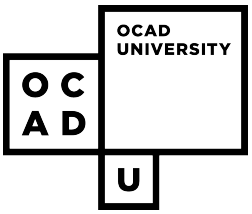

The Red Carpet Experience

A video based spatial augmented reality platform

by Demosthenes Kandylis

A thesis presented to OCAD University in partial fulfillment of the thesis requirements for the degree of Master of Design in the Digital Futures Program.

Toronto, Ontario, Canada, April 2014

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The Red Carpet Experience: A video based spatial augmented reality platform

2014

Demosthenes Kandylis

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Abstract

This research investigates screen based public space experiences that require little to no verbal or written instructions. The purpose of the research was rooted in observations and experiences developing screen based interactive and reactive public space installations for commercial use in the fields of marketing and advertising. The research initiated with an experimental prototype called "Walk The Red Carpet", which evolved through experimentation into a platform for video based spatial augmented reality (SAR) experiences. Using the research approach of reflective practice, the first prototype was followed by a review of applicable concepts in the field of human computer interaction (HCI) and related social and cognitive psychology. The findings of this research, which are summarized and the conclusion of this work, is that video based SAR that effectively embodies the user's form in the experience requires little or no written or verbal instructions in order for users to engage.

Dedication

For my son, my wife and my parents.

Table of Contents

LIST OF TABLES & FIGURES ..... **VIII**

BACKGROUND & MOTIVATION **1**

HYPOTHESES & RESEARCH QUESTIONS **2**

HYPOTHESES 2

RESEARCH QUESTIONS 2

RATIONALE **3**

RESEARCH APPROACH **5**

KEY CONCEPTS & TERMS **8**

HCI 8

AUGMENTED REALITY 9

EXPERIENTIAL MARKETING 10

LITERATURE REVIEW & RESEARCH IN THE AREA **12**

USER BEHAVIOR & USER ENGAGEMENT 13

Intuitive Interaction and Dual Process Theory *13*

Affordances *14*

Presence *15*

Telepresence *15*

Context *18*

Embodied Interaction *21*

Behavioral Confirmation *22*

Proteus Effect *23*

Immediacy *23*

Hypermediacy *24*

INTERACTION FRAMEWORKS 25

Audience Funnel *25*

A Framework for Interaction Phases *27*

Implicit Interaction Framework *30*

Activity Spaces *31*

Elements Of Engagement *32*

DISCUSSION 35

RELEVANT IN-THE-FIELD PROJECTS 40

Hand From Above – Chris O'Shea *41*

Coca-Cola and WWF help conserve the Arctic Home – Appshaker *42*

Time Square Dunk Tank – Juxt *43*

Discussion *44*

CONCLUSION 45

RED CARPET EXPERIENCE PROTOTYPES 46

PROTOTYPE 1 – WALK THE RED CARPET 47

PROTOTYPE 2 – ELEO 52

PROTOTYPE 3 – TOUCH SCREEN OPERATED EXPERIENCE 55

PROTOTYPE 4 – SMS OPERATED EXPERIENCE 55

EXPERIMENTS 56

PARTICIPANT SELECTION 57

EXPERIMENT 1 60

EXPERIMENT 2 61

EXPERIMENT 3 62

DATA ANALYSIS 64

VIDEO REVIEW 64

Comparison 65

Experiment 1 65

Experiment 2 65

Experiment 3 66

FINDINGS 66

REFLECTION 68

CONCLUSION 70

FURTHER RESEARCH & WORK 71

REFERENCES & BIBLIOGRAPHY 73

APPENDICES 76

APPENDIX A - PREVIOUS WORK 77

Coca Cola – SAR Proof of Concept 77

APPENDIX B- RED CARPET PROTOTYPE SETUP 80

Walk The Red Carpet 80

APPENDIX C – QUESTIONNAIRE 91

Questionnaire 91

APPENDIX D – REB APPROVAL 95

List Of Tables & Figures

Figure 1: The progression of Economic Value (Pine & Gilmore, 1998) 4

Figure 2: Figure 2: Economic Distinctions (Pine & Gilmore, 1998) 4

Figure 3: Theory Building & Testing (Vaus, 2001) 6

Figure 4: Research Approach 7

Figure 5: Reality-Virtuality (RV) Continuum (Milgram et al 1995) 9

Figure 6: Perception, Intuition, Reasoning (D Kahneman, 2002) 13

Figure 7: Audience Funnel (Michelis & Müller, 2011) 26

Figure 8: Implicit Interaction Framework (Ju & Leifer, 2008) 30

Figure 9: Three Activity Spaces (Brignull & Rogers, 2003) 31

Table 1: Comparison of engagement attributes 40

Figure 10: Chris O'Shea - Hand From Above installation 41

(http://www.todayandtomorrow.net/2009/10/15/hand-from-above/)

Figure 11: Appshaker - Arctic Home Installation 42

(http://www.arlab.nl/media/ar-advertising-campaign-coca-cola-and-wwf-appshaker)

Figure 12: Juxt – Time Square Dunk Tank 43

(http://www.behance.net/gallery/Times-Square-Dunk-Tank/4564697)

Figure 13: The Red Carpet Experience (Illustration by Steve Wilson) 44

Figure 14: Reference Grid and Camera Setup 46

Figure 15: Tablet Application Interface 49

Figure 16: Final Booth Setup (Illustration by Cris Mora) 50

Figure 17: IDEO participant selection (Ideo & Bill & Melinda Gates Foundation, 2011) 58

Table 2: Comparison of the Red Carpet Experience Prototypes and Experiment 3 65

Table 3: Data collected during Experiment 1, broken down by user groups 65

Table 4: Data collected during Experiment 2, broken down by user groups 65

Table 5: Data collected during Experiment 3, broken down by user groups 66

Figure 18: Coca Cola Proof Of Concept Rendering (Illustration by Steve Wilson) 77

Figure 19: Reference Grid (Illustration by Cris Mora) 80

Figure 20: Grid Setup 81

Figure 21: Camera Setup 81

Figure 22; Camera Height 57cm 82

Figure 23: Camera Height 83cm – This camera height was used 82

Figure 24: Proposed Booth Setup 1 (Illustration by Cris Mora) 83

Figure 25: Proposed Booth Setup 1 - Alternate View (Illustration by Cris Mora) 83

Figure 26: Proposed Booth Setup 2 (Illustration by Cris Mora) 84

Figure 27: Proposed Booth Setup 3 – This setup was used (Illustration by Cris Mora) 84

Figure 28: Tablet Application Interface Concept 1 (Illustration by Cris Mora) 85

Figure 29: Tablet Application Interface 1st Draft (Illustration by Cris Mora) 86

Figure 30: Tablet Application Interface Concept 2 (Illustration by Cris Mora) 87

Figure 31: Tablet Application Interface 2nd Draft (Illustration by Cris Mora) 88

Figure 32: Tablet Application Interface 3rd Draft (Illustration by Cris Mora) 89

Figure 33: Final Tablet Application Interface (Facebook share not shown) 90

Table 5: Aggregated Questionnaire Results for "Light" users 92

Table 6: Questionnaire Results for "Light" users broken down by Experiment 92

Table 7: Aggregated Questionnaire Results for "Regular" users 93

Table 8: Questionnaire Results for "Regular" users broken down by Experiment 93

Table 9: Aggregated Questionnaire Results for "Expert" users 94

Table 10: Questionnaire Results for "Expert" users broken down by Experiment 94

Figure 34: REB Approval Letter 95

All figures and tables created by the author unless otherwise stated.

Background & Motivation

This section describes my background and explains the motivation that led to my research into ways of creating screen based public space installations that don't require a lot of verbal or written instructions for users to engage.

My background is in HCI. For the past 15 years I have been designing and developing interactive systems for commercial clients in Europe and North America as a consultant and I currently serve as the Chief Innovation Officer at a Toronto based experiential design studio that I founded in 2002. Most of the public space projects that I have worked on in the past were entertainment or infotainment related for advertising agencies and large brands as well as a few art projects. I produced commercial interactive installations for Google, Harper Collins, Mini and Sapporo among others.

During the development of these installations the problem of how to create experiences that have a low entry barrier for users was a recurring topic that was frequently discussed with clients and peers. The most common issue that was raised was the need for extensive instructions to users that negatively affected the seamlessness of the experience. Finding ways to solve this problem was the inspiration for my research.

Hypotheses & Research Questions

This research is grounded in an in-the-field deployment and evaluation of several video based spatial augmented reality (SAR) prototypes. The hypotheses and associated research questions were a result of the observations of these in-the-field deployments.

Hypotheses

1) Video based SAR that embodies the user's physical form in the experience provides a low entry barrier for users to engage with content in a public environment.

2) Users will interact with non-interactive content in video based SAR applications that embody the user's physical form in the experience provided that the experience is designed accordingly.

In order to test the hypotheses the following research questions were developed.

Research Questions

a) Is embodying users physical form in an experience an implicit call to action?
b) Do users act on non-verbal cues from non-interactive characters in such experiences?
c) Does the context where such experiences are staged have an impact on effective engagement?

Rationale

"Digital signage will soon appear in every aspect of daily life, offering a third foundational platform that, along with smart-phones and tablets, will support communication in the 21st century"

(Want & Schilit, 2012)

The Digital Out Of Home (DOOH) ("Outdoor Advertising Association of America, Inc. > Out of Home Advertising > OOH Glossary of Terms," n.d.) or Urban Digital Media (UDM) (Barker & Haeusler, 2010) market increased 11.4% to US$7.88 billion in 2012 globally ("Global Digital Out-of-Home Media Forecast 2013-2017," n.d.), is expected to triple by 2016 (Want & Schilit, 2012). A recent study showed that marketers and advertisers continue to increase spending on experiential marketing and event technology year over year and that event technology spending has been outpacing industry growth (Event Marketing Institute & Mosaic Experiential Marketing, 2012). This combined with the cost of display technology dropping (Kinetic Worldwide, 2012) and powerful, cheap consumer devices, like the Microsoft Kinect ("Kinect - Xbox.com," n.d.), that can track people's gestures and position in 3D space in real time supports Want and Schilit's view that there will be an increase in interactive DOOH advertising in the coming years (Want & Schilit, 2012). Interactive DOOH is just one aspect of a larger economic shift towards experiences. Pine & Gilmore suggest that there is a transition from the service economy to the experience economy (Pine & Gilmore, 1998). They first introduced the term *"Experience Economy"* in

1998 and defined it as *"staging meaningful events to engage customers in a memorable and personal way"* (Pine & Gilmore, 1998).

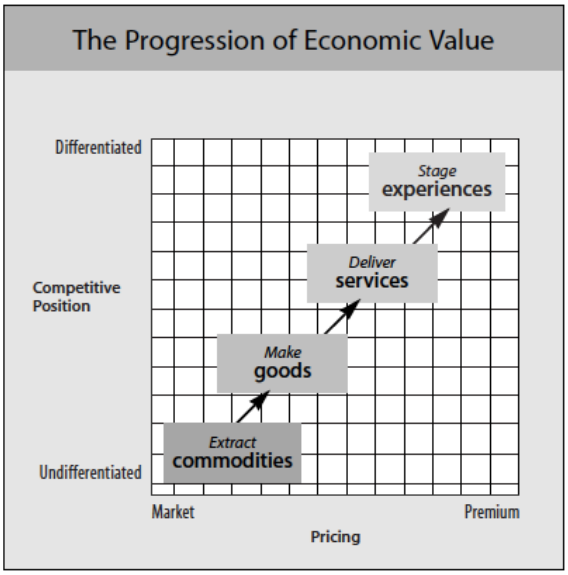

Figure 1: The Progression of Economic Value (Pine & Gilmore, 1998)

Economic Distinctions

Economic Offering	Commodities	Goods	Services	Experiences
Economy	Agrarian	Industrial	Service	Experience
Economic Function	Extract	Make	Deliver	Stage
Nature of Offering	Fungible	Tangible	Intangible	Memorable
Key Attribute	Natural	Standardized	Customized	Personal
Method of Supply	Stored in bulk	Inventoried after production	Delivered on demand	Revealed over a duration
Seller	Trader	Manufacturer	Provider	Stager
Buyer	Market	User	Client	Guest
Factors of Demand	Characteristics	Features	Benefits	Sensations

Figure 2: Economic Distinctions (Pine & Gilmore, 1998)

Smilansky also sees experience as the differentiator for brands since competitive brands are positioned similarly in their product offerings as well as in their added-value services to their products like free delivery (Smilansky, 2009). With no other points of differentiation price becomes the only differentiator, which is not a desirable scenario, hence the turn to experience (Smilansky, 2009). Event and experiential marketing companies have experienced double-digit growth again in 2012 after the recession slowed everything down in 2007 (Event Marketing Institute & Mosaic Experiential Marketing, 2013), which seems to support Pine and Gilmore's as well as Smilansky's view.

The combination of these two drivers, the increase in DOOH and the growth of the experience economy, indicate that an influx of engaging content in public spaces can be expected in the near future. This research is aimed at providing insights into how to enable instruction-free engagement with such content.

Research Approach

This research employs two main approaches, reflective practice (Schön, 1983) and research-oriented design (Fallman, 2003). Reflective practice and observations during the staging of the first prototype led to the formulation of the initial hypotheses and the related research questions as depicted in the theory building approach in Figure 3. This was followed by a research-oriented design approach, in conjunction with a survey of relevant work in the field of public space HCI and related social and cognitive psychology as well as

review of projects employing SAR for marketing and advertising. This resulted in a number of iterations of the first prototype and experiments related to the embodiment of the user's physical form inside the experience and it's effect on user engagement. Observations, video analysis and questionnaires were used to gather and analyze data based on a set of propositions. The results were then used to infer if the hypotheses could be confirmed or not. Figure 4 depicts the overall research approach that was employed.

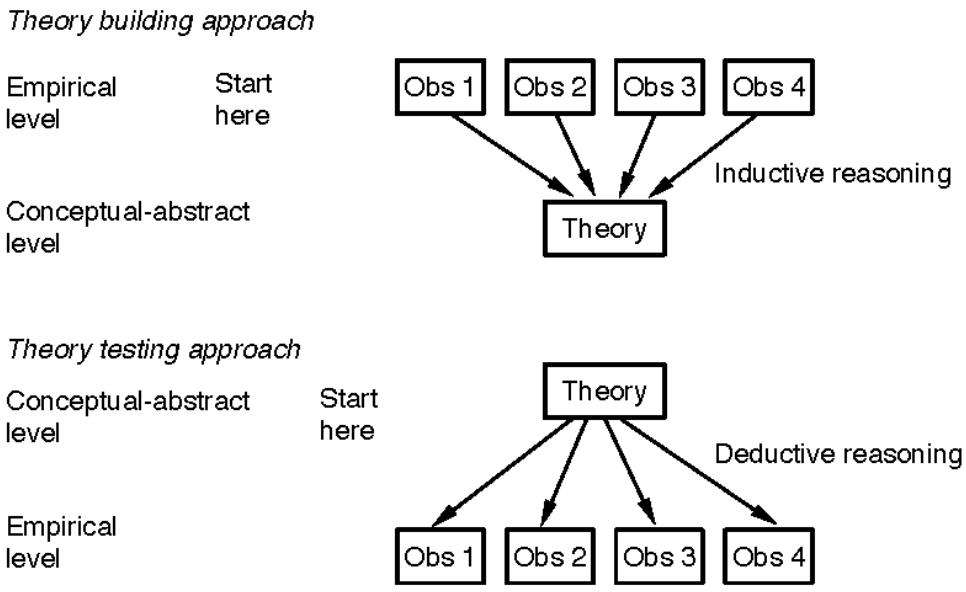

Figure 3: Theory Building & Testing (Vaus, 2001)

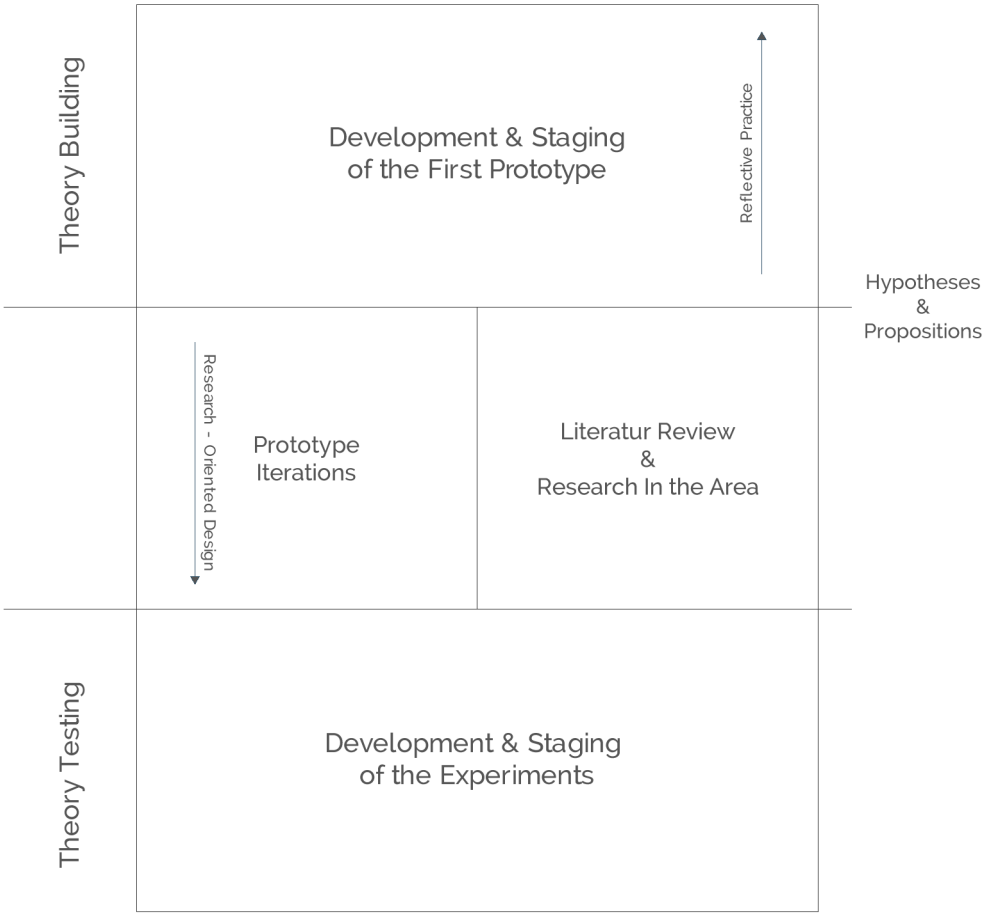

Figure 4: Research Approach

Key Concepts & Terms

In this section HCI, augmented reality and experiential marketing are being discussed. These are key concepts and terms that are used throughout this document in relation to this research.

