Intelligent Interface for Elderly Games

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Abstract. This paper proposes an intelligent interface to improve the game accessibility for the elderly based on the multimodal interface and dynamic load balancing. This approach aims to control the fidelity of feedback and the level of difficulty dynamically when the elderly become bored or frustrated with the game. By applying the proposed intelligent interface, we will present the implementation of a rhythm game for the elderly with a specialized game controller like a drum.

Keywords: Game Accessibility, Multimodal Interface, Dynamic Game Balancing, Rhythm Game.

1 Introduction

As the percentage of older persons in the world's population is continually increasing, the issue of accessibility to and usability of products and services has become more critical. And, there has been an explosion of interest and involvement in the field of gerontechnology[1] for innovative and independent living and social participation of older adults in good health, comfort and safety [1].

In recent years, we have been studied serious games for the elderly based on the previous research finding positive effects of video game use on the cognitive and neuromotor skills of the elderly [2]. And, we have started a project, "A research on serious games for the elderly toward human service" supported by Hoseo University. A research team in the faculty of game engineering, welfare for the elderly, nursing, and electronic engineering are working in collaboration.

The goal of this project is to improve the quality of their lives by means of game play interaction. And, our strategy to achieve this goal includes a change from technology development driven by technical feasibility towards one driven by the knowledge about behavior of the elderly, considered as a special category of users, whose particular abilities and needs, at cognitive, social and health levels, have to be taken into account during the research process.

This paper will present a way of adapting a game to the elderly dynamically in order to keep them challenged and interested based on the consideration and understanding of them. In section 2, we introduce our previous experiment and the concept

[1] The term of gerontechnology is a composite of two words, “gerontology” the scientific study of aging and “technology”: research, development, and design of new and improved techniques, products, and services.

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of game accessibility. Section 3 proposes our approach in order to improve the game accessibility for the elderly. Section 4 presents the implementation of a rhythm game with a specialized game controller like a drum. Finally section 5 concludes this.

2 Related Work

This section introduces our previous experiment to identify barriers posed by current video games and understand the content interests and the skill sets of the elderly. And, we present multimodal interface and design for dynamic diversity, which can be applied to improve the game accessibility.

2.1 Experiment

The objective of this study is to examine Korean elders' playing of video games. The total number of participants was forty. We recruited participants who were over the age of 65 at the time of the study. We conducted a series of four focus groups with four games selected for the study (2 Taiko master, Wii sports, and WarioWare).

Fig. 1. Participants were encouraged by the researchers to take turns and to play a variety of games within the one hour. During the game play, participants' comments were noted. In addition, the interview and participant's movement of hands and eyes were recorded by two video cameras in order to evaluate the difficulty or frustration of them.

Relating to the game controller, an input device used to control a game, the participants demonstrated no difficulty when using the drum-like game pad with sticks for Taiko master. And, participant remarks indicating difficulty with Wii remote controller. While the drum-like game pad is simple and easy to use, participants need more time to familiarize themselves with the Wii remote, especially the use of the buttons. This means that special purpose devices are more familiar and intuitive to use than general-purpose devices.

Relating to the game design, each mini-game of WarioWare lasts only about five seconds or so. It's too short to understand and enjoy the challenge of game for the elderly. And, one participant commented after playing Wii sports, "I don't know the rule of bowling. Make the games with common activity such as cleaning, dancing and so on. Taiko master provides weak feedback about the progress and activity of game play in spite of long playtime.

A majority of participants indicated after the game play that they would be interested in playing video games in the future. To appeal to an elderly people, existing games need some medications to the complexity of controls and simplifying the challenge of the activity. This study demonstrates that interactive games allow the elderly to enjoy new opportunities for leisure and entertainment situations, while improving their cognitive, functional and social skills.

2.2 Game Accessibility

Game Accessibility is defined as the ability to play a game even when functioning under limiting conditions. Limiting conditions can be functional limitations, or disabilities — such as blindness, deafness, or mobility limitation .

