The Virtual Foodscape Simulator – gaming, designing and measuring food behaviour in created food realities

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Introduction

Understanding and modelling food choice is of significant interest to food retailers, food caterers as well as researchers engaged in food, nutrition and consumer science. As a result, behavioural nutrition and the study of pathways leading to food choice is a growing field of scientific inquiry. In a study by Wansink, Just, Hanks, and Smith (2013) performed in school cafeterias, pre-sliced apples were found to sell better than whole apples. Marchiori, Waroquier, and Klein (2012) investigated the effect of serving half-sizes cookies instead of whole to children for afternoon tea and found that energy intake decreased when the children were served the half cookies. Rolls, Roe, Kral, Meengs and Wall (2004) and Wansink (1996) both found that the amount used or consumed increased with increasing package size in products such as potato chips and spaghetti. Such experiments are normally performed in real foodscape settings. Recent developments in information and communication technology have opened new avenues for researchers in the field. With the possibility of doing food choice experiments on the screen before doing a full scale real experiment the costs of uncovering consumer food behaviour can be reduced significantly. Being able to design food-oriented virtual environments e.g. in retail-/ buffet-environments, is convenient and furthermore has monetary benefits. Using virtual reality in shopping as well as in research of shopping behaviour is not a new phenomenon. It is increasingly being used commercially to allow consumers to shop virtually as well as in research to investigate different pricing strategies as a tool to stimulate healthier food choices (Waterlander, 2014). The virtual approach offers obvious advantages compared to reality. One of the most prominent advantages is the possibility to devise and simultaneously test multiple changes to supermarket settings, without any investments, physical efforts and interference. In addition, educating young people and citizens about food choice and healthy shopping and eating in a virtual setting opens new avenues for game-based nutrition and consumer education. Researchers at AAU (Aalborg University) have been working with new technologies under the umbrellas of the FoodScapeLab and the AAU Multi-sensory Experience Lab, and an experimental model has been developed and tested with promising results (Andersen et al 2014; Cekatauskaite et al 2015).

Purpose

Against this background a Virtual Foodscape Simulator (VFS) has been developed and tested as a design tool, and is currently being developed into a gamified version. The VFS is meant as an easy and inexpensive tool for predicting, gaming and designing in the area of food choice and behavioural nutrition. The project should further test the tool in real choice dynamics experiment where subjects will be exposed to a food choice condition in 2 different frames and validate the tool against a real experiment where real foods are used. The aim of the paper is to outline the two modes of operation of the virtual food reality and to give an account of the technical backbone of the solution. Finally, the paper discusses the potential of virtual food realities to serve as a reliable tool for testing consumer behaviour in food environments.

Methods

The project developed a simulated virtual supermarket foodscape, and it is building on dynamic reconfigurations i.e. it has the ability to do 3D-object texture-substitution of corresponding food items for a wider selection of product diversity. The idea builds on the ability to make true to life computer-mediated representations of a supermarket itself, together with textured products and fixtures. With the VFS-tool, we explore the possibility of enhancing real-life experiments as a virtual substitute. The notion of a customizable tool model for studying consumer behaviour, choice, and decision-making, in a virtual emulated environment, can greatly improve the feasibility and affordability of pre-existing real-life methods for studying and understanding consumers. VFS makes it possible to build additional interactive scenarios on top of it with an easy to use design and customization-tool. The mode of operation allows the user to pick items, turn them around, place them in a shopping basket and walk towards the checkout aisle. The ultimate VFS has the ability of fast prototyping of random foodscapes as 3D worlds with various degrees of interaction. The framework is designed with scalability and flexibility in mind, to facilitate a web based configuration manager to control some aspects of the 3D world, or a low fidelity version utilizing the more affordable Google Cardboard VR-platform.

Figure 1: The first iteration of the VFS utilizing the Oculus Rift DK1 HMD, and wearable technology to allow interaction with the virtual environment.

The first iterations of the VFS equipment was a Virtual Food Choice Simulator (VFCS) intended for conducting food choice experiments. It included the first edition of the Oculus Rift^{TM} Developers kit (DK1) VR-head mounted display (HMD), a custom-built data glove (dubbed Find 'n' Grab) that utilized an array of infrared LEDs detected by a Nintendo^{TM} Wii-controller attached to the HMD. This system captured the hands orientation, and could thus instantiate a virtual hand inside the VR-simulation (fig. 1). Furthermore, another Wii-controller was attached to the participants leg (dubbed Walk'n Choose), in order to facilitate locomotion through detection of changes in orientation**.** The Find'n Grab glove was used to imitate the movement of the hand to choose products. The Walk'n Choose leg sensors was used to allow test persons to imitate real walking. The VFCS utilized custom-built wearable technology to permit the user to interact with the virtual world.

