User Interfaces

Introduction

- Multimedia user interfaces are computer interfaces that communicate with users using multiple media, sometimes using multiple modes such as written text together with spoken language
- Multimedia would be without any value if applications did not use the various media at the user interface for input and output.
- Media determine not only how human computer interaction occurs, but also how well.
- Graphical user interfaces - using the mouse as the main input device - have greatly simplified human-machine interaction.

- Despite these advances, there are still many well known problems with current user interfaces.
  - One problem is computer interaction which is still neither natural nor effective e.g. speaking is often more suitable for the situation than writing and reading and listening are not alternatives to each other; they complement one another
  - Another problem is the specification of object movement. A specification of *movements* using graphics or text is often much more difficult and complicated than using a *motion video*
  - The development goes toward more effective human-computer interfaces using new interactive devices, which is an area of research in the field of virtual reality.
    - The goal is to provide interactive devices such as data globes and body suits for input, and holography, head-mounted displays and three-dimensional sound deice for output. These devices help to move objects in a 3D space.

1. General Design Issues

- The main emphasis in the design of multimedia user interfaces is multimedia presentation. There are several issues which must be considered:
  - To determine the appropriate information content to be communicated.
  - To represent the essential characteristics of the information.
  - To represent the communicative intent.
  - To chose the proper media for information presentation.
  - To coordinate different media and assembling techniques within a presentation.
  - To provide interactive exploration of the information presented.
- The objective of the multimedia presentation system should be the appropriateness principle

1.1 Architectural Issues

- An effective presentation design process should not only involve sequential flow of actions, but also parallel and interactive actions
  - there is a requirement for extensive feedback going on between the components making decisions about media and modalities
  - the design includes a number of higher-level concerns, such as goals and focus of the dialogue, the user's context and current task, and media selection to represent this information in a way that corresponds to these concerns
- A conceptual architecture with a knowledge base (lower part of the figure), used by an intelligent multimedia presentation system (upper part of the figure - both parts are separated by the black arrow), is shown in Figure

