HOW TO DESIGN A USER INTERFACE FOR MULTIMEDIA

Birgül EGELİ, Meltem ÖZTURAN, Nuri BAŞOĞLU, Bekir KARA
Boğaziçi University, School of Applied Disciplines, Management Information Systems Program, Istanbul

ABSTRACT

Multimedia environments need new user interface designs in order to be used effectively. The aim of this paper is to present the current design guidelines for multimedia user interfaces, define the design issues which have to be tested by users during the design process, describe such a test environment, and give the results of a usability test. The results of the test show that guidelines for multimedia user interfaces are usually necessary but not sufficient.

Key Words: Multimedia, User interface

ÇOKLU-ORTAMLAR İÇİN KULLANICI ARAYÜZÜ TASARIMI

ÖZET

Çoklu sunu ortamlarının etkin kullanımı için yeni kullanıcı arayüzleri tasarlanmalı ve geliştirilmelidir. Bu yazının amacı, çoklu sunu ortamları için var olan tasarım yol göstericilerini sunmak, tasarım süreci içinde kullanıcılar ile denenmesi gereken tasarım konularını belirlemek, bu amacı gerçekleştirmek üzere hazırlanan deneme ortamını tanımlamak, ve kullanıcılar ile yapılan deneme ile ilgili sonuçları sunmaktır. Yapılan test sonuçları göstermektedir ki var olan yolgöstericileri kullanmak gerekli ama yeterli değildir.

Anahtar Kelimeler: Çoklu-ortam, Kullanıcı arayüzü

1. INTRODUCTION

New technologies have evolved with the developments in computer technology and increasing of knowledge. Multimedia is one of those technologies that is being used since 1970's. Multimedia has been identified as working of devices for different media (texs, graphics, sound, animation, video, simulation, etc.) in a coordination and interact with each other.

User interface presents a system to a user and enables communication, for this reason it has been one of the main concerns of computer program designers. Any system designed for people to use should be easy to learn and remember, effective and pleasant to use (Molich and Nielsen, 1990). The desing experiences for constructing good human-computer interfaces have been documented in a number of guidelines. Following these guidelines is considered to be necessary but insufficient. Since these are interfaces for human-computer interaction, they should be tested or designed with the people who are going to use the system.

A system having a good user interface design will have benefits as; increase in user acceptance of system prototypes and the eventual system; increase in frequency of use of the system, lower operator error rates, decrease in operator training time, and increase in speed of performance (Shneidermann, 1990).

2. LITERATURE SURVEY

2. 1. User Interface Design Process

Design process of an interface can be identified in 3 steps (Shneidermann, 1990); usage profile, task profile and interaction styles.

Usage profile: All design should begin with an understanding of the intended users, including profiles of their age, sex, physical abilities, education, cultural or ethnic background, training, motivation, goals and personality. The process of knowing the user is never ending, because there is so much to know and because the users keep changing. A generic separation for usage profile can be novice, knowledge intermittent and frequent users, where each might lead to different design goals.

Task profile: After the user profile is drawn, the tasks must be identified. Design or implementation convenience should not dictate system functionality or command features. The tasks can be entering and exiting the system, text scroll, search for a keyword, zoom, etc.

Interaction styles: When the task analysis is complete and the semantics of the task objects and actions can be identified, the designer can choose from primary interaction styles.

2. 2. Principles of Interface Design

Underlying principles of traditional interface design given below are also considered during the design process (Molich and Nielsen, 1990; Mc Graw, 1992).

- Consistency: Requirement of consistent sequences of actions for similar situations (e.g. if right arrow is used to turn pages it should not be used to travel inside a page), use of same color for same purpose, word choice (If OK is used then do not use YES).
- Meet the needs of a wide range of users (e.g. enable frequent users to use shortcuts).
- Informative feedback: For every action there should be some system feedback, such as color change of an icon when it is clicked.
- Closure yielding dialogs: Sequences of actions should be organized into groups with a beginning, middle and end. The scrolling function in a text window and the placement of an elevator helps this kind of closure.
- Simple language: Only the knowledge that is necessary should be given to the user and it needs to be easy to understand.

- Error messages: There should be good messages to tell the user what the errors are and how they can be corrected.
- Simple error handling: The system should be designed so that the user can not make a serious error. And if an error has occurred, system state should be unchanged or give instructions about restoring the system.
- Easy reversal of actions: Reversibility of actions relieves the anxiety of a user since he/she knows that error can be undone.
- Support for internal locus of control: There should not be any surprising system actions or difficulty in obtaining necessary information.
- Reduce short-term memory load: The limitation of human information processing in short-term memory (7 ± 2 chunks) requires that displays should be kept simple, multiple page displays should be consolidated, frequent window motion should be reduced, and sufficient training time should be permitted for learning sequence of actions.