HCI

HCI is a fragmented discipline and there is currently no agreed upon definition for what disciplines are included in the field. The Curriculum Development Group of the ACM (Association for Computing Machinery) Special Interest Group (SIGCHI) on HCI provides this working definition *"Human-computer interaction is a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them."* (Hewett et al., 1996, p. 5). The HCI Handbook describes it as covering four major research disciplines, human factors, information systems, computer science, and library & information science (Grudin, 2008) and Harrison et al. suggest that engineering/human factors and cognitive science have formed the field (Harrison, Tatar, & Sengers, 2007). All these definitions are valid, but it is important to point out that there are many different views of what HCI encompasses, that the field is in a constant state of change and that it is not fully defined. For the purpose of this research the ACM's definition will be used when referring to HCI.

Augmented Reality

The Oxford dictionary defines augmented reality as

"A technology that superimposes a computer-generated image on a user's view of the real world, thus providing a composite view."

According to Azuma (Azuma, 1997) Augmented Reality (AR) is a variation of Virtual Reality (VR). While VR renders a fully synthetic environment that the user is immersed in without the ability to see the outside world, AR superimposes virtual objects onto the real world, supplementing reality rather than replacing it. Virtual and real objects coexist in the same space (Azuma, 1997). Milgram et al. also consider AR and VR as connected, but as part of a larger class of technologies, which they call *"Mixed reality"* (MR), They see AR and VR on the opposite sides of a continuum that they refer to as the *Reality-Virtuality (RV) Continuum*, which is illustrated in Figure 5 below (Milgram et al., 1995).

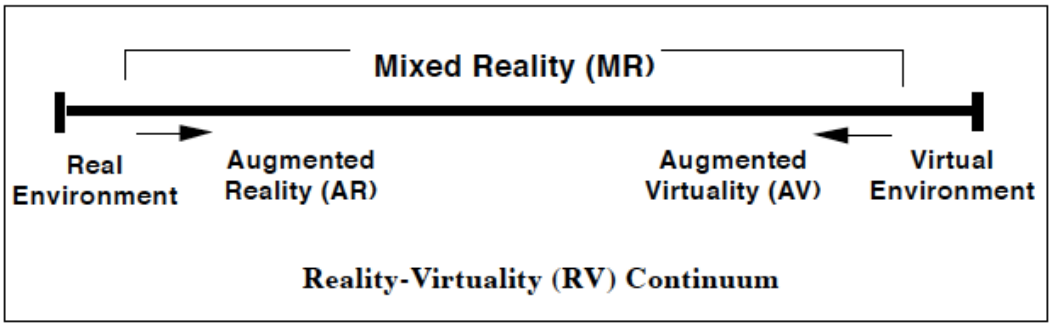

Figure 5: Reality-Virtuality (RV) Continuum (Milgram, Takemura, Utsumi, & Kishino, 1995)

Milgram et al. distinguish between two main categories of AR displays, see-through AR displays, like head mounted displays (HMDs) with see through displays and monitor based AR display systems, where computer generated

images are overlaid onto live or stored video images (Milgram et al., 1995). A current example of a HMD would be Google Glass ("Google Glass," n.d.). While one of the prototypes of the Red Carpet experience, which was displayed on a large screen, would at least partially fit Milgram et al.'s definition of a monitor based AR system, Bimber & Raskar's term, SAR, is used throughout this paper since it allows for a variety of display technologies to be employed.

"New display paradigms exploit large spatially-aligned optical elements, such as mirror beam combiners, transparent screens, or holograms, as well as video projectors. Thus, we call this technological variation spatial augmented reality (SAR)."

(Bimber & Raskar, 2005)

Experiential Marketing

Smilansky explains that an experiential marketing campaign has a live brand experience at its core and is built around one big idea, which is then amplified through other marketing communications channels (Smilansky, 2009). Schmitt suggests a number of scenarios where experiential marketing would be beneficial for a corporation (Schmitt, 1999). These scenarios include turning around a declining brand, differentiation from the competition, the creation of a corporate image and identity, the promotion of innovations and to induce trial, purchase and loyal consumption (Schmitt, 1999). He also claims that experiential marketing is changing the face of marketing forever and will replace traditional feature-and-benefit marketing going forward (Schmitt, 1999). He cites three simultaneous developments for this trend:

1) The omnipresence of information technology.
2) The supremacy of the brand.
3) The ubiquity of communications and entertainment.

(Schmitt, 1999, 1)

He points out though that while it might replace traditional marketing in some industries, like consumer products and services, it would be complementary to traditional marketing for others, like business to business or industrial markets for example (Schmitt, 1999).

Literature Review & Research in the Area

The purpose of the literature review was to find theoretical frameworks and concepts in an effort to explain the observations gathered during the deployment of the prototypes and to help inform the follow up experiments and the associated hypotheses. This section is divided into two parts. Part one investigates concepts regarding user behavior and user engagement and part two consists of a review of interaction frameworks for public space HCI. The findings were used to support the conclusion of this research. The main areas of interest were how user behavior can be influenced in a digital environment, how users engage with screen based content in public space as well as what other factors could play a role in creating applications that only require a minimum of instructions. The survey of related work in the area gave valuable insight into the current usage of SAR in marketing and advertising. The concepts and frameworks that are particularly relevant to this research are outlined below and related to the prototypes that were created as part of this research in the discussion following this section. The conclusion of this section summarizes the key findings and how they relate to this research.

User Behavior & User Engagement

Intuitive Interaction and Dual Process Theory

Tversky & Kahneman suggest a two-system view in order to distinguish between intuition and reasoning and note that there is considerable agreement on the characteristics that distinguish the two (D Kahneman, 2002). The two types of cognitive processes, which Kahneman refers to as System 1 and System 2 as labeled by Stanowich and West, have fundamental differences in how they work (D Kahneman, 2002). System 1 processes information fast and effortlessly; it is automatic and hard to control or to modify and it is excellent in pattern recognition and in associative tasks. In contrast, System 2 operates slower and is deliberately controlled but also more flexible than System 1 (Daniel Kahneman, 2011).

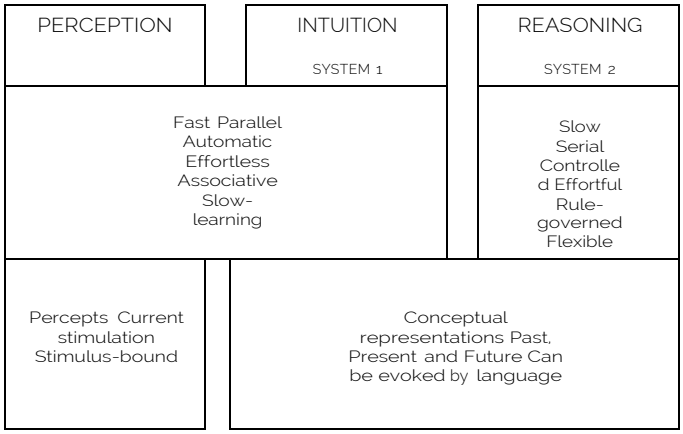

Figure 6: Perception, Intuition, Reasoning (D Kahneman, 2002)

Kahneman further explains that the way System 1 works has a lot in common with the processes of perception and suggests that impressions of the attributes of objects of perception and thought are generated by the

perceptual system and the intuitive processes of System 1 (D Kahneman, 2002). It is important to note that these impressions are not voluntary and that they don't need to be explicit. Judgments on the other hand are always intentional and explicit and System 2 is involved in all judgments, regardless of where they originate from (D Kahneman, 2002). Therefore any perceptions and the resulting actions that are only processed by System 1 can be considered intuitive.

Affordances

"The affordances of the environment are what it offers the animal, what it provides or furnishes, either for good or ill. The verb to afford is found in the dictionary, but the noun affordance is not. I have made it up. I mean by it something that refers to both the environment and the animal in a way that no existing term does. It implies the complementarity of the animal and the environment."

(Gibson, 1986, 127)

The term was later popularized by Don Norman in his seminal book "The psychology of everyday things" (Norman, 1988). Norman's use of the term differs from Gibson's though. Gibson refers to all possible actions, regardless of the actor being aware of them or not, but for Norman affordances or rather *"perceived affordances"* are all the possible actions that are known to the actor (Norman, 1988).

Presence

Gibson describes presence as the experience of one's physical environment (Gibson, 1979). He argues that it does not refer to one's actual surroundings, but to the perception of those physical surroundings, which are mediated through automatic and deliberate mental processes (Gibson, 1979). He continues to define presence as the sense of being in an environment (Gibson, 1979). While the perception of presence in the unmediated, real world is taken for granted, when mediated by a communication technology, two separate environments have to be perceived simultaneously; the environment in which one is actually physically present and the virtual, mediated environment (Steuer, 1992). Biocca (Biocca, 1997) suggests that, in virtual space, users are primarily constructing a mental model of that space and respond to cues in the virtual mediated environment. He also claims that presence in the virtual environment can rarely be maintained in the same way as in the real world (Biocca, 1997). Li et al. propose that the reason for adding affordances to interfaces is to create a sense of presence and therefore it is reasonable to expect that visual, behavioral and other stimuli in the virtual space are likely to create a sense of presence, which can lead to richer experiences (Li, Daugherty, & Biocca, 2001).

Telepresence

Marvin Minsky, the founder of MIT's artificial intelligence lab, first introduced the term telepresence, a name suggested by Patrick Gunkel, a friend of Minsky's, in 1980. It *"emphasizes the importance of high-quality sensory*

feedback and suggests future instruments that will feel and work so much like our own hands that we won't notice any significant difference" (Minsky, 1980), which, in his opinion, was not achieved by the terms 'teleoperator' or 'telefactor' that were commonly used by scientists at the time. Sheridan defines telepresence as *"means that the operator receives sufficient information about the teleoperator and the task environment displayed in a sufficiently natural way, that the operator feels physically present at the remote site. ... A more restrictive definition of telepresence requires further that the teleoperator's dexterity match that of the bare-handed operator"* (Sheridan, 1992). He also notes that "*Telepresence is sometimes used to mean virtual presence",* which he defines as *"... synonymously a virtual environment or virtual reality or artificial reality (the latter two are more fashionable but linguistically troubling terms), is experienced by a person when sensory information is generated only by and within a computer compels a feeling of being present in an environment other that the one the person is actually in"* (Sheridan, 1992). Sheridan refers to *"virtual presence"* in regards to virtual environments (VE) while he uses *"telepresence"*, like Minsky, for teleoperation. Rafael Lozano-Hemmer looks at telepresence through an artistic lens. He is an artist who blends performance art, virtual reality and teleperesence (Wilson, 2002). He created an event called "The Trace", where people could occupy each other's space in remote installations via telepresence. This was achieved by combining large projection screens and robotic lamps that move their focus based on user movement. The goal of "The Trace" was not to increase the sense of physical presence or "being there" for the user, but to investigate ways to create awareness of

remote users in a more abstract way as well as the possibilities of multiple people occupying the same space (Wilson, 2002).

"Participants know nothing about each other except for their relative 3-D movements and positions. The Trace is a telepresence piece in the sense that it constructs a deterritorial transmission of presence, but unlike most other telepresence technologies it does not seek to "amplify" the senses of the participants but to construct three-dimensional shadows that may occupy and encompass the real space of their bodies. "Telembodyment" happens when the two participants share the same telematic coordinates by entering the other's 3-D representation. Telembodyment can be seen as a metaphor for those moments in which humans are inside other humans: physically, as in pregnancy, sex, or surgery; or virtually, as in Mikhail Bakhrin's "intersubjectivity" or the holy communion's "the body of Christ.""

(Wilson, 2002)

Paul Sermon, an artist and professor of Creative Technology at the University of Salford, United Kingdom, also explored telepresence in several art projects. In 1992 he created "Telematic Dreaming", an installation that was commissioned by the Finnish Ministry of Culture and Telecom Finland.

"The ability to exist outside of the users own space and time is created by an alarmingly real sense of touch that is enhanced by the context of the bed and caused by an acute shift of senses in the telematic space." (Sermon, n.d.-a)

Telematic Dreaming consisted of two double beds located in separate rooms. One room was illuminated and had a camera located above the bed and a series of monitors surrounding the bed; the other room was dark with a projector and a camera located above the bed. A live video feed of a person on the bed in the illuminated room was projected onto the bed, with another person on it, in the darkened room. The camera located next to the projector in the dark room then relayed the image of the person on the bed and the

projection next to the person back to the series of monitors in the illuminated room.

"The telepresent image functions like a mirror that reflects one person within another persons reflection." (Sermon, n.d.-a)

In 2006 Sermon created "The Teleporter Zone", which is located on the ground floor of The Evelina Children's Hospital at St. Thomas in London (Sermon, n.d.-b). His goal was to allow patients and their families and friends to be transported to imaginary virtual worlds in order to escape the confines of the hospital. Users could see themselves on television screens in different settings, like a pirate ship, the Taj Mahal, on a beach or floating through clouds (Sermon, n.d.-b). An "S" shaped wall separated users and ensured that they could not see each other. Two cameras located on both sides of the wall captured the users actions and then combined the live camera feeds with the animated virtual background, displaying the resulting composite video on the screens located on both sides of the wall, placing users from both sides in the same virtual space (Sermon, n.d.-b).

Context

"Context is any information that can be used to characterize the situation of an entity. An entity is a person, place, or object that is considered relevant to the interaction between a user and an application, including the user and the application themselves."

(Dey & Abowd, 1999, 3)

In their paper "Towards a Better Understanding of Context and Context-Awareness" Dey & Abowd came up with this definition after carefully reviewing existing definitions and concluding that some of them were too limited or too narrowly focused while others just provided synonyms for the word context (Dey & Abowd, n.d.). It is geared towards developers and system designers and is meant to help them understand the context of a given application scenario and to determine whether a piece of information should be considered part of the application's context or not (Dey & Abowd, n.d.). They also point out that context is generally assumed to be implicit information which is a view that they find troublesome, hence their definition allows for context to be implicitly or explicitly indicated. The example given is a user who is identified implicitly via computer vision or explicitly via a standard login dialogue box. In both instances the user's identity is context (Dey & Abowd, n.d.). Dey & Abowd categorize context into different types in order to help developers discover the most useful pieces of context for their applications. They identify location, identity, time, and activity as the primary context types for characterizing the situation of a particular entity (Dey & Abowd, n.d.). Secondary context types can be seen as attributes of the main context types; for example a phone number could be a secondary context of identity.

