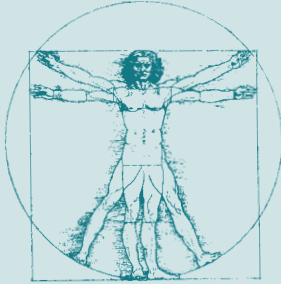


Research Update



HUMAN CENTERED S Y S T E M S

The Human Centered Systems Research Program addresses human performance-related issues that affect highway system design. Current human centered research focuses on Highway Safety and Intelligent Transportation Systems (ITS).

Human centered research products include driver performance models, highway system design guidelines, and handbooks based upon empirical human performance data collected in the laboratory and in controlled, on-the-road tests.



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DESIGNING EFFECTIVE IN-VEHICLE ICONS

Introduction

This research update provides general human factors design information relevant to the early phases of in-vehicle icon development and design. It reflects a subset of the results to-date of a Federal Highway Administration (FHWA) project to develop a set of clear, concise, and user-centered human factors design guidelines for in-vehicle icons. An important element of this project is the involvement of a project working group, comprised of over 20 representatives from the icon design, in-vehicle information systems, and human factors communities. This group has served as subject matter experts and consultants to the project, helping to ensure that the resulting design guidelines conform to icon designers' specific needs with respect to content, organization, and format.

Icons are visual representations or images used to symbolize an object, action, or concept. Icons are among the oldest forms of communication and provide a number of advantages over a text-only approach to presenting drivers with in-vehicle messages. For example, icons: (1) may be recognized more quickly and accurately than text-only messages, (2) can be presented in a much smaller area than can text, and (3) can convey information across many languages and cultures.

Despite the obvious applicability of icons to the design of ITS, such as advanced traveler information systems (ATIS) and collision avoidance systems (CAS), poorly designed icons can lead to driver confusion and errors and actually exacerbate existing traffic problems. Although the use of icons is widespread, few guidelines exist that can be confidently used by vehicle and electronics designers during icon development. The lack of guidelines, standards, and a systematic framework to aid icon design has resulted in design by consensus for many ITS-related icons, a lack of scientific rigor in icon development, non-intuitive, and difficult-to-learn icons for in-vehicle messages, and multiple icons for the same message.

Human Factors Design Guidelines to Increase Icon Effectiveness

Critical to icon development is a basic understanding of what icons are, as well as general procedures that can be used during icon design in order to maximize their effectiveness when used by the driving public. Of the 36 preliminary design guidelines that have been produced for this project, an entire chapter (6 guidelines) has been devoted to such basic design issues. Below, design guidelines associated with three general aspects of icon design have been summarized, reflecting key design questions such as: (1) when should icons be used, (2) what kinds of icons are there, and (3) what are the key components of an icon?

When should icons be used?

A critical element of icon design is understanding the criteria and issues that should be considered when determining if an icon is the appropriate element to use to display an in-vehicle message. **Figure 1** (on the following page) shows some

Icon Design Issue	Do This...	...Not This
Quick and accurate recognition is necessary.		
Displaying visual or spatial concepts.		
Presenting a set of alternatives.		

Figure 1. Examples of the appropriate use of icons.

Icon Types	Key Examples	Other Examples
Image-Related	 Fasten Seat Belt	 Telephone ahead Gas station ahead
Concept-Related	 Flash Function on a camera or High Voltage symbol in a power plant.	 Curve signs Elevator
Arbitrary	 Addition symbol, First Aid symbol, or International symbol for the Red Cross.	 U.S. Postal Service Medical Profession

Figure 2. Types of icons.

examples of the appropriate use of icons. Although all icons should be tested and evaluated before final implementation into vehicles, icons should generally be used in place of text when:

- quick and accurate recognition of a message is necessary (e.g., warnings);
- displaying visual or spatial concepts (e.g., augmented signage);
- the driver will be performing a visual search of alternatives (e.g., motorist services information);
- the amount of space on the display is limited and presenting the information textually will take up more space than is available; and
- one already exists and has a generally accepted meaning.

What types of icons can be used?

Icons can be classified based on their resemblance to a particular in-vehicle message or referent. Icons can fall into one of three categories; examples and summaries of these three categories are presented to the left in **figure 2**.

