The GazePlay Project : Overview in February 2018

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1   Introduction

In order to develop and enhance an augmentative and alternative communication (AAC), gaze is often considered as being one of the most natural way and one of the easiest to set up in order to support individuals with multiple disabilities to interact with their environment. Of course, for children who start by definition from scratch, who have in addition such difficulties, it is a strong challenge even to acquire or to support the required basic knowledge. They have to learn the power of their eyes, the consequences of the actions triggered by their gazes but even to improve their extraocular muscles,... Games are often considered as a good mean to learn. In the case of eye-tracking, video games could be a good way to improve basic requirements as gaze fixation and gaze pursuit as well as conventions like rewards or dwell interactions often used in AAC tools.

In this article, we present the GazePlay project which main contributions are

— *GazePlay*[1] a free and open-source software which gathers several mini-games playable with all eye-trackers including low cost ones. It permits people to access such games at a price which decrase from 2 000-3 000€ to 100-160€ excluding computer price.
— *TobiiStreamEngineForJava library*[2], a Java open library which links C++ library from Tobii to Java. With it help, is possible to develop software able to interact with Tobii's low-cost eye-trackers (Tobii EyeX, Tobii 4C).
— *GazePlay github*[3] a public repository hosted by GitHub which help us to manage GazePlay development. To date, 8 people directly contribute to the code and dozens on ideas (including therapists and parents).

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1. `https://gazeplay.net`
2. `https://github.com/coylz/TobiiStreamEngineForJava`
3. `https://github.com/schwabdidier/GazePlay`

2   Eye, Gaze and Eye-trackers

Eye is a sense organ that allows vision. It allows humans to see images in 3 dimensions and with colors. Eyes make specific motions (Yarbus, 1967) :
— Saccade happens when the eyes move from one point of interest to another.
— Pursuit happens when eyes follow a moving target.
— Fixation happens when the eyes stop scanning the scene, and the vision is kept in one place so it can take detailed information about the object or the scene it is focused on.
— Blinking is a rapid closing then opening of the eyelids. When it occurs spontaneously, it protects the eye by moistening it. When it occurs voluntary, blinking can be used to reestablish a basic communication.

Position of the gaze can be calculated thanks to eye-trackers. They are mainly, infrared camera which provide raw coordinates from which it is possible to estimate fixation, saccades, poursuites and/or blinking (Jambon & Luengo, 2012). Many companies started creating eye-trackers, but the cost is too high and it was not affordable by the majority of families of disabled people. For instance, in France, the cost of a basic eye-tracker for disabled people is over 1200€ in 2018. In 2013, the Eye-Tribe company is the first to have lowered the cost really much by creating cheap and more affordable eye-trackers with an elegant Java API and compatible with both Windows and OS X. Tobii, the most important firm to sell eye-trackers released their EyeX (2014, $\simeq$ 100€) followed by the Tobii 4C (2016, $\simeq$ 160€) and their C++ library. While the Eye-tribe was sold to Facebook for its Oculus division and is no longer developped, Tobii works a lot on their low-cost eye-trackers and their associated tools (multiple users, gaze trace, *etc.*).

These three eye-trackers can be used with GazePlay. We integrate directly eye-tribe library while our team has developed a Java Native Interface to build a java library, *TobiiStreamEngineForJava* which permits to use easily the Tobii EyeX and the Tobii 4C with Java.

3   GazePlay

We present in the following GazePlay 1.3, the current development version of Gaze-Play we plan to release before the end of March, 2018. Most of the features are already in GazePlay 1.2 which was released at the early beginning of February. GazePlay is a free and open-source software which gathers 16 mini-games playable with an eye-tracker. It is compatible with all eye-trackers which are able to control the mouse cursor, with Tobii EyeX and Tobii 4C on Windows and the Eye Tribe Tracker on Windows or MacOs X. To help motivating the players, it is very easy to modify

default images of the game. One player would prefer to play with Mickey Mouse while another would like to play with Princess Sofia, with his family or therapist. Another way to help motivating the players is to give them a reward (a big friendly smiley and applauses). Both games and interface can be displayed in French, English and German.

3.1 Games in GazePlay

GazePlay 1.3, gathers 16 playable games [4]. For each one, we aim to develop one or several skills for the children. We can consider that three kinds of skills are developed in GazePlay : action-reaction, selection, memorization skills.

3.1.1 Action-Reaction Skill

In these kinds of games, we aim to learn to the children that a gaze can have direct consequences. For instance, in the *creampie* game, the user throws a cream pie on the target when gaze looks at it ; in *Block*, a big image is hidden by colored blocs. The player looks at a block to destroy it. When all blocs have disappeared, a reward is shown. In the *Ninja* game, the target explodes when the player looks at it.

3.1.2 Selection Skill

Selection with eye-tracker is not as easy as it is with a mouse. Blink is both not easy to capture with an eye-tracker and often very difficult to perform for a child with multiple disabilities. In AAC programs, an usual way to select an element (photo, image, pictogram, etc.) is to keep the gaze on this element. It is called, a dwell interaction (Jacob, 1990). A feedback is given as a circular progress bar. When it is full after a configurable time, the element is selected. In GazePlay, *Magic Cards* several cards are displayed. When the player stares one card, it is turned. One of the card hides an image. A reward is given to the player when (s)he finds the image. Other games like *Memory* and *Where is it ?* aim to train the selection skill.

3.1.3 Memorization Skill

In these games our aim is to work on the short-term memory like in *memory* which has the same rules of the classic game. Several pairs of cards from 2 to 6 (following children/helper choice), face down. Then the player with a dwell interaction (see

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4. For a complete description of games see https ://gazeplayeng.wordpress.com/games/

previous section) turn over 2 cards. if they are the same, they disappear, otherwise after few seconds to permit to the player to remember them, they turn back over. When no card left, ie. when all the cards have been matched, the reward is given.

In other games, we aim to work on long-term memory. In the game *Where is the animal*, a sentence is pronounced and written to indicate to the player which animal to find (horse, dog, crocodile,...) and then several photos of animals are shown (from 4 to 9 following children/helper choice). Player selects photos until he finds the correct one. The same game is proposed with colors. While a last one is completely configurable ie. parents/therapists can build their own games with their own photos. The sentence can be completed with pictogram for instance to learn pictograms to the children. This last game and the usage of pictograms was inspired by the community (see section 4).

3.2   Analysis

When a game is stopped by the helper, several statistics are displayed and saved automatically. They includes charts which presents following the game, total active playtime, actual playtime, durations, reaction length, standard deviation,…. A heatmap also shows gaze position on the screen. With these statistics, helpers get objective information to evaluate evolution and/or motivation of children.

4   Community

The project is open source under a creative common licence. Nobody can sell it or use its code in commercial applications. Of course, it remains possible to sell services about/with GazePlay (formations for instance).

The code is hosted on GitHub. The repository permits to share code, information for developers, issues (enhancements, bugs, milestones, …) but also to find interesting projects. Due to his goal, some people from the open source community helped us especially on the software engineering side and permit to increase our efficiency. Similarly, we get feedback from many therapists who used GazePlay with children. We really think that a such project could inspire other people who would like to build a project related to people with special needs.

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