Dey & Abowd consider context as something that can be known, represented and processed like other information, Dourish on the other hand sees context as emergent and argues that applications should enable users to produce new contexts and meanings. SMS (Short Message Service) messaging, for example, was originally conceived as a paging mechanism for voice mails as part of the

GSM specification in 1992 (Zerfos, Meng, Wong, Samanta, & Lu, 2006), evolved into a communication tool and, although not intended by the designers of the system, was later used as an e-commerce platform that enables users to purchase items via sending an SMS message to a specified number and even as an advertising platform allowing marketers to push offers to mobile devices via text message. This underlines Dourish's point that context is not delineable and that the context of activities cannot be fully determined in advance. An example of a failure to properly understand the context in which an application is used is pre iPhone SMS messaging, which was not threaded. Early SMS messaging applications took a lot of things into consideration, like how many characters can be transmitted using existing infrastructure. What they did not take into consideration was that the context of the application's use is a conversation between two or more people and therefore creating a thread of that conversation, rather than just listing all messages from different people in chronological order, makes common sense. Dourish considers context to be an interactional problem rather than a representational problem. He proposes an *"interaction model of context"* in which the only question concerning context is *"how and why, in the course of their interactions, do people achieve and maintain a mutual understanding of the context for their actions?"* (Dourish, 2004). He argues that as a representational problem the central question concerning context is *"what is context and how can it be encoded?"* and therefore *"reflects a misunderstanding of the nature and role of contextuality in actual everyday affairs."* (Dourish, 2004). Dourish's view is that people draw on their common sense, everyday and cultural understanding of the world and that context emerges only when everyone involved mutually recognizes some

interaction (Dourish, 2004). Therefore, in his view, context is not an observation or premise, it is the actions that people take and the results of these actions (Dourish, 2004).

Embodied Interaction

According to Dourish, embodiment is the property of being manifest in and as a part of the world (Dourish, 2001). He further explains that this does not only apply to physical embodiment but that it also extends to other aspects of the everyday world, like conversations for example. He suggests that a conversation is not only the transmission of speech patterns through physical disruption of air, but that it is also embodied through the participation and engagement of two people in the context of relationships, actions, assessments and understandings, which are equally embodied in the real world (Dourish, 2001). This context situates the conversation and is not merely a background of the activity but a fundamental component of the activity that takes place. Therefore embodiment is not physical reality but participative status and that interaction is an embodied phenomenon (Dourish, 2001). Dourish refers to this phenomenon as *"embodied interaction"* that happens in the real world, which gives meaning and substance to the interaction. He continues to state that embodied interaction is a perspective on the relationship between people and systems rather than a set of rules or a technology (Dourish, 2001).

Behavioral Confirmation

Behavioral confirmation is a process where one person, the target, behaves according to the expectations of another person (the perceiver) (Yee, Bailenson, & Ducheneaut, 2009). Snyder et al. (Snyder, Tanke, & Berscheid, 1977) staged an experiment to demonstrate the behavioral confirmation of the physical attractiveness stereotype. The experiment included 51 male and female participants. Pairs of unacquainted males and females were formed and each participant was told that acquaintance process in social relationships was the reason for the study. It was ensured that each pair would not see each other and the method of communication was a telephone call. Male participants were told that a snapshot and a questionnaire were required from each participant, females were not told about the photograph. Before the conversation began males were supplied with a folder holding the questionnaire of the female participant and a photograph. The photograph though was not of the participant, it was either one of four photos of women that were considered attractive or one of four images of women that were considered unattractive. Snyder et al. took pictures of females from local colleges who agreed to participate and twenty college men then rated the attractiveness of each picture on a ten-point scale. The four with the highest score and the four with the lowest score were chosen for the experiment. The findings were that not only did the men fashion their communication based on stereotyped beliefs about attractiveness, but it was also observed that the female participants' behavior changed according to the male's perception of them (Snyder et al., 1977).

Proteus Effect

The Proteus effect is a phenomenon that refers to the behavioral change of users based on their avatar's appearance in virtual environments (Yee et al., 2009). Yee et al. discuss two studies; one that showed that height and attractiveness of an avatar in an online game was a predictor for the player's performance. The second study revealed a correlation between behavioral changes caused by a virtual environment and sub-sequent face-to-face interactions. Users who were given taller avatars negotiated more aggressively in the real world than users that were given shorter avatars (Yee et al., 2009).

Immediacy

Transparent Immediacy seeks to erase the interface in order to create a sense of presence, reality and authenticity. Reality is presented through *"the window of the medium"*. It is about the content and not about it's representation (Bolter & Grusin, 2000). Bolter & Grusin emphasize that in order to understand immediacy in computer graphics it is important to keep in mind that painting, photography, film and television sought immediacy as well, through linear perspective, erasure and automaticity. All of which are also applicable to digital technology. They refer to Duerrer and Panofsky in order to explain perspective as *"seeing through"* adding that the interface designers of today, just like the students of linear perspective in the past, seek immediacy through transparency. They stress though that transparent immediacy does not mean that viewers are fooled to the point where the representation is perceived as

the same thing that it represents.

Hypermediacy

"Where immediacy suggests a unified visual space, contemporary hypermediacy offers a heterogeneous space, in which representation is conceived of not as a window on to the world - but rather as "windowed" itself- with windows that open on to other representations or other media."
Bolter & Grusin (Bolter & Grusin, 2000, 34)

Bolter and Grusin explain the term *"hypermediacy"* as media that makes itself apparent. This is often illustrated in the form of windowed layout styles and desktop interfaces or World Wide Web pages. They cite William J. Mitchell as describing the visual style that *"privileges fragmentation, indeterminacy, and heterogeneity and … emphasizes process or performance rather than the finished art object"*. They also highlight the random access or non-linearity in the user experience or as Bob Cotten and Richard Oliver describe it *"It is a medium that offers 'random access'; it has no physical beginning, middle, or end"* (Bolter & Grusin, 2000).They continue to demonstrate the concept of hypermediacy by quoting digital artist David Rokeby *"… while engineers strive to maintain the illusion of transparency in the design and refinement of media technologies, artists explore the meaning of the interface itself, using various transformations of the media as their palette"* as well as Media theorist Erkki Huhtamo *"technology is gradually becoming a second nature, a territory both external and internalized, and an object of desire. There is no need to make it*

transparent any longer, simply because it is not felt to be in contradiction to the 'authenticity' of the experience..." meaning that hypermediacy can be an *"authentic"* experience in itself (Bolter & Grusin, 2000).

Interaction Frameworks

Audience Funnel

The audience funnel is a user interaction framework for gesture-based public display systems that was developed by Daniel Michelis and Jörg Müller (Michelis & Müller, 2011). It was a result of the observation data collected from their Magical Mirrors installation in downtown Berlin, Germany. The installation consisted of four large interactive public displays, which displayed a mirror image of their environment with different filters applied to them. Users passing by the displays would see their mirror image with the visual effects applied to them. Cameras mounted directly underneath each display were used to achieve this. Additionally three large projections showed screenshots of users interacting with the displays. The behavior of the 660 passers-by revealed reoccurring patterns which Michaelis and Müller used to deduce the six phases of their framework; passing by, viewing and reacting, subtle interaction, direct interaction, multiple interactions and follow up interactions.

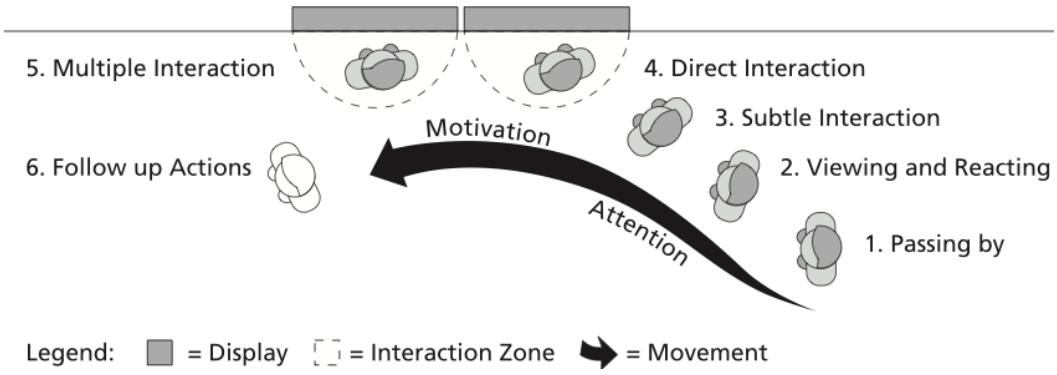

Figure 7: Audience Funnel (Michelis & Müller, 2011)

1. Passing by

Passing by was classified as anyone within viewing distance of the display and in range to be measured somehow. In the case of Magical Mirrors it was anyone within a 4-meter radius of the displays.

2. Viewing and reacting

Passers-by are considered viewers as soon as they exhibit any observable reaction to the displays, like subtle head movement in their direction or glancing at them. It was mentioned that with the manual observation technique used for the Magical Mirrors installation it was hard to detect every subtle movement and that with future advances camera and eye tracking technology more accurate readings will be achieved.

3. Subtle interaction

If a viewer makes any deliberate movement towards the displays expecting a reaction she or he can be classified as a subtle user. At this point

the user is still several meters away from the display and does not occupy the whole display. This allows for the interaction of others at the same time.

4. Direct interaction

The user transitions from subtle interaction to direct interaction by interacting directly with the screen for a period of time while being in the interaction zone in front of the displays. In the case of Magical Mirrors, users centered themselves in front of the screen before engaging directly.

5. Multiple Interactions

Interactions where users engaged into direct interaction with more than one display or with the same display more than once, after leaving the interaction zone and returning, were classified as multiple interactions.

6. Follow up actions

Follow up interactions occur after direct interactions or multiple interactions. They consist of activities like taking pictures and posting them online.

A Framework for Interaction Phases

Daniel John Vogel developed this framework for sharable, interactive public ambient displays (Vogel, 2005). It allows for transitioning between implicit and explicit interactions as well as between public and personal information. Gesture, touch, contextual body orientation and user position are used for implicit and explicit interactions. The framework consists of four phases with

fluid inter-phase transitions: Ambient Display, Implicit Interaction, Subtle Interaction, and Personal Interaction.

1. Ambient Display

This is the state that the display is in when nobody is interacting with the system. In this state the display shows different information simultaneously with infrequent updates. It provides the central context, which anchors all subsequent interaction. Vogel points out the importance that other phases don't radically alter or obscure this ambient state in order for users to get an understanding of the overall information space with a quick glance.

2. Implicit Interaction

When a user passes by, the system transitions to an implicit interaction phase. The system should be able to recognize the user's interruptability by measuring the user's openness to receiving information through analysis of body position and orientation. If it is determined that the user is open to communication, an abstract representation of the user is displayed on the screen and subtle notification mechanisms should inform the user about items that require attention, helping to draw the user closer to the display and into the next interaction phase. A mechanism should be provided that allows the user to explicitly opt out of the interaction.

3. Subtle Interaction

This phase is triggered by implicit cues towards the display by the user. Pausing for a moment would be considered such a cue. At this point more

detailed information is provided and the public information is also augmented with personal information that is relevant to the current user and information context. The example given by Vogel is an organization's calendar that would be augmented with a users own meetings or appointments. The total duration of the interactions in this phase is intended to be about one minute, just enough time to make a simple selection. Up to now users only interacted implicitly with the system. At this stage basic gestures or explicit body movements are used to navigate since the user is still an arm's length away from the display. This also allows other users to still see the display since it is not obstructed. Therefore no sensitive user information should be displayed at this stage due to privacy concerns.

4. Personal Interaction

This phase is meant for up close interaction where detailed information, including personal information, is displayed. While all the gestures from the previous phase are still available, direct touch is the preferred input method this close to the screen. Vogel contends that even though body occlusion does not provide full privacy, there is still information that is suitable to be displayed in this scenario, where another user might potentially eaves drop. Interactions should last between two and five minutes. This phase should be designed to create minimal disruption to the overall display, allowing for multiple simultaneous users.

Implicit Interaction Framework

The implicit interaction framework, developed by Wendy Ju and Larry Leifer focuses on attentional demand and initiative (Ju & Leifer, 2008). Attentional demand is the amount of attention the computer system demands from the user and initiative measures who is initiating the interaction and to what extend. Activities that have low attentional demand are considered background interactions, while interactions that require the user's attention are foreground interactions. Interactions initiated by the system are pro-active interactions and interactions initiated by the user are considered reactive interactions. Ju and Leifer explain that this allows them to generalize the capabilities and features of interactions in a domain-independent way.

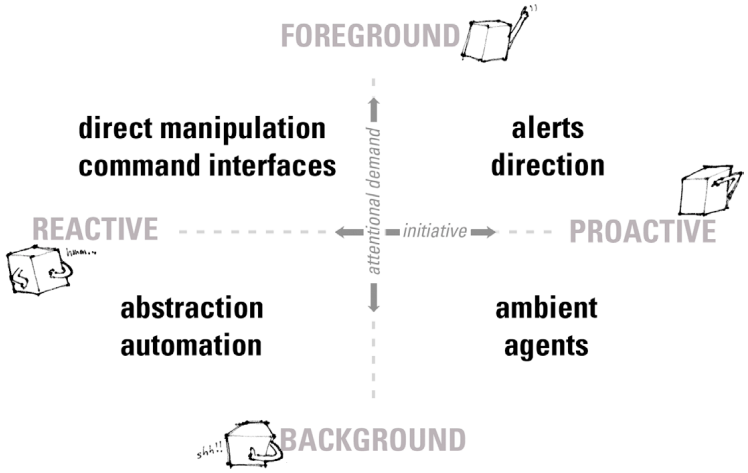

Figure 8: Implicit Interaction Framework (Ju & Leifer, 2008).

Activity Spaces

While researching social embarrassment when interacting with public displays, Harry Brignull and Ivonne Rogers identified three *"Activity Spaces"* in which actions took place and the transitions between them (Brignull & Rogers, 2003).

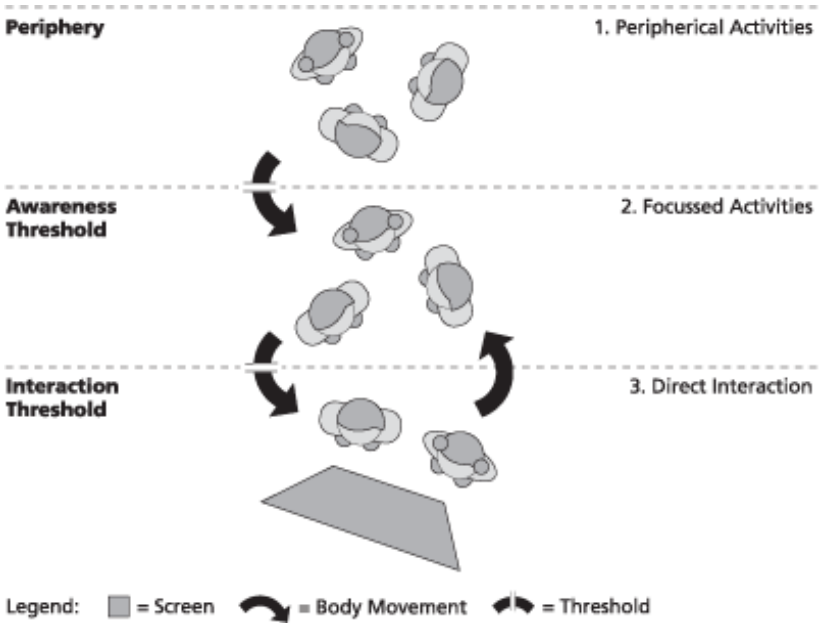

Figure 9: Three Activity Spaces (Brignull & Rogers, 2003)

Peripheral awareness activities:

These are activities that are unrelated to the display, like drinking or talking to people about other things than the display. In this stage people are aware of the display but don't pay any attention to it.

Focal awareness activities:

This is the point where people pay more attention to the display and learn more about it. Conversations and other activities related to the display, without actively interacting with it, are part of this phase.

Direct interaction activities:

People start to directly interact with the display.

Elements Of Engagement

Dalsgaard, Dindler, and Halskov's believe that engagement with interactive public space installations is a dynamic process with evolving relations between cultural, physical, content-related and social elements (Dalsgaard, Dindler, & Halskov, 2011).

Cultural

Dalsgaard et al. suggest that the physical environments and situations where the interactions take place afford particular kinds of activities and actions. They explain that in many situations, like visiting a museum or going to a concert, there are conventions that people are implicitly expected to follow. They refer to these conventions/affordances as cultural conventions or norms. Their theory is partially based on cultural historical activity theory and it's concepts of 'institution' and institutional forms of practice as well as the notion of performing perception, which refers to people being consciously or sub-consciously aware of the possibility of being observed and, as a result, adjust their behavior. This usually has an impact on how people interact with the installation in practice.

Physical

Dalsgaard et al.'s definition of physical engagement is expansive. It covers not only physical interaction with input devices or bodily movements, but also aspects of embodiment, affect, interactive cognition, and intertwined action-reflection. In particular they mention Dourish's interpretation of embodiment, which considers it to be *"the property of being manifest in and as a part of the world"*. They continue to explain that our physical existence in the world is central to how we make sense of the world and that the notion of sense making via physical action has been addressed in various areas of research, like in the fields of distributed cognition and interactive cognition (Dalsgaard et al., 2011). Furthermore they point out that these schools of thought also stress the importance of materials when interacting with our environment and that in the area of interaction design action/reflection and mental/physical has been explored from various angles, such as through the exploration of aesthetic interaction and the means of engagement based on pragmatist philosophy (Dalsgaard et al., 2011).

Content

Dalsgaard et al.'s interpretation of engagement with content is based on Dewey's pragmatist aesthetics, where people have to invest part of themselves in the encounter with the content in order for engagement to occur (Dalsgaard et al., 2011). They also claim that creating engaging content requires a balance between recognizable and perplexing elements and that engagement is often achieved by conflict that prompts users to investigate

further. They also mention that engagement with static or linear content is often internal.

Social

Dalsgaard et al.'s research into the social element of engaging interaction was inspired by computer supported cooperative work in general and more specific social interaction and co-experience (Dalsgaard et al., 2011). It focuses on the relation between active users and potential users. They identified several relationships that they consider crucial for understanding the different forms of engaging interaction.

- Social Interaction: Two or more people that don't know each other.
- Group Interaction: Two or more people that know each other.
- Individual Interaction: Single person.

Furthermore they differentiate between different ways of initiating and resuming interactions.

- Watch-and-join: This takes place when people who first watch what is happening and then join in.
- Watch-and-takeover: In this instance potential users wait until the current users have left before starting to interact.
- Walk-up-and-use: This applies when a person immediately starts to use the installation after walking up to it.
- Interact-and-run: This is the case when a user briefly interacts and then leaves.

- Return: It is considered a return when users who interacted with the installation before come back to use it again.

Discussion

The literature review resulted in a number of valuable insights that helped to further shape the direction of the research and the prototypes. Behavioral confirmation, dual process theory and Dourish's notion of context were useful theories to explain and test some of the observations that were made during the deployment of the prototypes, specifically why users engaged with the content without instructions and why users interacted with non-interactive content. Considering that, according to Kahneman (D Kahneman, 2002), perception and intuition are closely related, this finding could explain why users of the Red Carpet engaged with the content without instructions. If users perceived the experience as something that they automatically associated to a concept that is known to them, like a television broadcast from the red carpet at the Oscars, they might intuitively know what to do. Norman's interpretation of affordances could be relevant in the context of the Red Carpet experience as well. Much like Kahneman's theory of intuition, if users are aware that an actual red carpet event involves picture taking, then the perceived affordances for users of the Red Carpet experience could be posing for the camera and waving to the crowd and therefore allow for them to engage with the experience without any explicit instructions. In addition, the perceived affordances also enriched the experience by increasing the user's sense of presence inside the experience. Emergent behavior, where users made up the

context of their actions on the fly, was also observed during the staging of the prototypes, which is in line with Dourish's view that an application should allow for users to produce new contexts and meanings (Dourish, 2004). This in itself could be seen as lowering the entry barrier for engaging with the experience since there is no "wrong" interaction and therefore no instructions are required. On the other hand it was important to deliberately design the experience as per Dey & Abowd (Dey & Abowd, n.d.), taking the location of the experience, the identity of users and the actions that should be performed into consideration, in order to facilitate this emergent behavior. A substantial difference in the quality and duration of interactions was observed between the Walk The Red Carpet and the eLeo executions of the Red Carpet experience. The interactions during eLeo were a lot shorter and users seemed a lot less engaged and very mindful of their interactions. The reason for this could have been the performance of the actors, which was not ideal for the purpose, as well as that users might not have been invested enough in the experience, which Dalsgaard et al. consider as an important factor for user engagement. The main exhibitors at the eLeo event, which were also the actors that were recorded for the experience, would have been considered minor celebrities by the attendees compared to the Filipino star actors that participated in Walk The Red Carpet, which were adored by the participants. Therefore it would not be surprising that users did not invest a lot of themselves in the experience at the eLeo event. The eLeo event was also a lot smaller than the event where Walk The Red Carpet was staged and a lot of people knew each other or, at the least, of each other, mostly through work since it was an industry event where academia and industry came to mingle.

This may have resulted in the more muted behavior of most users compared to Walk The Red Carpet possibly fearing social embarrassment. Yee et al.'s Proteus effect was also investigated. In our current research however, the Proteus effect did not provide a useful framework for explaining the observations that were made during the staging of the Red Carpet experience since it affects user behavior by changing the user's appearance and this research is focused on what influences user behavior by modifying the environment the user is embodied in and not the user's appearance beyond the depiction of the users actual form inside the experience. It does provide an opportunity for further research though since the Proteus effect has not been studied in a public setting yet. Yee et al. only investigated the Proteus effect in the context of activities in cyberspace in a private setting, but it would certainly be interesting to investigate if the change of user behavior caused by the Proteus effect can be translated to interactive public space installations. Their research also investigated behavioral confirmation and Snyder et al.'s research into this topic, which took place in a mediated environment, over the phone, would suggest that the effect would be similar or even stronger in the case of the Red Carpet since the actors are not only visible to the user, but actually placed in the same visual space. It is important to note that the perceiver's behavior is what causes the change in the target's behavior (Yee et al., 2009). Therefore these findings could be used to explain why users interacted with the content by following cues from non-interactive actors to act in a certain way, through behavioral confirmation, while engaging with the Red Carpet experience.

Experiment 3 was created to test this theory in an effort to answer research question c):

> Do users act on non-verbal cues from non-interactive characters in such experiences?

The interaction frameworks that were reviewed revealed important information regarding how to attract users attention and the phases that users go through from first noticing an installation to actually directly engaging with it. During the eLeo execution of the Red Carpet experience a similar pattern to Brignull & Rogers' activity spaces was observed where users transitioned from peripheral awareness activities to focused activities and then finally to direct interaction. Most of the interactions were *"watch and take over"* as per Daalsgard et al. and in many cases we also observed *"return"* interactions, since users often wanted to try it again after knowing what the actor would do in order to give a more targeted, but not necessarily more realistic, performance. Both, Michelis and Müller's audience funnel as well as Vogel's framework for interaction phases, only pay little attention as to the context in which the displays are situated as opposed to Brignull and Rogers' and Dalsgaard et al.'s approach. Brignull and Rogers' activity space framework is based on interactions during social gatherings and events, while Dalsgaard et al. describe a more holistic approach. They suggest that evolving relations between cultural, physical, content-related and social elements lead to engagement and that the physical environment as well as the situation at hand provide affordances that support certain kinds of actions and activities. This is in line with how the concept for the Red Carpet was developed. One of the design decisions during the

development of the Red Carpet prototypes was the context of a photo op that was created, something celebrities would encounter at the Oscars or Emmys. Users posing for a picture or waving to an audience in this context would correspond to Dalsgaard et al.'s view on the role of cultural conventions and norms when interacting with public space installations. This was reinforced by cues from the pre-recorded actors that were part of the experience in order to create immediacy, as described by Bolter & Grusin, where users would have a sense of presence, reality and authenticity. Dourish's theory of embodied interaction, which states that interaction is a perspective on the relationship between people and systems, could also be applied to the Red Carpet experience, even though it is aimed at interactive systems. Given that according to Dourish embodiment is not physical reality but participative status and that interaction is an embodied phenomenon, users participation in and interactions with the Red Carpet experience could be seen as embodied interactions. Table 1 shows engagement attributes that are intrinsic to different applications in HCI but are also present in the Red Carpet prototypes, further supporting the hypothesis that effective experience design can illicit interaction without providing interactive components.

	Intrinsic to HCI	Red Carpet Experience
Affordances	X	X
Presence	X	X
Behavioral Confirmation	X	X
Proteus Effect	X	
Context	X	X
Embodied Interaction	X	X
Immediacy	X	X
Hypermediacy	X	

Table 1: Comparison of engagement attributes

Relevant in-the-field projects

A scan for relevant work in the field was conducted in order to understand what the current state of the art in SAR is in the field of marketing and advertising and to see if any findings could be used to inform the next iterations of the Red Carpet prototype. Certain commercial projects, even though they technically present a more polished execution, were deliberately excluded from this document in favor of projects by the artists that originated the idea and were not credited. Works from Chris O'Shea, Juxt and Appshaker Ltd were reviewed.

Hand From Above – Chris O'Shea (2009)

"Hand From Above encourages us to question our normal routine when we often find ourselves rushing from one destination to another. Inspired by Land of the Giants and Goliath, we are reminded of mythical stories by mischievously unleashing a giant hand from the BBC Big Screen. Passers by will be playfully transformed. What if humans weren't on top of the food chain?

Unsuspecting pedestrians will be tickled, stretched, flicked or removed entirely in real-time by a giant deity."

("Hand from Above | Chris O'Shea," n.d.)

Figure 10: Chris O'Shea - Hand From Above installation
(source: http://www.todayandtomorrow.net/2009/10/15/hand-from-above/)

Chris O'Shea, a British artist and designer, created hand from above in 2009. The application was displayed on large screens that were fitted with cameras overlooking a public space and linked to a computer. Computer Vision (CV) was used to identify people that were not part of a group and tracked their movement over time. A giant hand would then pick them up and toss them off

screen, shrink them to half their size or tickle a group of people. This was achieved by isolating a person from the background via background subtraction, which works similar to green screens in film and television with the difference that instead of removing all green pixels to isolate a subject it uses the color difference of pixels over time to differentiate the background from a person. If no isolated person could be detected the hand started to tickle groups of people randomly. This concept was re-appropriated by a fashion label and staged on Times Square in New York in 2010.

Coca-Cola and WWF help conserve the Arctic Home – Appshaker (2013)

Figure 11: Appshaker - Arctic Home Installation
(source: http://www.arlab.nl/media/ar-advertising-campaign-coca-cola-and-wwf-appshaker)

Appshaker is a UK based creative agency that specializes in mobile and large screen augmented reality applications. Their proprietary BroadcastAR system is used to seamlessly integrate virtual environments with real world camera

feeds to create an immersive environment for users to engage in.

Time Square Dunk Tank – Juxt (2013)

"Inspired by sensational vaudeville acts and mechanisms of old, we brought to life the tried and true carnival favorite "dunk tank". The Dunk Tank billboard was the latest, most advanced demonstration to date of how billboards are able to interact with social media and use augmented reality and gesture recognition innovation to transform the medium into a new form."

("JUXT • Work | Clear Channel Times Square Dunk Tank," n.d.)

Figure 12: Juxt – Time Square Dunk Tank

(source: http://www.behance.net/gallery/Times-Square-Dunk-Tank/4564697)

Juxt, a San Francisco based creative agency, created this installation that allows visitors at Time Square in New York to maneuver a virtual beach ball across a large public display towards a target, which, when hit, drops a woman into a dunk tank.

Discussion

The three examples of DOOH installations that use SAR that were reviewed were chosen to represent three different use cases of the technology. Appshaker's project is a non-interactive experience. It uses pre-rendered animations that overlay the live camera feet. Chris O'Shea's "Hand from Above" goes a step further, while it is also non-interactive, it transforms users inside the digital environment by shrinking them, tickling them or by picking them up and by throwing them off the screen using a giant hand. There are no other virtual items added to the scene. Juxt's installation for Clearchannel adds interactivity by allowing a crowd to move a virtual beach ball. It is meant for large groups of people to interact. These are encouraging findings, since they provide evidence that the related technologies and concepts have matured enough to be considered by large commercial clients as ways to engage users with their content. While this obviously means that there are people around the world working on similar things, based on our review, not a lot of companies are focusing on creating such experiences. Appshaker seems to be the exception; most of their projects are very similar to the Red Carpet experience. There are some important differences though, users don't seem to have any control over what content is being displayed. The Red Carpet experience allows users to choose who they want to appear with. While there is a mention on Appshaker's website that it is possible to share an image of the experience via social media it is not clear if users are able to do this by themselves or if staff has to assist them with it. One of the Red Carpet prototypes does not only allow for sharing images, it allows for sharing videos of the whole experience, which is completely controlled by users on their own mobile device. Another

prototype does content selection and sharing of the video via a staff operated tablet.

Conclusion

In this section HCI concepts relevant to this research were discussed along with the current state of SAR in the area of marketing and advertising. The key findings that relate to this research are as follows:

1) In order to design an effective and engaging experience presence, affordances, immediacy, context and embodied interaction as well as content are factors that should be considered.

2) Affordances and immediacy increase the sense of presence within an experience, which, in turn, may make users more receptive to act on the visual cues presented by the actors through behavioral confirmation.

3) Behavioral confirmation, affordances, context and embodied interaction can be used to explain why users interacted with non-interactive content when engaging with the Red Carpet experience.

4) Current implementations of SAR in the area of marketing and advertising suggest that there is commercial viability in creating such experiences.

Red Carpet Experience Prototypes

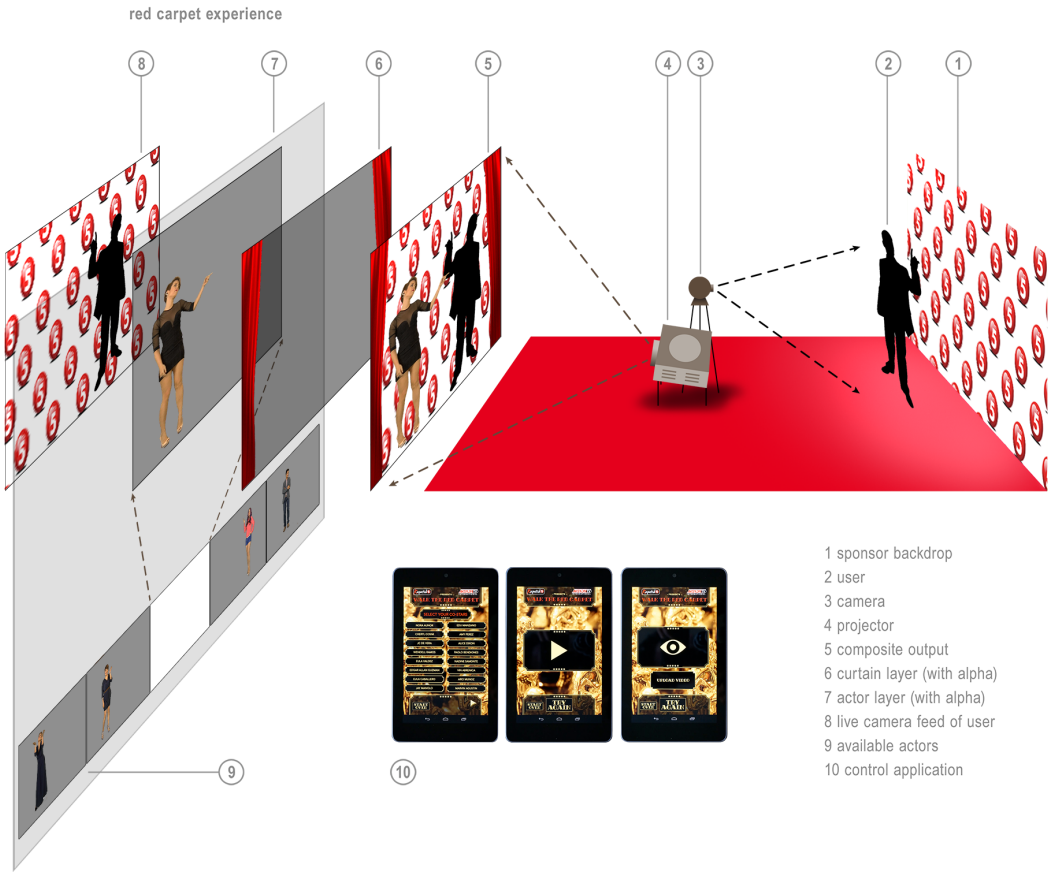

Figure 13: The Red Carpet Experience (Illustration by Steve Wilson)

Prototype 1 – Walk The Red Carpet

TV5, a major commercial television network in the Philippines that also operates in the United States, wanted to introduce their new star lineup to a broader Filipino audience in the US market. To achieve this a series of events was planned across the United States over the duration of two years. I was asked to create an installation for these events that would bring the network stars closer to the audience and provide users with a take away that they could share with friends and family. Given the amount of events, a turnkey solution that could be managed by the client with a minimal amount of training and effort had to be created. According to the client, Filipino audiences are obsessed with television stars and switch network if one of their favorites signed with a different channel. This star obsession was the basis of the virtual red carpet experience that was created, where users would pose on a real red carpet in front of a sponsor backdrop, in the same fashion as it is done at the Oscars or Emmys, effectively making them the stars. At this point, pre-recorded celebrities would walk up next to them and start posing and interacting with them as well as with an (imaginary) audience, just like at a real photo op, immersing the user even deeper into the star experience. Additionally, a tablet application was created to manage user data collection and consent as well as celebrity selection, recording and replaying of the experience and social media sharing. The social media aspect was very important, since it was an opportunity to give the user a digital memento, a souvenir of the experience, something to share with friends and family. At the same time the client's objective was to collect user information that would

allow TV5 to follow up after the event. Therefore a publishing system that would record the composited video in high definition, create a compressed and scaled down copy of it and then upload it to a video album on the client's Facebook page was created. The upload took mere seconds since the size of the compressed file was very small and the installation was connected to the Internet via mobile broadband. Once completed, users were prompted to share the experience on Facebook, which embedded the video in a user's timeline with a link back to the original on TV5's Facebook page.