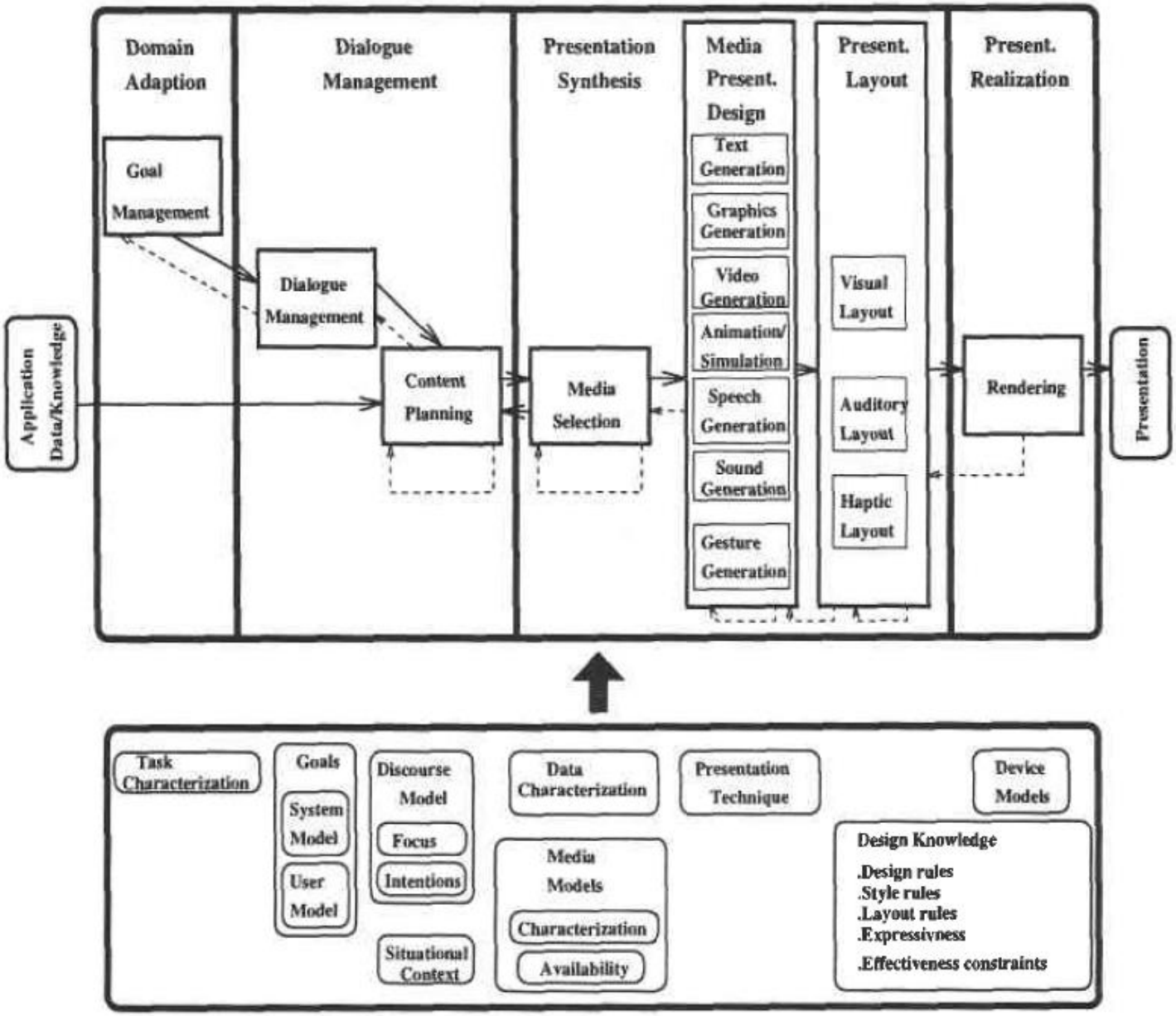

Figure 14.1: *Conceptual architecture of a multimedia presentation system*

1.2 Information Characteristics for Presentation

- A complete set of information characteristics makes knowledge definition and representation easier because it allows for appropriate mapping between information and presentation techniques. The information characteristics specify:
- **Types**
  - Characterization schemes are based on *ordering information* .
  - There are two types of ordered data: (1) *coordinates versus amount*, which signify points in time, space or other domains or (2) *intervals versus ratio*, which suggests the types of comparisons meaningful among elements of coordinate and amount data types.

- Relational Structures
  - This group of characteristics refers to the way in which a *relation maps* among its domain sets (dependency). There are *functional dependencies* and *nonfunctional dependencies*.
- Multi- domain Relations
  - Relations can be considered across multiple domains, such as: (1) multiple attributes of a single object set (e.g., positions, colors, shapes, and/or sizes of a set of objects in a chart); (2) multiple object sets (e.g., a cluster of text and graphical symbols on a map); and, (3) multiple displays.
- Large Data Sets
  - Large data sets refer to numerous attributes of collections of heterogeneous objects (e.g., presentations of semantic networks, databases with numerous object types and attributes of technical documents for large systems, etc.).

1.3 Presentation Function

- Presentation function is a program which displays an object (e.g., printf for display of a character).
- It is important to specify the presentation function independent from presentation form, style or the information it conveys.
- Several approaches consider the presentation function from different points of view.
- For example, one approach views the presentation function as a set of *information-seeking goals*, another approach considers it as a *hierarchical representation of media*-independent presentation goals derived from a plan-based theory of communication

1.4 Presentation Design Knowledge

- To design a presentation, issues like: *content selection*, *media and presentation technique selection* and, *presentation coordination* must be considered
- *Content selection is* the key to convey the information to the user. However, we are not free in the selection of the it because content can be influenced by constraints imposed by the size and complexity of the presentation, the quantity of information, limitations of the display hardware, and the need for presentation completeness and coherence.

