UNIVERSITY OF CALIFORNIA, DAVIS | LANDSCAPE ARCHITECTURE PROGRAM

A PROJECT BY AARON G DOMINGO

A WHOLE NEW PERSPECTIVE

The Creation of an Augmented Reality App
for Site Intervention Visualization

This thesis is presented to the University of California, Davis Landscape Architecture Program, in partial fulfillment of the program's requirements for the Degree of Bachelors of Science.

Reviewed & Approved by:

Dave Cubberly, Committee Member

Marq Truscott, Committe Member

Jona Garrucho, Committee Member

Dr. Stephen Wheeler, Advisor

A WHOLE NEW PERSPECTIVE

_ABSTRACT

Landscape architecture owes much of its progression to the advancement of technology. This thesis/project was undertaken with the intention of identifying the next major technological application that could change the profession in the near future. The first portion of this project is an analysis of the current technologies being used in the education and practice of landscape architecture, in an effort to understand the profession's deficiencies. While the analysis shows that there is a variety of computer applications that have become essential to the processes of site analysis and site intervention, it becomes apparent that there is an opportunity for improvement in what can be done while on a site visit. With the advancement of smartphones, tablets, and their respective capabilities, it becomes evident that the next area of growth should involve the use of these mobile devices. The project turns its focus to the use of augmented reality, which is an emerging technology currently being employed in many popular smartphone and tablet apps, but has yet to be successfully applied to aid landscape architecture. The project discusses the potential of such an application and goes on to explain the necessary steps for its actual development. Ultimately, this project sets up a framework for the development and creation of an augmented reality app that landscape architects and their clients can cooperatively use to visualize site intervention.

A WHOLE NEW PERSPECTIVE

_ACKNOWLEDGEMENTS

Many people were instrumental in the completion of this project.

I would firstly like to thank **Gayle Totton** and **Professor Steve Wheeler** for their guidance.

I would like to thank **Dave Cubberly**, **Marq Truscott**, and **Jona Garrucho** for agreeing to take part in this project as my committee members.

I would like to thank **Rachel Feliza De Jesus** for her unyielding support.

I would like to thank my little sisters, **Rissa, Steffi, and Jen** for letting me pick on them.

I would like to thank the members of the **UC Davis Landscape Architecture Program Class of 2013** for their critiques and suggestions.

A WHOLE NEW PERSPECTIVE

_DEDICATION

i dedicate this project to

my mother _ thanks for everything

&

my late father_ hope i'm making you proud

AARON G DOMINGO

_TABLE OF CONTENTS

_FIGURES

1_INTRODUCTION

1.1 Graphic of computer placed in front of drafting tools. Computers have become the essential tool for both students and professionals.

Not too long ago, landscape architects relied heavily on sheets of vellum, sketchpads, scales, and pencils to visualize and convey their design ideas. If a professional wanted to show a client what their proposed space would look like, he or she would have to draw a perspective view with a pencil and color it by hand, typically with markers or watercolors. Various skillsets were necessary in order to mentally envision a specific site intervention and produce quality graphics that would clearly communicate design objectives. While the ability to hand-render graphics is still quite valued in the practice of landscape architecture, one should understand that the advancement of technology has increasingly made hand-

1.2-3 Hand rendered drawings will never become truly become outdated, but computers are making it much easier produce high quality perspectives and graphics in general.

rendering skills less essential, if not slightly archaic. Today, a simple click of a computer mouse button can produce amazing photorealistic perspective views of an intervened space within seconds, and can do so with undeniable accuracy. In recent years, the profession has been supplied with an excess of different computer software programs to aid in the design and communication process, and in the ultra-competitive landscape of the profession, it behooves both students and professionals to understand the technologies available to them. Whether it is a mapping tool to aid in plan development, a 3D model building program to visualize the environment, or a graphics editor to produce presentation material, improvements to programs are made regularly, which is something all members of the field should be aware of.

To be completely fair, a paper set of drawings will never truly become outdated in the profession and can sometimes be easier and more efficient in particular stages of the design process. At times, hand renderings can even elicit an indefinable quality and character that a computer drawing might not be able to evoke. However, it should be understood that landscape architecture involves the design of three-dimensional spaces, and 2D drawings (whether they are hand drawn or computer-aided) will rarely outperform 3D mediums in terms of visualizing space.

The fact is that technology is fast-growing and as time goes on, becomes more accessible, more practical, and more affordable. Landscape architecture can and should always take advantage of what is available, in an effort to ensure that the field never gets complacent.