Multimodal interface provides the user with multiple modes of interfacing with a system beyond the traditional keyboard and mouse. Modality refers to any of the various types of sensation, such as vision or hearing. And, a sensory modality is an input channel from the receptive field.

A well-designed multimodal application can be used by people with a wide variety of impairments. This means that the weaknesses of one modality or sensory ability can be offset by the strengths of another. For examples, visually impaired users rely on the voice modality with some keypad input. Hearing-impaired users rely on the visual modality with some speech input. Among the most important reasons for developing multimodal interfaces is their potential to greatly expand the accessibility of computing for diverse and non-specialist users, and to promote new forms of computing not previously available [3].

[4] proposed a paradigm to support universal design is called Design for Dynamic Diversity (DDD or D3). Traditional User Centered Design (UCD) does not support this paradigm, as the focus of UCD is placed on the "typical user". As has been described, "the elderly" encompasses a very diverse group of users in which individual requirements change over time, making it a group that UCD has difficulties coping with. That is why a new methodology has been introduced to accommodate Design for Dynamic Diversity.

In this paper, we will apply the concept of DGB for game balance. Game balance is a concept in game design describing fairness or balance of power in a game between multiple players or strategic options. We will control the level of challenge dynamically and individually in order to help the elderly' game play.

3 Intelligent Interface

In this section, we propose an intelligent interface based on the understanding of skill sets of this significant population. We aims to keep the elderly in the mental state of operation in which the person is fully immersed in what he or she is doing by a feeling of energized focus, full involvement, and success in the process of the activity. The intelligent interface provides two methods to avoid the elderly becoming board or frustrated with the game.

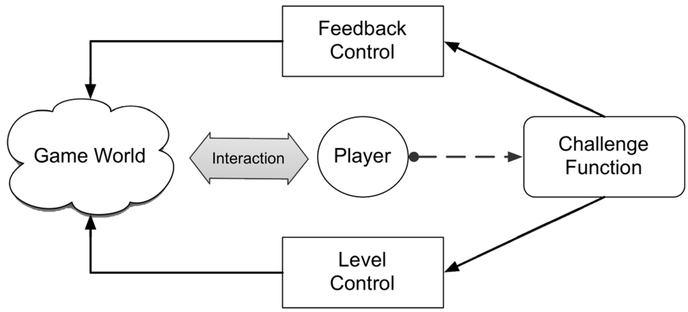

Fig. 2. Overview of intelligent interface

First method is to select the most appropriate mode of feedback to encourage and assist the elderly. Feedback is an important part of video games for a fulfilling interactive experience. And, it can be presented in several types of feedback such as visual, audio, action, NPC and so on. The more alternative type of feedback used with the use of multimodal interface, the greater the number of people who will be suited. In terms of function for elderly peoples with dexterity and strength impairment, this methods makes game accessible by the use of another modality or sensory ability. And, each feedback is designed to have multiple levels of fidelity.

Second method is to change the level of the difficulty dynamically in order to keep the elderly away from states where the game is far too challenging, or way too easy. Traditional game design is well suited to covering particular clusters of players as a developer's perception of what makes a good game is sure to appeal to someone. So, designers have relied on the provision of adaptable gaming experiences to make for better audience coverage, for example most games come equipped with an easy, medium and hard difficulty setting. But, the variety of the elderly means that some players will inevitably lie outside the scope of predetermined adaptation [5]. Our approach is to keep the elderly interested from the beginning to the end individually by changing parameters, scenarios and behaviors in video games.

In order to realize intelligent interface, we need to detect the difficulty the user is facing at a given moment. Challenge function maps a given game state into a value that specifies how easy or difficult the game feels to the user. Depending on this value, intelligent interface can control the fidelity of feedback and the level of challenge in order to making game adaptable to different users. And, intelligent interface can be used to positive or negative and explicit or implicit way to avoid the elderly becoming board or frustrated with the game

4 Implementation

We have implemented a rhythm game for the elderly in order to apply the proposed intelligent interface. This game has been developed using Microsoft Visual C++ and DirectX as the graphic API.