My colleague Cris Mora, who brought this project to my attention and acted as the client liaison, art directed the experience and was in charge of the on site execution. We remotely co-creative directed the green screen video shoot in Manila. A grid system was created and shared with the studio in Manila and we sent accurately framed and scaled videos with sample interactions, acted out by Cris, as references to match.

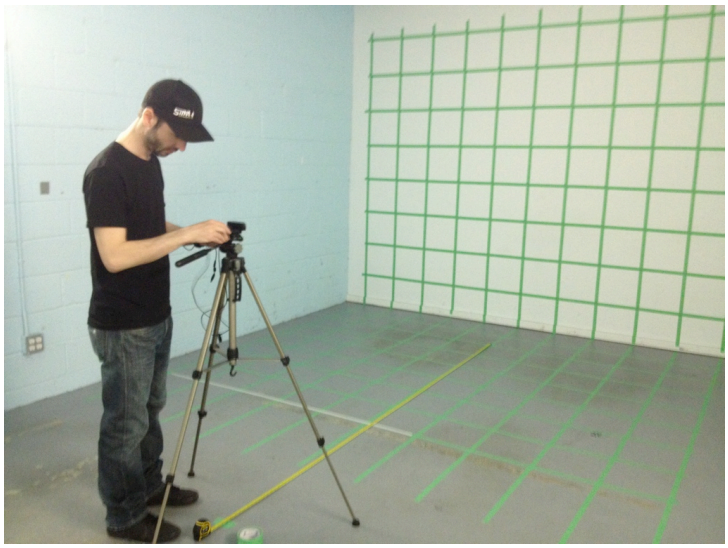

Figure 14: Reference Grid and Camera Setup

Even though the time frame was short, we only had seven weeks from ideation to launch, we insisted on test footage from the Philippines, based on our references, before the full green screen shoot with the actors. We needed to ensure that everything was in order since the full shoot was a one time only event due to the hectic schedules of some of the actors. This turned out to be worth the extra effort, since some adjustments had to be made. Fortunately the second round of test shots worked with our setup. Parallel to this I wrote the software and Cris designed the tablet interface based on the wire frames that I provided.

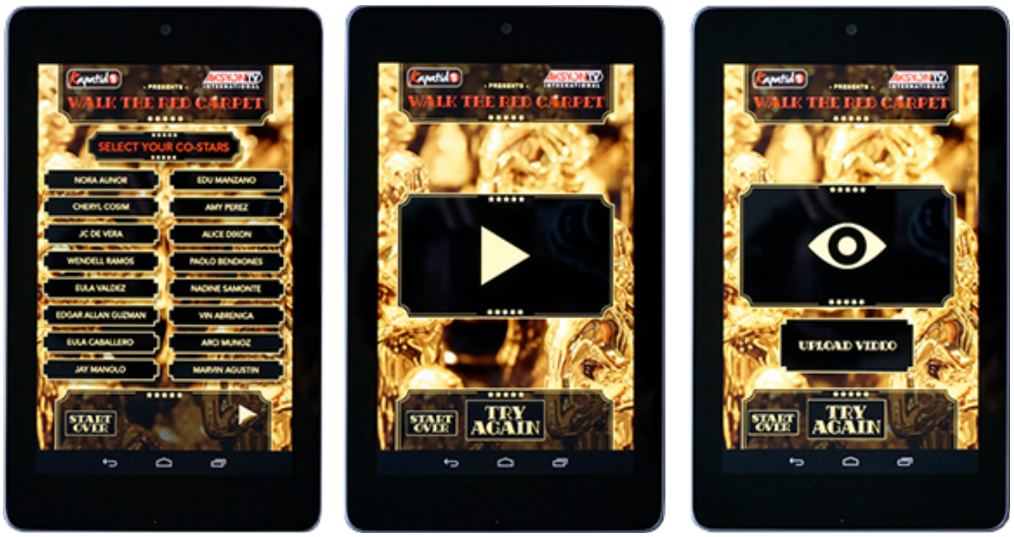

Figure 15: Tablet Application Interface (Data Collection and Facebook Share not shown)

We had to come up with a few different layouts for the installation since the size and setup of the footprint kept on changing. After a few days of testing and final adjustments everything was completed and ready for launch when the client made the last minute decision to remove the sponsor backdrop, effectively changing a key component of the experience.

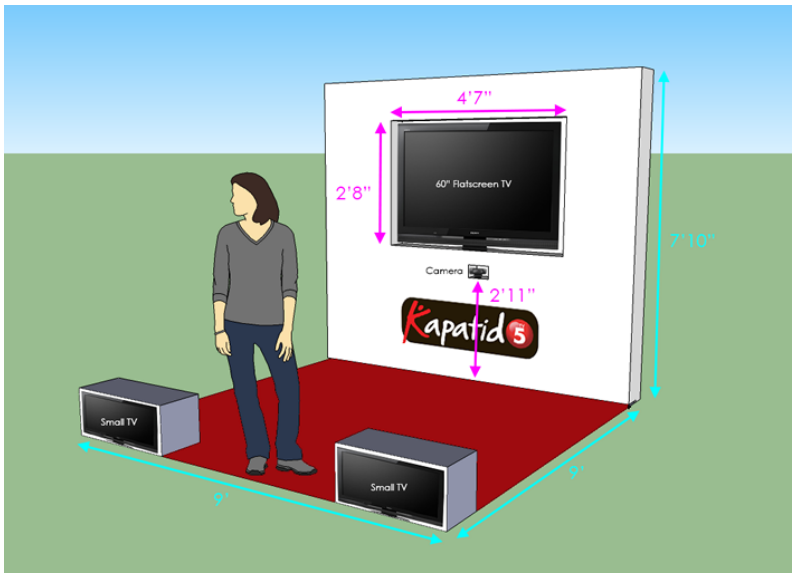

Figure 16: Final Booth Setup (Illustration by Cris Mora)

We heavily opposed this decision since the lighting of the pre-recorded footage would not match the lighting of the live feed, therefore breaking the illusion, but to no avail. The installation launched in New York at a festival celebrating Filipino Independence Day. It was a big event that drew large crowds with live music, a parade, food vendors and all kinds of activities.

My hypothesis was that users would engage with the experience as if it was interactive without being instructed to do so.

The following propositions were made:

a) Users will interact with the non-interactive characters.

b) Users will not interact with the non-interactive characters.

c) User will not require a lot of instructions.

d) Users will require a lot of instructions.

The purpose of this prototype was to see how many people would engage with the installation and to observe their overall experience. Our observations and sub-sequent video review of the participants revealed that the installation was much better received than anticipated. Based on the feedback that was received on site, users seemed to really enjoy the experience even with the flaws and shortcomings and people lined up around the block to engage with it. This led to hundreds of interactions in a single day and a similar result could be observed a week later in San Francisco at similar festivities. These somewhat surprising observations led directly to this research.

While everything went better than expected, there were a few things, good and bad, that caught my attention. The system was built with a sequential workflow that turned out to be a bottleneck in a real world scenario since it was not anticipated that so many people would want to engage in such a short amount of time. One tablet controlled the entire experience; from data collection to content selection and social media sharing, forcing users to wait until data collection and video upload were completed before they could start. This led to unnecessary wait times. The second issue that was identified was an obvious one, the removal of the sponsor backdrop made the recorded footage look different than the live footage. This was primarily due to the different lighting conditions but also because a different camera was used to record the actors than for the live feed. While this was a problem particular to the Red Carpet execution, it suggested that there could be many instances where the setup might not be as controlled as I would like it to be. On the positive side, users really seemed to follow cues from the pre-recorded actors,

like waving to the audience or pretending to kiss them on the cheek, which lead to the hypothesis that users follow non-verbal cues from non-interactive characters in an experience. The other important finding was that all of this was achieved with very little or no instructions at all. This observation was the basis for the main hypothesis that video based SAR that embodies the user's form in the experience provides a low entry barrier for users to engage with content in a public environment.

Proposition a and c were found to be, at least partially, true.

Prototype 2 – eLeo

Following "Walk The Red Carpet" I was invited to create a version of the experience as part of the eLeo exhibition at OCAD University in Toronto. This gave me the opportunity to test some of the hypotheses that were developed after the Red Carpet Experience. The data collection was replaced by a simple button click to consent to being recorded on video, which will also be made publicly available on social media, I had full control over lighting and setup and automatic social media sharing was removed for this execution. This was done in an effort to address the issues of bottlenecks and the difference in pre-recorded and live footage.

A green screen shoot was arranged since the Filipino actors from the TV5 version were not really useful for this project. Andrew Forbes, a cinematographer and colleague of mine, led the green screen shoot. We were given the opportunity to film some of the main exhibitors, Steve Mann and

Edward Gajidel, as well as the president of the University, Sara Diamond, the chair of the Digital Futures Initiative, Tom Barker, and the founding director of the CFC (Canadian Film Center) Media Lab, Ana Serano. The "actors" were asked to add some virtual one to one interactions to their performance in order to test whether non-verbal content cues, like an actor trying to shake a users hand, really result in users acting in an appropriate manner or not. This was also one of the hypotheses related to this research.

The following propositions were made:

a) Removing the sign up process solves the bottleneck issue.
b) Removing the sign up process does not solve the bottleneck issue.
c) Having a constant background and controlled lighting improves the seamlessness of the experience.
d) Having a constant background and controlled lighting does not improve the seamlessness of the experience.
e) Content cues from non-interactive actors prompt users to react appropriately.
f) Content cues from non-interactive actors don't prompt users to react appropriately.

The findings were similar to the Red Carpet experience. User feedback was good and people engaged with the content mostly as expected, but the interactions were a lot more muted compared to Walk The Red Carpet, which might have been due to social embarrassment, given that it was a smaller event and a lot of the attendees knew each other through work or had other work related reasons for attending. Propositions a and e were partially

confirmed and proposition c was fully confirmed. There was no bottleneck because of the sign up or sharing process, but it also revealed that even without these steps there would always be a need for users to wait if there is a lot of demand. Each individual experience took about one minute, depending on the length of the pre-recorded videos; therefore if twenty or thirty people arrive simultaneously it would result in substantial wait times. The live feed matched the pre-recorded footage much better than with the Red Carpet experience due to the permanent background and the controlled lighting, which confirms proposition c. The most striking finding though was how important it is to direct the actors' actions wisely. Three of the actors did not perform actions that allowed the user to respond or join in, while it was still fun for users to see their physical form embodied in the scene, there was only very little action on their part. There was also a difference between how users responded to the two other actors. One actor engaged users in a game of rock, paper, scissors and most people played along. Another actor did a frantic performance with a little dance and a lot of high fives. While users were unable to predict what was going to happen next and the actions of the actor were not in line with a regular red carpet behavior, they started to make up their own actions performing alongside the actor or engaging with the actor in unexpected ways. Therefore proposition e was just partially confirmed. None of the actors actually performed anything remotely appropriate for a real red carpet appearance, which might have been the reason why users needed very strong and explicit cues in order to know what to do. It was also interesting to see how people transitioned from noticing the experience, to watching it and then finally engaging with it. While I did not specifically collect data for this

purpose, it was certainly something that I wanted to investigate further in future installations of the experience. It also prompted the research of different interaction frameworks to see if the observations correlated with any of them.

Prototype 3 – Touch Screen operated experience

After staging the Red Carpet experience twice with dedicated staff operating it, the next step was to make it completely self contained where end users could control the whole experience themselves. After consultations with potential clients, it was decided to use large touch screens or capacitive touch membranes, which function similar to smart phone touch screens, as input devices. This was the easiest and most cost effective way to integrate the experience into the existing infrastructure at the potential points of installation. While this is an important progression of the platform that I set out to build, it is not directly related to this research. Therefore proper interface design and user testing has been scheduled for a later date, only a fully functional draft interface was implemented in order to demonstrate the functionality to potential clients. In the current iteration users are able to select the content, launch the experience, review the recorded video and then share the video to Facebook via the touch interface.

Prototype 4 – SMS operated experience

I also decided to create a SMS operated version of the experience in order to expand the use cases for the application to locations that might not be

suitable for touch screens, like show case windows, storefronts or large scale projections. It also allows for easy deployment in different markets due to the use of SMS, which is a global standard and does not require a data plan or a custom application. While there is a cost associated with sending SMS messages it is marginal in most markets and was therefore not considered as cost prohibitive. This approach also offers other advantages over the staff operated tablet and touch screen implementations. It allows for direct delivery of a link to the video of the experience, or of the video itself, to users' mobile devices from which the video can then be shared as users see fit. In this iteration of the application users text the name or id of the content that they choose to a specified number, which then launches the experience and, once it is completed, a link to the video along with a message is sent back to the user via SMS. This allows for greater privacy and less manual data entry for end users. As with the touch screen implementation, user testing has been scheduled for a later date.

Experiments

The experiments that were performed were a result of the observations during the staging of the prototypes and the findings of the literature review. The primary purpose of these experiments was to compare the results to the observations that were made during the staging of the prototypes and to test the hypotheses related to this research. Three experiments were conducted in total. User actions were recorded on video and later analyzed. Each user also

had to fill out a questionnaire after each experiment (see Appendix C). The questionnaire consisted of seven questions in total, five of which were answered on a scale of one to ten and two that required a short written answer. The experiments were staged at a rented studio space in downtown Toronto over a three day period.

Participant Selection

Due to the low amount of respondents to the recruitment drive for participants in the experiments, the approach for identifying suitable participants outlined in IDEO's human centered design toolkit was used (Ideo & Bill & Melinda Gates Foundation, 2011). While this research does not employ human centered design, IDEO's approach to identifying suitable participants, which is aimed at assembling a representative group of potential users of new technologies, seemed appropriate for the purpose of these experiments. IDEO suggests finding individuals who represent the extremes (Ideo & Bill & Melinda Gates Foundation, 2011).

"Extreme participants help to unearth unarticulated behaviors, desires, and needs of the rest of the population, but are easier to observe and identify because they feel the effects more powerfully than others. By including both ends of your spectrum as well as some people in the middle, the full range of behaviors, beliefs, and perspectives will be heard even with a small number of participants."

(Ideo & Bill & Melinda Gates Foundation, 2011, 26)

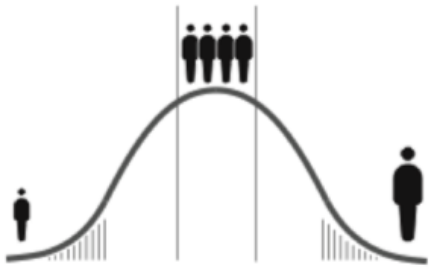

Figure 17: IDEO participant selection (Ideo & Bill & Melinda Gates Foundation, 2011)

The participants were divided into three groups based on their use of technology in the work place. While a more thorough discovery of the participants' usage patterns of technology would have been preferable, in the context of this research it was not feasible to require potential participants to fill out a questionnaire in order to be selected risking a lower response rate and a smaller sample size as a result. Another factor that influenced this decision was that a subjective self-assessment of skills by potential participants would not have guaranteed that these assessments would have been correct. Given that it was only necessary to identify the extreme cases, with anyone left over being considered a "regular" user, this seemed like a valid approach. The total amount of participants was 17 people of varying age, gender and occupation. Five users were considered "light users", six users were considered "regular users" and six users were considered "expert users". While this is not the optimal distribution as suggested by IDEO, which recommends 1/3 of users in each category, it was decided that it was close enough to continue with this approach.

