ABSTRACT

This paper describes a multi modal/multi media communication interface (CIF). The CIF is a basic management system for multi media/multi modal user interfaces. The CIF will support a user friendly man machine dialogue. This concept of interface design will open advanced man machine communication to a wide group of users. A classification of user interfaces is given on the basis of communication theory. The design of the CIF is based on the demands of the architecture and functionality of advanced user interfaces.

1) OBJECTIVES AND BASIC CONCEPTS

The use of computers moves from controlling the machine by giving commands and receiving messages to the communication with the computer to solve problems.

The spoken language is the most frequently used communication medium. The power of human communication relies on the integration of the communication media (spoken language, written language, pointing, gesture and facial expression). According to the intentions of the communication partners and the communication environment various combinations of media are used. Gesture and facial expression are excluded from this study. The focus will be on written language, spoken language and pointing. Pointing includes the reference to icons, graphics and other objects (entities).

The notion ‘medium’ denotes means (forms) of communication, which may be used by participants of a communication process and are the minimum of a set of means of communication for a specific communication process which is determined by the intentions of the communication partners and the communication environment. These minimal sets of means of communication (medium) form another set of media (a set of sets) which includes all means of communication structured by the way means of communication are used. If we relate to minimal and disjunctive media (sets of means of communication) the combination of these elementary media for human communication processes describes human communication as a multi media phenomenon.

Semantics, syntax and pragmatics are the basic dimensions of sign systems at various levels. As means of communication consist of sign systems the complexity of a communication medium is described by the complexity (degree) of each sign dimension at a certain level and the complexity of the levels of these dimensions. The complexity of each sign dimension is described as the modus of the means of communication (or the modus of the medium/the modus of communication). Obviously human communication is multi modal (/1/, /2/, /3/).

Written language is an example for a medium. The modus of this medium differs according to the complexity of the syntax, semantics and pragmatics of written language. A letter is an example for a complex modus. A telegram is an example for a restricted modus of this communication medium. In a communication process where a written document lies on a table and several persons discuss that paper by speaking about the document, pointing to specific paragraphs in the document and making written notes on the discussed document there is a multi media and multi modal communication taking place.

The technical basis for a broad use of the advanced user interface which integrates spoken language, written languages and pointing is a detailed software architecture. The communication interface (CIF) provides a coordination structure which supports the use of user specific man machine interfaces which perform on the basis of the CIF a multi media/multi modal man machine communication.
2) STANDARD USER INTERFACES

Standard user interfaces (SUI) use only one medium. The modus of this type of interface is usually restricted. Written language is the most frequently used medium. Spoken language (e.g. integrated telephone/computer applications) and pointing (e.g. computer games) are not that frequently used. The focus in this chapter will be on written language as an example for the other media.

The actual design of the user interface on the hardware level consists of the input device keyboard. Screen and printer are the output devices at the hardware level. The modus of the means of communications for the SUI media are restricted to basic commands and messages in the frame of the operating system or the application program. The written language is used as the input and output medium.

The SUI does not provide a sophisticated dialogue for the user. Error handling in this type of user interface is done by displaying messages which do not allow a user oriented dialogue.

3) EXTENSION OF STANDARD USER INTERFACES

Extensions of standard user interfaces (E-SUI) use two or more media parallel or complementary. The modus for a single medium may be complex or restricted. There is no substantial change in the architecture of the user interface between the SUI and the E-SUI except the number of parallel or complementary used media.

Extensions of the standard user interface use pointing and/or voice input/output as additional man/machine communication media. The integration of these media into the standard user interface is realized by the emulation of the voice input via the keyboard interface. The voice output on the HW level is done by specific devices. Pointing is integrated by standard interfaces (software/hardware) for several pointing devices (mouse, lightpen).

Standard operating systems are based in their design on paradigms stemming from information science. They are not based on concepts stemming from psychology or communication theory of human beings which is essentially different from a mathematical theory of communication. The extension of SUI within application programs has the disadvantage of implementing the communication procedures for each application program again and again.

4) ADVANCED USER INTERFACE

The advanced user interface (AUI) has properties differing from the structure of the standard user interface and the extensions of the standard user interface in the following way:

increase in the number of media for man/machine communication,

integration of parallel processing of different media,

natural language generation and understanding,

improvement in the quality of specific media (i.e. improvement of speech input/output),

ergonomic design of test based dialogue structures,

dialogue processing components (i.e. dialogue memory, dialogue handler, communicator model),

user friendly toolkit for the AUI for the end user/designer.

