

An Agent-based Game Platform for Exercising People’s Prospective Memory

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Abstract—Prospective memory, the ability to remember doing future tasks without being reminded, is a critical ability in everyday life. As the elderly are vulnerable to age-related declines in prospective memory, it is important to prevent this decline in advance. In this demonstration, we develop an agent-based game for practicing prospective memory. It can potentially provide a convenient and natural way to predictively monitor older adults’ prospective memory and motivate the elderly to practice the ability. Furthermore, multiple agents were applied in the game to promote user experience and provide personalized training program.

Keywords-serious game; prospective memory; agent; multi-agent; elderly

I. INTRODUCTION

Prospective memory (PM), a critical cognitive function, is the ability to remember to do future tasks without being reminded [1]. Prospective memory is employed in our everyday life, such as remembering to buy groceries when passing by a shop, or to take medications. Failure of timely action sometimes would be fatal. Scenarios include forgetting to turn off the stove in the kitchen and forgetting to take medication for diabetes. As people get older, there is a natural process of gradual deterioration and impairment of physical and cognitive functions, the deficit in prospective memory is one of the most commonly reported cognitive problems in older people [2].

Cognitive training plays an important role in maintaining elderly’s cognitive functions for their independent living. For example, a long term intervention program focusing on memory, reasoning and speed has shown to not only decrease depressive symptoms and chronic conditions but also enhance the everyday living functions [3]. Research also shows that with proper cognitive exercises, the deterioration of prospective memory can be slowed down [4], [5].

In clinical practices, completing the full set of prospective memory test is time consuming, usually taking 20-30 minutes or longer. When using these tools for training purposes, it will take even longer. For example, using the Virtual Week [6], a board-game based test, to train prospective memory, the patients will go over the whole procedure with more detailed feedback and repetition, which will cost one hour per session [4]. Meanwhile, medical professionals are always required to be present and to administrate. This limits the



Figure 1: Ongoing Task: Catching Fish.

availability of such tools to a wide range of residents in the free living environments that are essential for early intervention of the cognitive decline.

II. DEMONSTRATION CONTENT

In this research, we aim to develop an interactive game *Lotus Valley* that can evaluate and train the elderly’s prospective memory in a convenient and efficient way. The entire interaction between the player and the game is based on the Leap Motion controller, a tiny device that can sense hand movements. Through only three simple hand movements (i.e., swap, flip, and hold) above the controller, players can easily interact with the game. Without usability barriers, players’ performance then is subject to the ability of prospective memory only.

A prospective memory task typically consists of two components – an ongoing task that persists all the time, and a PM task that is planned upfront and is expected to be executed after a certain period of time. There are two types of PM tasks according to the cue that triggers a certain task. Event-based task is induced by obvious and external cues such as objects, persons and locations; whereas time-based task is supposed to be completed at a particular time that requires one’s internal monitoring of the time [7].

Specifically, the player acts the role of a virtual fisherman in the game. The ongoing task is to catch as many fishes as possible and collect falling flower petals (Figure 1) in the leisure time. The three PM tasks are baking fish by flipping the board using left hand, gifting the fairy with a petal, and selling the fish to a fisherman (Figure 2). These tasks can be triggered by specific time points (e.g., at 2:30pm, in 20



Figure 2: PM Task: Flipping Fish.

seconds) or events (e.g., when the fisherman appears). The PM tasks are embedded in the ongoing tasks and assigned at a random interval with a message window popping out. By recording the completion rate and time delay in performing the PM tasks, player's prospective memory capability can be evaluated [8].

In past research, intelligent agents have been applied to various domains [9], [10], including performance assessment [11], [12], companioned game play [12]. In the present project, multi-agents are utilized. First, a companion agent interacts with the player to bring him or her from one stage of the game to the next; it give feedbacks to the player about the performance and encourage the player to take further challenges. Second, one monitoring agent tracks the player's real time progress and controls the occurrence of the PM tasks for creating different levels of cognitive loads. Such variations in cognitive loads will present different scenarios and difficulties to the players so as to progressively train their prospective memory capabilities over time. Third, another reminder agent will send notifications about forgotten PM tasks when necessary. The principle of reminders is to appropriately assist the player in learning strategies of remembering tasks while avoiding fostering over-reliance on the memory aid.

III. DISCUSSIONS AND FUTURE WORK

While older adults are engaging in the pleasant scenery, their prospective memory is assessed and trained automatically. The game can be easily converted to be adaptive to different platforms, so that senior citizens can freely access the game, and monitor their performance on perspective memory on a daily basis.

It is expected that by playing the game persistently, elderly can retain their prospective memory better over time than their counterparts who do not play the game. Moreover, transfer effect is one of the major concerns in cognitive training, which concerns to whether the ability practiced in the game can be transferred to daily life activity. Therefore, future work should test the effectiveness of the game-based training on senior's daily life functioning.

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