2. 3. Suggested Guidelines

There are different guidelines for different properties; interaction style, information display, effective use of windows, text design, character type, icon design, color, effective message design, manual design, evaluation; of a user interface. All of these guidelines should be taken into consideration during design process.

Interaction Style

Primary interaction styles are given as (Ok-Choon, 1991) menu selection, form fill-in, command language, natural language and direct manipulation. Form filling is used when there should be some input to the system from the user. Natural language usually requires some input from the user and it is easy to use because it is similar to the language the user speaks. Command language can be used for some tasks but this requires some skill, the user have to know the commands of the language. The tasks to be performed by the user can also be selected with menu items or by direct manipulation. For the menus the user have to know which menu item performs which task and where it is located. Using direct manipulation approach the user can point and select the task visually.

Direct manipulation approach is attractive because the users can avoid learning commands, reduce the chance of typographic errors on a keyboard, and keep their attention on the display (Shneidermann,

1990). The advantages of direct manipulation are given as; easy to learn, easy to retain, visually presents task concepts, fewer errors, faster performance, encourages exploration and high subjective satisfaction; where the disadvantages are difficulty in programming and requirement of graphics display and pointing devices. There is a new style widely known as Graphical User Interface (GUI) which is a subset of direct manipulation interface. By this interface the world is represented by objects and actions; point, drag and click replaces keypress; feedback is immediate; actions are rapid and reversible. Benefits of GUI are given as (Mc Graw, 1992). It is learned easily and quickly when graphic representation is carefully selected and kept to a manageable size, results in a more friendly looking display, familiar to users who are used to abstracting concepts as graphical representations, easy anticipation of errors, enable use of supporting elements such as animation and sound.

Information Display

Every screen should have only one purpose (Chimaera, 1996). When the activity for a screen is limited to one then it is quicker for users to understand. The screens in an application are basically collection of visual objects designed to help a user perform a task. In order to increase the communication of the objects with the user: the objects should be grouped into functional areas, if the user is not going to interact with certain portions of the screen, those should be differentiated from the other areas, command buttons should be grouped within a box.

White space (areas of the screen that do not contain controls, buttons or frames) should be used to set off important items to enhance recall, to set off chunks of supporting information from the main ideas and to aid the interpretation of complex tables, figures, or graphics (Mc Graw, 1992). Maximum desired density for text is in a range of 25 % to 31 %. The screen can be separated into 3 to 5 units, where each unit can have densities up to 58 %. Local density for decision making units should be under 35 %.

Effective Use of Windows

Opening, moving, changing size, closing, or scrolling are common operations supported for windows but users must be taught about these operations. System should have a default position for windows. Windows should not make other functions invisible. The extra effort of manipulating windows can distract use from the task they are accomplishing. Windows can be advantageous if independent tasks are being carried out and when it is necessary to look at a problem in multiple ways. Number of open windows should be restricted and every window should have a name on the title bar (Mc Graw, 1992).

Text Design

When users view a screen, they recall relevant material from long-term memory, form clarifying and follow-up questions about misunderstandings, decide what is important on the screen, recognize words on the screen and retrieve their meanings, parse phrases in which the words exist, organize ideas presented on the screen, integrate ideas with prior knowledge, and determine what to do next. To help the user viewing a screen data display guidelines given by Smith and Movier (1985) can be helpful:

- Use short simple sentences
- Left justify columns of alphabetic data to permit rapid scanning
- Use affirmative statements rather than negative statements
- Maintain consistent format from one display to another
- Put a title or header for every display

Character Type

Character type is also an important factor for text design which includes features as (Mc Graw, 1992):
- Openness of characters is important
- Use Serif types fonts (Bookman and Times) that make reading easier by connection of letters that makes the word and use 18 point size
- Optimum readability for a line is 8 to 10 words where the length of a line can change from 15cm. to 23cm., and total length of the text should be 28 lines which may require the use of scrolling
- A larger type font size is needed for headings
- All capitals can be used for headings and title text
- Bold style is effective to emphasize headings, highlight important piece of text and help differentiate foreground text from a colored background (Chimaera, 1996)
- Italic is useful when selecting a word or a phrase and highlighting it for emphasis
- Underlining drastically reduces readability
- Use intensity, marking, text size, choice of fonts, inverse video, blinking, color, and audio for attention getters.