The AUI allows a way of man machine interaction which is very similar to human communication. The sophisticated components of an AUI like speech processing, natural language handling and a dialogue handler will improve the performance of user interfaces. The user is not anymore restricted to specific syntax, semantics and pragmatics which are determined by principles of formal logic.

5) USER INTERFACE MANAGEMENT SYSTEM

User interface management systems (UIMS) support the task of the AUI. The structure of the components of the AUI are becoming more complex. User interface management systems provide tools to modify and adopt user interfaces (advanced, extensions of standard user interfaces) to the needs of the user. The efficient installation of user interfaces and their link to application programs is done with the help of the user interface management systems.

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Existing user interface management systems like X-Toolkit, AIDA or SMALLTALK-MVC only support icon and graphic oriented user interfaces. The integrated and parallel processing of communication media like voice input/output and pointing are not handled by these management systems. They are designed to relate one or two specific communication media to application programs (like icons and written commands e.g. to a database).

In /4/ an approach is described for the efficient handling of various communication media which is (like a lot of other approaches) influenced by the object oriented programming paradigm. Considerations based on communication theory are not relevant in this article.

In /5/ there is the focus on the integration of pointing (including icons and graphics) into an E-SUI. The multi media aspect is not the central aspect in his contribution. Speech (as the majority of articles on user interfaces) is not discussed.

In /6/ is demonstrated that the implementation of UIMS based on modular design principles (like the CIF) drastically reduces the efforts for porting a UIMS to another machine.

6) THE MULTI MEDIA/MULTI MODAL COMMUNICATION INTERFACE

The communication interface (CIF) will integrate the parallel processing of different media of man machine communication:

input / output:
written language:
basic commands / natural language
pointing:
icons / graphics
spoken language:
basic commands / natural speech.

The parallel use of these communication procedures up to now is not integrated by any operating system or application program. The communication interface does not interpret or generate the content of the different media. The CIF organizes the multitasking processing of the different input and output media respective to existing applications. The CIF consists of the following components:

the media oriented communication handler,
the user oriented communication handler,
the coordination of the CIF layers and
the application program communication handler.

The media oriented communication handler stores the commands coming from the user interface components (input) which will control the application program and integrates them according to the user interface settings and the command structure of the application program. The messages coming from the application program which inform the user about the current status of the application program are stored in the media oriented communication handler and routed to the output devices.

The user oriented communication handler integrates the different media a user refers to when he is working with an application program. This communication handler manages in multi user systems the relation between the various users, the input/output media and the application program. The user oriented communication handler is the direct link to the user interface management systems for each communication medium and the according modus and integrates the user profile protocols into the communication interface.

The application program communication handler stores the messages which are coming from the application programs and the commands going to those application programs. This communication handler schedules the commands and messages according to the individual user interface style and the structure of the application programs.

The coordination of the CIF layers integrates the three modules described above and assures a real time processing of the interactive communication management system. This component works as controlling system for the multitasking activities of the communication interface.

The addition of communication functions in the way described above to existing application programs seems to be no solution as the conditions to fulfill
these concepts are not given by the existing operating systems. To add the communication functions to each application program in a separate way is an enormous amount of work which will not pay off.

The operating system, user interfaces and application programs that will be used together with the CIF will have certain interfaces and components which will connect the CIF with the operating system, user interfaces and application programs. These components process the activity and status of the media, the user and the application programs. These interface modules have to be added to existing application programs and existing user interfaces and user interface management systems. The definition of these interfaces is essential for the use of the AUI (and the CIF). Diagram 1 illustrates the integration of the CIF and the AUI.

7) THE COMMUNICATION INTERFACE TOOLKIT

The communication interface toolkit (CIF-TK) consists of certain components for the design and the integration of the CIF for different user interfaces, user interface management systems, application programs and operating systems. Without this support the advantage of the development of the CIF in the field of SW engineering would be lost.

Some of the results presented in this article are part of the ESPRIT I project number 64 'Speech Interface at Office Workstation' (SPIN).

8) ABBREVIATIONS:

CIF/AM: Communication Interface - Application Program Module
CIF/UM: Communication Interface - User Interface Module
CIF/MM: Communication Interface - User Interface Management

9) REFERENCES:


