Menu System Suited to Novice and Experienced Users of an Automobile Navigation System

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Computer-based products require designers to make trade-offs between the product's initial and long term ease of use. The trade-off decisions are particularly important in the design of a computer-based automobile navigation system (ANS). An ANS designed for the mass market must serve the needs of both first time users, such as rental car drivers, and those who may purchase cars equipped with the device and use it on a daily basis. In our efforts to design the user interface to an ANS, we sought a means to protect new users from advanced functions that would frustrate the early learning experience. At the same time, we sought a smooth method for everyday users to access advanced functions. In this paper, we briefly explain automobile navigation systems, and then discuss our design solution.

INTRODUCTION

Computer-based products require user interface designers to make trade-offs between the product's initial and long term ease of use. The trade-off decisions are particularly important in the design of a computer-based automobile navigation system (ANS). An ANS designed for the mass market must serve the needs of both first-time users, such as rental car drivers, and those who may purchase cars equipped with the device and use it on a daily basis. Many computer-based products fail to achieve a balance between the needs of novices and experts because they are designed for the "average user;" a person with needs positioned somewhere between those of the novice and those of the expert. Unfortunately, novices are likely to describe such compromised products as hard to use because they do not provide enough direction to the first-time user. Meanwhile, experienced users are likely to describe such products as slow to use and inflexible due to a lack of shortcuts. Our challenge as ANS designers was to develop a user interface well suited to users with varying levels of proficiency.

ABOUT THE NAVIGATION SYSTEM

Globally, automobile manufacturers, electronics manufacturers, public agencies, and universities are involved in efforts to reduce traffic problems and improve safety on our roadways. One major thrust is to develop effective automobile navigation systems (Case, 1989; Gillan, 1989; Boyce, Kirson, & Schofer, 1991). Such systems use global positioning satellites, map matching, and wheel sensing to determine the automobile's present position. With the addition of regional database information directories on CD ROM, these systems are able to guide the driver to a specific destination. ANSs may be installed in a vehicle's dashboard at the time of manufacture, or they may be retrofitted to an existing vehicle.

The extensive functions of an ANS require a user interface that provides data entry, data presentation, and data retrieval capabilities. Because of this, usability becomes an important design consideration. The manufacturer of the ANS described in the balance of this paper incorporated a usability engineering program into its development process in order to address these design considerations.

BACKGROUND RESEARCH

In our efforts to design the ANS's user interface, we sought to "protect" new users from advanced functionality - optional capabilities of the system likely to frustrate the early learning experience. At the same time, we sought an efficient method for users to access advanced functions at the point they had gained operational experience with the system. As part of our research, we conducted a series of 6 focus groups in Boston, Houston, and San Francisco with 72 potential users. Many potential users felt a complex-appearing user interface with too many options would intimidate first-time users. Further, they felt experienced users would want to accomplish tasks in the shortest possible time. They warned us that most people would not be willing to sit in a parked car for several minutes to program their route to work; that people will want to take only a few seconds to get started on the trip.

One of our options was to introduce to the public an ANS with limited functions, and then add additional functions in later versions of the product. In fact, there are already several ANS devices that exist today designed along this line of thinking; products that may only track an automobile's position on an electronic map, for example (Petchenik, 1989). However, our goal was to demonstrate a large set of ANS functions, consistent with industry plans for extensive ANS infrastructures, enabling accurate route following, dynamic route planning, access to regional information directories, and extensive record-keeping. This meant building a function-packed interface that users would still perceive as simple.

DESIGN DEVELOPMENT

Early in the design process, we developed rapid prototypes and conducted a usability test as a means of exploring alternative user interface schemes and associated menu systems for choosing functions. We developed three low-fidelity color prototypes using SuperCard™ running on a Macintosh® IIx computer. As its primary interaction scheme, the first prototype had arrow cursor keys and soft keys, the second had a touch screen, and the third had a rotary knob which controlled cursor position. We conducted a 12-subject test in our usability testing laboratory. Users felt that the most direct way to interact with the ANS was simply pressing one's finger to a spot on a touch screen.

We also observed people driving and navigating in a minivan equipped with an operational prototype. With the operational prototype, users made choices from lists using a hand-held remote control. Observation and recording of task times showed this approach to be advantageous from the standpoint of design consistency; users quickly learned the method of selecting from scrolling lists. However, users found the process of making choices exclusively from lists to be slow and mundane. Users also expressed concern about losing the remote control in the vehicle, and, therefore, their ability to use the ANS.

