Improving Navigation in Touch-Tone Interfaces

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Abstract

In this paper we describe a system we have developed for improving navigation in touch-tone applications by personalizing the menu interface. Telephony applications rely heavily on hierarchically structured menus (or prompts) for creating a dialog between the user and the information being retrieved. The highly hierarchical structure to the method of retrieving information in touch-tone interfaces reduces the efficiency of navigating the various menu layers. The system we describe in this paper allows users to bookmark any given node in the menu-based system. Bookmarks provide a method for bypassing the entire hierarchy structure to access only that node of interest in the menu tree. By means of our approach, users can access personalized information more efficiently and without spending time listening to prompts before making decisions. Participants of a user evaluation expressed highly positive attitudes toward the touch-tone interface we implemented as it enables them to rapidly access nodes of interest, particularly items that are frequently retrieved.

Key words: Telephone voice user interfaces, personalized touch-tone menus, telephony bookmarks, touch-tone interface navigation, voice user interfaces.

1. Introduction

In recent years, touch-tone interfaces (or telephony interfaces) have been widely deployed for accessing various types of information. Although some have argued that these interfaces may not continue to exist [Tatchell, 1999], touch-tone voice applications still represent a significant component of our electronic day-to-day transactions. Their popularity has recently grown due to the introduction of automated call-centers. Using touch-tone interfaces, end-users are able to perform their daily banking transactions, pay their bills and retrieve ticketing information, city directions, and cinema listings at their convenience. In general, touch-tone interfaces have been used in instances where access to high information bandwidth (i.e., visual displays) is impractical and the task of querying and delivering information is complex. Touch-tone interfaces are also coupled with voice input to support tasks where verbal interaction is the most effective medium of communication, such as while driving, operating machinery, and assisting the disabled.

Unlike the presentation of visual information which can be accessed in parallel, touch-tone interfaces deliver information serially. The narrow interaction bandwidth available in touch-tone interfaces results in degraded usability performances [Karat et al., 1999; Schumacher et al., 1995]. To optimize the interaction channel, the backbone structure for guiding a user in accessing the information is primarily a hierarchy (with versions that more closely resemble a network structure). Options for executing a given command are presented as a tree, with the

user entering the system through the root node. By listening to the appropriate prompts (or menu items) the user can navigate the hierarchy that branches the users' calling path into sub-hierarchies until the final task has been achieved. Using sub-hierarchies for directing a user in a system has direct implications on the navigation efficiency of the system. In systems with large hierarchical structures, where many levels are necessary, users lose context, go astray, or increase their error rates in selecting options. One of the major obstacles for promoting touch-tone interfaces has been the high level of user frustration in navigating hierarchical menus [Yankelovich et at., 1995].

Recently there has been considerable interest in exploring methods for reducing the amount of time a user necessitates for navigating a hierarchical menu structure. Some of the major solutions that have been provided involve either optimizing the potential paths a user can undertake in a system [Balentine, 1999], finding a balance between the length of menus and their associated prompts [Suhm, et al., 2001], inserting additional location cues in the menus [Brewster, 1998], enhancing the system with features such as barging-in [Larson, 2002], and determining the most efficient balance between wide and deep hierarchies in telephony systems [Bonneau, 1999]. In this paper, we describe a new method for reducing the access time necessary to retrieve information in touch-tone interfaces. The core concept relies on allowing users to personalize their menu options by giving them direct access to nodes of interest in the hierarchy without going through the various layers of prompts.

The remainder of this paper provides an overview of the touch-tone feature we have implemented, and describes the results of a study we conducted for evaluating users' experience with our interface.

2. Related Work

The basic mode of interaction with a touch-tone interface is through menus structured in the form of a hierarchy. Results from several studies suggest limits on the number of menu choices ranging from no more than four [Roberts & Engelbeck, 1989] or in some cases up to a maximum of nine [Balentine & Morgan, 1999]. Suhm et al. (2001) compared long menus containing items with well-defined functions to shorter menus consisting of prompts that compressed several functions into one menu item. Their results indicate that long menus with specific and clearly defined categories, can route users more efficiently than systems containing short menus with items consisting of broad categories. Since long menus consisting of items with succinct functions result in fewer layers than short menus, Suhm et al. (2001) suggest using long menus with fewer levels if possible.

