colors.

Effective Foreground/Background Combinations:

- Lalomia and Happ (1987) established effective foreground/background color combinations for the IBM 5153 Color Display.
- From a color set of 16 different foregrounds and 8 different backgrounds, 120 color combinations were evaluated for (1) response time to identify characters, and (2) subjective preferences of users.
- The results from each measure were ranked and combined to derive an overall measure of

color combination effectiveness.

- The results yield some interesting conclusions:
  - The majority of good combinations possess a bright or high-intensity color as the foreground color.
  - The majority of poor combinations are those with low contrast.
  - The best overall color is black.
  - The poorest overall color is brown.
  - Maximum flexibility and variety in choosing a foreground color exists with black or blue backgrounds.
  - Brown and green are the poorest background choices.

Table 12.3 Effective Foreground/Background Combinations

	BACKGROUND							
FOREGROUND	BLACK	BLUE	GREEN	CYAN	RED	MAGENTA	BROWN	WHITE
BLACK	x			Good		Good		Good
BLUE		x			Poor			Good
H.I. BLUE			Poor	Poor			Poor	Poor
CYAN	Good		Poor	x			Poor	
H.I. CYAN	Good	Good		Good	Good	Good		
GREEN	Good	Good	x	Poor	Good		Poor	Poor
H.I. GREEN		Good						
YELLOW	Good	Good		Good		Good		
RED			Poor		x	Poor	Poor	
H.I. RED			Poor					
MAGENTA			Poor		Poor	x	Poor	
H.I. MAGENTA	Good		Good			Poor		
BROWN			Poor			Poor	x	
GRAY		Poor			Poor		Poor	
WHITE		Good		Poor				x
H.I. WHITE	Good		Good	Good				

(H.I. = High Intensity)
From Lalomia and Happ (1987).

- Bailey and Bailey (1989), in their screen creation utility Protoscreens, have a table summarizing research-derived good foreground/background combinations. This table, which uses the results of the Lalomia and Happ study plus some others, is shown in modified form in Table 12.4.

Table 12.4 Preferred Foreground/Background Combinations from Protoscreens

BACKGROUNDS	ACCEPTABLE FOREGROUNDS	
Black	Dark Cyan Dark Yellow Dark White	Light Green Light Cyan Light Magenta Light Yellow Light White
Blue	Dark Green Dark Yellow Dark White	Light Green Light Cyan Light Yellow Light White
Green	Black Dark Blue	Light Yellow Light White
Cyan	Black Dark Blue	Light Yellow Light White
Red		Light Green Light Cyan Light Yellow Light White
Magenta	Black	Light Cyan Light Yellow Light White
Yellow	Black Dark Blue Dark Red	
White	Black Dark Blue	

- **Choose the Background First**: When choosing colors to display, it is best to select the background color first. Then, choose acceptable foreground colors.
- **Maximum of Four Colors**: Restrict the number of colors to two or three.
- **Use Colors in Toolbars Sparingly:** Use color in toolbar icons simply and conservatively, and only if the color aids icon identification, makes it easier to distinguish icons.
- **Test the Colors:** Always test all chosen colors as part of the system testing process.

5.3.6. Choosing Colors for Statistical Graphics Screens

The visual, spatial, or physical representation of information is known as statistical or data graphics. Common kinds of statistical graphics include bar graphs, line graphs, scatterplots, and pie charts. Color can also be used to render a statistical graphic screen more legible and meaningful.

Emphasis:

- Emphasize the graphic's data.

Number of Colors:

- Use no more than six colors at one time.
- Use one color of five values or

lightness. **Background**s:

- Surround images:
  — In a neutral color.
  — In a color complementary to the main image.

Size:

- Provide images of an adequate size for the task.
- If the image changes in size, use colors that exhibit a minimum shift in hue or lightness.
  — White, yellow, and red on dark backgrounds.

