

# Multimedia Games for Visually Impaired Children

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**Abstract.** The TiM project intends to develop and to adapt computer games for visually impaired children. To describe the user's needs is the first step of this project. This analysis will allow us to define two important points: the soft architecture & the authoring tools and the computer Human Interface for children and the resources (audio, tactile,...). This paper presents TiM's approach concerning to human dimension and the advance concerning adapted games.

## 1 Introduction

### 1.1 Objectives of the TiM Project

The overall aim of the TiM project is to offer to young visually impaired children of various levels of psychomotor development the possibility to play computer games in an autonomous way.

Currently, blind and severely visually impaired children cannot access multimedia games existing on the market independently because they cannot use the mouse and these games are based on a graphical interface. Moreover, the systems of adaptation such as enlarging software or screen readers are incompatible with these games [1].

TiM aims to develop adapting tools which allows to design computer games using different kinds of special devices (tactile, audio, adjustable screen displays) from existing contents.

The TiM project is founded by the European commission (IST programme). It involves researchers from various disciplines from human sciences (ergonomic specialists who study the usability, therapists specialised in handicapped people or visually impaired children, educators, teachers, psychologists specialised in toys) to technical fields (computer science), from 3 European countries: France, Sweden and United Kingdom.

## 1.2 Adapting Tools

These software adapting tools are composed by a game platform and authoring tools for creation and adaptation of computer games. The game platform will facilitate the use of sound and different specific devices. This platform manages automatically the use of the different devices (standard devices as well as specific ones) connected to the system according to an user profile and according to generic game scenarios (which are independent from devices).

## 1.3 Designing Steps

This project will follow four iterative steps (Fig 1):

*Step 1:* Description of technical and user's needs

*Step 2:* Development of

- the software environment (adapting tools)
- adapted games

*Step 3:* Evaluation of the adapted games so as to improve the adapting tools

*Step 4:* Dissemination of

- adapting software
- designing Guidelines
- adapted games

This paper describes the first step and the approach to adapting games from users oriented perspective.

The development carried out by TiM highlights the importance of taking into account the human dimension in order to better understand the needs and the final expectations of the user (children with visual impairment and future designers of games). Indeed, the adapting tools must use interfaces adjusted with the physical characteristics of the children and their competence (cognitive).

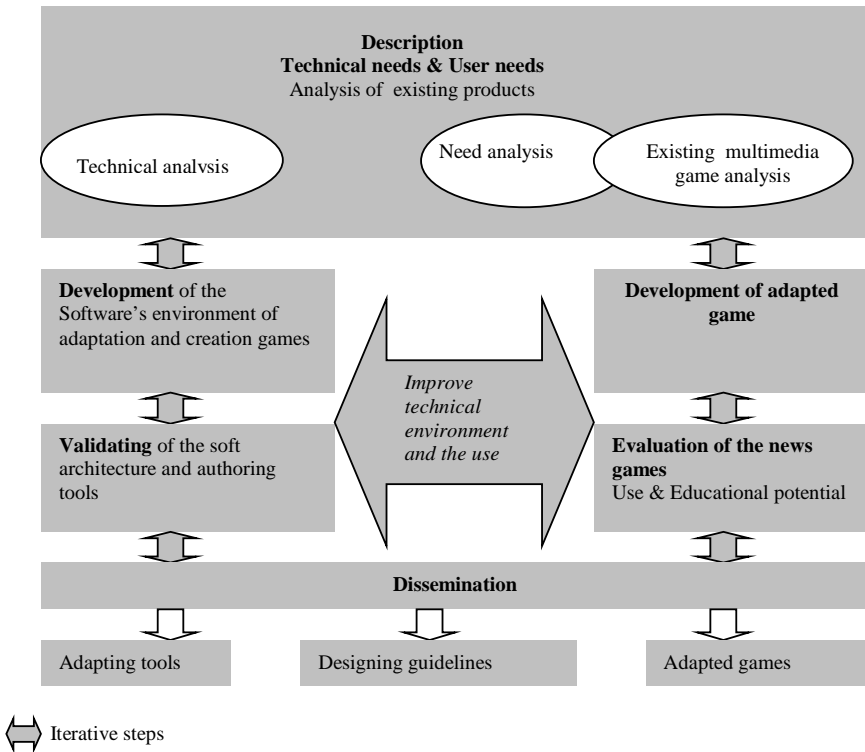
## 2 User's Needs

The study of users needs have been based on quantitative questionnaires and interviews that have been carried out in the 3 countries of the partners involved in the project. In parallel an ergonomic analysis about adapted games prototype has been carried out in France.

### 2.1 Quantitative Analysis

Two different questionnaires were send to parents and teachers in France, Sweden and United Kingdom. The main purpose of the questionnaires was to collect information about access to computers in the educational environment as well as at home and how frequently/in what situations the equipment is used. Of special interest for the project is the availability of different types of helping devices for input and output and what

kind of difficulties the young users have met. Finally 78 questionnaires were returned from parents.