OUR FIRST TOUCH SCREEN DESIGN

Our evaluation of interaction methods led us to select a touch screen interface. Figure 1 shows one of the early menu schemes employing a touch screen. In this scheme, we placed functions (choices) which users perform frequently or with urgency on the "Your Choices" menu (the top level menu); we located the remaining functions on the "More Choices" menu (a second tier menu).

We found this approach had several shortcomings, particularly a somewhat artificial layering of functions between the two top-level screens. New users might be overwhelmed by the dual, nine-tile menus, while expert users would need to flip between the two screens to access desired functions; a time-consuming task. A limited usability test, involving only a few subjects, as well as our design judgement, led us to limit the number of choices on the menus and find a way to present related choices on the same screen.

OUR SOLUTION

Our preferred solution employs a touch screen menu system that initially presents the user with four choices on any given screen; a limited number of choices unlikely to overwhelm new users (see Figure 2). After a period of familiarization with the device, users will learn there are four additional menu choices. Users will display additional choices by pressing a "More" key located on a control panel on the right side of the touch screen.
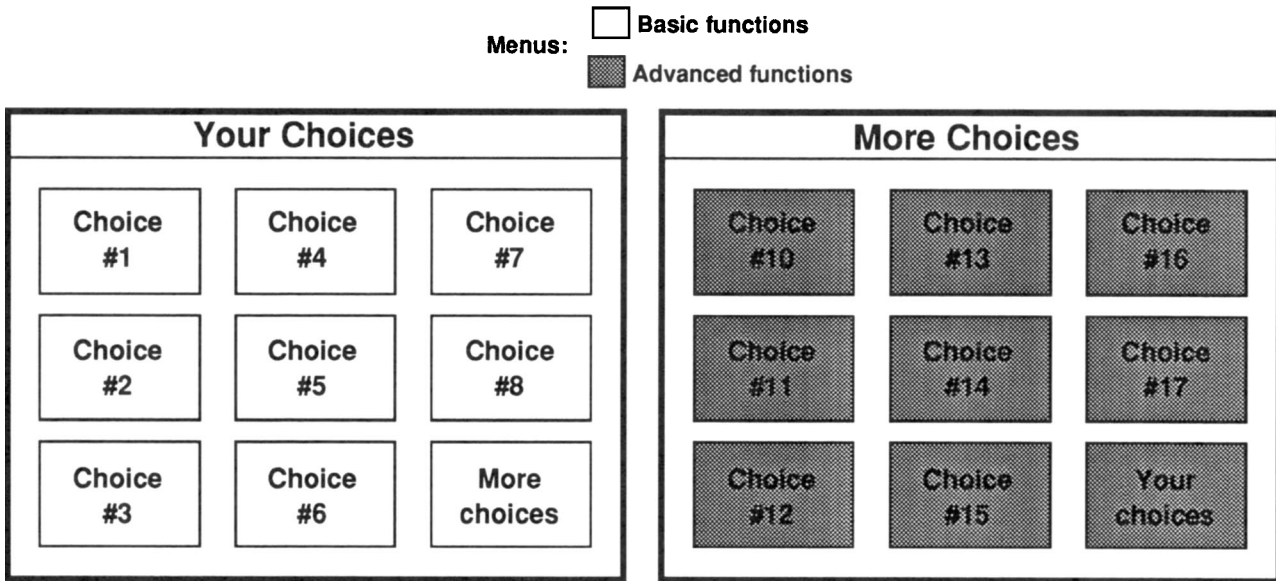
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Menus: ☐ **Basic functions**
⬜ **Advanced functions**

