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ADAPTATION OF WORK PLACES AND HOMES FOR THE DISABLED USING COMPUTER-AIDED DESIGN

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ABSTRACT

When adapting environments for the physically disabled, it is important to encourage and activate not only the person concerned, but also other people involved or affected. A computer aided planning tool has been developed to support the participation of *all* persons involved, as well as supporting the planner's (e.g. an occupational therapist) design of the environment. The prototype development and evaluation were based on 6 case-studies, which also provided experience of the needs and requirements in real-life planning situations. The tool was found useful in the planning process, and it was mainly positively evaluated by the persons involved. It seemed to enhance understanding and participation, support an iterative planning process, and aid the design in e.g. checking the accessibility, clearance and reach, concerning an individual's size and abilities. However, effectiveness was in most cases not satisfactory, since modelling is still relatively time-consuming.

INTRODUCTION

A well-adapted environment, both in the home and the working place, is the basis for an independent life for a disabled person. It is important that a thorough analysis of the future user's needs and abilities is performed during the planning phase. A basic assumption in this project was that an improvement in the quality of the planning process will also improve the quality of the final solution. In this type of adaptation many persons are involved and/or affected. Beside the disabled person himself, there can be relatives, colleagues, service personal, as well as various experts such as occupational therapists, physiotherapists and construction engineers. It is essential to create a common language to be able to utilise the knowledge and experience of the persons involved.

To support the understanding of the different solutions suggested and to stimulate active participation of all the persons affected by the solution, we have employed computer-aided planning (CAP).

METHOD

To develop and test the planning tool we have used a case-study approach, observing realistic planning situations at rehabilitation centres. So far, the planning of the working places or the homes of six persons has been documented and evaluated. In the two first cases, we studied how two young men could gain access to their respective work places,. The two following case studies treated the adaptation of a computer work place and a

reception desk at a medical centre. Finally, the two last studies were carried out in domestic environments. Special effort was put into the adaptation of the bathrooms (see figure 1).

The experience and knowledge gained from each case study was used to continuously improve the prototype of planning tool. The improvements include modelling the human models out of anthropometric data, establishing libraries of objects and human postures and motions, facilitating biomechanical calculations directly on the three-dimensional man model, and registering human movements (MacReflex and DataGlove systems).

THE CAP TOOL

In Sweden, the person responsible for the planning of new environments for the physically disabled is often an occupational therapist. These therapists, who have previously only used computers to a minor extent, will be our primary user of the planning tool. Also others involved in the planning process, especially the disabled person himself, should independently be able to use some functions of the tool to create his own solutions.

Considering the prospective users we have emphasised user-friendliness when developing our planning tool. The following requirement were initially stated for the planning tool:

simplicity in learning and using.

- moderate expenditure in purchasing and maintaining.
- useful in aiding the design of the future environment, in supporting the communication and understanding and in encouraging active participation of all persons involved.
- effectivity considering both quality and the effort/time spent.

The prototype of the planning tool was based on commercially available hardware and software products. After selecting appropriate software, the work then emphasised the development of methods of using the programs in this field of application and complementing these with special programs to support the planner.

The present prototype is based on Macintosh computers (Apple Inc.) and mainly the commercial programs Swivel 3D Professionals, MacroModel, Modelshop II, MacroMind Three-D and MacroMind Director (MacroMedia Inc.). The planning tool and its usage are described in great detail in Johansson et al, 1992 and Eriksson et al, 1994. Figure 2 shows schematically the use of the different programs.

RESULTS AND CONCLUSIONS

The case studies have shown that a computer-aided tool is useful when planning environments for the physically disabled and it has been positively evaluated by the persons involved. The three-dimensional visualisation improves understanding and supports an iterative planning process with active participants. It is also very useful in checking the accessibility of the environment and the person's ability to reach different objects directly in the computer model.

The persons involved in the case studies were of the opinion that the quality of the final solution will be improved when using computer aided design. The criteria of effectiveness was, however, in most cases not fulfilled, as the modelling of complex objects is very time-consuming. To be time-effective the number of objects in the library must be increased to reduce the time spent on modelling a suggested solution. This may limit the use of the planning tool to common and well-structured environments where comprehensive libraries could be achieved. Our future work will therefore concentrate on

- · homes for disabled persons.
- service homes for disabled and housing for elderly people.
- special work environments such as the computer working place and the working place close to the person, e.g. the work table.

FUTURE RESEARCH

At present we are planning two new research projects based on experience gained hitherto. In the first project the work is directed towards adaptation of homes. The occupational therapists at a rehabilitation centre will independently test the CAP-tool. Besides improving user-friendliness and effectiveness of the tool, we expect to find out more about where the CAP-tool is most useful/efficient, the optimal design of the planning process, and the effect on the rehabilitation of the disabled person.

In the second project, we are planning to continue our work on adaptations in working places by using a CAP-tool. We will concentrate on persons who use their hands/arm when working but have considerable difficulties due to his/her disability. Furthermore the aim will be to match the analysis of the person's ability by i.e. movement analysis with the precise analysis of the work. The overall goal with this project is to design a working place for a disabled person that will reduce and hopefully eliminate the musculo-skeletal disorders caused by the work in question.

ACKNOWLEDGEMENT

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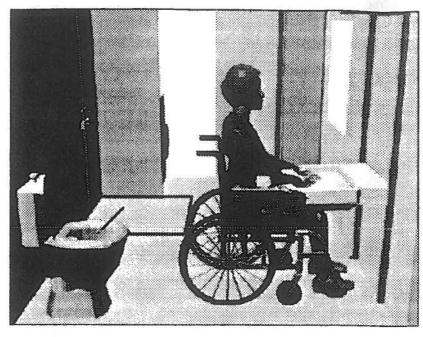


Figure 1. A suggestion of a bathroom adaptation (from case study no. 6).

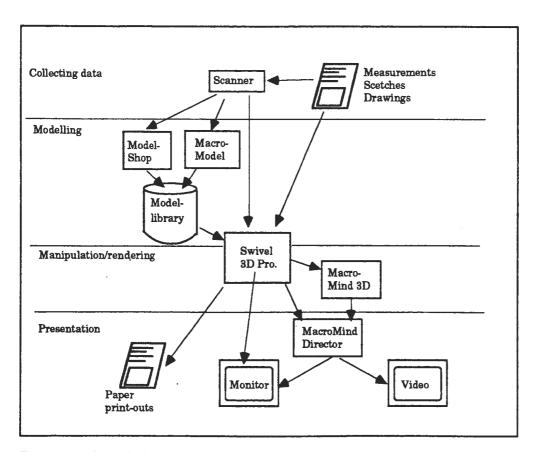


Figure 2. A schematic description of the use of the different programs.

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