Icon Design

Pictures do not have language barriers, when properly designed they are understood by people regardless of what language they speak. Icons have potential for conveying more information than their verbal counterparts, greater structural distinctiveness, superior economies of space and comprehension, easier to locate and point a desired object than to remember and find a menu command. But still icons do not guarantee instant understandability across (or even within) cultures. Icons should be designed to fit the metaphor, to represent the task appropriately and to make sense to the user.

Labels (written explanation) should be provided for icon actions for minimal memory load. Key design principles are unity (fit together), consistency (use of icons and their placement), clarity (effective communication of the message), restraint (should not be as learning a new language), and recognition (represent concepts familiar to majority of the population) (Mc Graw, 1992). The icon ideas should be selected and worked with target users to analyze and refine selections, aim for simplicity, present a common frame, use same type of graphics (abstract or pictorial), should not mix color with icons. A final test of the overall system should also be performed.

The report of Chimaera Consulting Group (1996) indicates that designers should not get artistic and creative for icon designs, because icons are meant to be immediately identifiable with the action they represent. When creating an icon for a purpose, the designers should try to include the symbols the user has already reference for.

The study done by Brems and Whitten (1987) about the icon-based interfaces have proved that icons were learned easily, but verbal representations and labeled icons were preferred over unlabeled icons. The results show that both learning and preference should be considered before implementing an icon-based interface.

Color

Color displays are attractive to users and can often improve task performance. Color can improve performance to recall a task, to retrieve from memory, search and locate task, scan screen to locate information, retention task and a decision judgment task. Images require color but there is a controversy about benefits of text color. Suggested guidelines are:

- Limit the number of colors in text: Number of colors in a single alphanumeric display should be limited to 4, with a limit of 7 colors in the entire sequence of screens.
- Use of color coding: Color coding should be used as attention getters (e.g. giving overdue accounts in red)
- Color coding should be under user control: When appropriate, the user should be able to turn off the color coding, if it is not appropriate, users should select the colors in the design stage.
- Workable pairing of text background and foreground colors are white-bright blue, off-white-black, off-white-navy-blue, lightgray-black, black-white, and blue-white.

The Chimaera Consulting Group (1996) has also identified some rules for use of colors:
- Use only a 3-D gray background.
- Use white background for text boxes.
- Use black text color and non-bold fonts on all controls.
- For highlighting a text box use a red foreground while keeping the background white
- Keep the colors simple.

Effective Message Design

System to user prompts should be recognizable (center of the screen, etc.), should be specific as to tell what to do next or what the result of a selection would be, and the respond should be easy (mouse click, etc.). Help should include, basic instruction on system use, available user aids and allowable commands with descriptions, definition of a term or command, pointers to specific sections or pages in user documentation, increasingly more detailed explanations of a question posed to the user (Mc Graw, 1992). Helps should be entered from all parts of the system. For alert and error messages it should be anticipated when an alert message should be designed, determined how or where the message should be presented, appropriate help messages should be constructed, a file of messages should be maintained for consistency, and explanations of messages through online help or user documentation should be provided.

Manual Design

All users of interactive computer systems require some training (Shneidermann, 1990). Traditional printed manuals can be very effective if properly prepared. When it comes to learning about computer systems many people experience anxiety,

frustration, and disappointment. Much of the difficulty flows directly from the poor design of display formats or prompts that lead to error conditions.

Traditional user manual is a paper document that describes the features of the systems. User manuals can be in the form of; alphabetic listing and description of commands, quick reference card with a concise presentation of the syntax, or novice user introduction and tutorial. A manual can have one or all of the given types.

Evaluation

Some of the evaluation methods are surveys, interviews-group discussions, online or telephone consulting, online suggestion box or trouble reporting (Shneidermann, 1990). User surveys are inexpensive and generally acceptable. After it is prepared it should be reviewed among colleagues and tested on a small sample of users before a large-scale survey is conducted. Interviews with individual users can be productive because the interviewer can pursue specific issues of concern. After a series of individual discussions, group discussions are valuable to ascertain the universality of comments. It can be costly and time consuming. Online or telephone consulting is an extremely effective idea for providing assistance to users who are experiencing difficulties. Electronic mail can be employed to allow users to send messages to the designers for suggestion or trouble reporting. Such an online suggestion box encourages some users to make productive comments.

