
Augmented Reality Television

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Abstract

Augmented reality (AR) has shown potential in creating engaging entertainment experiences for the general public. In this paper we take a user-centred design approach to a specific case of AR entertainment, specifically AR TV hybrid experience. We first investigate the passive AR TV viewing experience by adding AR artefacts to an existing TV programme. A prototype was implemented augmenting a popular nature documentary. Synchronised content was delivered using a Microsoft HoloLens and a TV. We evaluated the prototype with a user-study (n=12). Our results suggest adding AR artefacts to an existing TV programme can create an engaging user experience. We propose a hackathon and subsequent prototyping of an original short piece of AR TV to explore stakeholder expectations, in particular content creators and early adopters. Findings from this body of work will help TV content creators in producing engaging experiences that leverage AR's properties.

Author Keywords

Augmented Reality; TV; User Study; User Engagement; User Experience.

CCS Concepts

•Human-centered computing → Human computer interaction (HCI);

Introduction

Augmented reality (AR) has been researched and applied in industrial, military and medical settings extensively. The primary contribution of AR in these settings is increased efficiency by reducing task completion time [3], error rates and mental effort [8]. Although AR has obtained some success in gaming, its application in entertainment for the general population has been largely ignored in the research community and in practice. One potential use-case for AR in everyday life is to use it to enhance TV viewing. We found two studies that have looked at this use-case [4, 2]. However, their work is primarily technology driven and fails to take into account viewer's expectations, needs and experience. We aim to understand how and when to use AR, in the TV viewing context, to create an engaging viewer experience. Some of our research questions under consideration are:

RQ 1 How should AR be combined with TV to create an engaging experience?

RQ 2 Which of AR's properties, and to what extent, can be used in the AR TV hybrid?

Further unpacking RQ 2, we consider two of AR's main properties as outlined in [1]. Namely *interactivity* and *registration* of virtual objects to the real environment.

RQ 3 How much and what type of *interactivity* with the virtual content is desirable in AR TV?

RQ 4 How can *registration*, or lack of it, be leveraged to enhance the user experience in AR TV?

This research will create a set of guidelines for the AR TV hybrid. The TV content creators can use these guidelines to help design and produce engaging AR TV experiences.

Methods and Progress

We take a user-centred design approach to understand the requirements and needs of stakeholders. To get an initial understanding of the possibilities provided by the technology, we created a prototype of AR TV and evaluated it with a user study (n=12).

Prototype

The prototype implemented HbbTV 2.0 [6] to deliver synchronised content via a TV screen (the main content) and a Microsoft HoloLens (AR artefacts). The main content was a video clip from the BBC's Blue Planet programme following the activities of a female sea turtle. The AR content consisted of:

- 1) Two virtual screens, either side of the TV. One showing a 2D map of Australia with the Great Barrier Reef marked. The other showing information about artefacts due to appear.
- 2) A life-size virtual human male with idle animation, sitting on a real armchair in the viewer's environment, who appears to look at the TV screen and makes eye contact as the viewer looks at him.
- 3) A set of AR artefacts related to the main content. Corals, a shoal of parrot fish and a life-size sea turtle. The parrot fish and the sea turtle were animated and move towards the viewer as the story unfolds.

Figure 1 shows screen shots of the AR TV experience.

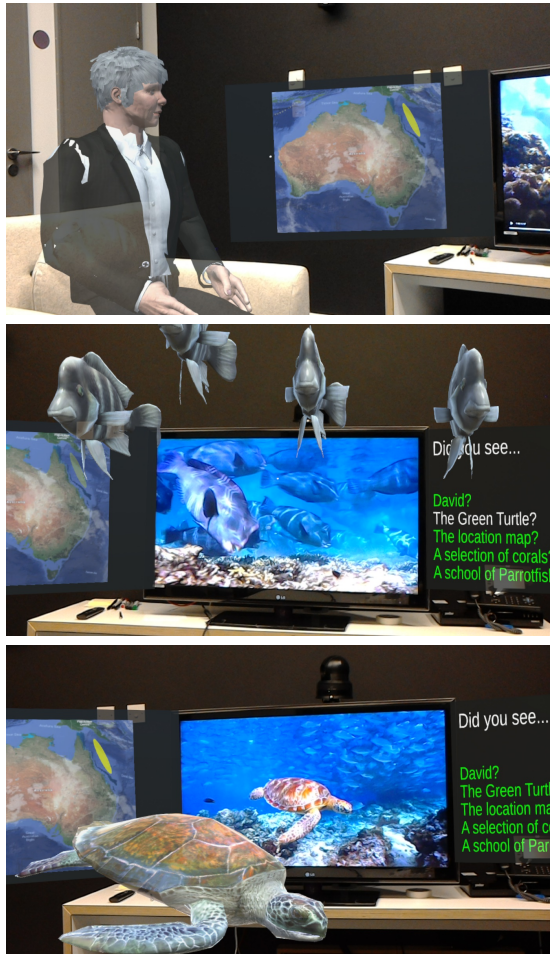


Figure 1: Screen shots of the AR TV experience.
Top: virtual male human. Middle: Shoal of virtual parrot fish.
Bottom: Virtual sea turtle.