1) Light users (Extreme)

Gender: 3x Female, 2x Male

Age: 26 – 52

Occupation: Carpenter for Film and Television, Bookkeeper, Book Publisher, Classical Illustrator, Craft Beer Manufacturer

2) Regular users (Middle)

Gender: 2x Female, 4x Male

Age: 32 – 44

Occupation: Community Manager, Director, Animator, Designer, Student, Producer

3) Expert users (Extreme)

Gender: 6x male

Age: 30 – 39

Occupation: Web Developer (x2), Software Developer, Technical Director, Creative Technologist (x2)

Experiment 1

Purpose:

To test if recreating a real red carpet experience leads to appropriate user behavior without instructions. I.e. posing for pictures, waving at people, etc.

Approach:

Users were placed in front of a sponsor backdrop, one by one, facing a virtual curtain that was projected on a wall. The curtain opened and users saw themselves and their environment, including the backdrop, projected onto the wall with nothing else added to the scene. Users were informed that this scene was supposed to represent a celebrity red carpet event.

The curtain stayed open for 20 seconds and the users' actions were recorded.

Hypothesis:

Users will act appropriately for a red carpet photo op.

Propositions:

1) Users will act appropriately.
2) Users will make up their own interactions.
3) Users will take no action.

Outcome:

Twelve users took what they considered appropriate actions for a red carpet photo op. Five users did not take any actions, none of the users made up their own context or interactions.

Proposition 1 and 3 were partially confirmed.

Experiment 2

Purpose:

To test if embodying the users physical form is an implicit call to action.

Approach:.

This experiment was conducted in two parts.

a) Users were placed in the space, one by one, facing a virtual curtain that was projected on a wall. The curtain opened and users saw themselves and their environment projected on the wall with nothing else added to the scene.
b) Users were placed in the space, one by one, facing a virtual curtain that was projected on a wall. The curtain opened and users saw themselves and their environment projected on the wall with a virtual push button super imposed onto the scene.

In each of the scenarios the curtain stayed open for 20 seconds and users' actions were recorded.

Hypothesis:

In the first part of the experiment (a) users will make up their own context and interactions. In scenario b users will reach for the push button.

Propositions:

1) Users will not interact in either scenario.
2) Users will interact in both scenarios. Making up their own interactions in scenario a and reaching for the push button in scenario b.
3) Users will reach for the push in scenario b but take no action in scenario a.
4) Users will make up their own interactions in scenario a but will not interact in scenario b.
5) Users will make up their own interactions in both scenarios.

Outcome:

None of the users took any actions in scenario a of the experiment, seemingly waiting for something to happen. Some users thought that the system was malfunctioning. All users except for one reached for the virtual button in scenario b. Users were only required to fill out a questionnaire in relation to scenario b.

Proposition 3 was confirmed with the exception of one user.

Experiment 3

Purpose:

To test if users will act on prompts from non-interactive actors embedded in the same environment.

Approach:

Users were placed in the space, one by one, facing a virtual curtain that was projected on a wall. The curtain opened and users saw themselves and their environment projected onto the wall. After a few seconds an actor appeared in the scene prompting users to engage in a game of rock, paper, scissors.

The curtain stayed open for the duration of the actor's interactions, 26 seconds. The users' actions were recorded.

Hypothesis:

Users will play rock, paper, scissors with the non-interactive actor.

Propositions:

1) Users will engage with the actor.
2) Users will make up their own interactions.
3) Users will take no action.

Outcome:

Fourteen users engaged in the rock, paper scissors game with the actor, five of those also made up their own interactions during the experience, two participants only made up their own interactions and one user did not take any action.

Proposition 1 was partially confirmed.

Data Analysis

Video Review

In this section the videos that were recorded during the staging of the Red Carpet Experience prototypes and during the experiments were reviewed and compared in an effort to confirm the observations during the events and in order to test the main hypotheses of this research. The videos of the prototype installations were retrieved from the rights holders public Facebook page and from YouTube. During the events participants were instructed by the staff that operated the experience as to the nature of the experience and the recording capabilities of the system as well as to the use of the videos, which, if consent was provided, were automatically uploaded to a public Facebook page after each user and users were prompted to share the videos through their own social networks at the same time. Participants were provided with a consent form that complies with privacy laws in the respective jurisdictions. Legal counsel was obtained to ensure compliance. In addition, signage containing the same wording as the consent form was placed around the installation in order to inform users prior to approaching the installation, which is standard procedure at public events that use recording equipment. In addition, the Red Carpet Experience prototype only recorded the experience if explicit consent was given. If users decided to withhold consent they could still enjoy the experience, but the system did not capture the interactions, ruling out the accidental recording of participants. This is also the reason for the discrepancy between the number of users that engaged and the number of videos that were recorded.

Comparison

		User Behavior			Physical Setup		
	Total User Engagement/ Reviewed Videos	**Behavioral Confirmation**	**Users' Own Actions**	**No Action**	**Red Carpet**	**Sponsor Backdrop**	**Public setting**
Walk The Red Carpet	361/184	142	29/74*	13	**x**		**x**
eLeo	83/66	46	15/17*	5		**x**	**x**
Experiment 3	17/17	14	2/5*	1		**x**	

* Users that exhibited behavioral confirmation, and made up their own actions

Table 2: Comparison of the Red Carpet Experience Prototypes and Experiment 3

Experiment 1

		User Behavior			Physical Setup		
	Total User Engagement/ Reviewed Videos	**Appropriate Behavior**	**Users' Own Actions**	**No Action**	**Red Carpet**	**Sponsor Backdrop**	**Public setting**
Light Users	5/5	2	0	3		**x**	
Regular Users	6/6	6	0	0		**x**	
Expert Users	6/6	4	0	2		**x**	

Table 3: Data collected during Experiment 1, broken down by user groups

Experiment 2

		User Behavior			Physical Setup		
	Total User Engagement/ Reviewed Videos	**Reached for the Button**	**Users' Own Actions**	**No Action**	**Red Carpet**	**Sponsor Backdrop**	**Public setting**
Light Users	5/5	4	0	1		**x**	
Regular Users	6/6	6	0/3*	0		**x**	
Expert Users	6/6	6	0	0		**x**	

* Users that reached for the button, and made up their own actions

Table 4: Data collected during Experiment 2, broken down by user groups

Experiment 3

		User Behavior			Physical Setup		
	Total User Engagement/ Reviewed Videos	**Behavioral Confirmation**	**Users' Own Actions**	**No Action**	**Red Carpet**	**Sponsor Backdrop**	**Public setting**
Light Users	5/5	4	0	1		**x**	
Regular Users	6/6	6	0/2*	0		**x**	
Expert Users	6/6	4	2/3*	0		**x**	

* Users that exhibited behavioral confirmation, and made up their own actions

Table 5: Data collected during Experiment 3, broken down by user groups

Findings

The key findings of the video review and the experiments related to this research confirm the observations that were made during the staging of the Walk The Red Carpet and eLeo prototypes. The majority of participants in the experiments, 82.4%, engaged in a game of rock, paper, scissors with the non-interactive actor, compared to 77.2% of users that engaged at the Walk The Red Carpet event and 69.7% of the eLeo participants. This supports the second hypothesis, which states that:

Users will interact with non-interactive content in video based SAR applications that embody the user's physical form in the experience provided that the experience is designed accordingly.

These finding also suggest that users act on non-verbal cues from non-interactive characters in such experiences, which could be used to answer

research question b, While a definite difference in the quality of the interactions between the Walk The Red Carpet and eLeo installations as well as the third experiment were observed, given the high engagement numbers, the findings are not conclusive enough to determine how much the context of where such experiences are staged has an impact on effective engagement and therefore research question three can not be answered conclusively.

Experiment one and two were staged in an effort to test the first hypothesis, which states that:

Video based SAR that embodies the user's physical form in the experience provides a low entry barrier for users to engage with content in a public environment.

Experiment 2a revealed that just embodying the users physical form by itself, without anything else, does not induce interaction. Putting the embodiment of the user's physical form in context of an experience, as was done with experiment one by letting participants know that it is a red carpet photo op., resulted in high engagement numbers, 70.6% overall, even though the numbers varied substantially between the different groups of users in this case. This was not the case with experiment 2b, which added an element that could be perceived as interactive to the scene, a simple push button. This resulted in 94.1% of users reaching for the button without any instructions to do so, leaving only one user that did not try to push it. This finding strongly suggests that hypothesis one can be confirmed and also suggests that embodying users' physical form in an experience is an implicit call to action, which is what research question one was concerned with.

Reflection

After the in-the-field deployment of the first Red Carpet prototype, I was amazed by how well it was received by the audience. While the hope was that people would embrace the scenario that we created, I did not expect the level of engagement that was achieved. Possibly jaded from creating interactive systems for so many years, I only saw the first prototype as a stepping-stone towards a fully interactive experience. To my surprise people "interacted" more with this non-interactive installations than with many actual interactive pieces that I have worked on in the past and without any or very little instructions as to what to do. This finding was ultimately so intriguing to me that it became the focus of this research. While the experience was designed to replicate a real celebrity red carpet appearance, it was the embodiment of the physical form of the participants that seemed to make engaging with the content natural and intuitive. This was partially confirmed in the sub-sequent experiments that were performed in a controlled environment. It became clear though that the content of the experience has to provide affordances that users perceive as being interactive. While the findings of this research can easily be applied to installations that actually are interactive, one of the most important and unexpected insights was the potential of content that is not interactive but offers affordances for people to (inter)act. In the context of DOOH marketing and advertising this could have big implications for cost and the required setup for an experience. It also opens the door for experimentation with hybrid systems that are partially interactive and use non-interactive content to provide cues to users as to how to interact, therefore reducing the need for

explicit instructions. Another interesting discovery was the importance of getting the content right. It is a given that the content is important for user engagement, but in the case of the Red Carpet experience it had to be even more carefully set up since it does not react to user input. Therefore the actors had to leave just enough time between actions for the user to be able to naturally respond and the actors also had to engage the user in a way that allowed for eye contact with the screen at all times in order to sustain the immediacy of the experience. Moreover, in order to take advantage of behavioral confirmation and to allow for emergent behavior at the same time the actions that the actors performed had to be carefully chosen. The actions had to make sense in the context of the set up and the overall experience but still had to allow for a variety of responses in order to prevent having people do the same things over and over again and to leave room for interpretation, which lead to new and unexpected responses. The discovery of users interacting with non-interactive content led to an investigation into what attributes of HCI are important for user engagement and an analysis of which of those attributes corresponded to the non-interactive Red Carpet experience. The resulting insight was that if an experience is designed effectively, user interaction could be achieved without providing any interactive elements. The findings of the experiments, specifically the responses of the three groups of users to the questionnaire seemed to give valuable insight into how such experiences could be designed effectively for different audiences. While it was beyond the scope of this research to investigate this matter further, it presents an opportunity for future research. There was a discrepancy in the quality of interactions between the

experiments and the staging of the experience during public events. There was even a substantial difference in how users engaged with the experience at the two public events that it was staged at, which suggest that, aside from the content, the context in which the interaction takes place is also an important factor for user engagement. This could not be conclusively confirmed through the experiments though.

Conclusion

The purpose of this research was to find ways to lower the entry barrier for engagement with screen based content in public spaces. This led to the creation of the Red Carpet Experience prototype, which provided the basis for the hypothesis that video based SAR that embodies the user's form in the experience provides a low entry barrier for users to engage with content in a public environment. One of the experiments, where users were presented with a live camera view of themselves and the surrounding environment with a simple push button super imposed over the camera view, could be used to confirm this hypothesis. The result was, as outlined in the Data Analysis section, that a high percentage of users reached for the button without any instructions, but it also revealed that the content of the experience has to provide perceived affordances for interaction in order for users to know what to do. The second hypothesis, which was also a result from observing how users engaged with the Red Carpet Experience prototypes, was concerned with users interacting with non-interactive content. Behavioral confirmation,

affordances, presence as well as intuition in the context of cognitive dual process theory were theoretical frameworks that, in conjunction with the findings of the experiments, were used to support this hypothesis. It became also clear that the content that is being displayed is an important factor to help facilitate this engagement. The survey of related work in the field showed that there is commercial viability and demand for such experiences and the interaction frameworks that were investigated gave valuable insight into how to prompt users to engage in the first place. Based on the findings of the literature review and the outcomes of the experiments we suggest the following design considerations when creating a SAR experience that requires a minimum amount of verbal or written instructions for users to interact.

1) Embodiment of the users physical form in the experience.
2) Creation of physical and/or virtual affordances.
3) Creation of content that allows users to make up their own context and interactions, while providing enough cues for users to understand what the experience is about.
4) Creation of content that considers the context of where the experience takes place.

Further Research & Work

Future directions of my research include, most immediately, the creation of a commercial turnkey solution based on the Red Carpet prototype for creating and staging such experiences. This turnkey solution will provide different ways

to operate the experience, via staff operated tablets, via touch screens and via mobile phones. It will also provide the ability to produce suitable content via built in chroma keying, a technique used in film and television to isolate content from the background, which is usually a green screen. Preliminary talks have begun with the Toronto Zoo as well as with professional sports teams to create installations that would give visitors a closer experience with the animals and sports stars and to provide them with a digital memento, a video of visitors interacting with the content, as a take away. Following this, further experimentation with hybrid interactive/non-interactive experiences will be conducted in an effort to extend the findings of this research to task based interactivity in public space. Different ways to display content will also be investigated in order to expand the use cases of the system, like Pepper's Ghost for example, which is a simple optical illusion technique that uses Plexiglass or a glass film and specific lighting in order to make objects appear and disappear. This technique is used in Disneyland's Haunted Mansion to create the appearance of translucent ghosts in the ballroom. Another area for further investigation is the creation of a personalized souvenir or memento of the experience and to see whether, in some instances, this could be more important that the experience itself.

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Appendices

Appendix A - Previous Work

Coca Cola – SAR Proof of Concept

Figure 18: Coca Cola Proof Of Concept Rendering (Illustration by Steve Wilson)

George Argyropoulos from Meta Design, who is also an industry partner at OCAD University, was looking for an experiential public space installation for one of his clients, Coca Cola. He asked me to develop a concept to present directly to the president of Coca Cola Canada.

My goal was to create a connection between users and content, while keeping the entry barrier as low as possible (i.e. no instructions necessary) and the fun/interest factor for non-participants as high as possible. In an ideal world it would also be fully automated. I proposed a SAR installation that would

seamlessly combine a real time camera feed with interactive 3D characters based on the Coca Cola happy factory campaign. The installation would be located at a public storefront, where the combined output is rear projected onto the showcase window that the user stands in front of ready to interact. Basic gesture interaction between the user and the characters would be supported. This led to the creation of a non-interactive proof of concept. The purpose of this prototype, aside from giving the client an idea of what the experience would look like, was to demonstrate technical feasibility. In order for this experience to work the CG (Computer Generated) scene and the live, real world video feed had to be seamlessly combined. Pyramid Attack, a Toronto based CG and Motion Graphics studio donated their time and created two virtual winter environments for this prototype. For this simple proof of concept a HD (High Definition) web cam was used and starting and stopping the experience was controlled via a laptop. Setting up the application was easy and there were no reliability issues with the hardware. The biggest challenge was setting up the real world camera and the virtual camera identically, which was imperative in order to achieve the desired effect. While everything went flawless, it became apparent during testing that the position of the camera had a big impact on how people interacted. In this scenario, due to the constraints on location, the camera was positioned high up, capturing the user from a steep angle. The virtual camera in the CG environment matched the real world camera perfectly and the composite output was projected on a wall directly in front of the user. This high up view made it hard for users to position themselves in the environment. These were just casual observations while building the prototype, since the purpose of this proof-of-concept was not to

test user interaction or usability. Playing with this prototype, even though it was not interactive, made me think about the possibilities of SAR. One of the design decisions that were made was to give users a cue to interact with the non-interactive character, in this case a snowman raising a can of Coke. This was done in an effort to show the client what it would be like once the CG characters are actually interactive. While testing I noticed that everyone who engaged with the content for a few times tried to virtually touch coke cans with the snow man, knowing that it is only a pre recorded animation and not interactive. While this was neither a representative sample group of users nor a structured attempt to gain insights, it made me wonder if this was just coincidence or if real interactivity might not be necessary in such a scenario. This proof of concept became the foundation of the Red Carpet experience.