Developers are encouraged to adhere to standards and follow principles and guidelines when designing screens. Because of the limited research behind current standards and because each product involves many considerations, just applying today's standards, principles, and guidelines does not guarantee good screen design. Designers should also test the screen design with users (Schell, 1986).

3. FACTS ABOUT SURVEY

Besides the above mentioned guidelines, the preferences of the users are also important factors that effect the design of a multimedia user interface. This study aims to design the best possible multimedia user interface for a system that has the following properties:

- This system will be a English-based multimedia information presentation system. The users of a presentation system does not need to have knowledge about the computer to get the necessary information about a topic. Therefore this system aims for the novice users assumed to have no syntactic knowledge about using the system and little semantic knowledge of computer issues. Designing for novice users restricts vocabulary to a small number of familiar, consistently used terms. Novice users need to carry out a few simple tasks. The system should provide information feedback, keep number of possibilities at minimum and include an online help.

- The tasks for a multimedia presentation system for novice users can be specified as:
    - Starting the system
    - Moving backward and forward inside a concept
    - Reading scrolling text
    - Use audio settings
    - Read help
    - Quit system

- This system will be using graphical user interface as interaction style. The task commands will be represented by graphical symbols (icons).

For the above purpose a test user interface is designed considering the guidelines and a survey is done where users have the chance to specify their preferences.

3. 1. Test Environment

The test user interface which runs under Windows 3.1 and Windows 95 environments is prepared using Visual Basic software. Design considerations of the test interface are as follows:

- The display is divided into 4 main areas: Picture, text box, control icons, and white space. Nine different placements of the areas are presented to the users as a startup screen (Figure 1). This main display presents 9 different display selections. When one is clicked, it is changed to screen size and menu items show up for text, color, audio and icon selections.
- Window size is set to screen size so that novice users will not be able to click somewhere else on the screen and lose the sight of the system window. Since the task is presentation, only one window is kept open at a time.
- Every text box has a title bar. Text is left justified. Font type and size of the text can be selected by the user from a set of 5 choices for font (Ms Sans Serif, News Gothic, Serif, Arial,

Times New Roman) and 5 choices for font size (8.25, 9.75, 12, 13.5). Font size 18 could not be used since only 2 words per line can be fit into the text box which prevents the optimum readability. Heading size is selected to be one size larger than normal text size and its style is set to be bold. The text box is a scrolling text box. No underlining or italic characters are used.