As a fan of technology, I am always intrigued by what new advancements are coming out of the technological world. As a student of landscape architecture who aspires to be a successful member of the profession, I always have the urge to ask how the next big thing in technology can be applied to my work. What is the next tool or program I must learn to contend with my peers and future colleagues? For my Senior Thesis/Project, I chose to answer these questions and investigate an immediately available technology that could possibly change landscape architecture in the near future. Augmented reality systems are where the profession can take its next step of advancement, and in this thesis I will show how and why the profession can take advantage.

2_ TECHNOLOGY & LANDSCAPE ARCHITECTURE

_THE PROFESSION'S TECHNOLOGICAL LANDSCAPE

Computers have become an integral part of the practice of landscape architecture. It is safe to say that in the profession's current landscape, neither an individual nor a firm can be competitive without a proficiency, if not a mastery, of several different computer programs. To understand how technology has become an integral part of the practice of landscape architecture, however, one must first understand exactly how landscape architects successfully gain work. Specifically, one must understand the interaction between professionals and their prospective clients.

Landscape architecture is multidisciplinary, so there are many facets of work within the field, but there is usually a specific process that involves a client employing a landscape architect and a landscape architecture firm for a project's design and development (Landscape Architects Techincal Committee, *Selecting A Landscape Architect Private Guide*). Projects can range from a small backyard to a public park or even a zoo, but the phases of design and construction are generally the same. While clients can go directly to a reputable landscape architect to ask for design help, typically clients who need to explore different design possibilities will send out requests for proposal (RFP's) to several firms. These RFP's lay out what the client is looking to find in a firm and in a design. A firm will respond to these RFP's, laying out their project development services and each firm will have their own distinctive take on the project at hand. Naturally, the content and execution of firms' presentations will distinguish which firm is the right fit for the project.

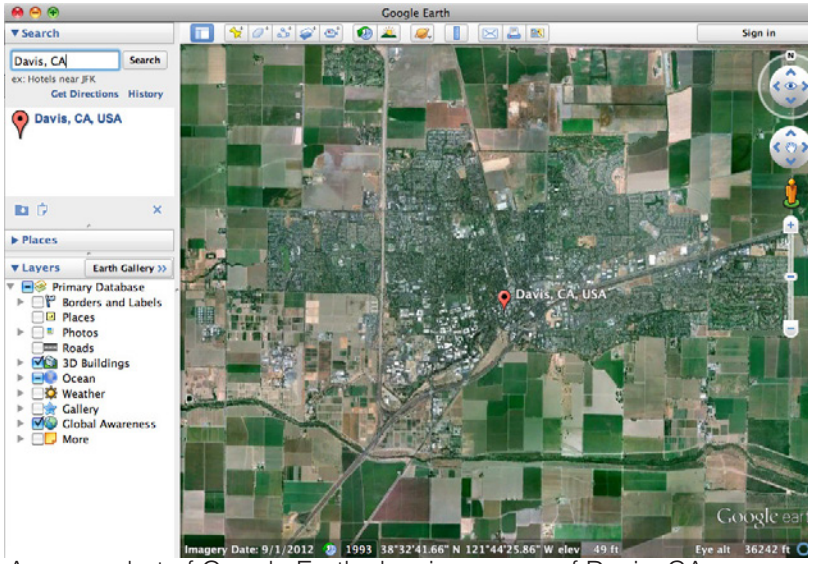
The deliverables are where firms can tangibly differentiate themselves from competing firms, as they will show off their past relevant projects and

provide presentation graphics of their site analyses and design concepts. One cannot understate the importance of attractive graphics that accompany a presentation. Especially when pitching to lay people, the presentation can be the most significant factor in a client's decision to pick one firm over another. Unlike a trained landscape architect, the lay person most likely does not have the ability to visualize the experience of a landscape design. It is the landscape architect's duty to make the client see the effectiveness of the design. It is in the presentation that the professional can engulf the client in the experience of the site intervention, and this is where technological tools can play a huge role.

