



Unified Physical and Digital Experiences: Exploring Art and Digital Media via Augmented Reality Interface

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Abstract

Advancement in human computer interaction technology has transformed our world to become increasingly connected and interspersed with digital media and information. This has given rise to a new form of environment called 'mixed reality' that opens a hybrid landscape for artists, designers and researchers to explore in creative and innovative ways. This paper presents the development of a framework for creating immersive augmented environments and showcases two of my Augmented Reality (AR) projects, exURBAN Screens and MADA AR Posters. Both projects explore augmented interactions with smart devices, focused on human-computer interactions and human-real world interactions. The projects utilize contextually and geographically aware artistic AR contents and code design. These projects demonstrate the successful use of a Mixed Reality framework for employing augmented interaction methods with smart devices in exhibitions and public environments. Developing video see-through display technologies such as AR glasses and other wearable smart devices are expected to take this experience to new heights. I can envision future environments becoming increasingly hybridized and fused, employing augmented interactions to enhance our sensory perception of the environment through computer mediated reality. This will create new pathways for sharing information and promote new forms of digital media and art. The paper concludes with my project findings and a vision for future development.

Keywords

Augmented Reality, augmented interaction, Mixed Reality, hybrid environment, digital media, art, smart device, computer-mediated reality

Introduction

Human beings rely on their senses to perceive the world around them. Our everyday experiences rely on our cognition and perception of reality. Jaron Lanier, CEO of VPL, coined the term 'virtual reality' (VR) [1] which was popularized by others [2, 3] and is now widely used. Descriptions of VR include the notion of both electronically simulated environments and of 'goggles 'n' gloves' systems that act as a personal interface for exploring virtual environments [4]. VR is used to enhance human-computer experiences and facility expanded

perceptions of reality. In contemporary life, advanced smart devices such as iPhones, Android phones and tablets enable us to interact with computer-mediated environments in more creative and innovative ways than those envisioned in the early days of 'virtual reality'. Furthermore, our view of real and virtual worlds have started to blur with the advent of computers and the internet. We now associate virtuality with everything that is computer-generated or that exists in cyberspace. This is a simplistic view of virtuality, which can be considered more deeply as images that form part of the imagination, rather than the objects from which images are derived. In recent years, the separation of real and digitally derived images has started to disappear, with the emergence of hybrid environments. My primary research interest is in exploring the relationship between humans and smart devices such as video see-through displays, and focusing on not only human-computer but also human-real world interactions within the domain of mixed reality environments.

Creative Inspiration

I have been greatly influenced by works in different fields of the humanities, particularly philosophy, aesthetics, linguistics and anthropology. These areas of research explore humans and their relationship with physical and conceptual realities. I feel it is necessary to understand human cognitive abilities and their perception and representation of the real world in order to design a mixed reality environment that is immersive and aesthetically appealing.

Mixed Reality (MR) provides creative ways to add together real and virtual worlds [5]. It can be observed in many spaces such as digital billboards and movies. MR is often discussed in view of the technological and visual display aspects, however, it is more than just a display technology. In my design approach, I refer to MR as a transformative tool and propose MR as an aesthetic metaphor for both human-computer interactions and human-real world interactions. MR can support interactive and responsive environments and has the potential to enrich human experiences through interactive computer-generated contents. It utilizes virtual information to aid

multisensory perceptions of human environments.

To address this concept, I refer to the definition from Migram's 1994 classification of real and virtual environments [5]. Figure 1 expresses the levels of reality-virtuality overlap.

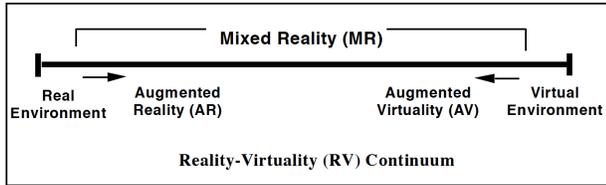


Figure 1. Simplified representation of a RV Continuum

Reality is at one end of this continuum virtuality is at the other. In between the two are AR and Augmented Virtuality (AV). Many key developments are taking place in two domains: AR and Virtual Environment (VE). AR has been used to supplement real world objects with information, through techniques such as QR, AR codes and products like Google Glass. By contrast, AV consists of virtual worlds like Second Life, or other game environments that employ some representation of real world objects [6, 7] such as a live video stream projected onto the surface of a virtual object.

This classification is useful for categorizing implementations of digital technology but the concepts of reality and virtuality can also be considered as images inside the human imagination. The human imagination represents real world objects as images, and their construction can come from transformations of existing images. Following the conceptual model developed by Brian Massumi [8], the virtual is also a product of 'topological transformations' of images in the imagination. This view of the real and virtual shows them as being conceptually tied and not opposing ends of a continuum, however this paper is concerned with the mixture of digital content and the physical environment so the term 'virtual' is used in the context of digitally constructed content.

