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A Review Paper on Mobile Eye Tracking using Virtual Reality for Shoppers Research

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ABSTRACT
In this paper we present the outlines of a new project that aims at developing and implementing effective new methods for analyzing gaze data collected with mobile eye-tracking devices.Technological advances in eye tracking methodology have made it possible to measure consumer visual attention during the shopping process.The present paper argues that virtual reality can provide an alternative setting that combines the benefits of mobile eye tracking with the flexibility and control provided by lab experiment. In a virtual supermarket into a single source data analysis to examine consumer choice, customer experience,and shopping behavior in a store. In the present study, we investigated whether people distribute their gaze in the same way when they are immersed and moving in the world compared to when they view video clips taken from the perspective of a walker.

KEYWORDS: Eye-tracking Visual attention, Virtual Reality, Gaze

INTRODUCTION
The recent research and availability of mobile eye tracking devices are leading in various statistical analysis of shoppers' decision making. Manufacturers and retailers spend millions of dollars every year on in-store communications. The effectiveness of these dollars depends onwhether shoppers notice, pay attention to, and engage with these communications, something that is best determined from eye-tracking data [1].

As shoppers enter a retail store and walk the aisles, a tremendous amount of information enters the brain through the lens of the eye. Attention is a mechanism that helps to filter and selectively process this flow of information.Focusing on what to look at can be thought of as the first step in seeing.Vision scientists have identified a number of low-level features of thevisual stimulus, such as color, contrast, and orientation, which either guideor modulate attention; what is called "bottom-up" processing.[2]

Most of what we know about how people look at natural scenes is based on the ‘‘free viewing’’ of static images presented one at a time for a few seconds. While we have undoubtedly uncovered much about how people respond to such stimuli, it is crucial to consider whether this research generalizes to the way that people behave when immersed in the real world[3]

VIRTUAL REALITY AND MOBILE EYE-TRACKING TECNOLOGY
Virtual reality can be defined as a simulated environment in which the perceiver experiences telepresence, which is the extent to which a person feels present in a virtual environment.

Two main implementations of virtual environments can be distinguished so-called CAVEs (Cave Automatic Virtual Environments) and HMDs (head-mounted displays):

CAVEs consist of stationary display surfaces, typically fed by projectors, with multiple projection screens and loudspeakers surrounding the user.

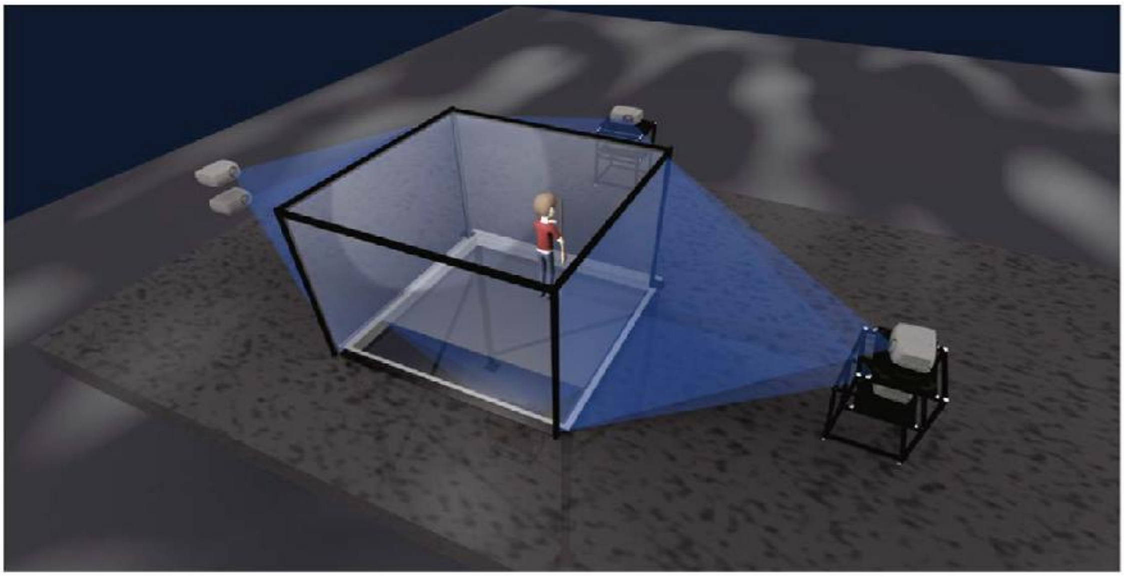

Fig. 1: Three sides of a CAVE projected from the rear. The user's perspective is tracked using optical tracking systems.