To improve caller navigation and routing in a system, Balentine (1999) provides a range of features for re-engineering the speech menu. Some of these features include ensuring that users' success path minimizes the total navigation time and that superfluous information is not presented to users. The study also suggests that providing checks during the user's traversal through the system will reduce their error rates and improve navigation time.
Another study by McInnes et al. (1999) suggests that users' actions at each level in a touch-tone interface needs to be supported with confirmations. Their results provide guidelines on the types of confirmation messages that can positively affect users' attitudes. In addition, navigation is improved since confirmation reinforces in the caller their previous action and therefore facilitates further progress in their task.

While the above described studies focus primarily on redesigning menu prompts and restructuring the flow of a caller's session, Leplatre and Brewster (2000) provide a framework for using non-speech audio to support navigation in menu-based interfaces. Their approach puts emphasis on mapping earcons [Blattner et al., 1989] to nodes in a hierarchical menu structure. Earcons are created using non-speech sounds such as timbre, and have an inherent hierarchical composition. In their study, earcons were assigned to nodes based on their depth and their left-to-right positions in the tree. Results show that users employ fewer key presses and complete navigation tasks more successfully when menus are enhanced with earcons. The primary limitation to their approach is that earcons have to be created dynamically each time a touch-tone interface is restructured.

The major drawback to the studies described above is that users are forced into following all the prompts before arriving at their final destination. In certain cases, frequent callers memorize the sequence of actions but nevertheless have to follow the prompts in order to avoid erroneous routing paths.

3. Personalizing Touch-Tone Menus

For illustrating the concept we refer to a menu prompt as a node in the menu hierarchy. At each level in the hierarchy the user is presented with options that will either retrieve information that is requested (leaf node) or will lead to another sub-tree in the menu-based system.

We have implemented a system that will allow callers to bookmark or save their favorite nodes in the menu hierarchy. The bookmarks later appear as options higher up in the menu tree. Users can then bypass the various layers of prompts and access directly their bookmarked information. The set of bookmarks created by the user is provided in a different sub-tree of the application. The personalized list will dynamically create prompts for each saved node that exists in the database. By selecting an item in the list of personal options, the user is directly routed to the corresponding node in the original hierarchy. From that point onward in the session, control in the application is passed to the destination node.

4. User Interaction Dialogs

We developed the proof of concept system by implementing two touch-tone applications. The first application was created with the intention of having a deep hierarchy (cinema listings which require that the user traverse several layers) and the other is structured using a wide hierarchy (local bus transit information). The bus transit application we implemented is identical to the one that is currently available by the local city transit system with the exception of the additional features of saving personal favorites. We illustrate the levels of users' interaction with the system through a scenario for the transit system.

In table 1 we illustrate the sequence of direct dialog interaction adopted by the user. The number of dialog interactions between the user and the system is significantly reduced when more complex queries are involved. Table 1 illustrates the sequence of actions for a user requesting timings for a future bus schedule. In this scenario the user goes to work at 1:00 pm on Thursdays and therefore wishes to save the schedule for 12:00 pm.

Table 1. Interaction dialog for accessing bus schedules for Thursdays at 12:00 pm and for saving the node of interest in the list of bookmarks (this sequence is replicated to match the dialog provided by our city transit system).

System	Welcome to the local transit system. To save information at any level please press "9". Press 1 for English or 2 for French.
Caller	**Presses 1**
System	Please enter the bus stop number.
Caller	**Enters 60613**
System	Press 1 for current schedule or 2 for future schedule.
Caller	**Presses 2**
System	Enter the day, 1 for Sunday and 7 for Saturday.
Caller	**Presses 5 (Thursday)**
System	Enter the time.
Caller	**Enters 12:00**
System	The bus timings are: - Bus 75 at 12:15 pm, 12:50 pm and 1:35 pm - Bus 60 at 12:20 pm, 1:40 pm and 2:15 pm
Caller	**Presses 9**
System	If you wish to save this schedule please record an associated prompt for this function.
Caller	**Says "Thursday schedule after 12:00 pm"**
System	Item saved.