- *Media selection* determines partly the information characteristics described earlier. For selecting presentation techniques, rules can be used. For example, rules for selection methods, i.e., for supporting a user's ability to locate one of the facts in a presentation, may specify a preference for graphical techniques. Media must be chosen to be "adequate".
- *Coordination* can be viewed as a process of composition. Coordination needs mechanisms such as : (1) *encoding techniques* (e.g., among graphical attributes, sentence forms, audio attributes, or between media); (2) *presentation objects that represent facts* (e.g., coordination of the spatial and temporal arrangement of points in a chart); and, (3) *multiple displays* (e.g., windows)

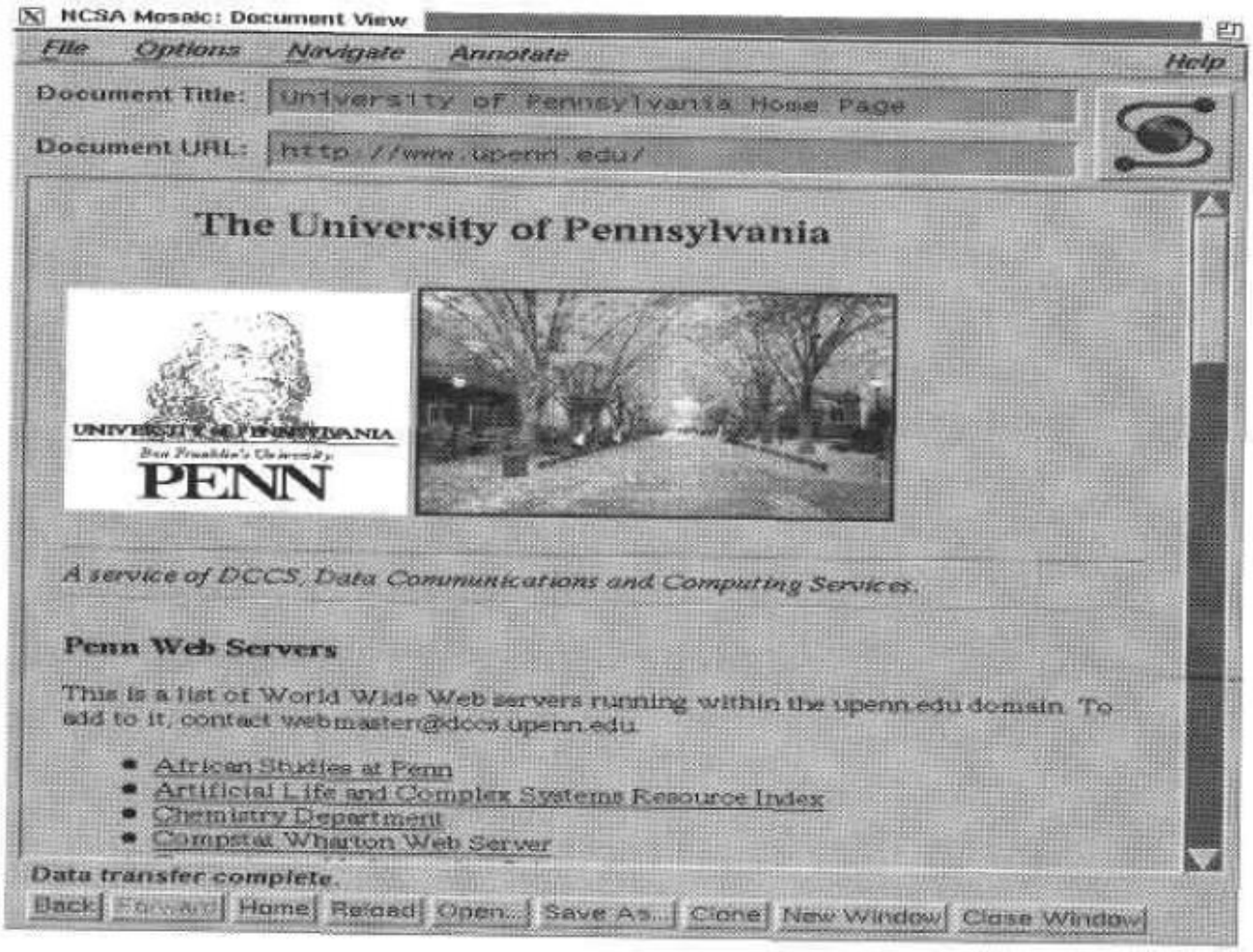

Figure 14.2: *User interface of University of Pennsylvania's Mosaic home page illustrating a result of coordination.*

1.5 Effective Human-Computer interaction

- One of the most important issues regarding multimedia interfaces is effective human-computer interaction of the interface, i.e., *user-friendliness*.
- Here, we will just briefly enumerate the main issues the user interface designer should keep in mind: (l) *context;* (2) *linkage* to the world beyond the presentation display; (3) *evaluation of the interface* with respect to other human-computer interfaces; (4) *interactive capabilities*; and (5), *separability* of the user interface from the application.