**Fig. 1.** TiM's methodology

66% of questioned children have access to a computer and 70% use it regularly (week and week end). This type of use is influenced by the child's age. (the older the children are the more they use computers, the youngest they are the more they use it for work school).

One third of the questioned children use computer in an independent way. The age and the degree of visual impairment are important, as expected. Target users are equally less able to use a computer independently than children with a visual acuity better than 0,01. But still there is a for great need help among all children regardless of the degree of visual impairment. The same results have been observed concerning the use of computer games. The existing games do not seem adapted and target user met more difficulties than the other children.

This quantitative analysis does not enable us to define the difficulties actual met by the children during the use of computer games and thus the characteristics of the needs. Therefore, we completed this quantitative analysis by semi-directive interviews, realized in France and Sweden, with a qualitative questionnaire.

## 2.2 Interviews

From the analysis of the interviews two separate groups of children with different needs have been stressed.

A first group of children is composed of the partially sighted children (acuity better than 0,05), autonomous in the use of video games. They can play with the games on the market using the standard interfaces. Most of the time, the difficulties they meet are due to inappropriate contrast or colours, so that they cannot see the obstacles they have to get across. They prefer to play with a joystick or a "joypad" because the buttons are easy to use.

The second group of children, composed of children with severe visual impairment (from blind to acuity lower than 0,05), cannot access to computer games in a autonomous way. To play, these children need the help of a sighted person because they cannot access to graphical interfaces. In such conditions, many of them do not access all the game. Their direct input on the game are only occasional ones. The children strongly express the wish to have the possibility to play alone, or with others, and to choose by themselves.

These interviews show the importance of researching the means with which the children could be able **to interact to the whole game in an autonomous way.**

Several game scenarios have been described by children and they would like adapted action games, where the main character is living an adventure with obstacles and plots. In this game, the child will be able to access his performances, for instance thanks to a score or a reward.

## 2.3 Ergonomic Analysis

The observation of children using adapted games allowed to identify **interactional behaviour** and **utilisation difficulties**. Specific recommendations arise from this information about the adapted games which allow to work out "**usage functions**" intended to improve the design of adapted computer games for visually impaired children. The integration of these functions in the conception of adapted games, **has to allow the child to navigate and to find easily a way in computer games**. These functions result from the analysis of observations and bibliographical analysis [2, 3]: Scapin [2] cites the ergonomic principles to respect for the design of an ergonomic interface.

The objective of these first observations is to evaluate the adaptation of two games: "A l'abordage, Pit!" and "Petit Ours Brun".<sup>1</sup> These games have been adapted in an user-friendly way using a tactile interface and modifying the sound interface.

Observations have been made in schools or specialized institutes. The children were between 6 and 20 years old. They were blind or partially-sighted people.

Recommendations for game adaptation have been extracted from this analysis, related to the navigation and the location (by the sound modality) in the Game, and to the layout of information on tactile board .

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<sup>1</sup> These games have been adapted from existing French mainstream multimedia games from Bayard Jeune with their free acknowledgement.

## 2.4 Target Users

From these studies, a specific user group have been decided, addressing children from 3 to 10 years old, blind or having severe visual impairment (acuity below 0,05), with or without additional impairment (from slight to moderate). For these children the information presented on the computer screen in an ordinary way is not accessible and therefore it must be presented in an alternative way.

The specific needs related to the visual handicap when playing must be defined. We should not forget that the visually impaired child is a child. "The adult designer cannot characterize precisely a toy user, he must observe the children's behaviour with the toy to validate his choices" [2]. The author refers to some specialists of child psychology, like Piaget who has thought its research on the universal laws of development, shows that the child goes through by various stages during which he has develops a specific logic and a particular way to see the world around him.

Thus the game's designers must know these various stages to understand the way of reasoning of the users for whom will be make the product. The children's needs, related to level of visual handicap and psychological development, must be taken into account all along these designing process.

## 3 Existing Multimedia Games Analysis

A multimedia game is composed by an environment and a scenario.

### 3.1 Game Environment

A game environment is made up by a background and characters who follow the child all along the game. This environment depend on the age of the children.

For children from 3 to 6, game environments are inspired from comics, cartoons, fairy tales, animals and nature. The topic is discovery and the child is guided by an imaginary character. For children from 7 to 10, game environments are inspired from films, cartoons, science fiction. In some games, the objective is related to thought (looking for information, solving enigmas.). The other games allow the child to let off stream.

### 3.2 Game Scenario

A multimedia game scenario describes, in a operational way, various interactive game scenes.

Let us consider for instance an environment and scenes from "*Lapin Malin, Maternelle I*".<sup>2</sup> The environment is a magic environment (Fig. 2) with an imaginary character: a mouse. The interactive scenes are symbolised around the main character

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<sup>2</sup> designed by TLC Edusoft.

(elephant, train, flower,...). The child has to click one of the scenes symbols to enter into the corresponding scene (Fig. 3).