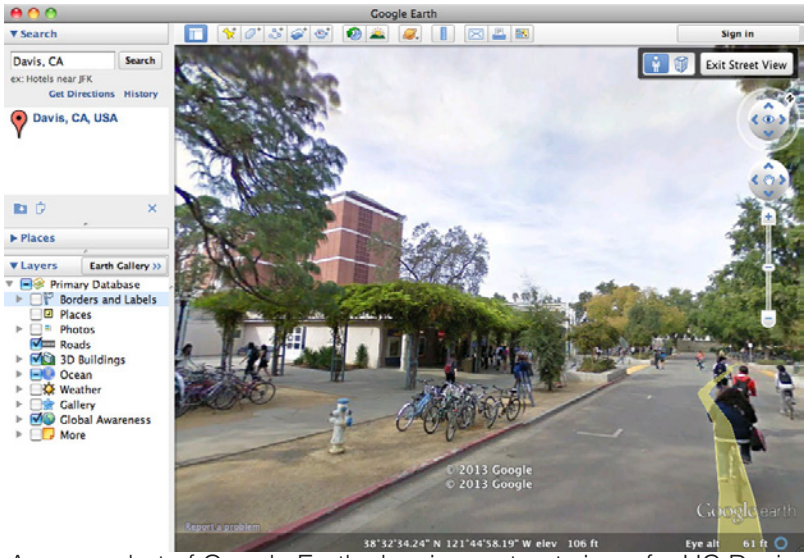
A landscape architect that has mastered available technological tools is more equipped to gather information quicker and more accurately, perform analyses more systematically, and produce high quality graphics more efficiently. That is not to say that a practicing professional cannot get by without the use of technology, but one should understand that technology's core purpose is to make tasks simpler for humans to perform. As tasks decrease in difficulty, the time it takes to complete the task decreases as well. In a world that holds performance speed to the highest of values, it is necessary for a practicing professional to understand what tools are available to get the project done more efficiently than his or her competition. While each practicing professional can employ a unique set of software programs to aid in the design process, there are a few basic types of programs that are generally being used across all landscape architecture firms (Tal, D. 2012 Interview). The following pages give brief overviews of the most commonly used programs.

Mapping- *Google Earth*

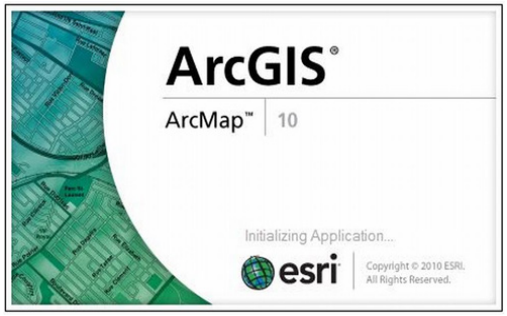
Google Earth is a virtual mapping and geographical information program that gives landscape architects the ability to view their sites through satellite imagery. Since its release in 2001, the program has greatly improved, using NASA shuttles to garner 3-dimensional images of topography. Landscape architects have the ability to see their sites to scale from a plan view and are even given the ability to see their sites in a street view. Google has started to also build 3-dimensional buildings within the program,which provides landscape architects a useful tool for spatial information. The program is free to use and can be used on computers, smartphones, and tablets. Typically, a landscape architect will use this program to develop a base map and even to perform site analyses. Google Earth has become available for use on smartphone and tablets, giving landscape architects the freedom to use the program anywhere.