Figure 2: The second iteration of the VFS using the Oculus Rift DK2 and the Leap Motion technology to facilitate interaction with a virtual supermarket-shelf.

To allow for a more robust and versatile tool, the focus has been shifted towards more readily available technology that does not entangle the user in wires (Fig. 2). Thus, the VFCS has since been developed into a 2nd generation of the technology - the VFS program. Overall, we consider the VFS to be more scalable and flexible for both measuring food choice, virtual design of food outlets at different levels, as well as a learning tool in a gamified version for pupils in home economics.

The VFS equipment includes an Oculus Rift™ Developers Kit 2 (DK2) VR-headmounted display (HMD), a LEAP Motion hand-motion tracker, and a custom-built VR-ready computer. Both the simulator and the gamification are created using the Unity3D open-source game engine, version 5.3. The system utilizes Walking-In-Place (WIP) techniques, detected by contact-microphones, to facilitate virtual locomotion. Finally, the LEAP Motion is used to track the user's hands, and visualize them in the virtual world. The ultimate VFS will have the ability of fast prototyping of random foodscapes as 3D worlds with various degrees of interaction. Log data is available for download that will help analyse behaviour of users within the aforementioned 3D foodscapes.

State of the art

Virtual reality (VR) has experienced an increase in interest across many different areas, and although the concept has been around since as early as 1962 with the development of the Sensorama (Sensorama, 1962); it has experienced a second wave initiated by the crowdfunded success of the Oculus Rift. Major companies have invested their finances to create VR-solutions for the consumers, including Google (Google Cardboard), Samsung (Gear VR) and finally Valve and HTC partnered up to create a high-end VR experience with their upcoming release of their HTC Vive.

To achieve a true to life virtual environment (VE) in which consumer behaviour can be tested, it is essential that this environment is accepted by the user. Thus we must create a VE that facilitates realistic response. According to Mel Slater, a professor of virtual environments at UCL, this response is the end goal; several steps that allow to achieve a realistic response, i.e., response-as-if-real, are described in (Slater, 2009).

The sensation of presence can be divided into four overall categories i.e. the place illusion (PI), which offers a sensation of "being there", and plausibility illusion (Psi), which is the sensation that the environment offers a realistic response (Slater, 2009). Lastly, presence can be enhanced by introducing a virtual body, while immersion and sensorimotor contingencies relates to how well the technical system enforces and "recreates" our senses (e.g. vision, touch, proprioception) in the VE (Slater, 2009).

Technologies that allow for interaction in such a way that it is possible to track actions of the users such as reaching, pointing, grasping and walking, and map such actions to corresponding events in the virtual world are not a new thing. However, they have developed in such a way that this sensation can be enhanced with auditory feedback, since interactions with hard objects produce audible sounds. In the field of virtual supermarkets and virtual buffets, most of the simulations are Web based and allow limited interactions with the available objects. In this project we are interested in exploiting the state of the art research in virtual reality and multimodal interaction, in order to create a faithful simulation of the act of grocery shopping or selecting food at a buffet.

Discussion

The experiences with the VFS approach so far is that it is a good demonstration of the potentials of virtual food realities as well as the challenges related to interdisciplinary work. The first version of the foodscape simulator was developed by students from Medialogy and Integrated Food Studies in the context of the Multisensory Experience Lab and Foodscape lab. In the further development of the device the VFS team will perform a high impact stress test and develop the technology and test it in non laboratory settings. The set-up for the first generation of the device is shown in Fig. 1. The 2nd generation VFS is currently in development. As a next step, the VFS will be tested in a experiment investigating the role of staging on FV choice at a buffet and in retail check out aisles and this part is intended to validate the method against a real food experiment with real subjects. Furthermore the VFS project includes a gaming part (Shop4Health), which aims to test the VFS and its potential to develop nutrition and consumer education tools for young people. The idea is to create a gamified virtual food reality that can be used as a teaching tool for young people in home-economics. The target audience is elementary school children in the age range 11-12 years old.

Acknowledgements

This paper has been made possible through the support from the dVices4food and Foosions program. The dVices4food has been supported by the Danish Agency for Science, Technology and Innovation and the Foosions has received funding from the Aalborg University matchmaking program. The authors wish to thank Ilja Rieki, University of Eastern Finland, Nanna Nymand, Metropol University College and Kristian Bunker from Bunker 43 for fruitful discussions during the preparation of the manuscript.

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