2. Extension through Video and Audio

- Continuous stream audio and video play a significant role in multimedia.
- The main issue during the presentation of continuous media streams is the continuity in time.
- Hence, time is a new presentation dimension in a user interface
- An illusion of a continuity by the user is created through the presentation of a sequence of static elements

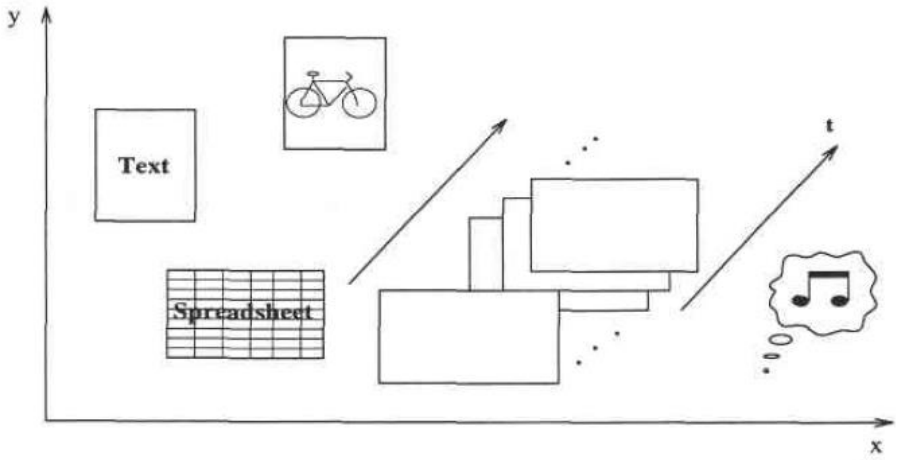

Figure 14.3: *Multimedia at the user interface with the presentation dimension "time".*

3. Video at the User Interface

- A continuous sequence of, at least, 15 individual images per second gives a rough perception of a continuous motion picture.
- At the user interface, video is implemented through a continuous sequence of individual images.
- Hence, video can be manipulated at this interface similar to manipulation of individual still images.
- An example of a user interface for manipulating images is the software *package xv*.