2.1 A screenshot of Google Earth showing a map of Davis, CA

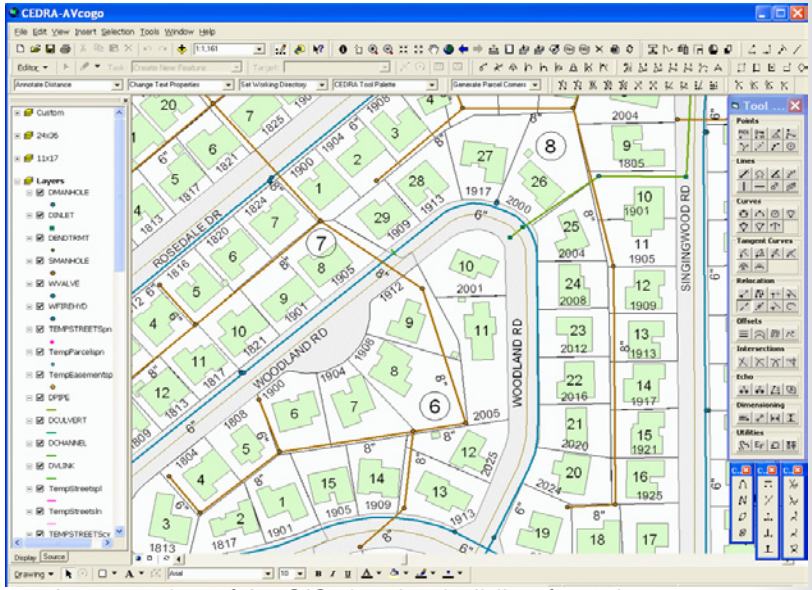


2.2 A screenshot of Google Earth showing a street view of a UC Davis road

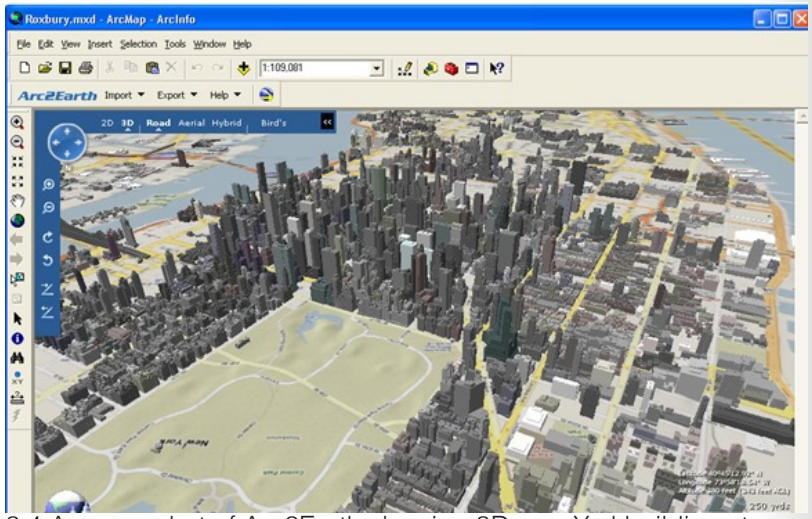


Mapping - ***Esri ArcGIS***

ArcGIS is the premier geographic information system program. This program allows for landscape architects to create maps and compile map data. New information on geographic tendencies and deficiencies can be found through the use of this program. Landscape architects have access to a database of map data to easily map out such things as building footprint and land use. Landscape architects can easily layer different sets of information to understand the effects each variable has on the areas they are researching. Esri products can reach up to several hundreds of dollars a year for use, but there are not many programs that have the ability to engage in such systematic approaches to maps and map data.



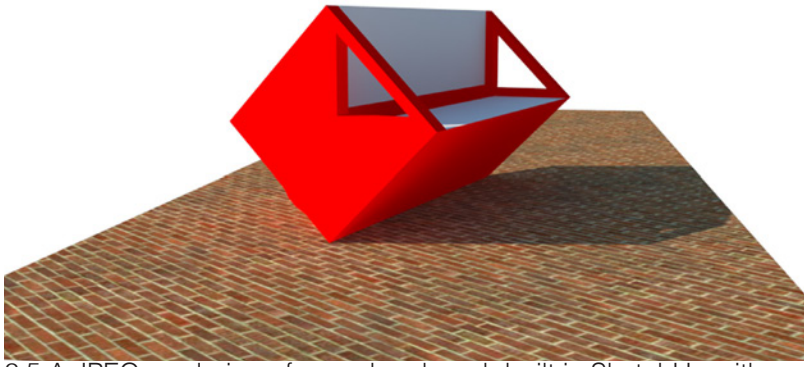
2.3 A screenshot of ArcGIS showing building footprints



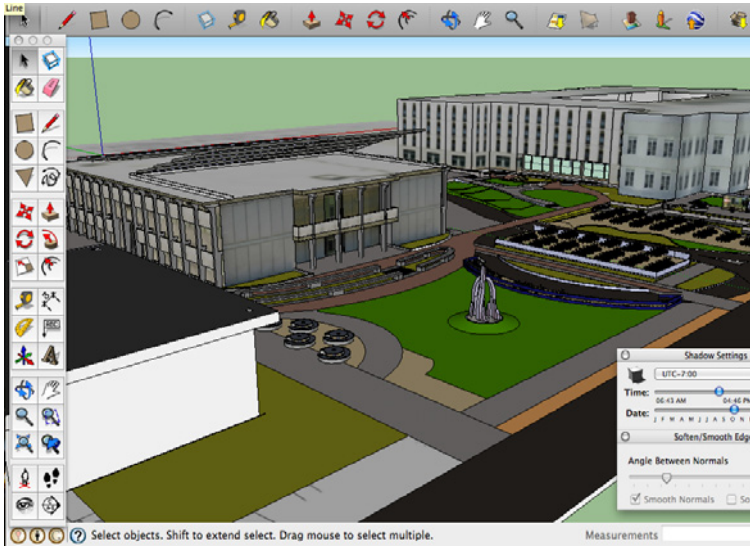
2.4 A screenshot of Arc2Earth showing 3D new Yorkbuilding structures in New York

Design/Graphics - ***Trimble SketchUp***

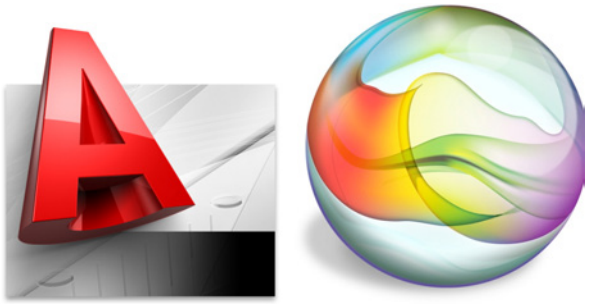
Previously owned by Google, Sketchup is a 3D modelling program that landscape architects use to build their site in a three-dimensional environment. There is an online repository/database of built objects that anyone can access and contribute to. While there are other 3D modelling programs that outperform SketchUp in terms of rendering quality, SketchUp's ease of use and repository of built objects is unmatched. PlugIns can be added to supplement the program with more rendering options.What is most attractive is that SketchUp is a free program, with Trimble offering a professional package that requires payment for serial key.



2.5 A JPEG rendering of a modern bench built in SketchUp with VRay plugin

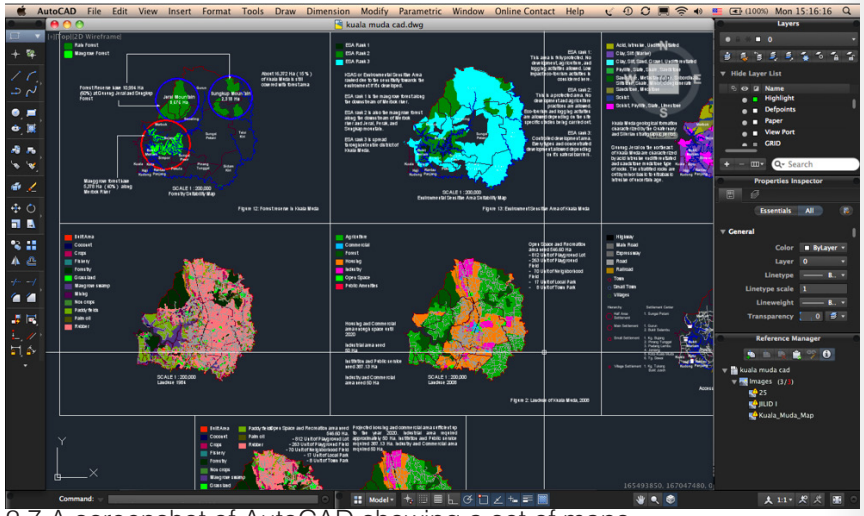


2.6 A screenshot of SketchUp model with built 3D objects

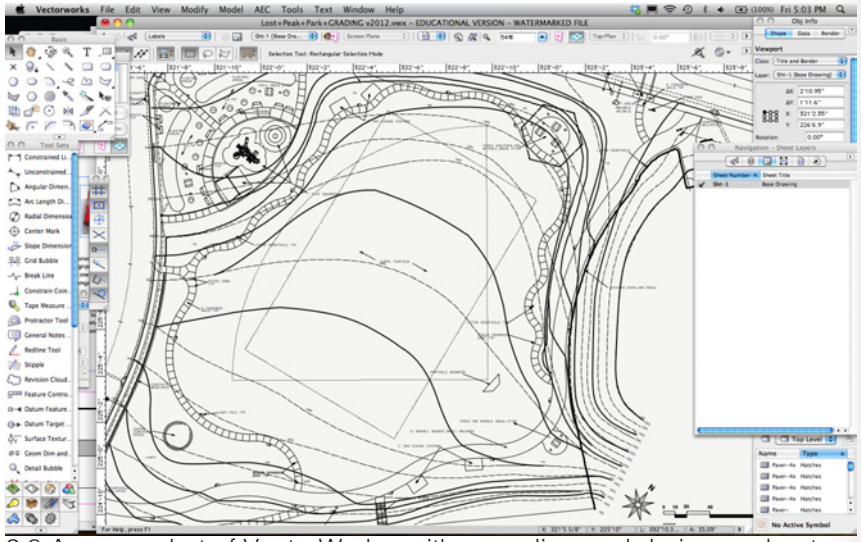


Design - ***Vectorworks/AutoCAD***

Vectorworks and AutoCAD are computer aided design programs. Landscape architects typically use one or the other to create vector based drawings of designs or construction documents (AutoCAD seems to be the more popular among firms, although there is a growing interest in the use of Vectorworks). Both programs have the ability to build 3D models, but typically landscape architects will use these programs for base maps and construction details. These programs have the ability to layer information, making it simple to create several drawings on base maps. Both programs are free for educational use, but require purchase for professional use. AutoCad and Vectorworks are industry standards that all students and professionals should be familiar with.



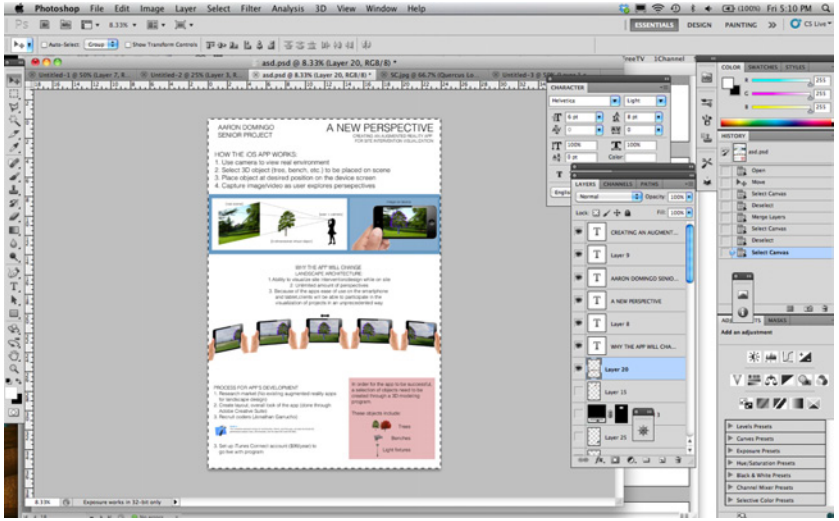
2.7 A screenshot of AutoCAD showing a set of maps



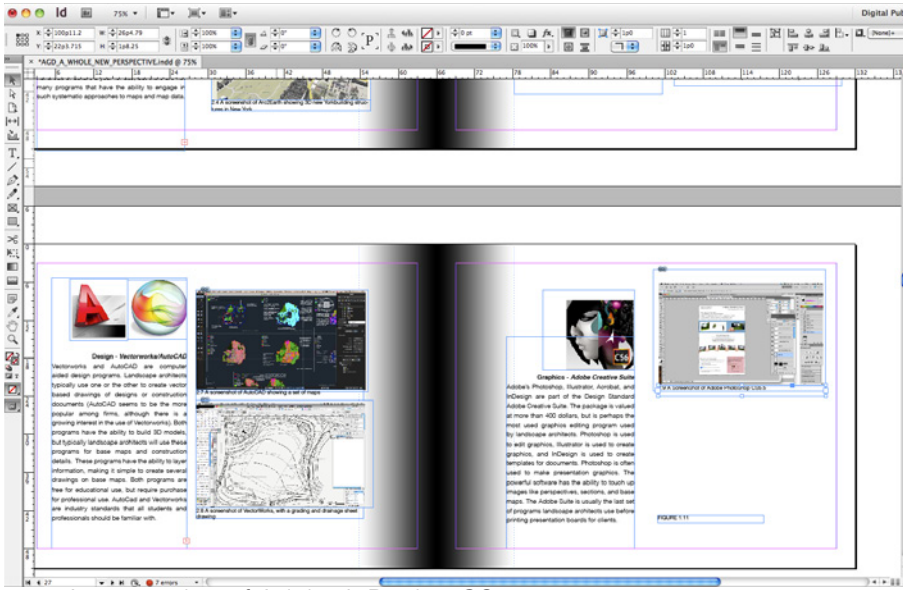
2.8 A screenshot of VectorWorks, with a grading and drainage sheet drawing

Graphics - ***Adobe Creative Suite***

Adobe's Photoshop, Illustrator, Acrobat, and InDesign are part of the Design Standard Adobe Creative Suite. The package is valued at more than 400 dollars, but is perhaps the most used graphics editing program used by landscape architects. Photoshop is used to edit graphics, Illustrator is used to create graphics, and InDesign is used to create templates for documents. Photoshop is often used to make presentation graphics. The powerful software has the ability to touch up images like perspectives, sections, and base maps. The Adobe Suite is usually the last set of programs landscape architects use before printing presentation boards for clients.



2.9 A ScreenShot of Adobe PhotoShop CS5.5



2.10 A screenshot of Adobe InDesign CS6

ANALYSIS

The aforementioned programs share a common feature -- they are all to be used at home or at a studio, on a personal computer. Because these programs have so many capabilities, options, tweaks, and settings, one could easily believe that all these programs are all a landscape architect could ever need, so long as they can be used harmoniously with each other. These programs already have the ability to do so much that it is hard to imagine what else can be done to improve upon them further. However, it is a certainty that developers and coders will find a way to make better versions of these programs.

