

A Multimedia Man-Machine Interface for the Disabled and Elderly

P. Angelidis, G. Anogianakis, S. Maglavera
BIOTRAST S.A., Thessaloniki, Greece

Keywords: man-machine interfaces, domotics, assistive technology.

Abstract. The multimedia user interface we present, allows users to access a fully automated robot which enables severely disabled or bed-ridden users to play a more effective and active role in everyday domestic activities. It is part of a fully automated robot called MOVAID. The primary role the multimedia man-machine interface fulfills is to provide a) the user with an easy and friendly access to the system and b) the system with a tool for communication with the user. The interface has been released on December 1996 and since then it is tested by people experiencing various types and levels of disability mainly in Italy and Greece. The initial feedback is positive and constructive remarks have been received and they will be taken into account as soon the testing procedure will be completed by the end of April 1997.

1. Introduction

In geographic Europe alone, where the overall population is around 800 Million, there are currently about 100 million elderly people and 50 million people with a disability (this figure includes disabled people who are also elderly). The figures for the European Union are currently about 77 million elderly people and 43 million people with a disability [1].

There is a growing movement in the EU to improve the rights of disabled people. The problems of providing assistance are high and they are exacerbated by the difficulty of finding professional staff to assist the disabled and elderly and by the high cost of such assistance. Specialised products can enable individual users to perform everyday tasks more easily and less expensively [2],[3].

More and more companies are becoming willing to support these moves - both as an employer and service provider. Disabled organizations have been keen to point out specialist products and services that are of key importance to disabled people. One of the areas of high interest and wide research activity is *Domotics*, i.e. the design of assistance machines that replace humans in performing household activities [4].

The interface we are presenting in this work is part of a fully automated robot which enables severely disabled or bed-ridden users to play a more effective and active role in everyday domestic activities. The project was financed by the EU within the DGXIII TIDE programme under the name MOVAID (MObility and actiVity AssIstance system for the Disabled) [5].

2. Description

2.1 General principles

The Multimedia Man-Machine Interface (MMMI) of MOVAID is the gateway to the system. It enables able-bodied users or disabled with limited hand functionalities (enough to operate a mouse) to access the available functions in order to perform certain tasks.

The MMMI provides:

- a tool to pass instructions to the system
- an overview of system status, system responses and messages, particularly when some user reaction is required.

The main design disciplines of the MMMI are:

- ergonomically correct interface, as easy as possible to learn and use
- minimal number of steps to complete each process and task
- easily accessible interface components
- interface components accessible to the user are selected according to the user's expertise
- the system should not intimidate the user
- task execution follows the KISS (Keep It Simple and Stupid) principle, whereas interface design is distinctively intelligent.

2.2 Functional Description

The MMMI interacts in the front level directly with the user. It aims to serve the user manipulate the system, give orders and directions, watch the requested action as it evolves and in some cases configure the system.

In the back level the MMMI provides tools (in form of functions) to pass instructions to the rest of the software modules and especially the supervisory module (SM), to accept feedback from the rest of the modules particularly when some user reaction is required and an overview of system status, system responses and messages.

The primary role the MMMI fulfills is to provide the user with an easy and friendly access to the system and the system with a tool for communication with the user.

The task of the MMMI is basically twofold:

1. to receive user's requests;
2. to 'translate' the user's request into a list of Elementary Actions and sent them to the supervisory module.

Two different sub-modules, corresponding to the above mentioned tasks, could be identified within the MMMI: the 'Graphical Interface' in the front level and the 'Interpreter' in the back level.

The Graphical Interface guarantees that the user can only ask for allowed actions. For example, if the first part of action requested by the user is "GO TO THE BATHROOM", the second part cannot be "OPEN THE MICROWAVE OVEN".

The sub-module directly communicating with the supervisory module is the Interpreter. It interprets the correspondence between the user's input and a proper list of Elementary Actions, by accessing both its own local data-base and the system data-base.

In some cases, this correspondence can be dependent on the objects and/or actions involved. For example, if the user asks "OPEN" combined with "MICROWAVE

OVEN", the list of actions generated by the Interpreter must be different from the one generated in case of "OPEN" "REFRIGERATOR". So, the MMMI accesses to the System Data-Base, whenever appropriate indications, associated to the objects or the movements of the system, are required.

The following picture shows the functional scheme of the modules interacting with the MMMI. The arrows highlight the interfaces between the modules and the MMMI.