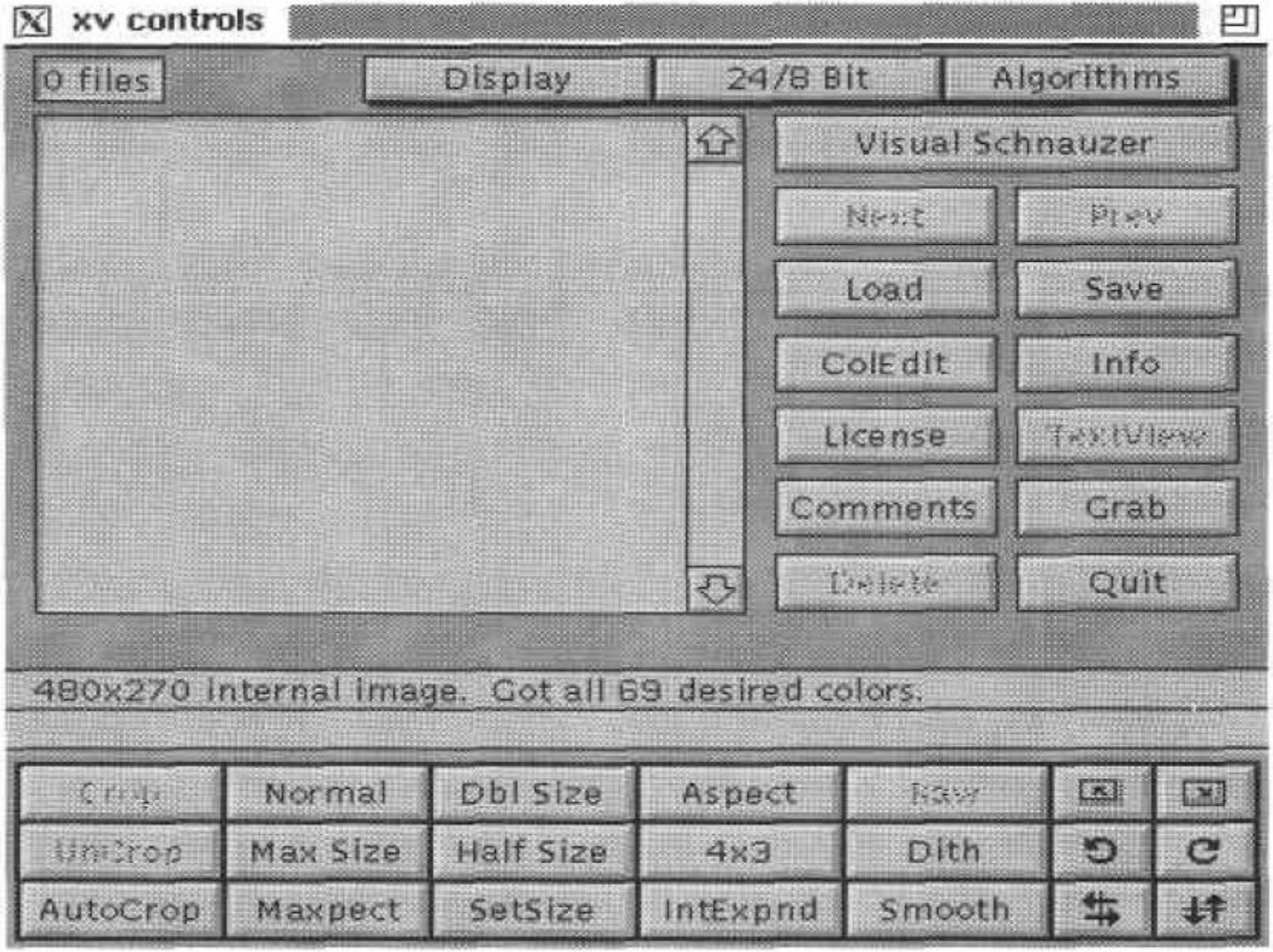

Figure 14.4: *xv user interface.*

Hardware for Visualization of Motion Pictures

- Special hardware for visualization of motion pictures is available today mostly through additional video cards e.g. IBM-M-Motion and Action Media II (Intel/IBM) cards, etc.
- Today, these cards have become an integral part of the multimedia system.

4. Audio at the User interface

- Audio can be implemented at the user interface for application control. Thus, *speech analysis* is necessary.
- Speech analysis is either speaker-dependent or speaker-independent.
- Speaker-dependent solutions allow the input of approximately 25,000 different words with a relatively low error rate. Here, an *intensive learning phase* to train the speech analysis system for speaker-specific characteristics is necessary prior to the speech analysis phase.
- A speaker-independent system can recognize only a limited set of words and no training phase is needed.

- For more natural distribution of sound—*stereo*
- In the case of monophony, all audio sources have the same spatial location. A listener can only properly understand the loudest audio signal. The same effect can be simulated by closing one ear.
- Stereophony allows listeners with bilateral hearing capabilities to hear lower intensity sounds. It is important to mention that the main advantage of bilateral hearing is not the spatial localization of audio sources, but the extraction of less intensive signals in a loud environment

- The concept of the audio window allows for application independent control of audio parameters, including spatial positioning.
- Most current multimedia applications using audio determine the spatial positioning themselves and do not allow the user to change it.