- Icons are designed for the tasks forward, backward, main menu, audio, help, and quit. The user selects the graphic of an icon from a selection of 4-5 icons (Figure 2). Icons include verbal definition for minimal memory load and are not subject to change in color. Placement of icons are done according to main display selections.
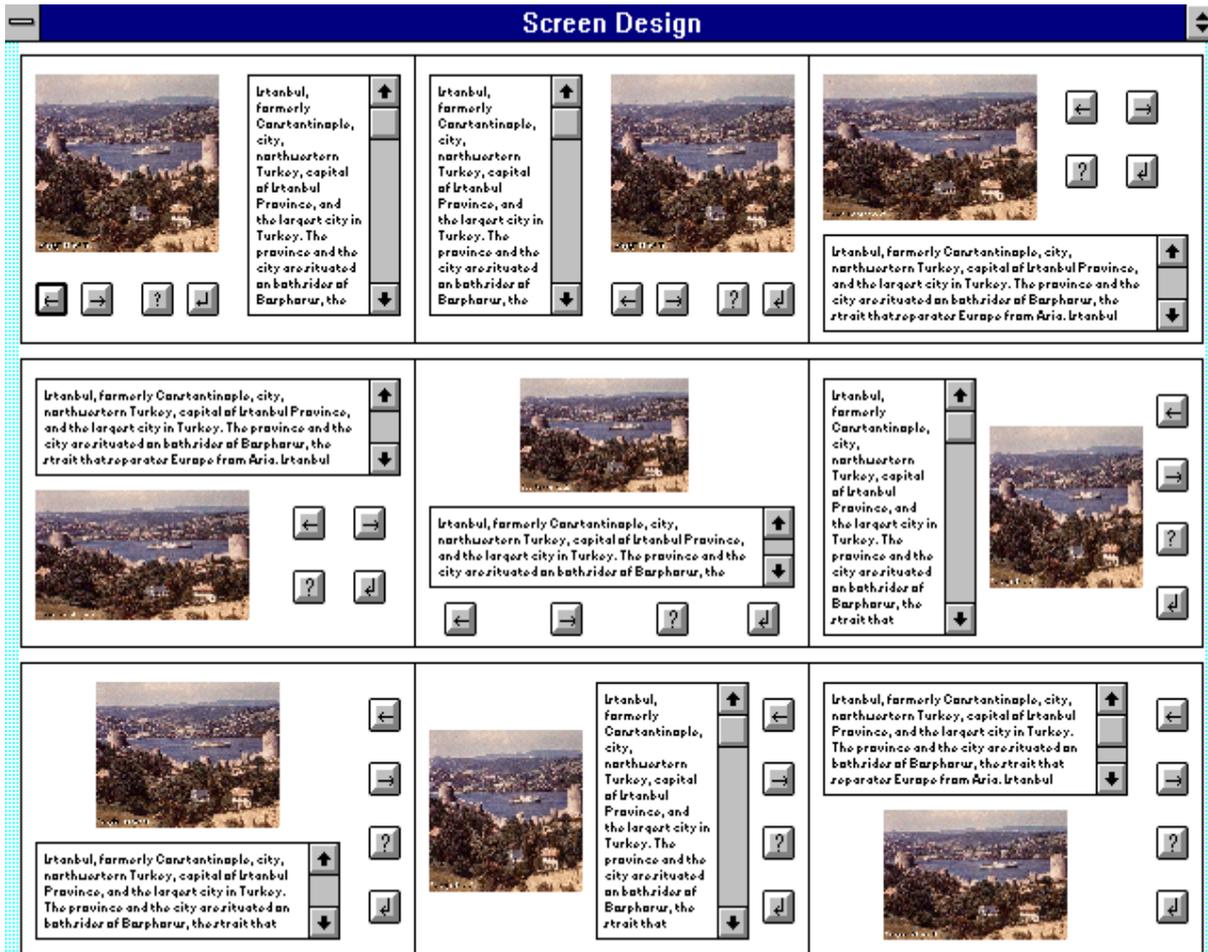
Figure 1. Screen configurations
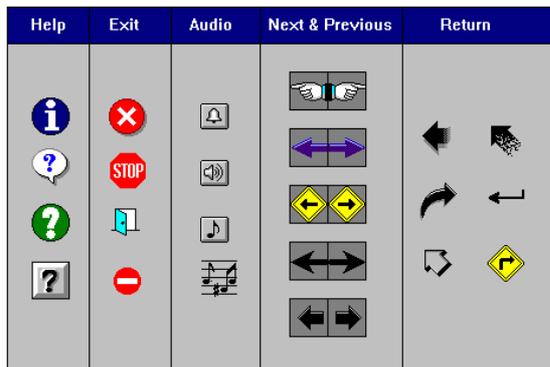
Figure 2. Icon selections

- The user will be able to select the color for white space, color for text foreground and background. All three colors are selected from an 8-color palette. The color palette for screen and text background includes colors white, gray, blue, yellow, pink, green, blue/green, and Turquoise. The color palette for text color includes colors white, gray, blue, yellow, green, blue/green, Turquoise, and black. The system is designed so

that text background color can not be selected same as text foreground color.

- There has not been any guidelines for background music and text reader so this selection is also given to the users. The selections are background music, text reading, both background music and text reading, and none.

3. 2. Participants

The test is performed with a convenience sample of 50 users (at least high school graduates working or studying in Boğaziçi University) who basically are familiar with Windows environment and whose native languages are Turkish. The system is explained to each user and they are told what is required from them. The selections of the users are saved to a text file while exiting the system for further evaluation.

3. 3. Results

Frequency distributions of user selections are as follows:

Screen Configuration: The startup screen selections are numbered from left to right and from top to bottom starting from 1. Table 1 shows the frequency distribution for screen configurations.

Text Selection: The default starting font type is Ms Sans Serif with size 8.25. Table 2 gives the results for font and font sizes.

Color Selection: The default starting screen and text background color is white and text foreground color is black. Table 3 gives results of frequency analysis for color selections.

Icon Selection The default starting icons are labeled and without any symbols. Table 4 gives the frequency analysis results of icon selections .

Sound Selection: The default starting sound is no sound. Table 5 gives the frequency analysis results of sound selections.

Table 1. Screen Configuration Frequency Results

	Screen Number	Picture Position	Frequency	Percent
1	Top Left	Left	18	36
2	Top Middle	Right	5	10
3	Top Right	Left	9	18
4	Middle Left	Bottom	3	6
5	Middle	Top	6	12
6	Middle Right	Right	0	0
7	Bottom Left	Top	8	16
8	Bottom Middle	Left	1	2
9	Bottom Right	Bottom	0	0

Screen Layout Histogram
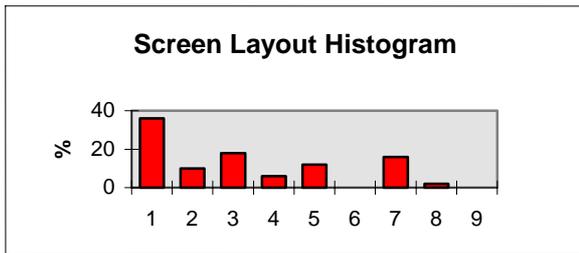
Table 2. Text Selection Frequency Results

Font	Frequency	Percent	Text Size	Frequency	Percent	Cumulative Percent
Ms Sans Serif	8	16	8.25	10	20	20
News Gothic MT	2	4	9.75	24	48	68
Serif	4	8	12	14	28	96
Arial	17	34	13.5	2	4	100
Times New Roman	19	38	Mean : 10.23 Mode : 9.75 Median : 9.75			

Text Size Histogram

Text Font Histogram
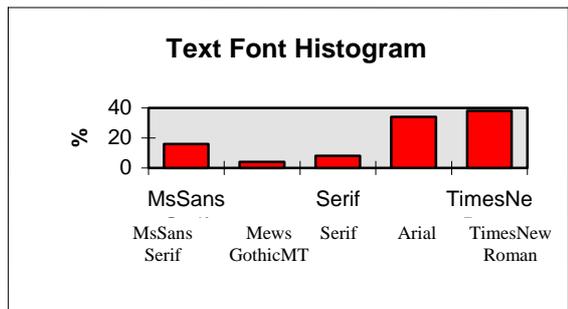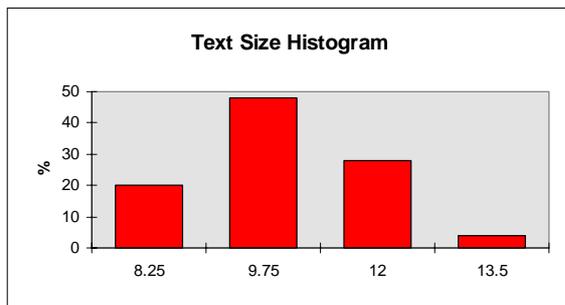
Table 3. Color Selection Frequency Results

Background Color	Frequency	Percent	Text Background Color	Frequency	Percent	Text Color	Frequency	Percent
White	12	24	White	28	56	Black	40	80
Turquoise	0	0	Turquoise	0	0	Turquoise	2	4
Gray	11	22	Gray	11	22	Gray	1	2
Pink	2	4	Pink	2	4	White	1	2
Blue	5	10	Blue	2	4	Blue	6	12
Blue/Green	17	34	Blue/Green	6	12	Blue/Green	0	0
Yellow	3	6	Yellow	1	2	Yellow	0	0

| Green | 0 | 0 | Green | 0 | 0 | Green | 0 | 0 |
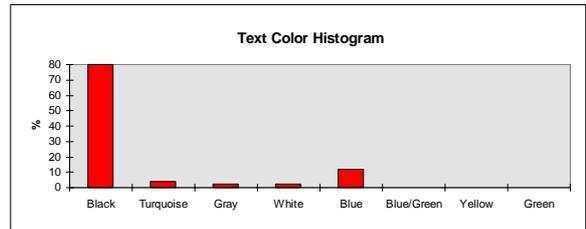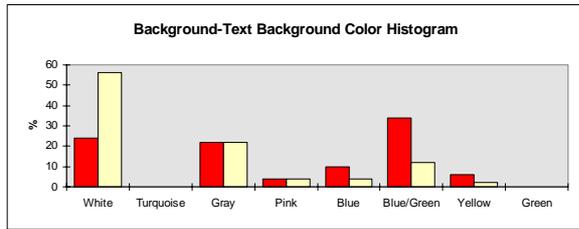
Table 4a. Icon Selection Frequency Results