In rhythm games, the players must match the rhythm of the music by pressing specific buttons, or activating controls on a specialized game controller, in time with the game's music. This kind of interaction helps the elderly improve perceptual motor skills and cognitive functioning. Motor skills can be defined as a refined use of small muscle controlling the hand, and fingers, usually in coordination with the eyes. This skill allows one to be able to complete tasks such as writing, drawing, and buttoning. A decline in perceptual-motor functions has serious consequences which affects a range of activities of daily living[6].

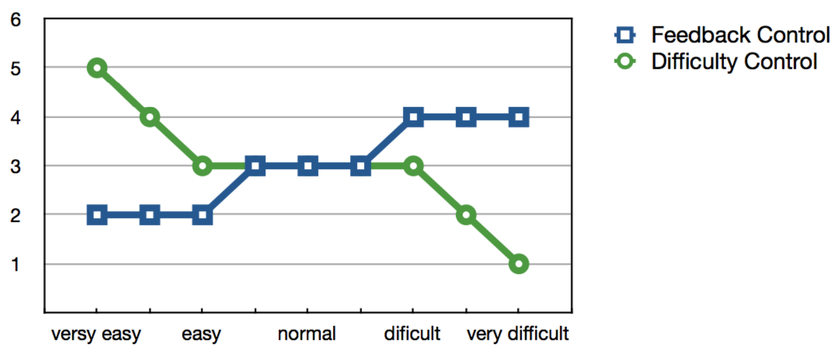

Fig. 3. Feedback and Difficult Control for Rhythm Game

Fig. 4. (a) The buk is a traditional Korean drum, with a round wooden body that is covered on both ends with animal skin. Performers usually beat their buk with bukchae (a drumstick) on one hand or two hands together. (b) We modified buk to detect when a sensor in the drum's surface is hit. And, there are two blue buttons, left, and right, which are used to select and decide in the selection screens.

To implement intelligent interface in this game, we need to define a challenge function to detect the difficulty of gameplay. The first way is to allow the user press button when he or she feels difficulty. The second way is to make an equation dependent on a game score. If the variation of game score for a given time is positive, then the level of challenge become sink. Intelligent interface aims to keep this value stable to avoid the elderly becoming board or frustrated with the game.

And, we need to control the level of difficulty for intelligent interface in rhythm game. In rhythm games, the player is required to hit the drum in time when large beats will scroll across the screen. So, the difficulty of this game can be controlled by the speed and amount of note on screen. This is a way to make the game easy or difficult directly. For the fidelity of feedback,

To improve the accessibility of game, we developed a specialized game controller by modifying buk[2], traditional Korean drum (Fig. 1). Instead of using standard interfaces like keyboard and mouse, buk is so intuitive and simple that the elderly don't need to spend the time to learn how to use. This game is played simply by hitting the drum in time with notes traveling across the screen. And, we can design our game as a one-switch game that can be controlled by single button.

Fig. 5. Introduction and gameplay Screenshot

5 Conclusion

To identify barriers posed by current video games, we examined Korean elders' playing with three popular games. And, we presented an intelligent interface, which enables to control the fidelity of feedback and the level of difficulty dynamically. Our approach is based on the multimodal interface and dynamic game balancing for the accessibility of games. By applying the proposed interface, we developed a rhythm game and specialized controller especially for the elderly. This game can help the elderly improve perceptual motor skills and cognitive functioning. And, intuitive and simple game controller was also developed by modifying a traditional Korean drum.

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[2] The term buk is also used in Korean as a generic term to refer to any type of drum. Buk have been used for Korean music since the period of the Three Kingdoms of Korea (57 BC – 668 AD).

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