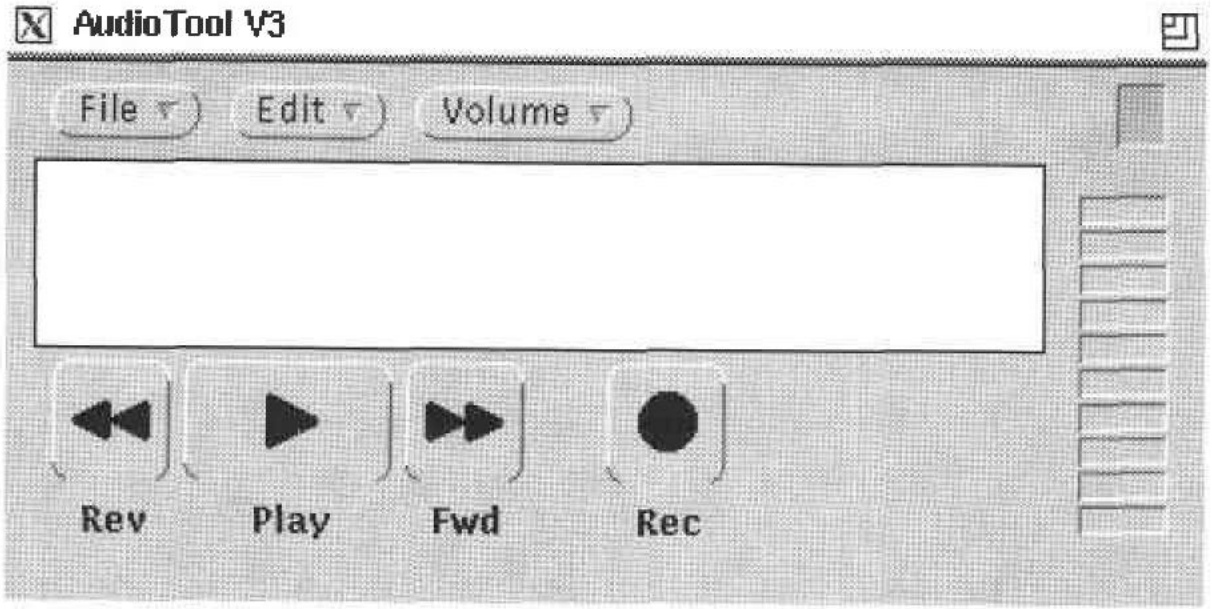

Figure 14.5: *Audio tool user interface.*

5. User-friendliness as the Primary Goal

- User-friendliness is the main property of a good user interface.
- Example:
  - Compare a multimedia-integrated telephone service with an ISDN telephone service. Today's telephones consist of a large number of touch keys, each sometimes representing three different functions. It is not an easy task to operate such a telephone.
  - Indeed, given sporadic user the user may forget many of these functions. However, with a multimedia-integrated telephone, some of the disadvantages of the ISDN telephone user interface can be eliminated through use of multimedia data, e.g., through display of some multimedia information on the screen. The goal is implementation of a user-friendly human-computer interface.

- We will restrict the discussion of user-friendliness to multimedia systems in the office or home. The reason is that different applications have different user-friendliness requirements.
- For example, in the case of a car phone, *speech recognition* is one important requirement of user-friendliness. By speaking a person's name, that person is called. Loud noise caused by a car, together with reflected sound waves, put higher requirements on this technique.

5.1 Easy to Learn Instructions

- Application instructions must be easy-to-learn.
- A multimedia application must support similar mechanisms which are known to the user from other applications.

5.2 Context-sensitive Help Functions

- A context-sensitive help function using hypermedia techniques is very helpful, i.e., according to the state of the application, different help-texts are displayed.
- For example, after selecting the call re-routing function, the help function provides a brief explanation of call re-routing

5.3 Easy to Remember Instructions

- A user-friendly interface must also have the property that the user easily remembers the application instruction rules.
- Easily remembered instructions might be supported by the intuitive association to what the user already knows. For example, the user knows the phone book (register).
- Hence, the user interface of a telephone service, implemented in a multimedia system, can show the participant a list on the screen.
- The user can simultaneously select and call another user through a double-click of the button.