Figure 1: ANS Displays Showing Two-Tier Menu

Menus: ☐ **Basic functions**
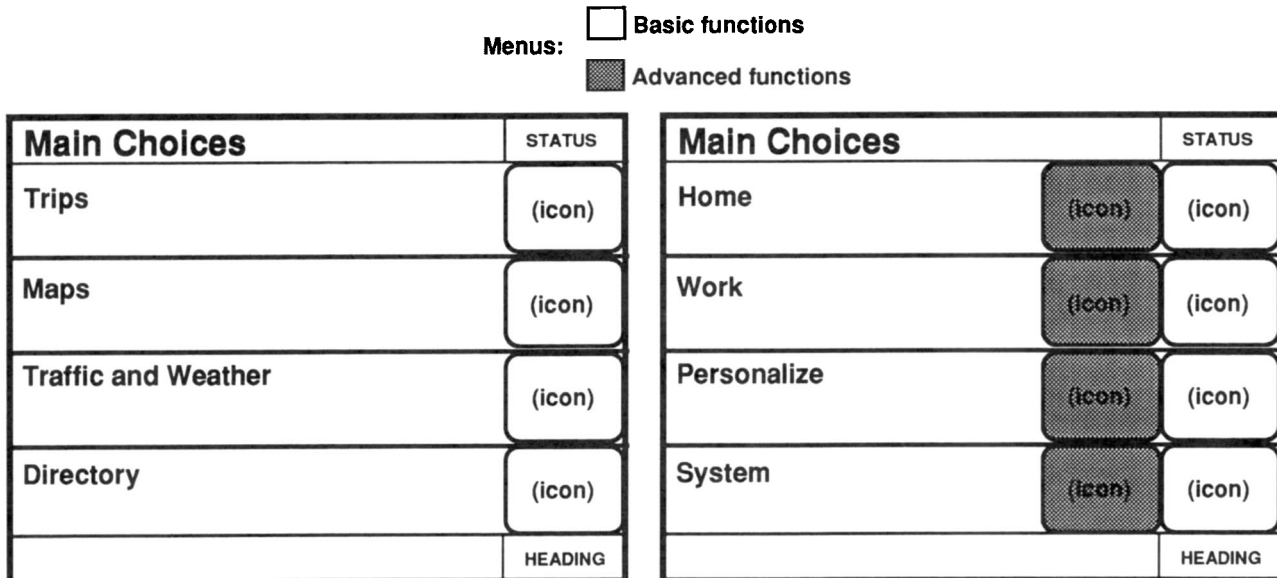⬜ **Advanced functions**

Figure 2: ANS Displays Showing Limited and Enlarged Menu

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Advantages of this approach are:

- Users view advanced functions by choice, on a task-by-task basis.

- Displays look simpler.

- We provide experienced users the option to display continually the cascading menus, thereby avoiding an extra key press to access advanced functions. However, we expect experienced users to leave the system in its most basic menu mode, accessing the advanced functions only when necessary.

- We avoid the need to define artificially a "novice" mode and an "experienced" mode for the entire set of user interactions. Therefore, a user at any level of proficiency can function as a novice when performing certain tasks, and as an expert when performing others.

LOOKING AHEAD

Within the next year, a refined ANS user interface, utilizing the menu system illustrated in Figure 2, will begin field testing. This will be accomplished as part of the ADVANCE program (Boyce, Kirson and Schofer, 1991). In this field test, vehicles will be equipped with ANSs and volunteers will be recruited as participants. ADVANCE leaders plan that the experiment will include 4,000 to 5,000 vehicles, and continue for five years. Over the course of the experiment, feedback will be acquired from the volunteers regarding their experiences using the ANS, especially the learning process. Data collection will include taking objective and subjective measures of performance to determine the effectiveness of the cascading menus and the ability of drivers to make a smooth transition from novice to expert on a task-by-task basis.

REFERENCES

Boyce, D.E.; Kirson, A.; and Schofer, J.L. (1991). "Design and Implementation of ADVANCE: The Illinois Dynamic Navigation and Route Guidance Demonstration Program." In *Vehicle Navigation and Information Systems Conference Proceedings* (VNIS '91), IEEE, Piscataway, NJ, pp 415-426.

Case, E.R. (1989). "An Advanced Driver Information System Concept for North America: A Mobility 2000 Report." In *Conference Record of Papers Presented at the First Vehicle Navigation and Information Systems Conference* (VNIS '89), IEEE, Piscataway, NJ, pp 489-493.

Gillan, W.J. (1989). "PROMETHEUS and DRIVE: Their Implications for Traffic Managers." In *Conference Record of Papers Presented at the First Vehicle Navigation and Information Systems Conference* (VNIS '89), IEEE, Piscataway, NJ, pp 237-243.

Petchenik, B.B. (1989). "The Nature of Navigation, Some Difficult Cognitive Issues in Automatic Vehicle Navigation." In *Conference Record of Papers Presented at the First Vehicle Navigation and Information Systems Conference* (VNIS '89), IEEE, Piscataway, NJ, pp 43-48.

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