With that being said, there is a definite learning curve before one can truly be proficient with these applications, especially when using several programs at a time. I do not see that as a major deterrent for a practicing professional, but to the lay person or to the student, using these programs simultaneously can be overwhelming.

What I began to notice when researching all these programs was that they all function the best when using a personal computer from home or in a studio. While the Google Earth application can be used on tablet and smartphone, the program design is much more capable on a computer. As portable as a laptop is, they are not designed to be used while standing on site. It is interesting to notice that with all the value landscape architects put into visiting sites in person to fully understand a space before intervening, there is no current, practical technological tool that helps in visualization of site intervention.

While on site, a professional is likely limited to few actions that aid in visualization: (1) taking measurements of the space, with the hopes of being able to build the space in a 3D modeling program, (2) taking pictures of the space with a

camera, with the hopes of uploading the pictures and using a photo editing program to superimpose images of site interventions, (3) perform a hand drawing. Computers, even small laptops, are not equipped to be able to be taken out to a site and effectively perform as well as it would when a user is sitting at a desk with a keyboard and computer mouse. Computers are not designed to be used while standing in a field, and drawing accurately can be difficult without a table. Taking measurements and taking pictures while on site, in a sense, is only half the battle when a landscape architect has to rely on his or her computer to complete the visualization process. This is where a technological deficiency lies in the profession of landscape architecture, and that deficiency presents glaring opportunity.

2.11 Photo of woman using laptop. Notice laptops are not designed to be used while standing.

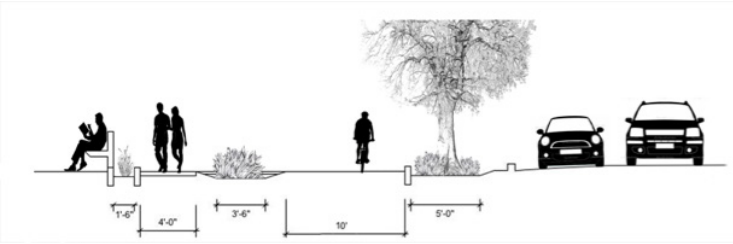
Having the ability to visualize site interventions while in the proposed space can have so much value, especially when clients accompany landscape architects to the site. Having the ability to help the client understand design options and visually show them possibilities is of great importance in the interactions and relationships between client and professional. It only makes sense to have a tool that can promote mutual understanding between the two parties.

The obvious truth is that a proficiency in all the landscape architecture computer programs in the

world does not mean anything if the client is unable grasp the idea a professional is trying to convey. At the core of it, proper design decisions are what clients ask of professionals. Clients want answers to their problems and trust that a professional has the proper training and the access to tools to provide sensible solutions. Firms will use all their technological tools to provide the clients with data, plan view maps, and section cut drawings to explain their decision-making. However, a client will ultimately want to go beyond the maps, diagrams, and charts, and understand the experience that encompasses the site intervention, and understandably so. The client has to know if the experience within the space would be enjoyable. In order for a firm to communicate the experience of the user in the designed space, several rendered perspective views must be provided.

It is in the rendered perspective images that allow for the client to truly see the space as it would be in real life. While an experienced landscape architect can probably visualize his or her site design through a simple plan view drawing, a client more than likely will not have that ability. The perspective drawings peak a client's interest and sell the experience of the prospective designed environment. A professional should want to wow the client, and the client should want to be wowed. The rendered perspective scenes, more often than not, can provide that wow factor.

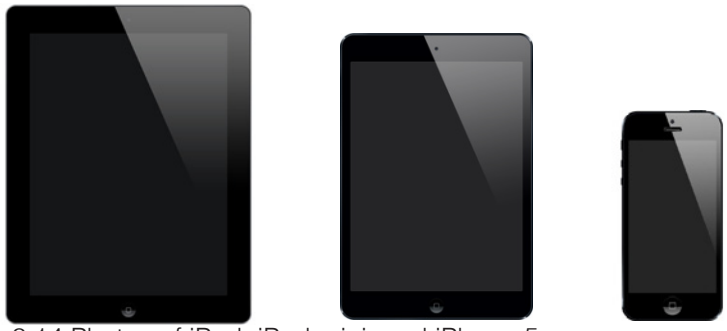
With the importance of perspective views in



2.12 A screenshot of a typical section drawing


2.13 A screenshot of a typical rendered perspective drawing

the communication with clients and the inability of landscape architects to give clients those views while on site, it is evident that the next technological advancement should involve a visualization program using more mobile devices.



