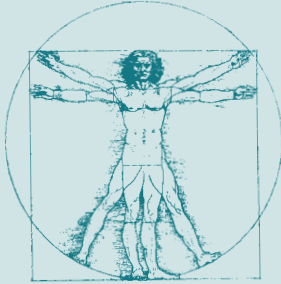


Research Update



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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IMPROVING DRIVER RECOGNITION OF 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, consisting of more than 20 representatives from the icon design, intelligent transportation systems (ITS), 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 can actually exacerbate existing traffic problems. Although the use of icons is widespread, few guidelines exist that can be used confidently 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, nonintuitive and difficult-to-learn icons for in-vehicle messages, and multiple icons for the same message.

Human Factors Design Guidelines to Increase Driver Recognition of In-Vehicle Icons

A key element of icon comprehension and use by drivers is the extent to which in-vehicle icons can be quickly and easily recognized by drivers. Icon recognition reflects the relationship between the driver, the icon, and *other* icons or visual display elements. Icon recognition will depend on design issues such as the shape of the icon, figure/ground relationships, level of detail, use of overlapping elements, and discriminability from other symbols. Of the 36 preliminary design guidelines that have been produced for this project, an entire chapter (5 guidelines) has been devoted to the topic of icon recognition. Design guidelines associated with three areas that influence recognition of icons are summarized below, reflecting key design questions such as: (1) What basic principles of perception can be used to increase icon recognition? (2) What is the appropriate level of detail for in-vehicle icons? and (3) What is the appropriate level of realism for in-vehicle icons?






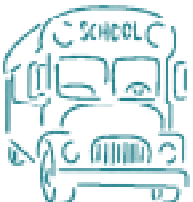


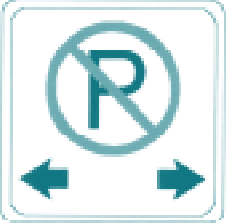

Icon Design Parameter	Recommendation	Do This...	...Not This
Figure/Ground Relationship	Emphasize a clear, stable, and solid relationship between a symbol and its background.		
Figure Boundaries	Solid shapes are better than thin line boundaries or dotted-line boundaries unless the element in question is depicting action or movement.		
Closure	Use closed figures instead of figures with discontinuous lines, outlines, or disjointed elements.		
Simplicity	Icons should be simple with only the necessary detail included.		
Unity	All parts of the symbol should be enclosed within a single boundary.		

Figure 1. Key perceptual principles for icon design.

What basic principles of perception can be used to increase icon recognition?

Many of the perceptual principles about how we decode and comprehend symbols have come from the ideas and experiments that were completed by Gestalt psychologists around the turn of the century. These perceptual principles reflect the notion that the structural properties of symbols and icons are important determinates of their perceptibility and, hence, recognition and usefulness. **Figure 1** (to the left) highlights some of these perceptual principles.

What is the appropriate level of detail for in-vehicle icons?

Only those details that will add to the meaning of an icon or symbol should be included in the design of an icon, while those that distract from the true goals of recognition and comprehension should be omitted. **Figure 2** shows an example of the appropriate level of detail for an in-vehicle icon.

The following are key human factors design guidelines for determining level of detail for icons:

- Design symbols on a 20 x 20 unit grid, making sure that no significant detail is smaller in size than 1 square unit.
- Significant details within a symbol should subtend, at a minimum, 3 degrees of visual angle.
- Line thickness for a significant detail should subtend, at a minimum, 2 degrees of visual angle.

What is the appropriate level of realism for in-vehicle icons?

Level of realism refers to the style in which a symbol is drawn. Deciding whether to use a detailed, realistic style or a simplified style can have a great impact on the recognizability of symbols. Including detail in the design of some symbols and icons can make them easier to recognize, while adding detail to others can make them harder to recognize. **Figure 3** (see next page) presents some design guidelines and examples of the appropriate level-of-realism for an in-vehicle icons.

Future Guideline Development Activities

The 36 preliminary guidelines developed so far in this project reflect an integration of existing empirical studies, literature

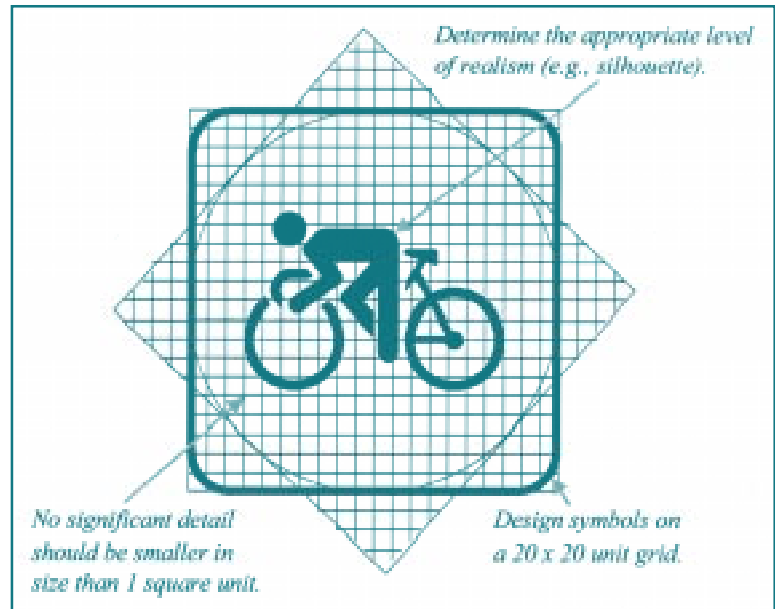


Figure 2 . Example of appropriate level of detail.

reviews, and icon design principles. The guidelines represent only a necessary first step toward 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 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.

References

- Horton, W. K. (1994). *The Icon Book: Visual Symbols for Computer Systems and Documentation*. New York: J. Wiley & Sons.






Example	Level of Realism	Design Style	When to Use
	Photographic Realism	Photographs and photographic	Use for presenting complex symbols with a lot of detail (e.g., specific people, buildings, or landmarks).
	Simplified Drawing	Outline with distinct interior details	Use for presenting complex symbols with small significant parts, especially when the objects have similar profiles (e.g., mechanical or electrical devices).
	Caricature	Exaggeration of crucial details	Use for presenting those symbols that have a small, crucial feature or for simplifying complex details.
	Outline	Outline with only prominent details	Use for presenting small symbols that represent a familiar object with a distinct profile.
	Silhouette	Shape filled with solid color contrasting with background	Use for presenting symbols that are too thin to show in outline format and for symbols that have a very distinct profile and do not require detail for recognition.

Figure 3. Five levels of icon realism (from Horton, 1994).

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