Status:

- To indicate a status, use the following colors:
  — Proper, normal, or OK: Green, white, or blue.
  — Caution: Yellow or gold.
  — Emergency or abnormal: Red.

Measurements and Area-Fill Patterns:

- Display measurements in the following colors:
  — Grids: Gray
  — Data points: Yellow.
  — Variance or error bars: Blue
  — Out of specified range data: Red
  — Captions and labels: Lavender, lime green, or cyan
- Display area-fill patterns in the following colors:
  — Widely spaced dots: Red
  — Closely spaced dots: Green

— Wide dashed lines: Magenta

— Narrow dashed lines: Cyan

— Wide crosshatch: Blue

— Narrow crosshatch: Yellow

Physical Impressions:

- Size:
  — To convey an impression of:
    - Larger: Use bright or saturated colors.
    - Smaller: Use dark or desaturated colors.
    - Similar: Use colors of equal lightness.
- Weight:
  — To convey an impression of:
    - Heavy: Use dark, saturated colors.
    - Light: Use light, desaturated colors.
- Distance:
  — To convey an impression of:
    - Close: Use saturated, bright, long-wavelength (red) colors.
    - Far: Use saturated, dark, short-wavelength (blue) colors.
- Height:
  — To convey an impression of height, use desaturated, light colors.
- Depth:
  — To convey an impression of depth, use saturated, dark colors.
- Concentration level:
  — To convey an impression of concentration level, use:
    - High: Saturated colors.
    - Low: Desaturated colors.
- Magnitude of change:
  — To convey an impression of magnitude of change, use:
    - Lowest: Short-wavelength (blue) colors.
    - Highest: Long-wavelength (red) colors.
- Actions:
  — To convey an impression of action, use:
    - Required: Long-wavelength (red) colors.
    - Not required: Short-wavelength (blue) colors.
- Order:
  — To convey an impression of order with color, use:
    - Low end of a continuum: Short-wavelength (blue) colors.
    - High end of a continuum: Long-wavelength (red) colors.

  — When displaying an array of ordered colors, position:
    - Short-wavelength colors at the left side or at the bottom.
    - Long-wavelength colors at the right side or at the top.

— To convey an impression of order with value or lightness, use the lightness order of a color (darkest to lightest or vice versa).

- Neutrality: — To convey an impression of neutrality, use black, gray, and white.

5.3.7. Choosing Colors for Web Pages

- Purpose:
  — Color must always have a meaningful purpose.
- Palette:
  — Use the browser 216-color palette.
- Presentation:
  — Minimize the number of presented colors.
  — Always consider color in context.
  — Use similar or the same color schemes throughout.
    - For foregrounds: Use black or strong colors for text and headings.

  — For backgrounds: Use weaker contrasting colors such as off-white or light gray.
  — Use a uniform color in large areas.
  — The smaller the element, the more contrast is required between it and its background.
  — Larger images should use:
    - Flat, Web-safe colors.
    - Fewer colors than small images.

  — Select colors that can be easily reproduced in black and white.
- Links:
  — Use default colors for links.
    - Make unselected/unvisited links blue.
    - Make selected/visited links purple.

  — Do not display non-link text in link colors.
- Testing:
  — Test all colors.

5.3.8. Uses of Color to Avoid

- Relying exclusively on color.
- Too many colors at one time.
- Highly saturated, spectrally extreme colors together: — Red and blue, yellow and purple.
- Low-brightness colors for extended viewing or older viewers. Colors of equal brightness.
- Colors lacking contrast: — for example, yellow and white; black and brown; reds, blues, and browns against a light background.
- Fully saturated colors for text or other frequently read screen components.
- Pure blue for text, thin lines, and small shapes.

- Colors in small areas.
- Color for fine details.
- Non-opponent colors.
- Red and green in the periphery of large-scale displays.
- Adjacent colors that only differ in the amount of blue they possess.
- Single-color distinctions for color-deficient users.
- Using colors in unexpected ways.
- Using color to improve legibility of densely packed text.