Next-Previous Icon	Freq.	Percent	Help Icon	Freq.	Percent	Exit Icon	Freq.	Percent
1	17	34	1	4	8	1	6	12
2	4	8	2	14	28	2	10	20
3	10	20	3	5	10	3	21	42
4	2	4	4	18	36	4	3	6
5	10	20	None	9	18	None	10	20
None	7	14						
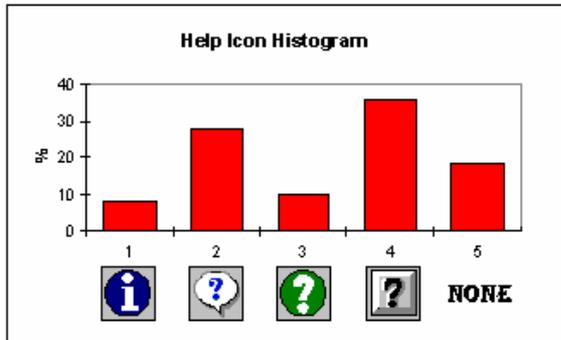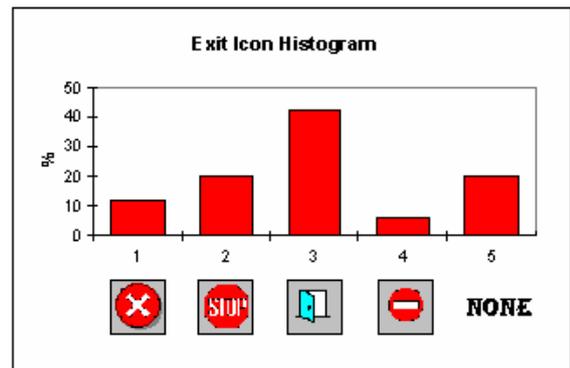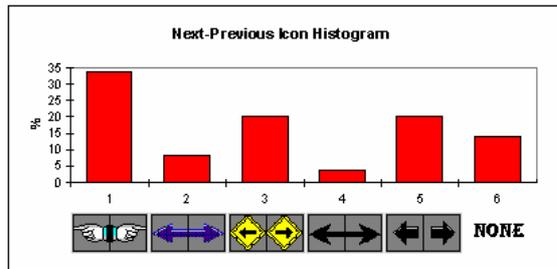
Table 4b. Icon Selection Frequency Results

Return Icon	Freq.	Percent	Audio Icon	Freq.	Percent
1	10	20	1	2	4
2	8	16	2	21	42
3	4	8	3	8	16
4	7	14	4	12	24
5	7	14	None	7	14
6	5	10			
None	9	18			

Return Icon Histogram

Audio Icon Histogram
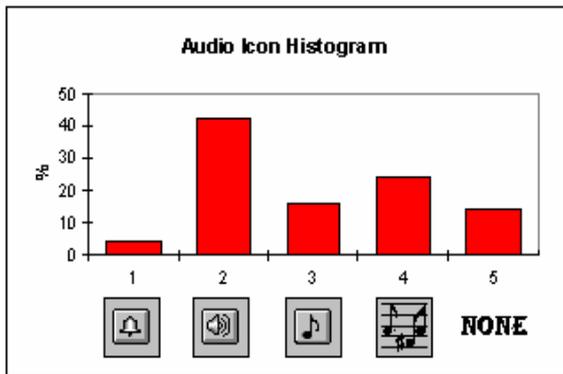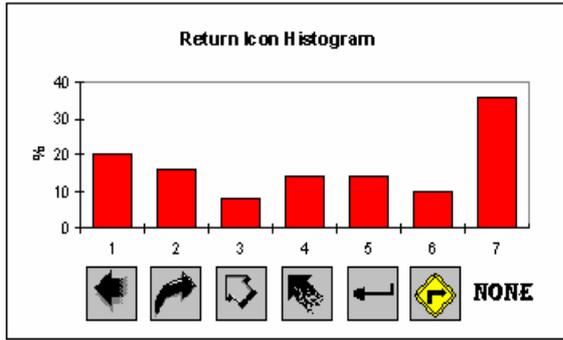
Table 5. Sound Selection Frequency Results

Sound	Frequency	Percent
Background music	15	30
Text Reader	5	10
Both	29	58
None	1	2