User Study

Twelve participants were recruited from the BBC R&D staff, each providing informed consent at the beginning of the session. Each session lasted approximately one hour and consisted of a brief introduction to the research, familiarisation with the HoloLense, viewing the AR TV experience, answering two questionnaires and a semi-structured interview.

We used the User Engagement Scale Short Form (UES-SF) and the User Experience Questionnaire (UEQ).

The UES-SF contains twelve items and measures six dimensions (*aesthetic appeal*, *focused attention*, *perceived usability*, *rewards* and *overall engagement*) on a 5-point Likert scale [7].

The UEQ contains twenty six items and measures six dimensions (*attractiveness*, *perspicuity*, *efficiency*, *dependability*, *stimulation* and *novelty*) on a 7-point Likert scale [5].

The interviews were recorded, transcribed and qualitatively analysed.

Results

UES-SF results indicate an overall high engagement score. Most people scored close to the median on *aesthetic appeal* with a few outliers. Spread for *focused attention* and *reward* was much larger [Figure 2].

UEQ results indicate a large spread for *perspicuity*, *stimulation* and *novelty*. These results suggest a tight agreement for *efficiency* and *dependability* on the neutral value [Figure 3].

Overall the questionnaire results suggest that an engaging experience was created. The neutral scores of *efficiency* and *dependability* suggest that these dimensions were not

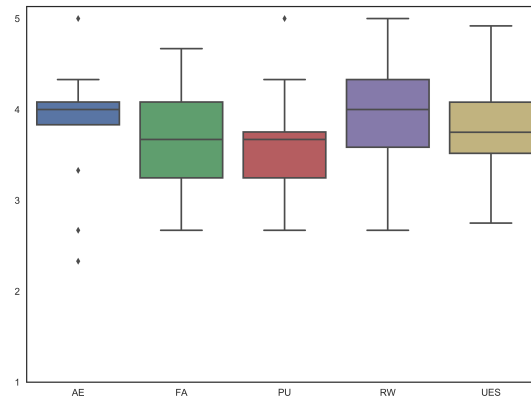


Figure 2: Aesthetic Appeal (AE), Focused Attention (FA), Perceived Usability (PU), Reward (RW) and overall engagement (UES) score distributions for the UES-SF.

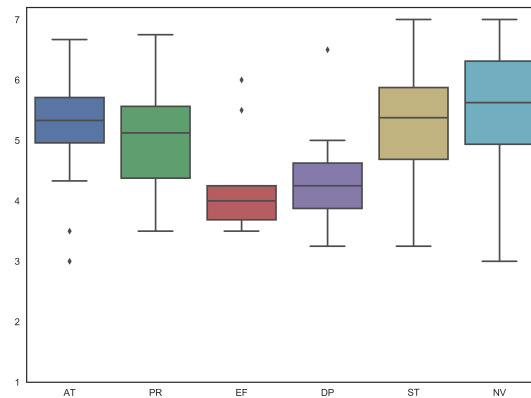


Figure 3: Attractiveness (AT), Perspicuity (PR), Efficiency (EF), Dependability (DP), Stimulation (ST) and Novelty (NV) score distributions for the UEQ.

considered in the design of the experience.

Interview transcripts were analysed qualitatively. There was overall agreement on the novelty of the experience. In general, the fear of missing content (either TV or the AR) was a common theme in the interviews. We found that, if not cued properly, AR content can be missed which subsequently can reduce engagement levels. This leads to our first putative guideline:

Guideline For AR content that appears outside the field of view, an appropriate cueing mechanism is required to orient viewer's attention.

Future Work

We propose collecting findings from existing user-centred AR literature and our own study to synthesise a set of putative guidelines. Next, we will test our suggested guidelines using a short piece of AR TV content written and designed from scratch. We aim to elicit the narrative for this original content using a hackaton event with potential stakeholders such as film makers, screen writers and game designers as participants.

Summary

AR's potential in entertainment has not been fully explored. We looked at a use-case; augmenting an existing TV programme with AR. Our preliminary findings suggest that a novel and engaging experience can be created by applying AR to TV. We suggest creation of guidelines and their subsequent evaluation by creating an original piece of AR TV.

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