The difference between AR and AV can be understood by how the world is represented through computer-generated images using AR and AV. AR and AV aim to create different forms of environment using computer generated imagery. The interaction between human, computer, and environment can be seen more clearly through the perspective of Jun Rekimoto's diagram [9] in Figure 2. This model allows for dynamic forms of interaction between people and real world environments. At the same time it allows for human-computer and computer-real world interactions as seen in the Augmented Interaction diagram. It is an open model that shows potential effects over a range of experiences, resulting from the combination and manifestation of human, computer and real world interactivity.

Paul Milgram and Fumio Kishino have defined three key factors for the level of immersion in AR [5, 6]:

- Extent of Presence Metaphor (EPM): The extent to which a person feels immersed in a virtual or augmented environment.
- Extent of World Knowledge (EWK): A measure of the level of information that the simulation or AR environment possesses regarding the real world objects so that it can blend into the real environment.
- Reproduction Fidelity (RF): The accuracy with which physical world objects are represented in Augmented reality. The higher the fidelity, the better the representation of physical objects.

Synopsis

This section describes part of my ongoing PhD practice-based research. Specifically it outlines two projects that utilized practical applications of AR that I undertook in the last three years.

My first AR project, *exURBAN Screens*, undertaken in 2012 in partnership with the City of Frankston, the Frankston Arts Centre and Monash University in Australia. My role as an interaction designer and researcher in this collaboration was as follows:

- To investigate the usage of smart devices based on consumer AR tools such as Layar, Junaio, Google Goggles, and Wikitude
- Development and design of an AR mobile application to support the festival program
- Design a special edition AR exhibition of artworks by Brian Alfred
- To enhance the visitor's experience using the AR application by providing a digital tour guide

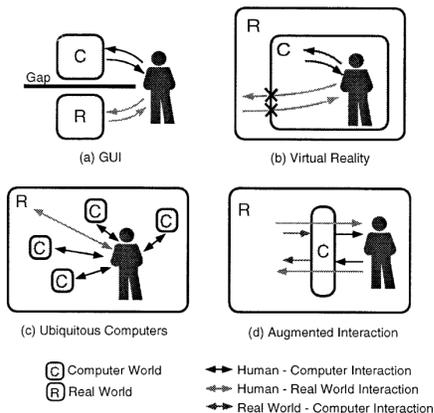


Figure 2. A comparison of HCI styles

My second AR project, *MADA AR Posters*, was undertaken at the Monash University Caulfield campus in Australia for their 2012 open day. The project comprised of AR posters designed by John Warwicker that displayed artwork from different students and faculty members. The art was separated into two categories. Physical and digital works. The physical works consisted of 12 posters, displayed on a glass wall. The augmented version of each poster was viewable on user's display by using a custom made AR application for smart devices. The major goals of this exhibition were:

- Redesign and revamping of the faculty (MADA) / department site-specificity and identity
- Exploration of art in an AR environment [10]
- Promotion of the department's vision and academic endeavors

Framework of Mixed reality in Exhibition and Public Environment

My approach to augmented reality design is two pronged. It suggests a design perspective and information-centric view. The information-centric view involves GPS data, image processing and dynamic content while the design view focuses on the combination of digital media content with artistic expression. This systematic approach supports the creation of a new form of AR mobile application by considering how to communicate effectively with state-of-the-art techniques and how to design interactive digital contents.

Design Model

When designing two AR projects I adopted two slightly different model approaches based on the development of the framework.

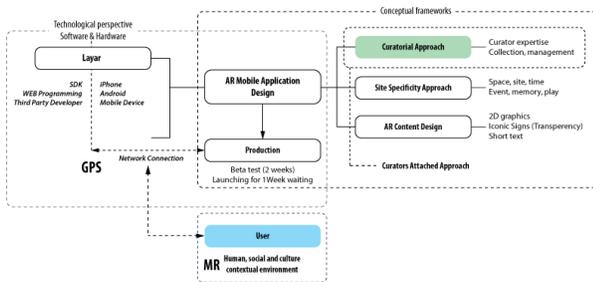


Figure 3. The design model for exURBAN Screens project

exURBAN Screens focused on AR design in the context of site-specificity such as outlined by Miwon Kwon [11]. Kwon defines site-specificity as a tactic or critique of the institution: of the museum/ gallery space. She further describes it as a phenomenological model of “lived bodily experience” as a cultural framework [11]. To explore these

concepts in interaction design, I integrated reinterpretation of AR as a process of hybridized images from the real and the virtual defined by Massumi [8] into a form of smart device application design. The application displays not only an artistic expression of their artwork but also disseminates detailed information about the artist and interpretations of the artwork. This site-specific content is triggered by users actions such as finding a new relevant site. The design utilized PGS data and real-time event information for the creation of the AR environment.