Functionally, the MMMI is organised in four levels. Each level allows different ways of manipulation; the higher the level, the more advanced the user requirements, the complication of the instruction and the higher the freedom degree. The style and effort of interaction from the user point of view is different according to her/his skills and experience with the use of the MOVAID system. In fact, the following different levels of use have been defined (at any level the user is allowed to access to all the functions available at the lower levels, plus some functions typical of the current level of use):

- Beginner: training procedures, self-explanatory commands, only pre-defined macros, indication of objects on the screen;
- Standard: simplified on-line help, pre-defined macros, indication of objects on the screen, optional involvement in error management;
- Advanced: no on-line help, pre-defined macros, indication of objects on the screen, involvement in error management;
- Expert: no on-line help, pre-defined macros, indication of objects on the screen, involvement in error management;

Each level is designed to provide functions to fulfill the manipulation level described in the design concepts of the MOVAID system [6].

Another task of the multimedia MMI is to monitor the status of the mobile unit. It is able of displaying the position of the mobile unit, messages from the Supervisory module, pictures from the cameras, and other information that presents to the user the status of the mobile unit and help for its navigation in the house environment.

The multimedia MMI is also able of recording sequences of low level functions into "macros" for faster execution of tasks by the user. Macros will be used for making frequent tasks more easy, after the user has learned the system better. In this way, the user will be able to "customise" the system. Additionally, functions and pre-programmed sequences can be provided for use by a third helper.

The MMMI is designed to provide on-line guidance and help to the user through a series of multimedia objects including sound, graphics and text.

2.3 Technical specifications

MMMI's main purpose is to display the commands and actions available to the user in a user-friendly form, accept the user's response, and then pass the commands to the Global Supervisor module where the commands will be interpreted and processed.

The multimedia MMI supplies support for all low level functions of the mobile unit. The user is able of moving the mobile unit forwards or backwards, turn the mobile base clockwise or counter-clockwise, handle the arm movement and the cameras. Support for low level function is important for the adaptability of the system even though it makes handling more difficult. It also makes the system more interesting for the user to explore and find out more things that can be done with it. Low level function support is also important for critical situations, that the system cannot handle, and returns some sort of error message to the user. These are moments where the user must handle the mobile unit manually to get it out of its critical situation.

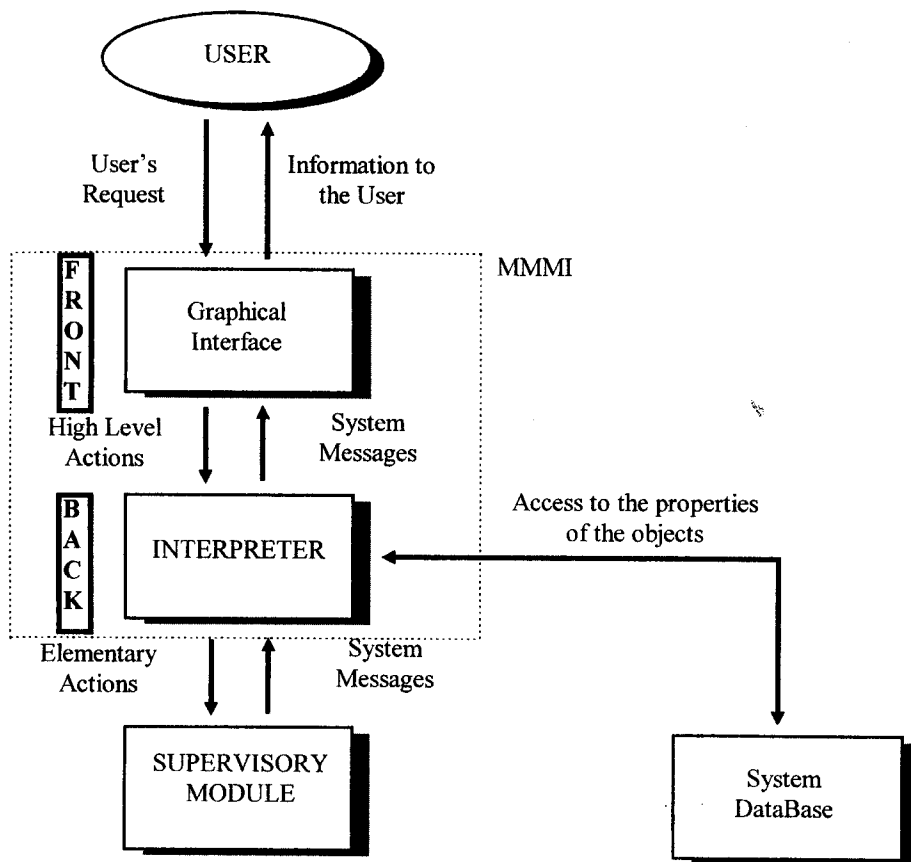


Figure 1. The functional scheme of the modules interacting with the MMMI

The multimedia MMI has a two-way communication with the user to accomplish. First the input to the module must be provided at the lower level through the mouse. This way certain multimedia devices can be added to the system that makes access to it more human friendly. Those devices emulate mostly the mouse. Devices like that, that emulate the mouse are touch screens, joysticks, digitizer boards, head controlled devices, sound recognition equipment.