Besides CAVEs, the second form of implementation is to use a HMD (Fig. 3) together with a computer and a head tracker. Inside an HMD are two screens (except if a split-screen presentation mode is used), one for each eye, to provide stereo images.

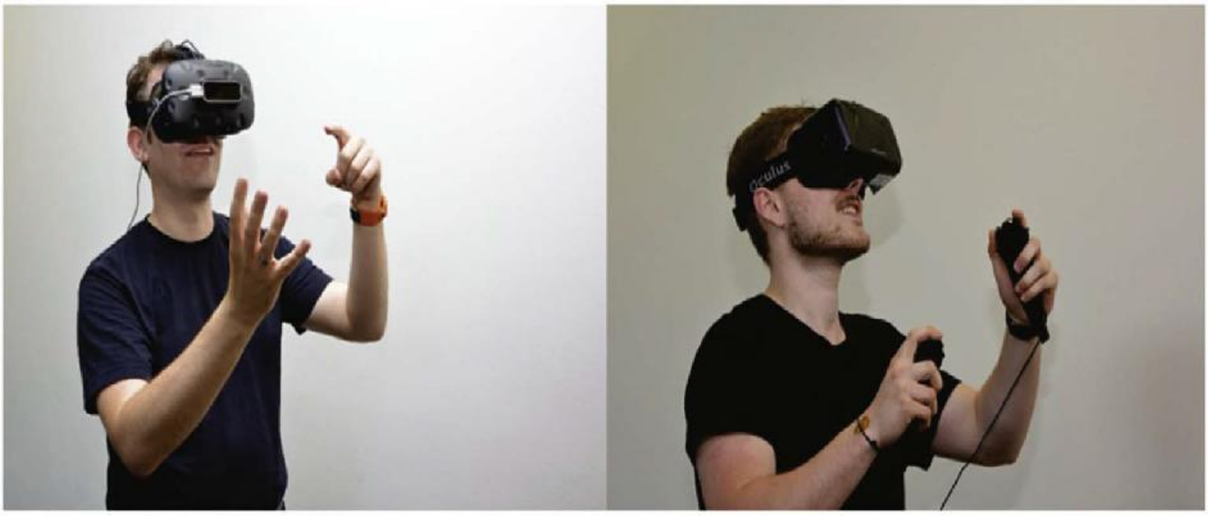

Fig. 2 : Left- An HMD called HTC Vive as visual stereo display and a leap motion controller fortracking the hands; right- An HMD called Oculus Rift DK2 and a Razer Hydra controller for interaction.

The application of eye tracking to virtual reality environments combines the strengths of mobile and desktop-based eye tracking. It provides the respondent with full flexibility regarding natural movements in a fully immersive 3D environment. At the same time, the analysis of the data is not more complicated than with 2D desktop eye tracking applications. Once the 3D models of the target stimuli have been created, subparts of the objects can be annotated by additional geometries to define areas of interest (or better: volumes of interest) (Fig. 2).

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Fig. 3: Annotated 3D model of a product package. The AOIs are 3D geometries invisible to the respondent

The paper first reviews key advantages of different eye tracking technologies as available for desktop, natural and virtual environments. It then explains how combining virtual reality settings with eye tracking provides a unique opportunity for shopper research in particular regarding the use of augmented reality to provide shopper assistance.[4]

The core of virtual reality is an advanced interface to a human-machine simulation system, in which the system amplifies human intelligence rather than replacing it. Virtual reality consists of virtual sensations, visions, sounds, and other kinds of perceptual input.[5]

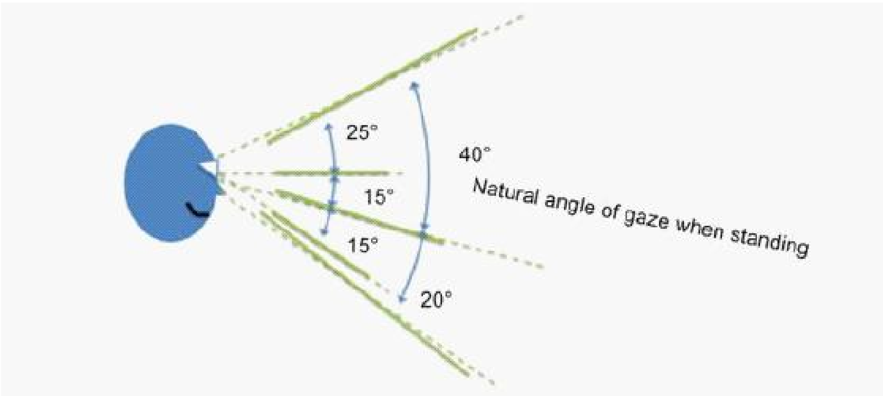

Fig 4: natural gaze span

In AOA analysis system, physical markers are attached to specific areas in a research site to define a two-dimensional plane, which allows for automatic mapping of eye-tracking data.