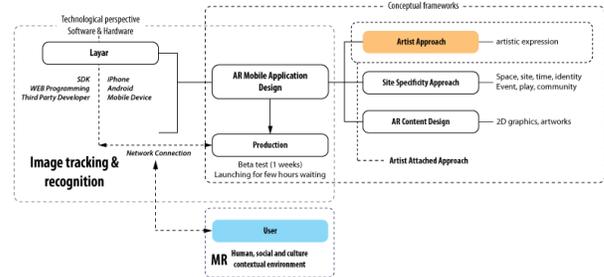


Figure 4. The design model for MADA Posters project

MADA AR Posters: This project was planned for Monash University Open Day. It was a combination of a marketing approach and creative communication method to show the University's identity and campus space. The design focused on highlighting various events and displaying artistic works with image tracking and recognition. My goal was to unify a collection of diverse designs and artworks from staff members and students to reveal a more consistent identity of the University. It was also important to carefully consider the space, through which many visitors would pass. To develop the design concept I referred to Jeff Kelly's concept of 'place' and 'space'.

According to Kelly, site (or space) represents the physical characteristics of an area, like its location, mass, light and material processes, whereas place represents the practical, social, cultural, psychological and historical dimensions [12]. I hold a similar view of the distinction between space and place. 'Space' refers to a physical location, that is, a visible, measurable and quantifiable area, whereas 'Place' refers to the symbolic, historical or social meaning associated with a particular location. Place is subjective to an individual or group of individuals, and therefore can be a crucial factor in the creation of an identity.

There are common themes underlying both of these projects:

- The integration of art and information expressed in a mixed reality environment
- The use of the latest readily available technologies to improve and enhance the viewers experience

- The concept of digital 'flâneur' [13] or Urban Explorer, where the viewer is both an observer and a participant in the event
- Geographically and contextually aware design, which blends the augmented information with the environment and the event

Design Outcomes from AR Mobile Projects

Figure 5. and Figure 6. show captured screens from two AR applications running on smart devices.

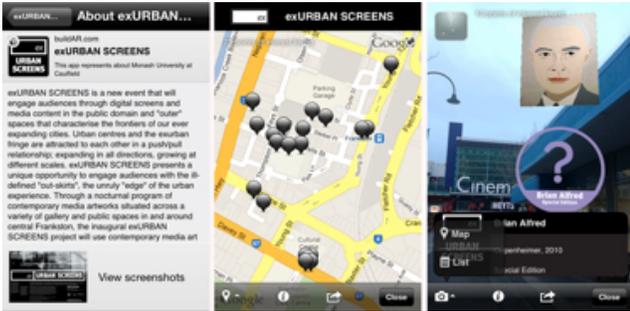


Figure 5. Images from exURBAN Screens application

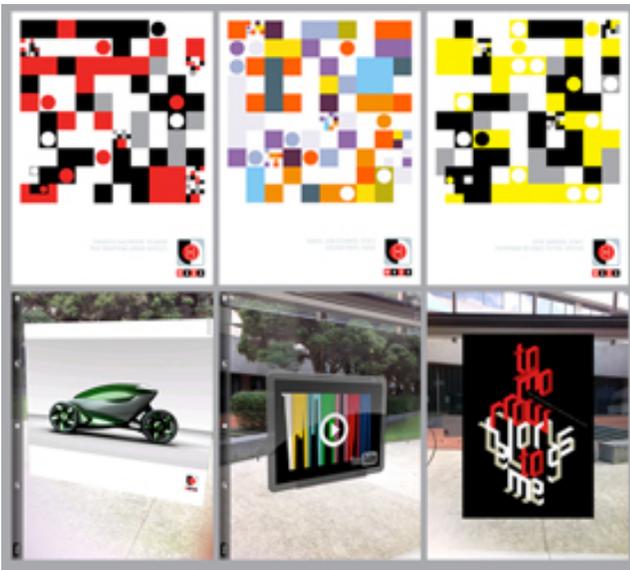


Figure 6. Images from MADA AR Posters and screens from AR application

Conclusion and Further Research

Overall the AR projects were a success. Based on user feedback gathered on-site via face-to-face conversations, both of these projects provided valuable information by creating interactive experiences and providing an entertaining interface. In order to produce rich augmented interactions in mixed reality environments, the effective use of multimedia content and technical tools are required to be used in an appropriate way. Unique, creative AR contents and physical artistic code design is aesthetically appealing to the user's augmented interactions. However,

the important foundation of AR interface construction is the creation of a hybrid physical-digital place. A place that includes audience, inter-audience communication, interaction with digital information and artistic expression. Thus, the objectives of AR is not just to replace the real world with digital content, however, it should consider creative, new means of communication and interaction to enhance the user experience in real-time.

In future works I am to further explore the outlined framework for producing augmented interactions in dynamic and increasingly connected environments. These explorations will come in the form of computer mediated exhibitions or/and public places that provide new interactive experiences with the aim of creating unprecedented opportunities for AR artists, designers and researchers.

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