Table 2 demonstrates the reduced amount of interaction necessary for accessing information that requires multiple layers of user input. Upon entering a new session users can directly access their saved information. The system will therefore replay the bus schedules for the previously saved date and time and allow the user to bypass four layers of prompts. By reducing the amount of criteria inputted into the system (see Table 1), possible user errors are avoided in the requesting the needed information.

Table 2. Retrieving future timings from the list of bookmark options.

System	Welcome to the local transit system. To save information at any level please press "9". Press 1 for default options or 2 for personal options.
Caller	**Presses 2**
System	Press 1 for "Current schedule at stop number 60613, in English" Press 2 for "Thursday schedule after 12:00 pm"
Caller	**Presses 2**
System	The schedule is: - Bus 75 at 12:15 pm, 12:50 pm and 1:35 pm - Bus 60 at 12:20 pm, 1:40 pm and 2:15 pm

5. User Evaluation

The feature we implemented was evaluated with users who were given specific tasks and were asked to rate the usability of the system.

5.1 Method

5.1.1 Participants

10 volunteer students from the University of Manitoba participated in the evaluation. None of the participants reported a history of auditory disorders or exhibited any hearing problems. All the participants reported that they had heard about or used touch-tone interface systems at least once. The participants also had previous experience in listening to synthetic speech and spoke English fluently.

5.12 Procedure

Participants took the test one at a time and were told that the intention of the evaluation was to test the usability of the system and not their abilities. Prior to the start of the study, the users were given a brief introduction to touch-tone systems. The participants were informed of the general concept behind building the personalized touch-tone interface and were then given a brief explanation of the tasks to be performed. The evaluator demonstrated the interface during which details were given about how to interact with the system. The demonstration included examples of tasks for accessing information using the conventional as well as the personalized touch-tone menus. Participants were specifically shown how to bookmark and then to later access a saved node.

The tasks began when the users indicated that they were comfortable interacting with the systems. Users were given printed instructions that contained information about the various nodes they were asked to bookmark. After saving all the options that were listed in the instructions, the users performed various sets of tasks using the conventional touch-tone interface and then the personalized touch-tone interface (the ordering was different for half the users). After completing their tasks, users compared the conventional touch-tone menu interface to the personalized touch-tone interface using the two distinct sets of applications discussed in section 4. Their tasks included for example retrieving future transit times or movie listings for a given day. In the first application users traversed fewer layers of the hierarchy while in the second application the users were performing tasks that required traversing deeper hierarchies. With respect to retrieving information from the list of personal options, users were asked to obtain information that had been previously saved. Users' evaluation was categorized in terms of efficiency, navigation, ease-of-use, and learnability. We also recorded the time it took users to access their bookmarks under the personalized touch-tone system.

5.2 Results

We summarize users' average ratings in this section. Results from the trial run showed that the mean ratings for all the questions in the evaluation for both, the shallow as well as the deep trees were identical. We therefore asked the participants to complete only one set of questions after completing tasks using both types of hierarchies. Users were asked to fill out two sets of questionnaires, the first for comparing the two types of systems and the second for evaluating particular aspects of the personalized touch-tone interface only.

The first post-experiment questionnaire contained questions comparing the performance of the personalized touch-tone interface to the conventional touch-tone interface for the same set of tasks. For each task, the participants chose the interface that they felt was better suited for that task. The analysis of the first questionnaire is summarized into the various categories listed below.

5.2.1 Efficiency

Eighty percent of the users favored the personalized touch-tone interface for accessing menu items efficiently. There was general consensus suggesting that participants found specific information quicker when they used the personalized touch-tone interface if items had been bookmarked earlier. All the users confirmed that the personalized touch-tone interface would facilitate their daily transactions.