5.4 Effective Instructions

- The user interface should enable effective use of the application. This means:
  - Logically connected functions should be presented together and similarly. For example, call re-routing and call forwarding functions
  - Graphical symbols or short video clips are more effective than textual input and output. They trigger faster recognition.
  - Different media should be able to be exchanged among different applications.
  - Actions should be activated quickly.
  - A configuration of a user interface should be usable by both professional and sporadic users.

5.5 Aesthetics

- *Is a set of principles concerned with the nature and appreciation of beauty*
- With respect to aesthetics, the color combination, character sets, resolution and form of the window need to be considered. They determine a user's first and lasting impressions.
- It is desirable to develop only one application for different users and languages. This is achieved by separating (either in the window system or application) the text, graphics and actual program.

5.6 Effective Implementation Support

- To achieve effective implementation of a user-friendly human-computer graphical interface, *the user's requirements must be considered.* This influences the cost of the implementation.
- An effective implementation of a user-friendly interface can be influenced by the following:
  - If the user's requirements are missing, *Rapid Prototyping* should be used. This means that the user-interface is developed, changed and tested without filling in the contents of the actual programs.
  - If window systems are used, the user interface *becomes hardware-independent* and the development effort is shorter. Also *maintenance-friendliness increases* if program generators are available, or uniformly accessible programming environments are used.

5.7 Entry Elements

- User interfaces use different ways to specify entries for the user
- *Entries in a menu* is current menus there are visible and non-visible entry elements. Entries which are relevant to the particular task are visible.
- *Entries on a graphical interface*
  - If the interface includes text, the entries can be marked through color and /or different font
  - If the interface includes images, the entries can be written over the image.
  - If the interface includes images, the functions can be activated through direct positioning of the cursor on the image object (user clicks on a certain object (street or room) and a new image, audio and/or text describes the object)

5.8 Meaningful Location of Functions

- Individual functions must be placed together in a meaningful fashion.
- This occurs through (1) alphabetic ordering or (2) logical grouping.
- For example, entries in the telephone book are sorted alphabetically, whereas the *call re-routing and call forwarding functions* are logically connected, similarly processed and displayed.

5.9 Presentation

- The presentation, i.e., the optical image at the user interface, can have the following variants:
  - Full text
  - Abbreviated text
  - Icons, i.e., graphics
  - Micons, i.e., motion vide

5.10 Dialogue Boxes

- Different dialogue boxes should have a similar construction.
- This requirement applies to the design of: (1) the buttons OK and Abort; (2) joined windows; and, (3) other applications in the same window system
- Semantically *similar entry functions can be located in one dialogue box instead of several dialogue boxes*.
- It is important to decide how many dialogue boxes should be opened at the same time, how the entry should be visible and how a new requirement can be expressed through an additional box.
- For example, the *Abort* button in a window should never be positioned in the same location as the save button of the underlying window.

5.11 Additional Design Criteria

- The form of the cursor can change to visualize the current state of the system. For example, a *rotating flsh* instead of a *static pointer* shows that a task is in *progress*.
- If *time intensive* tasks are performed, the progress of the task should be presented, such as formatting a disk
- A selected entry should be immediately highlighted as *work in progress* before performance actually starts. This approach ensures that no further input is given to the entry.

5.12 Design-specific Criteria

- In addition to the above described general criteria for the design of a user interface, the problem specific properties of the actual task need to be considered.
- These properties are demonstrated in our telephone service example.
- The telephone network and telephone-specific end-devices are provided by the telephone companies. They specify the user interface characteristics:
  - The end-device must have the basic function of dialing a number– *requires compatibility among different phone devices*
  - ongoing tasks should be signaled—to represent call forwarding a telephone icon can be used if no window is opened, but the application is still active.

- A telephone device must always be operational. This requirement influences the corresponding hardware and software.
- The state of the telephone-device (i.e., telephone application) must be always visible. The nonselective functions can be: nonexistent, displayed but non selective, overlapped--designed as the confirmer
- When a call request arrives, it must be immediately signaled ("e.g., ringing).

- *Design of a user interface is also influenced by a specific implementation environment.*

- For further reading visit: http://ce.sharif.ir/courses/84-85/2/ce342/resources/root/BOOK/Multimedia/215814-%20Chapter%203.pdf