Fig. 5: OA based analysis of gaze data

Fig 6: Object recognition illustration in shopping setting

Prior research using eye-tracking data has been done in the lab due to the technological and physical constraints of the eye-tracking equipment. The equipment consists of a pair of high-resolution cameras mounted on a pair of lightweight clear safety goggles. One camera records the scene and the other records the participant's eye. The goggles are connected to a small recording unit that is carried in a small backpack or belt pouch.Therecording unit can also transmit wirelessly, allowing remote viewing of the participant eye tracking in real-time.[6]

HORIZONTAL VERSUS VERTICAL BLOCKING

Blocking divides the display into horizontal or vertical blocks of similar products; the grouping can be based on product sub-category, brand or product attributes (Figures C and D). It is almost always achieved via packaging design especially using a distinct packaging color for each group. Retailers use the color cue to visually direct customers' eye movements thereby helping them navigate through a cluttered store shelf . We hypothesize that this visual factor (horizontal vs. vertical display or blocking) will influence how consumers process the assortment, which in turn will affect how much variety they perceive, and subsequently how much variety they choose. Horizontal displays should be easier to process than vertical displays due to a match between binocular vision field (which is horizontal in direction) and the dominant direction of eye movements for processing horizontal displays.

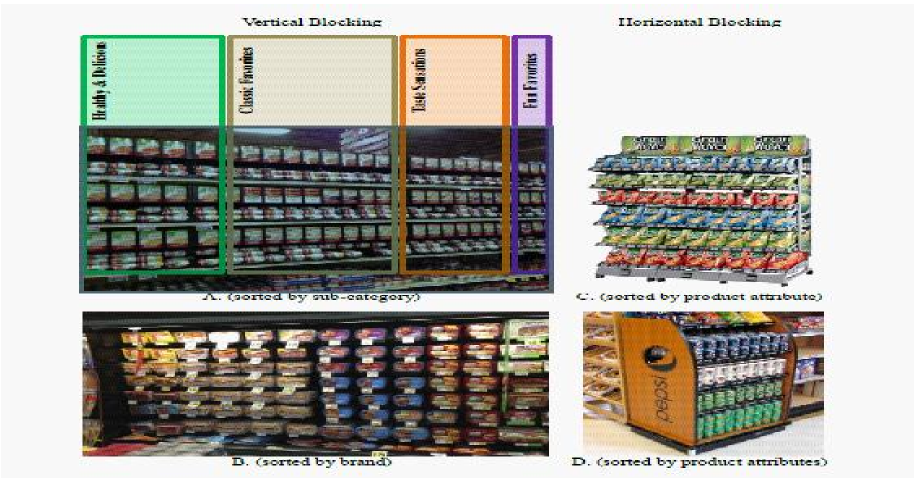

Fig. 7: Horizontal versus vertical blocking

So in advertising attraction is almost always achieved via packaging design especially using a distinct packaging color for each group. Retailers use the color cue to visually direct customers' eye movements thereby helping them navigate through a cluttered store shelf [7]

ADVANTAGES AND DISADVANTAGES OF USING EYE TRACKING

Ease of controlling and randomizing treatment and extraneous factors. As virtual environments are promising for retailing research because they allow greater ecological validity while maintaining high levels of experimental control. Purchase decisions made in a virtual supermarket may serve as a good example. Factors like the position of the product on the shelf , the salience of product packages, design elements of the food package , and the prices shown next to the products can be more easily varied or controlled for in a lab experiment. Not on the general discussion about the differences between lab and field experiments. For a broader discussion on the latter issue. It is also worth.[5]

CONCLUSION

Although much of the work discussed is still in progress, the general architecture of the project presented based on eye-tracking. It was shown that the implementation of robust and flexible object recognition techniques may significantly improve and simplify the analysis of real-world visual behavior through eye-tracking.

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