Appendix B- Red Carpet Prototype Setup

Walk The Red Carpet

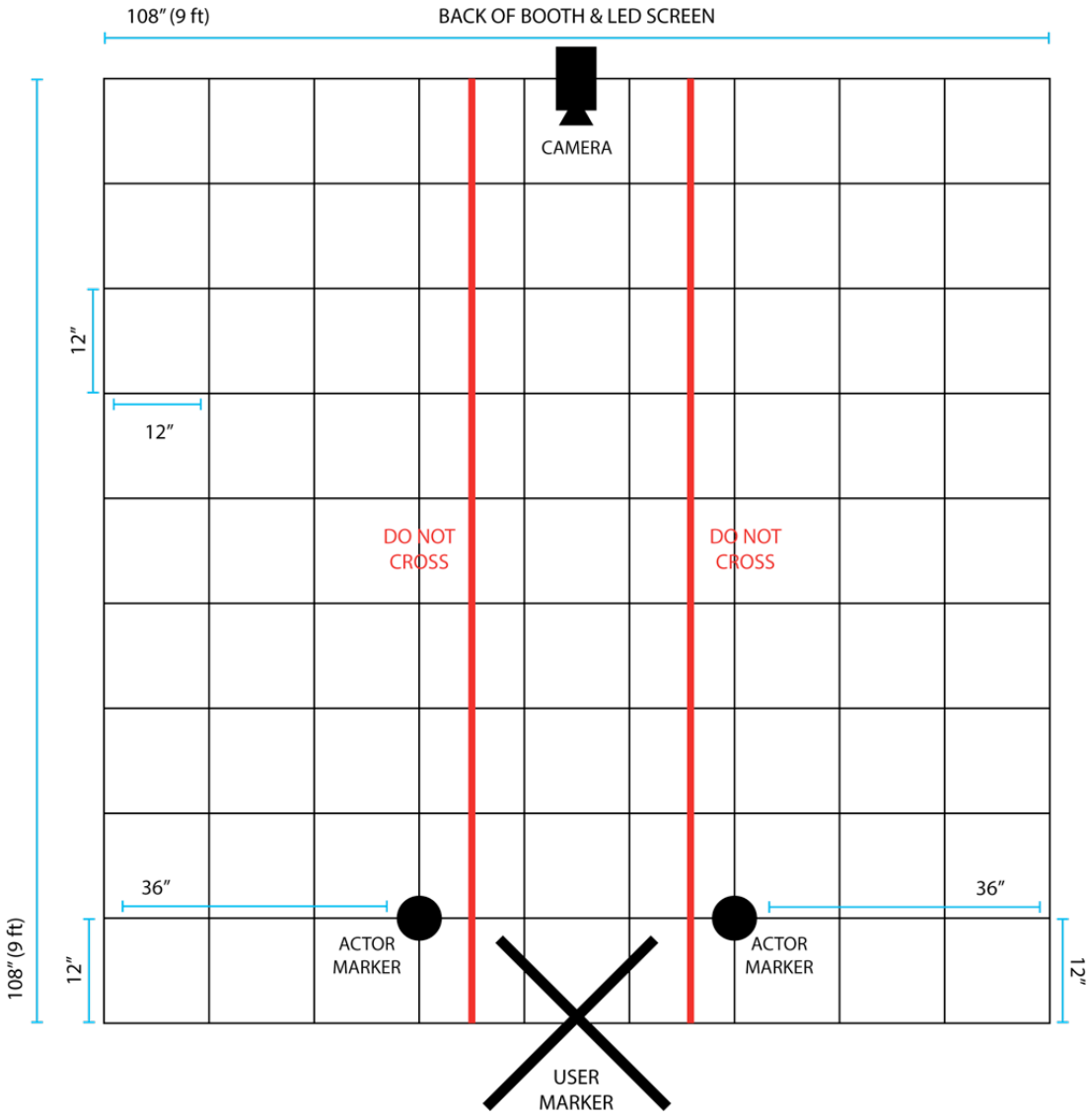

Figure 19: Reference Grid (Illustration by Cris Mora)

Figure 20: Grid Setup

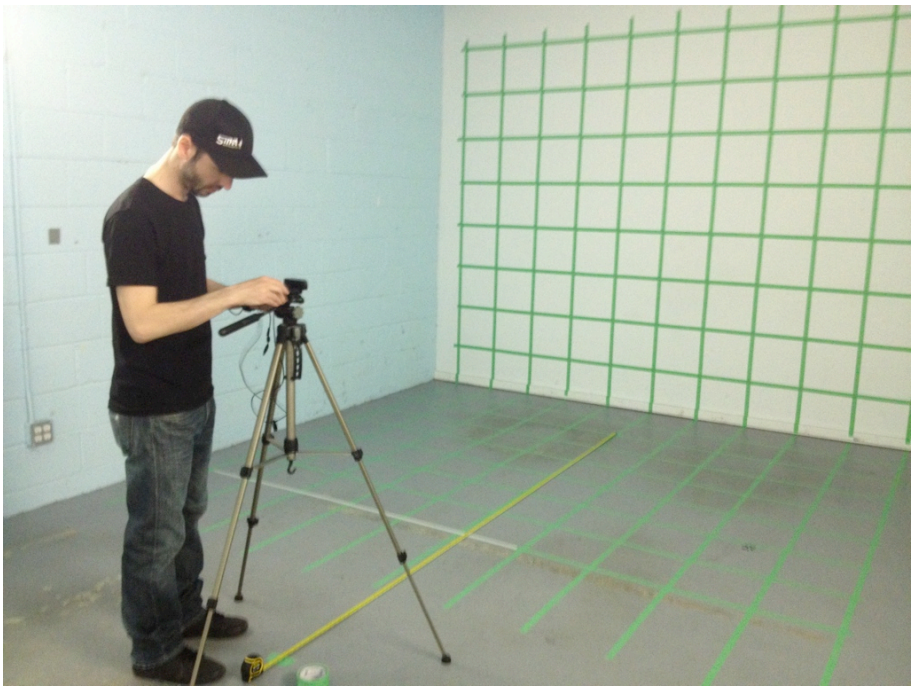

Figure 21: Camera Setup

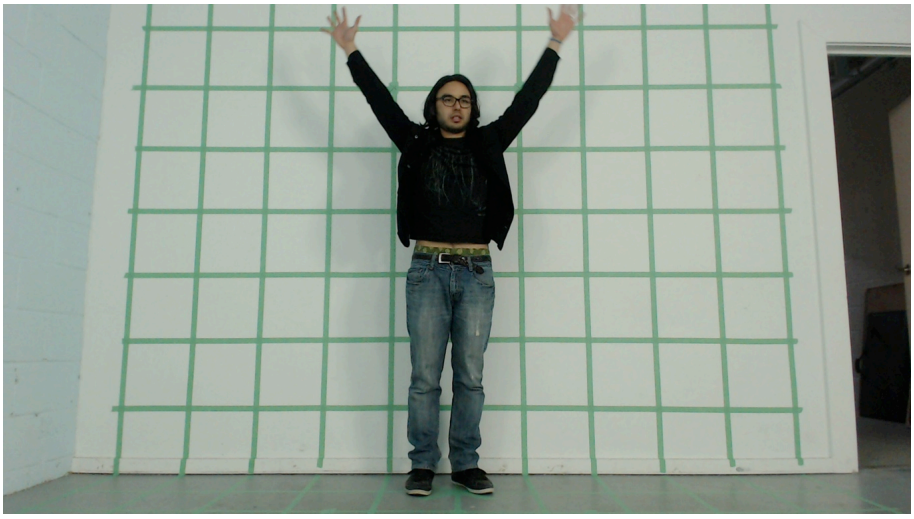

Figure 22: Camera Height 57cm

Figure 23: Camera Height: 87cm – This camera height was used

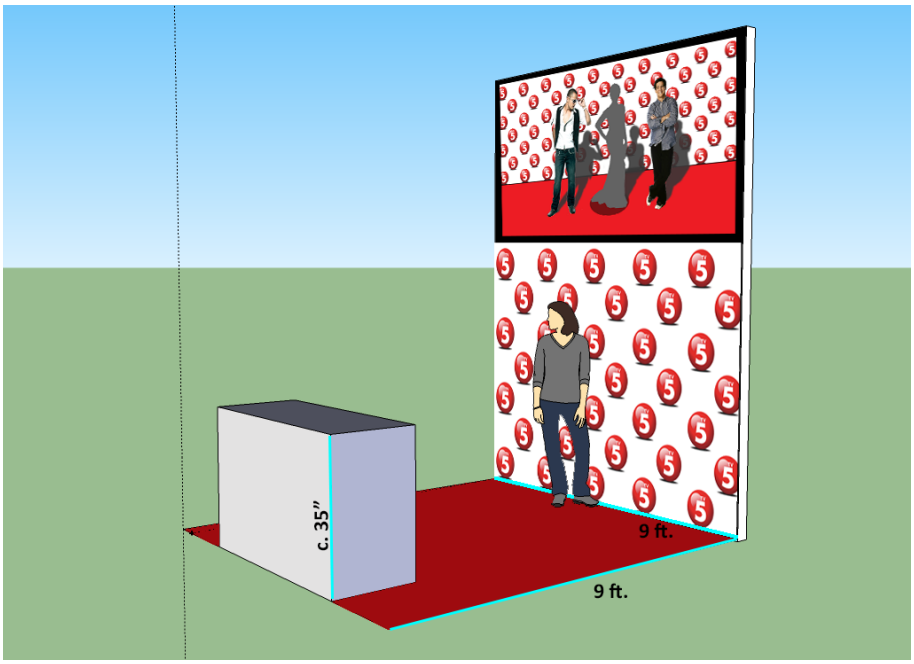

Figure 24: Proposed Booth Setup 1 (Illustration by Cris Mora)

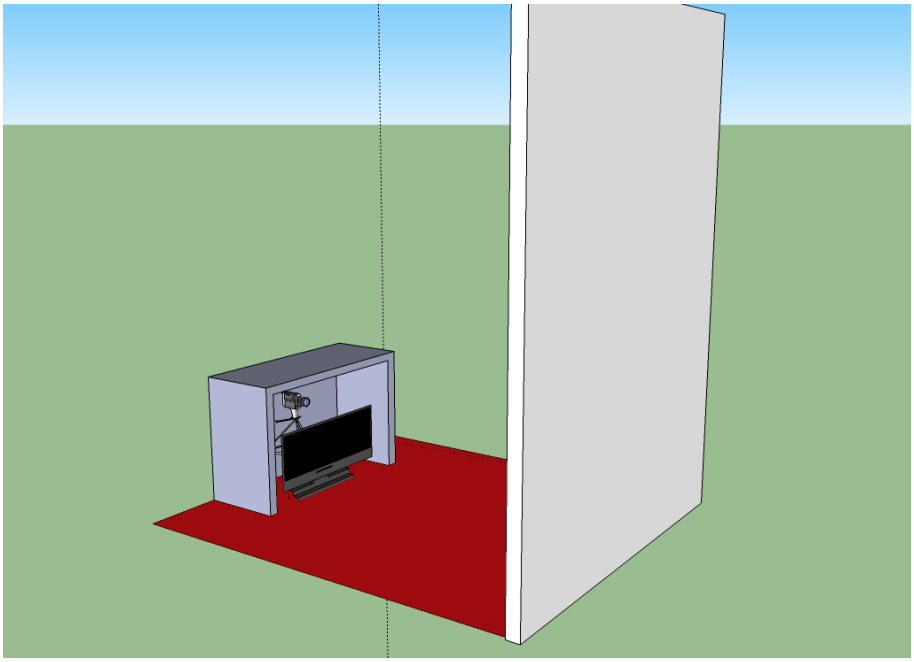

Figure 25: Proposed Booth Setup 1 - Alternate View (Illustration by Cris Mora)

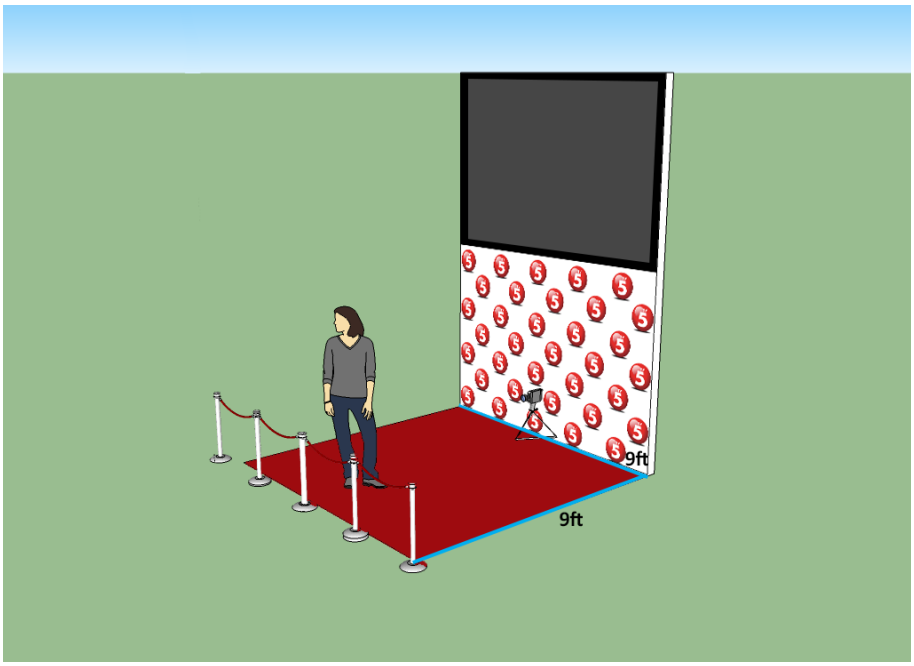

Figure 26: Proposed Booth Setup 2 (Illustration by Cris Mora)

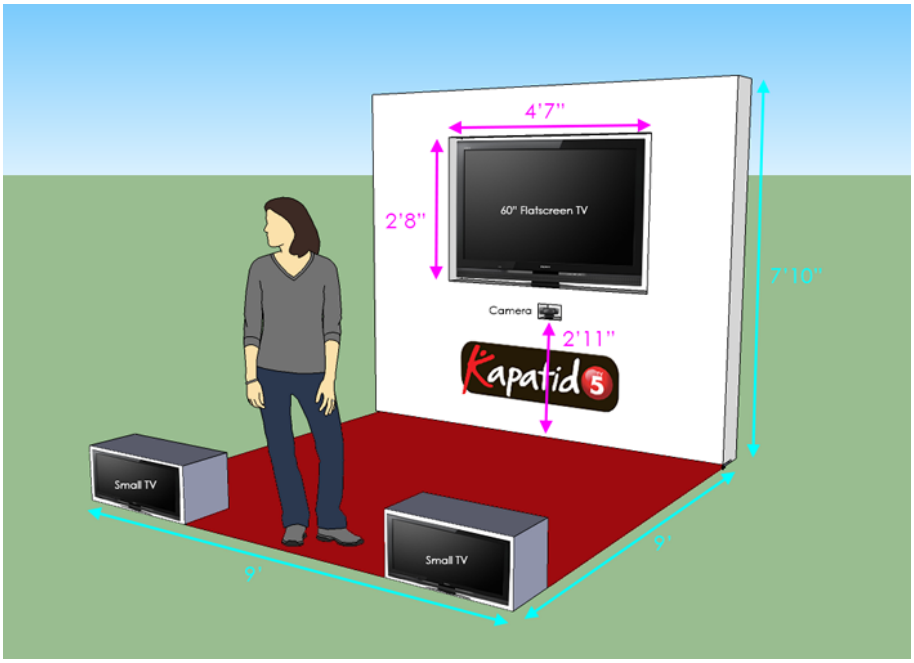

Figure 27: Proposed Booth Setup 3 – This setup was used (Illustration by Cris Mora)

Figure 28: Tablet Application Interface Concept 1 (Illustration by Cris Mora)