5.2.2 Navigation

Sixty percent of the users favored the personalized touch-tone interface to choose the right menu in order to reach the intended destination efficiently and effectively (faster and better).

5.2.3 Learnability

Fifty percent of the users suggested that the personalized touch-tone interface is as easy to learn as the conventional interface. By allowing users to record their own prompt, language did not impose a barrier in accessing the bookmarked information. The remaining fifty percent of the user group suggested that the personalized touch-tone interface was slightly more difficult to learn.

5.2.3 Ease-of-Use

Ninety percent of the users suggested that they liked using the personalized touch-tone interface system after repeated use as they understood the system well and were comfortable using and navigating through the options. Eighty percent of the users said that they would like to use the personalized touch-tone interface as they could skip levels and options that slow down their navigation speed. All the users also highly recommended the personalized touch-tone interface for flexibility and ease of use.

The second post-experiment questionnaire evaluated users' perception of specific aspects in the personalized touch-tone interface. Participants responded to questions using Likert-style replies ranging from 1 to 5 (1=strongly disagree, 5=strongly agree). Questions that were designed to evaluate a given category are grouped together and their ratings are summarized in Table 3.

Table 3. Summary of the post experiment quetionnaire.

Statement	**Mean** (1-5)
Q1: Difficult to locate menu options using the personalized touch-tone interface.	2.4
Q2-Q4: Accessing information in the personalized touch-tone interface is efficient.	4

Q5-Q6: Navigation is simplified in the personalized touch-tone interface.	4.1
Q7: Replay of recorded human voice is pleasant.	4.1
Q8-Q9: Personalized touch-tone interface is easy to learn.	3.4
Q10-Q11: Personalized touch-tone interface is easy to use.	3.2
Q12: Recording option is a necessary element of the interface.	4.3
Q13: Personalized touch-tone interface is the preferred choice for daily transactions.	4.4
Q14: Overall satisfaction of personalized touch-tone interface.	4.1

The ratings echoed our initial intuition about the usability and practical use for personalized menus. Users found the feature to be most useful when performing routine transactions. The second most liked feature was the replay of their recorded voices for the menu options provided. In most touch-tone interfaces, designers have to be cautious about the wording of the prompts used in the system. Our observations suggest that telephony systems should provide the flexibility to users for recording their prompts whenever possible. Overall, users "liked" the feature of personalizing their menus and were in strong favor of having the feature implemented in systems they use regularly, such as for paying bills.

6. Conclusion and Future Work

In this paper we described a method for personalizing menus in touch-tone interfaces. The method consists of creating bookmarks for nodes in the tree of menu options that the user can then access immediately. Results of our evaluation indicate that navigation time is reduced significantly when subjects use the personalized touch-tone interface for accessing information. Users mentioned that they were pleased with the effectiveness and efficiency of personalized touch-tone interface and that the feature would be most useful in transactions performed on a regular basis.

Though the technique of mixing human speech and synthetic speech lacks consistency and can generally degrade performance [Gong & Lai, 2001], users confirm that their personal voice provides a higher level of familiarity with the system. By mixing the user's voice within the system, impoverished performances reported in the above mentioned study could reduce inconsistencies in the interface.

The personalized touch-tone interface has its limitations. Accessing information using personalized menus depends upon the information that the users have recorded or stored. Therefore chances of going astray could increase if users improperly record their prompts. Furthermore, user configured options can only be utilized by the user having customized their menu options. Navigation time in the personalized touch-tone interface can be further decreased by allowing the user to reorder the bookmarks in the personalized menu list. As personal options increase, users have to wait until the entire sequence of prompts gets replayed in order to obtain the information they require. Future work will consist of allowing users to perform maintenance operations on their list of options. For example, users may want to re-record a particular bookmarked option, change the order of the bookmarks in the entire list, and be given the flexibility of skipping non-interested bookmarks in the middle of their

operations. Overall, the results of our preliminary investigation suggest that users would be willing to adopt the technology if it were made available.

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