The Hong Kong Polytechnic University
Department of Computing

Capstone Project(2016/2017)
Project Proposal

Vision Screening Virtual Reality Game for Children

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1. Introduction

1.1 Background

Virtual reality(VR) technology refers to the technology that uses computer generated images, audio to recreate a real environment or create an imaginary space[1]. Because of the hardware improvement and cost reduction, it has become more and more popular and easily accessible in the public.

Vision screening is a relatively short test that can indicate the presence of a vision problem or a potential vision problem[2].

Although there is no VR vision screening game at this point, similar idea has already been implemented and tested using computer games, which are useful as they provide information of what is good and what have to be improved.

EyeSpy is an automated computer program that assesses vision while a child plays a video game. In addition to visual acuity, it incorporates an analysis of binocular function[3]. It is claimed that EyeSpy screening results were not significantly different from the gold-standard professional eye examination results.

DoDo's Catching Adventure is a color vision deficient screening tablet game for young children. A user study conducted at Singapore National Eye Centre showed that DoDo was adequately effective in identifying Red-Green color vision deficiency and comparable to two current gold standard colorblind tests, Ishihara and FarnsworthD15[4][5].

A research in automated computerized distance visual acuity and stereo acuity test using an interactive video game also claimed that the test has good reliability and acceptable validity compared with the Snellen visual acuity chart and the Distance Randot Stereo test.[6]

1.2 Problem Statement

Although the above computer games used for vision screening have high accuracy, their functions are separated and the level of automation is not high enough to reduce the time and human resources in the tests compared to compared to professional eye examination. It is important as the aim of using the technology in vision screening is not only to entertainment for children, but also to reduce the cost so as to increase the efficiency of traditional vision screening tests.

For example, EyeSpy vision screening system is running on an laptop computer performed by a lay screener, which means an examiner is required to give instructions to children and to setup the accurate distance between the computer and the children.

2. Objectives and Outcome

This project aims to create a virtual reality game used as an alternative vision screening tests for children which does not require an examiner and include three sub-tests: nearsightedness, color blindness and diplopia tests. It can run on a smart phone using Google cardboard.

The target users are children aged above three years old as researches have conducted that the benefit-to-cost ratio was highest for the visual acuity screening (VAS) in children 3 to 4 years of age[7], and earlier detection may allow for treatment to be more cost effective by reducing the number of medical visits required for resolution.[8].

The objective of this project is to increase the efficiency of vision screening by lowering the cost of time, resources and manpower, as well as to remove children's trepidation about getting their vision screened[9] using a virtual reality game.

I t is expected that the children are able to play the game by themselves without a vision screening examiner giving instructions, the result should be output after the game is completed so teachers or parents can understand the vision condition of the children.

If the overall result of the product is accurate and acceptable compared to traditional vision screening provided by the government and other organizations, it may hopefully replace traditional eye charts and equipments in order to increase the mobility of the vision screening services provided by these parties.

3. Project Methodology

The virtual reality game will be developed using Unity game engine with Google cardboard. The game includes three different stages in one game play, with each stage performing one corresponding vision screening tests: nearsightedness, color blindness and diplopia tests. The background story of the game is about space adventure.

The detailed designs of each stage are shown below:

Stage one is the nearsightedness test, also known as the vision acuity test. Based on the satisfying result of the EyeSpy research and the strict requirement of the size of the symbols and distances in traditional vision acuity test, the design of stage one is similar to the EyeSpy game. There are four symbols/letters, in each turn, one is randomly selected and the player has to select the corresponding symbol in a fixed size. The size of the randomly displayed symbol will be smaller if the player get the correct answer until the player answer incorrectly in two consecutive try, similar to the traditional vision acuity test.

Stage two is the color blindness test. The player will control a space ship using the gyroscope sensor in the smart phone. There will be rings in different colors, player are asked to control their space ship to fly through the rings in specific color in a sequence. The idea is similar to the DoDo game, while having more interaction in the game instead of a “question-and-answer” method.

Stage three is the diplopia test. The player will look around to find the treasure chests in the space, they have to get the treasure using the magnet attached on the google cardboard, the number of treasure chests increases level by level. Since the virtual reality environment output two different image to different eyes, players should easily find the treasure as they do not have overlapped image. Similar to the first stage, the player loses if they anwer incorrectly in two consecutive try.

After player complete the three stages, results of different tests will be generated by the game and further suggestions and explanations will be shown as a recommendation to parents or teachers.

4. Project Schedule

The project is divided in smaller parts for a better time management and schedule planning.

Date	Planned task to be finished
By week 13, semester 1	A Prototype of stage one testing with input control and the virtual reality output
By week 4, semester 2	Full Prototype of all stages
By week 5, semester 2	Result cauculation and Report Generation
By week 7, semester 2	Basic graphics and user interface for the game
By week 9, semester 2	Tests with children and adjust the game setting
By week 11, semester2	Advanced graphics and music

The above graph show the work order of different tasks, with important parts put in the front and the extra functions in the back, the project schedule is more flexible when encountering obstacles that are difficult and take time to solve.

5. Resources Estimation

The resources needed include a Google cardboard for testing and the development, a smart phone which supports Google cardboard.

The basic version of Unity 3d game engine which is free of charge, is enough for the development of the game.

6. References

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