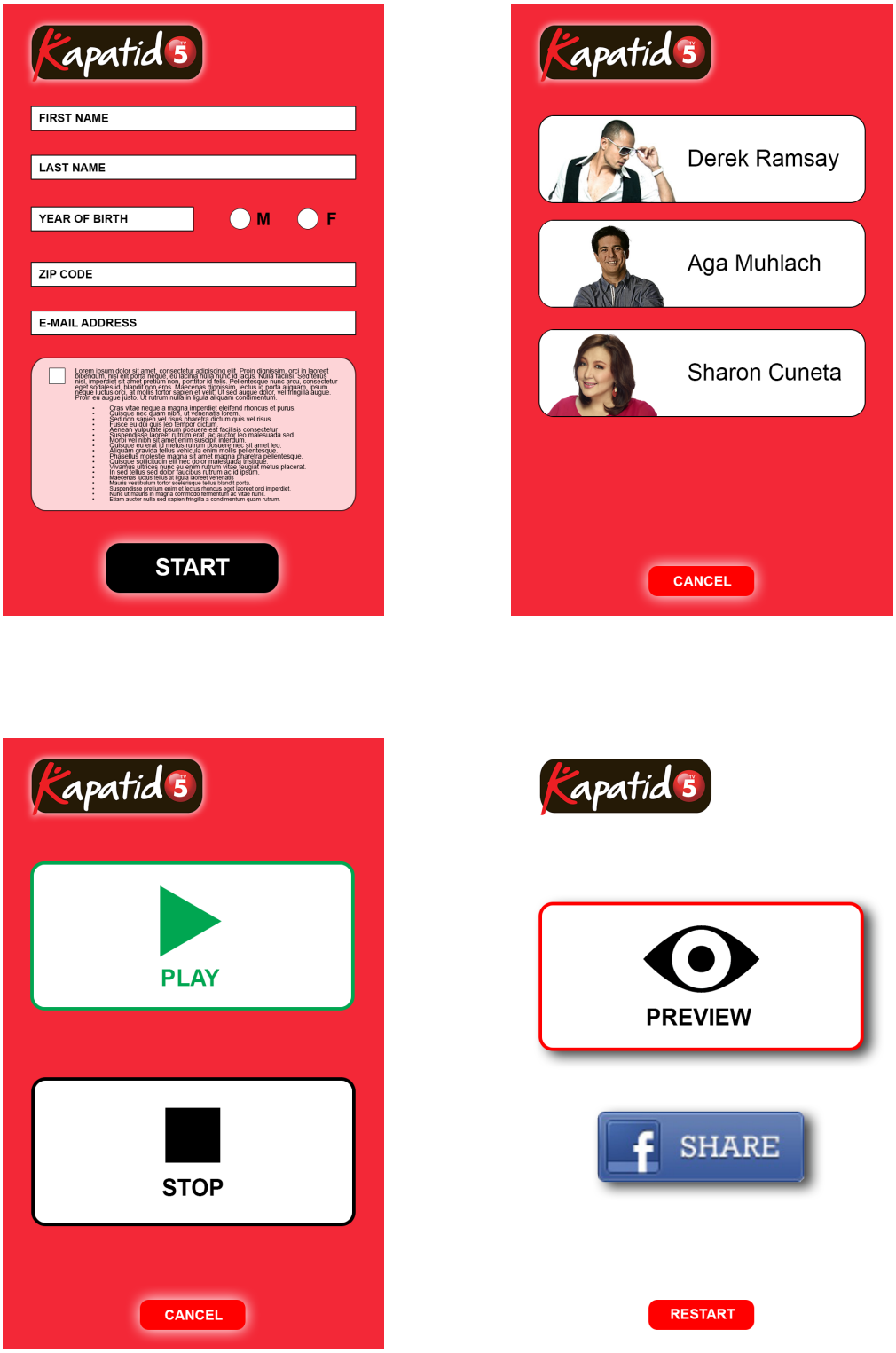

Figure 29: Tablet Application Interface 1st Draft (Illustration by Cris Mora)

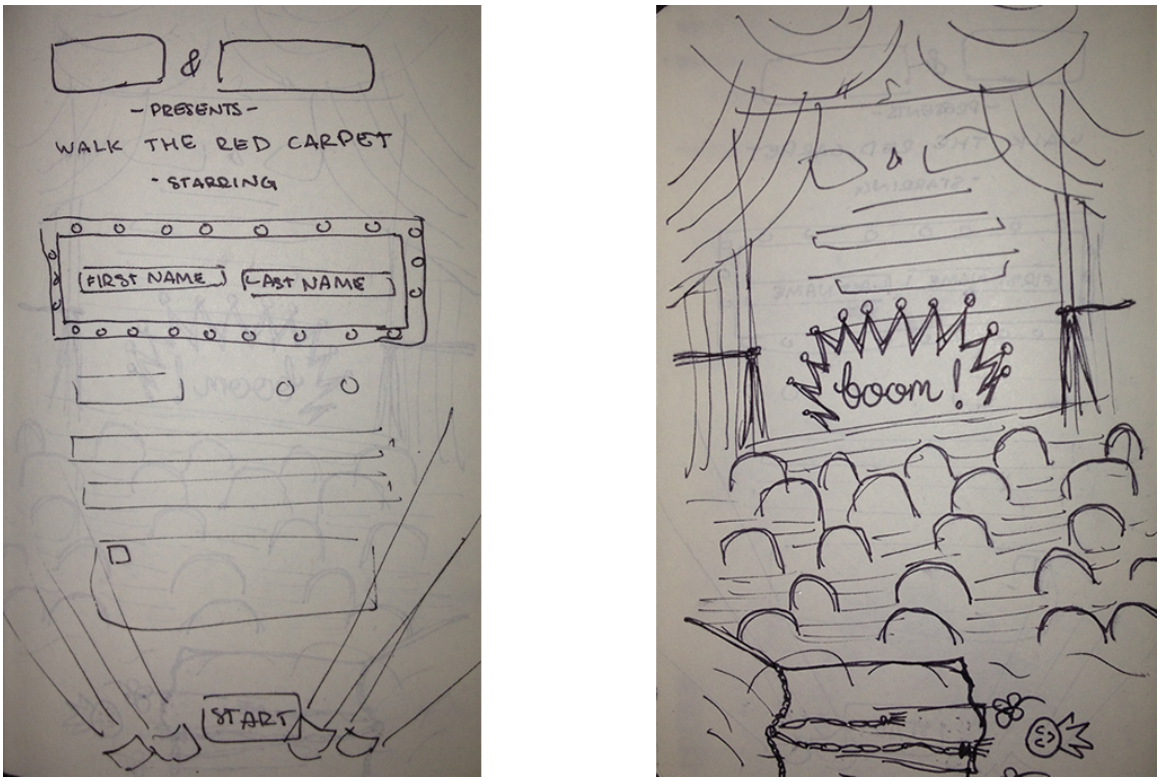

Figure 30: Tablet Application Interface Concept 2 (Illustration by Cris Mora)

Figure 31: Tablet Application Interface 2nd Draft (Illustration by Cris Mora)

Figure 32: Tablet Application Interface 3rd Draft (Illustration by Cris Mora)

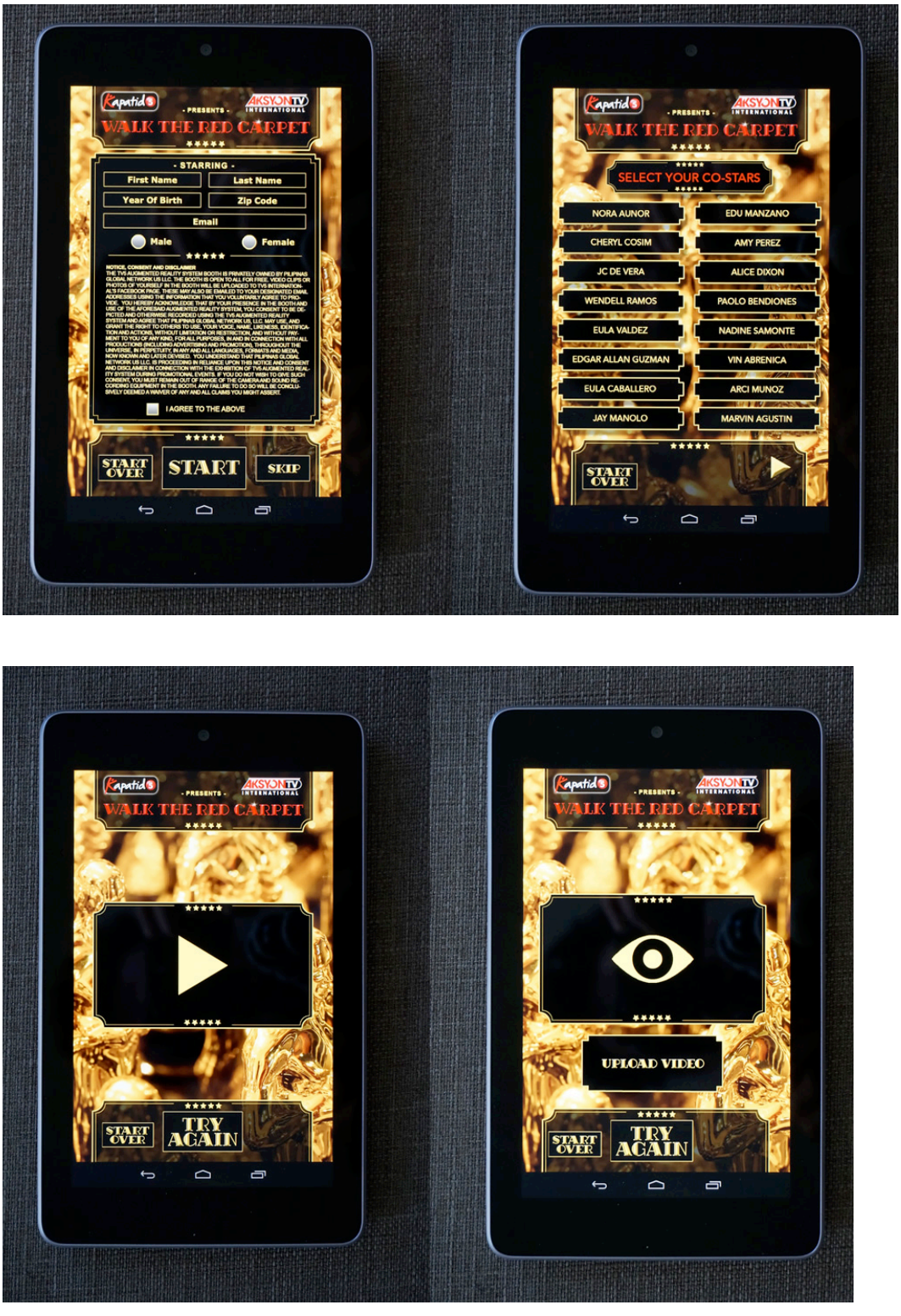

Figure 33: Final Tablet Application Interface (Facebook share not shown)

Appendix C – Questionnaire

Questionnaire

1. How easy was it to understand what you had to do?
2. How much did the visual aspects of the environment involve you?
3. How much did your experiences in the virtual environment seem consistent with your real-world experiences?
4. How involved were you in the virtual environment experience?
5. Did you feel "present" in the experience?
6. Please briefly elaborate why feel "present" in the experience.
7. Why did you start interacting or not interact at all?

Light Users

	Experiment 1			Experiment 2			Experiment 3		
Question/Result	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**
1	1	10	6.2	8	10	9	6	10	8.2
2	2	9	6.4	8	9	8.4	4	10	8
3	2	9	5.4	3	9	5.2	4	9	6.2
4	2	7	4.6	4	9	6.2	4	9	7.4
5	2	7	4.4	5	8	7	6	8	7.2

Table 5: Aggregated Questionnaire Results for "Light" users

Experiment 1	**User 1**	**User 2**	**User 3**	**User 4**	**User 5**	**Mean**	**Median**
1	1	10	9	9	2	6.2	9
2	4	8	9	9	2	6.4	8
3	8	3	2	9	5	5.4	5
4	4	7	5	5	2	4.6	5
5	4	7	4	5	2	4.4	4
Experiment 2							
1	9	10	9	9	8	9	9
2	8	8	9	9	8	8.4	8
3	5	3	3	9	6	5.2	5
4	6	4	6	9	6	6.2	6
5	5	7	8	7	8	7	7
Experiment 3							
1	7	10	9	9	6	8.2	9
2	8	10	9	9	4	8	9
3	8	5	5	9	4	6.2	5
4	8	8	8	9	4	7.4	8
5	7	8	8	7	6	7.2	7

Table 6: Questionnaire Results for "Light" users broken down by Experiment

Regular Users

	Experiment 1			Experiment 2			Experiment 3		
Question/Result	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**
1	5	10	7.8	8	10	9.3	7	10	8.7
2	4	8	6.8	8	10	9	7	10	8.7
3	6	9	8	5	9	7.5	7	10	8.3
4	6	8	7.3	8	10	8.8	7	10	8.7
5	5	9	7.6	9	10	9.2	8	10	9.2

Table 7: Aggregated Questionnaire Results for "Regular" users

Experiment 1	**User 6**	**User 7**	**User 8**	**User 9**	**User 10**	**User 11**	**Mean**	**Median**
1	7	5	9	9	7	10	7.8	8
2	8	4	7	7	7	8	6.8	7
3	9	9	7	8	6	9	8	8.5
4	8	6	7	8	6	9	7.3	7.5
5	8	8	9	7	5	9	7.7	8
Experiment 2								
1	8	10	9	10	9	10	9.3	9.5
2	8	9	9	9	9	10	9	9
3	7	8	5	7	9	9	7.5	7.5
4	8	8	10	9	9	9	8.8	9
5	8	9	10	9	10	9	9.2	9
Experiment 3								
1	8	7	10	10	8	9	8.7	8.5
2	8	9	10	9	7	9	8.7	9
3	8	7	10	7	8	10	8.3	8
4	8	8	10	9	7	10	8.7	8.5
5	8	8	10	9	10	10	9.2	9.5

Table 8: Questionnaire Results for "Regular" users broken down by Experiment

Expert Users

	Experiment 1			Experiment 2			Experiment 3		
Question/Result	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**
1	1	7	3.8	1	10	6.2	1	9	6.7
2	1	6	4.3	5	8	7	5	9	7
3	1	7	3.8	1	9	5.7	1	9	5.3
4	1	8	4.5	3	8	6.2	3	10	6.5
5	3	9	5.8	3	9	6.2	3	9	6.2

Table 9: Aggregated Questionnaire Results for "Expert" users

Experiment 1	**User 12**	**User 13**	**User 14**	**User 15**	**User 16**	**User 17**	**Mean**	**Median**
1	2	5	1	2	7	6	3.8	3.5
2	1	5	3	5	6	6	4.3	5
3	3	4	3	1	5	7	3.8	3.5
4	1	6	3	3	8	6	4.5	4.5
5	9	6	3	3	8	6	5.8	6
Experiment 2								
1	1	7	10	5	5	9	6.2	6
2	8	5	8	6	7	8	7	7.5
3	3	7	8	1	6	9	5.7	6.5
4	8	5	8	3	7	6	6.2	6.5
5	9	5	8	3	7	5	6.2	6
Experiment 3								
1	1	8	8	7	9	7	6.7	7.5
2	8	5	8	6	9	6	7	7
3	3	3	8	1	9	8	5.3	5.5
4	8	5	7	3	10	6	6.5	6.5
5	9	4	8	3	8	5	6.2	6.5

Table 10: Questionnaire Results for "Expert" users broken down by Experiment

Appendix D – REB Approval

Approval Number: 2014-06

Research Ethics Board

January 28, 2014

Dear Demosthenes Kandylis,

RE: OCADU 168 "Designing for Intuition."

The OCAD University Research Ethics Board has reviewed the above-named submission. The protocol and the consent form dated January 28, 2014, are approved for use for the next 12 months. If the study is expected to continue beyond the expiry date (January 27, 2015) you are responsible for ensuring the study receives re-approval. Your final approval number is **2014-06.**

Before proceeding with your project, compliance with other required University approvals/certifications, institutional requirements, or governmental authorizations may be required. It is your responsibility to ensure that the ethical guidelines and approvals of those facilities or institutions are obtained and filed with the OCAD U REB prior to the initiation of any research.

If, during the course of the research, there are any serious adverse events, changes in the approved protocol or consent form or any new information that must be considered with respect to the study, these should be brought to the immediate attention of the Board.

The REB must also be notified of the completion or termination of this study and a final report provided before you graduate. The template is attached.

Best wishes for the successful completion of your project.

Yours sincerely,

Tony Kerr, Chair, OCAD U Research Ethics Board

OCAD U Research Ethics Board: rm 7520c, 205 Richmond Street W, Toronto, ON M5V 1V3
416.977.6000 x474

Figure 34: REB Approval Letter