Fig. 2. Magic Environment

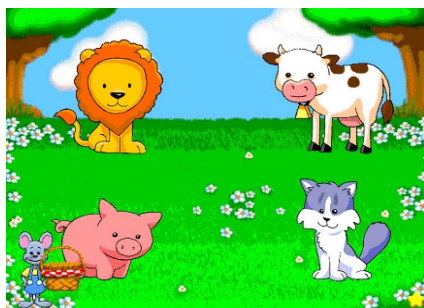


Fig. 3. Scene

In order for the child to have access to the whole of game, the child must be able to:

- navigate and be find his easily in the game’s environment (interface’s game is allowed to get to scenes)
- and the scenes (to achieve the goals of each one of them).

In section 4, we will describe an adaptation of a game on title “A l’abordage, Pit” using a tactile interface.

### 3.3 Elementary Scenes

By thus breaking up a game, scenes can be isolate in order to adapt them separately. We observed that some elementary situations occurs in many games: the interaction is the same and the various resources involved make different games. It can be for instance the navigation in a maze, a set of questions, a memory game.

The TiM’s approach is to provide generic adaptation schemes, or “templates”, for these “elementary scenes”, that allows access to various specific devices as well as standard devices. Then the adaptation of a given game situation that fit an elementary scene is very easy: the multimedia resources corresponding to this game situations are inserted in the template. Such game will automatically work with any device that was planned in the adaptation scheme.

In section 4, an elementary scene using only sound interface (Bird) will be introduced.

## 4 Adapted Games

### 4.1 Game Using Tactile and Sound Interface

We developed an adaptation on mainstream game “A l’abordage, Pit!” (“Let’s Go On Board Pit”) intended to children 6/7 years old. It is an interactive story. Children can read and watch the story by following the words lighting up on the screen. The

original software interface is based on the “book” principle (Fig. 4): the player can navigate in the pages of the book. On each page the child can go to the next page, can try to answer to a question and can access a game.



Fig. 4. Story (environment scene)

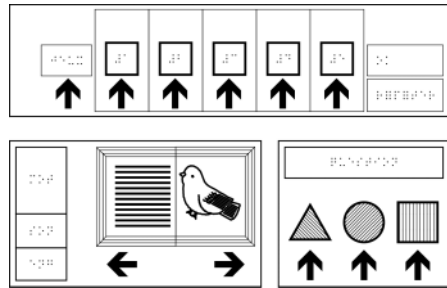


Fig. 5. Tactile sheet

This game was also adapted using the Concept Keyboard. A tactile sheet (Fig. 5) was designed, to give access to the game: the child navigates and plays thanks that tactile sheet. Three large rectangles correspond to the 3 parts of the CD-Rom:

**Bottom left rectangle:** this part allows to navigate in the pages, to listen to the text of the pages and to the audio illustration of the page (by pressing on the book’s pages).

**Bottom right rectangle:** this rectangle allows to answer questions.

**Top rectangle:** the button “games” gives access to 5 different games which are played using the same tactile interface. By pressing several times the button “games”, the titles of the games are given successively. Then a game is selected by pressing the arrow after its title has been given. For example: “*Afrique*” (“Africa”)



Fig. 6. Africa

In the original game, 8 animals are displayed on the screen (Fig. 6) and the player has to select the animals which lives in Africa. In the adaptation 5 animals are attached to the 5 buttons (Fig. 5) and their name is said if the player presses these buttons. The player has to press the arrows corresponding to the animals that live in Africa.

#### 4.2 Elementary Scene Using Surround Sound Interface: “Bird”

The player interacts with a joystick or the four arrows on the keyboard in a surround environment. He/she have to catch a bird which is localised in the surround environment by a sound. The sound intensity increases or decreases as the child gets nearer or further. As the child moves he/she will ear the bird in front, behind, or on

the left or right side. This generic scene is the basis for more complex games using surround environments.

## 5 Conclusion

The study of the elementary scenes is intended to provide adaptation schemes including an independent access to specific devices. Then these schemes will be easily used to adapt any corresponding game situation. Testing the functionality of games is essential in the process of design. All the adapted game situations are tested in that perspective with the children. These tests must validate if the adapted games fit the needs of the children (autonomy). The description of various elementary scenes with validated adaptation schemes is intended to improve the usability of the adapting tools.

Currently various elementary scenes are studied and the recent release of the first version of the game platform allows to develop game prototypes that implement the corresponding games situations.

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## References

1. Archambault, D., Burger, D.: TIM Development and adaptation of computer games for young blind children – *Interactive Learning Environments for Children* – ERCIM WG U14ALL & i3Spring Days 2000, Athens, 2000
2. Scapin, D.: Ergonomics guidelines for the design of human-computer interfaces, Institut National de Recherche en Informatique et en Automatique, 1986
3. Valentin, A.: Evaluation ergonomique des logiciels – une démarche itérative de conception, collection outils et méthodes, ANACT, 1993
4. Richir, S.: La conception de produits nouveaux dans l'industrie du jouet (Design news products in toy's industry) – Thèse de doctorat, ENSAM, Paris, 1996

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