From the above it is clear that command input to the multimedia MMI had to be made as much as possible with straight commands, and not with invocation through many level menus or even typing of commands. The user has a list of actions and a list of items that must associate them with the help of the mouse (and this way with every device that emulates it). For example touching the word GO and the item KITCHEN, makes the mobile unit to start the process of moving to the kitchen.

All the commands of the system are represented with actions and items as described above, and this is the backbone on which every other way of interaction will be based on. Video and sound makes the user interface even more friendly. Besides video windows that display the "vision" of the mobile unit, video can be used for on-line help, showing

the user how to handle a certain device. All the messages from the system to the user can be made with sound. Also certain cartoon-like figures can be used for giving the user advices about certain matters. All the interaction between the MMMI and the user is displayed in figure 2.

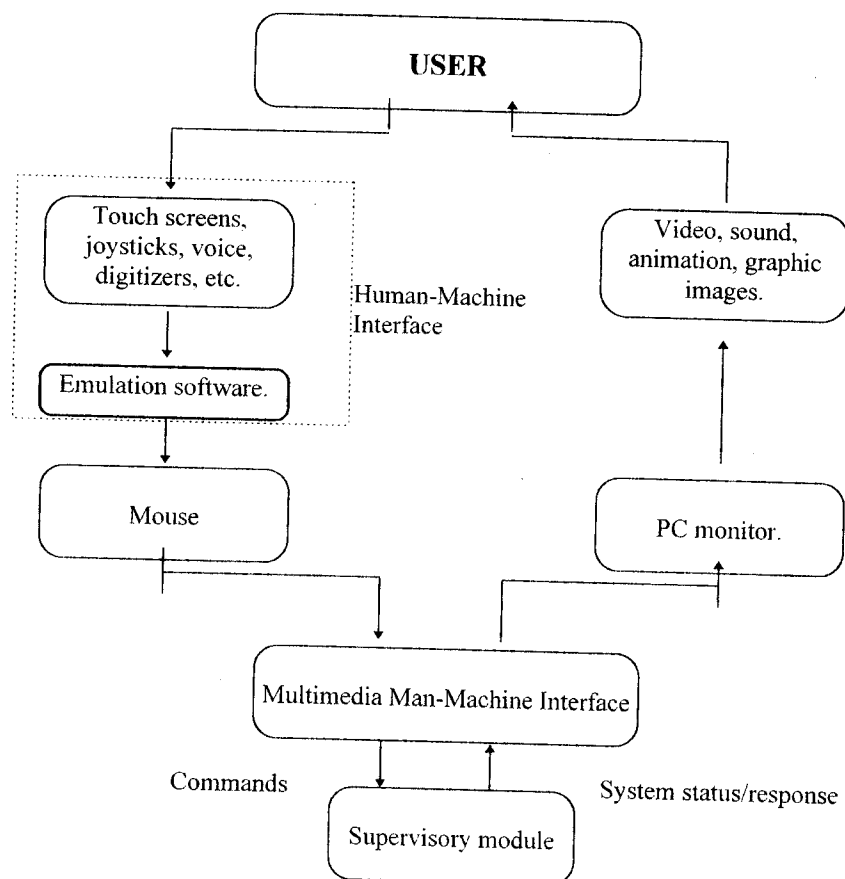


Figure 2. Interaction between the MMMI and the user

References

- [1] EUROSTAT, (1992). Rapid Reports, Population and Social Conditions: Disabled People - Statistics. Commission of the European Communities, Luxembourg
- [2] S. Hasino *Aiding Robots*, *Advanced Robotics*, vol. 7, no. 1, 1991, pp. 97-103
- [3] *WS3 Robots for Disabled and Elderly People*, International Conference on Robotics and Automation, May 27, 1995, Nagoya, Aichi, Japan.
- [4] P. Dario, E. Guglielmeli, B. Allotta and M.C. Carozza, *Robotics for Medical Applications*, *IEEE Robotics & Automation Magazine*, vol. 3, no. 3, Sep. 1996, pp. 44-56
- [5] P. Dario, Project Coordinator TIDE Project #1270 *Mobility and Activity systems for the Disabled*, Feb. 1994
- [6] C. Laschi, E. Guglielmeli, L. Leontaridis, P. Dario, TIDE Project #1270 Deliverable 5.1/6.1 *Design Specifications of the Workstations*, Apr. 1995