Music-Text Histogram
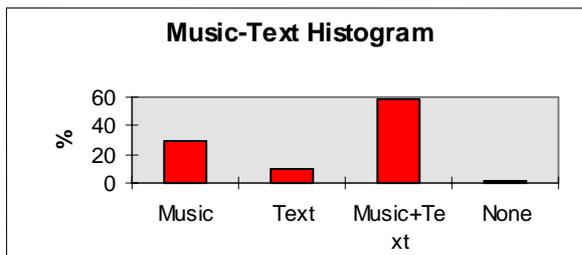
4. CONCLUSION

Analysis of the frequency distributions show that;
- Users like to see the picture on left of the screen (62 %), but the places of the text box and the control icons are not so important.
- Users like to use the fonts Times New Roman (38 %) and Arial (34 %), which are generally used in Windows environment and come as default for Write and Word programs.
- Users do not want the font size to be more than 12 unlike what the guidelines specify (use size 18 for fonts). The mean value for font size is 10.23, where mode is 9.75.
- Users like the screen background to be white, gray or green/blue (total 80 %), and they do not like to use bright colors. Text background color is chosen mostly from pastel colors (total 90 %), and 80 % of the participants prefer text color as black. All color selections are similar to what the guidelines suggest.

- For next and previous icons, the "hands" image is found to be the preferred one by 34 %.
- Most users preferred "question mark" image (total 74 %) for help icon.
- "Door" image is generally selected for exit icon (42 %) which is also referenced in Windows environment.
- Distribution for return icons show that there is no high preference for a specific icon.
- 42 % of the participants preferred the "Speaker" image for audio icon.
- 58 % of the participants prefer to hear the text reader with a background music where 88 % preferred to hear the background music.

While the users were performing the survey, they pointed out the following comments which are planned to be taken into consideration for further studies:
- There must be a chance to switch between background music and text reader.
- The picture effects the selection of background color.
- The number of colors and tones should be increased.
- There may be alternatives for the song of the background music.
- Learning a new language can effect the selection for the text reader.
- Purpose of some icons, especially return icon is not clear.

Above mentioned criticisms will also be taken into consideration for the final design of the multimedia user interface. This project will be finalized after preparing a presentation of Boğaziçi University using this final design as a template.

The final screen is determined to be as given in Figure 3, according to the results of frequency analysis only.
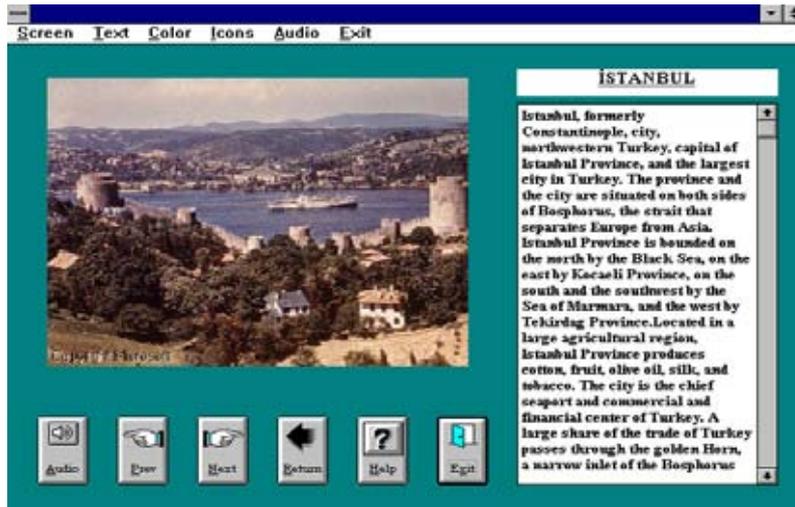
Figure 3. Final screen example

5. REFERENCES

Brems, D. J., Whitten, W. B., 1987. "Learning and Preference for Icon-Based Interface", **Proceedings of the Human Factors Society 31st Annual Meeting**, 125-129.

Chimaera Consulting Group. 1996. Internet address: http://ourworld. Compuserver. Com/homepages/ chimaera.

Mc Graw, K. 1992. Designing and Evaluating User Interfaces for Knowledge-Based Systems, Ellis Horwood Ltd., West Sussex, England.

Molich, R., Nielsen, J. 1990. "Improving a Human-Computer Dialogue", Communications of the ACM, 33 (3), 338-348.

Ok-Choon, P. 1991. "Hypermedia: Functional Features and Research Issues", Educational Technology, August, 24-31.

Schell, D. 1986. "Usability Testing of Screen Design: Beyond Standards, Principles, and Guidelines", **Proceedings of the Human Factors Society 30th Annual Meeting**, 212-1215.

Shneidermann, B. 1990. Designing the User Interface: Strategies for Effective Human-Computer Interaction, Addison-Wesley Publishing Co.

Smith, S. L., Mosier, J. N. 1985. "Application of Guidelines for Designing User Interface Software", **Proceedings of the Human Factors Society 29th Annual Meeting**, 946-949.