Importantly, these three different types of icons have different implications for icon development and design.

1. *Image-related icons* are highly pictorial representations of the object or act they represent. **Image-related icons are directly comprehended and should be used whenever possible.**

2. *Concept-related icons* are based on an example or property of a real object or action. **Concept-related icons can be used if the user can be expected to be able to comprehend the context in which the icon is presented.**

3. *Arbitrary icons* do not resemble the object or action they represent, but become meaningful only through convention and education. **Arbitrary icons can be difficult to recognize, hard to learn, and hard to remember. They should be**

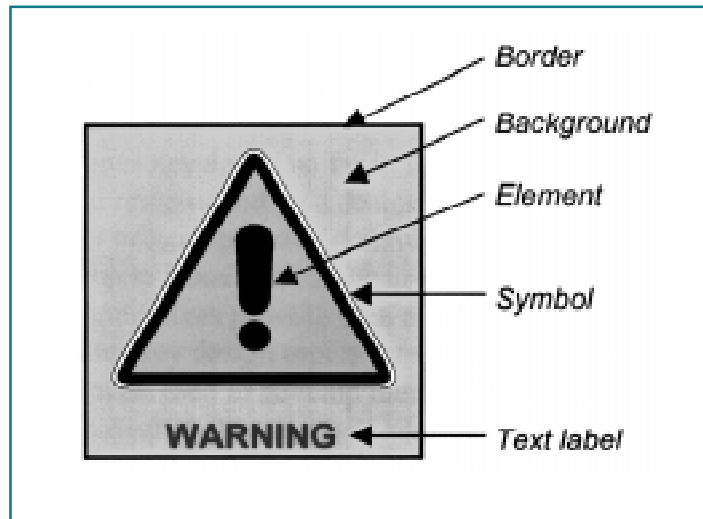


Figure 3. Composition of an icon.

Icon Component	Human Factors Design Guidelines
Border	<ul style="list-style-type: none"> • Can be used to show the extent of an icon (beginning and end).
Background	<ul style="list-style-type: none"> • Don't cover more than half the available area with objects. • Avoid patterns in the background. • Put the image clearly in front of the background. • Place objects in the center and the background around the periphery. • Use unsaturated, cool colors for the background and saturated, warm colors for the foreground image. • Keep the background static; if anything blinks or moves, the viewer perceives it as a foreground image. • Limit the background image to a simple rendition of a recognizable, concrete object.
Element	<ul style="list-style-type: none"> • Use commonly accepted or standardized elements when possible. • Elements should reflect design principles appropriate for increasing icon recognition, such as using the appropriate level of detail and realism, and incorporating perceptual principles for icon design.
Symbol (Shapes)	<ul style="list-style-type: none"> • Circles should be used for presenting prohibition or mandatory information. • Triangles or diamonds should be used to present warning or cautionary information. • Squares or rectangles should be used to present general information, instructions, or safe condition information.
Text Label	<ul style="list-style-type: none"> • Use only when necessary, especially when the icon is concept-related or arbitrary. • Keep text to no more than two-three words.

Table 1. Design guidelines for icon components.

used only if the user understands the context in which they will be presented and also possesses the specialized knowledge required to understand them.

What are the different parts of an icon and how can they be designed to maximize icon effectiveness?

Icons are complex visual images with a number of different parts. Through careful design, these different parts can work together to increase the likelihood that the icon will be comprehended by drivers. **Figure 3** summarizes the key

components of an icon; **table 1** presents human factors design guidelines associated with each component.

Future Guideline Development Activities

The 36 preliminary guidelines developed so far in this project reflect an integration of existing empirical studies, literature reviews and icon design principles. They represent only a necessary first step towards the larger project goal of developing a clear and comprehensive human factors design handbook for in-vehicle icons that can

be used throughout the in-vehicle icon design process. The preliminary guidelines provide both a valuable resource for icon designers as well as a “roadmap” that indicates key design topics for which design guidelines are needed, but little empirical data exist that can be used to develop them. The next phase of this project will involve conducting a series of empirical studies that will address critical icon design issues. The final version of the handbook will reflect both the results of these empirical studies, as well as reviews of the preliminary guidelines conducted by the project working group and others from the icon design community.

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