Diplopia: A Virtual Reality Game Designed To Help Amblyopics

James Blaha
Apollo VR

Manish Gupta
Apollo VR

ABSTRACT

Virtual reality has the potential to measure and help many vision problems. More than 3% of the population have amblyopia, commonly known as lazy eye, a weakness and impairment of vision in one or both of the eyes [1]. Amblyopia often results in a suppression of the information coming from the bad eye, and a loss of stereoscopic vision as a result. It was long thought that people with amblyopia could not improve the vision in their bad eye or gain stereoscopic vision after a critical age of 10-12 years old. Recent research indicates the adult brain is more plastic with regards to suppressiion than previously thought. [2]. Inspired by this, we have built a virtual reality game, called *Diplopia,* using Unity3D which utilizes the Oculus Rift head-mounted display (HMD) and the Leap Motion controller to help people with amblyopia restore vision in their amblyopic eye.

Keywords: Amblyopia, Strabismus, Oculus Rift, Leap Motion, Virtual Reality, Head-Mounted Display.

Index Terms: J.3.4 [Applied Computing]: Consumer Health

1 INTRODUCTION

Short version of the demo (using an old version of the software) here: https://www.youtube.com/watch?v=W5tVBfBJr-s

1.1 Demo

Diplopia will be available to play using the Oculus Rift, Leap Motion controller and Razer Hydra. Conference attendees will be able to use the game and all of the vision tests, including the suppression test, that come with it.

If you have never seen in 3D, be sure to come play the game!

1.2 About Amblyopia and Strabismus

Strabismus, commonly known as crossed eye, affects millions of people worldwide. In those born with strabismus it is common to develop amblyopia, or lazy eye, a muscle weakness in the eye. This muscle weakness combined with the offset of the crossed eye makes it difficult for the brain of someone suffering from amblyopia to integrate the information coming from both eyes.

This often results in the suppression of the information coming from the weak eye unless the muscle weakness can be strengthened in early childhood. It was long thought that once a person had passed a "critical age" of ten to twelve years old this suppression could not be overcome.

Recent research has indicated that the adult brain's visual cortex is far more plastic that originally thought. With the right stimulus suppression can be overcome and strengthening of the weak eye can result in stereoscopic vision, even if the player has never had stereoscopic vision before and has passed the "critical age."

1.3 How Diplopia Works

Diplopia works by turning on a special game mode we call *"Diplopia Mode."* In *"Diplopia Mode"* the game delivers a different image to each eye, forcing the two eyes to work together in order to win the game.

We use a simple "break the bricks" style game where you bounce a ball off a gesture controlled paddle to score points by clearing the level of bricks.

By showing the paddle only to the strong eye, the ball just to the weak one, and the bricks very brightly to the weak eye and very dimly to the strong eye the game breaks through the player's suppression.

By limiting the information shown to each eye the player must use both of them and their brain must understand the correct positions of the game objects and integrate the two sets of visual information into one coherent picture.

By showing the fast moving ball only to the weak eye, the player must exercise the muscle in control of that eye more than normal. Their stronger eye has the relatively easier task of tracking the paddle and is not needed to be as active.

As soon as *"Diplopia Mode"* is turned on sufferers of amblyopia who have never seen an object in three dimensions should be able to perceive depth for the first time in-game. With sufficient play-time over weeks or months they may even be able to gain depth perception in normal seeing conditions.

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2 About Apollo VR

2.1 Introduction

Apollo VR is a company focused on using virtual reality to solve real problems.

It was founded in January 2014 by James Blaha and Manish Gupta after a successful crowd funding campaign for its first product: *Diplopia*. After that campaign ended, Apollo VR received an invitation to participate in the Leap Axlr8r in San Francisco to work on *Diplopia* and other software under the guidance of renowned gestural UI mentors including Philip Rosedale, creator of Second Life, Dav Rauch, UX design lead on Iron Man and other movies, and John Underkoffler, who was science advisor for Minority Report and worked for the MIT Media Laboratory.

You can find us in San Francisco working next to Leap Motion on virtual reality, 3D gesture interfaces, user interface design, video games, and vision problems. We are particularly interested in providing brand new solutions to well known problems.

2.2 Founders

James Blaha
jamesjblaha@gmail.com

James has been working as a freelance web developer, programmer, and designer for over nine years. He has participated in founding several startup companies during that time, the most recent of which is Apollo VR. He is currently living in San Francisco, California, but is originally from Michigan.

Manish Gupta
guptama3@gmail.com

Manish is a software developer who worked at IBM before co-founding Apollo VR. He has nearly a decade of experience working with various software and hardware technologies. Originally from Michigan, he is currently working and living in San Francisco.

References

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