2.14 Photos of iPad, iPad mini, and iPhone 5

WHY SMARTPHONES & TABLETS?

When I first started exploring ideas for my Senior Project, I was initially looking for the next computer software development that could make a splash in the profession. As I found a couple of different updates and improvements on current programs like Bryce, VectorWorks, and SketchUp, I did not really find anything that could be suitable for an extensive research project. As I was surfing the internet on my iPhone, it occurred to me that maybe the next big software could come in the form of an iPhone application. It seems that everyone has a smartphone nowadays and everywhere I look, someone is using a phone for something. Personally, it is hard for me to go a day without using my phone, and I wondered why. I came to the conclusion that it is not so much that I am on the phone talking to or texting friends and family, but that I use several different programs to make my life easier. I use a map app for directions, Safari app to search the web, flashlight app to see in the dark, games to keep me entertained, and many more.

An increasing amount of people have smartphones nowadays for two basic reasons: smartphones are becoming more affordable and and are produced at a higher quality, AND applications are being

produced at elevated rates, also at a higher quality. Tablet computers are only recently becoming more affordable, but the same reasons apply for its boosts in popularity. Tablets sport much bigger screens than phones, so there is greater opportunity when developing applications that would do better with more screen real estate. Every year, companies push out improved models (which generates general frustration and amazement at the same time), and it should be noted that the improvement of phone and tablet technology becomes exponential as time goes on.

To be completely fair, tablets and smartphones are not as powerful as desktop computers or laptops and probably never will be, but they are powerful enough to be effective, and their ease of use is quite attractive. The big factor is that it is becoming easier to program for the operating systems being employed in smartphones and tablets. Combine that with the fact that millions of

2.15 Photo of woman comparing computer and tablet

people are paying for and downloading these apps daily, it is easy understand why the opportunities for smartphones and tablets are so appealing.

While smartphones and tablets might not be as powerful as computers when it comes to processor speed, memory, and hard drive space, when it comes to value, they make up for it in several ways.

1. **Portability** – Smartphones are meant to fit in your pocket. They are the ultimate bring-with-you-anywhere device. Tablets are like the medium

between smartphones and laptops. They are light and thin, and can be easily held and transported without being a nuisance.

2. Internal Devices –

a. Camera - Unlike laptops, current smartphones and tablets typically have two cameras, one front facing and another rear facing. These cameras usually take higher quality pictures (8 megapixels on the latest iPhone) and higher definition video (1080p HD on latest iPhone).

b. Accelerometer – This device has been put into almost all current smartphone and tablets. Accelerometers measure proper acceleration or g-force to primarily determine orientation of smartphone and tablet devices. This device is quite useful as it can be used effectively for image stabilization, orientation sensing, and collision notification.

3. Touch Screen – Smartphones and tablets typically do not have many physical buttons as the touch screen has become greatly improved and responsive in the past decade. Touch screens allow for more screen real estate, while creating new ways of controlling devices. Gestures such as the tap, double tap, swipe, and pinch can all perform different actions.

4. Connectivity – All up to date laptops, smartphones, and tablets have the ability to connect through Bluetooth and WiFi. However, smartphones and tablets typically have data plans through a wireless provider.

Smartphones and tablets are not just watered-down versions of computers, These devices have distinct advantages, some of which that will probably never be realized in computers. In terms of augmented reality, smartphones and tablets are the perfect platforms for use.

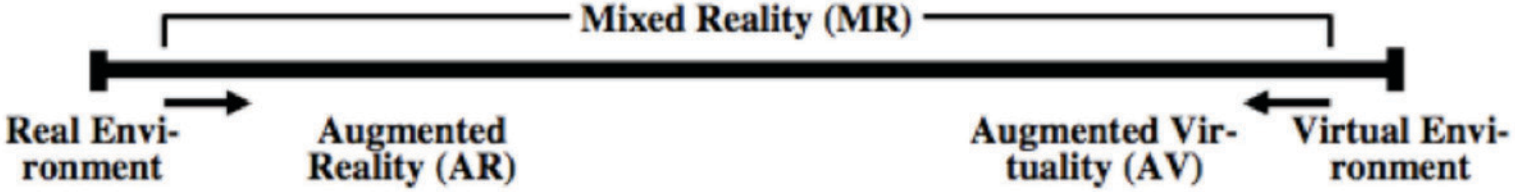
3_AUGMENTED REALITY

WHAT IS AUGMENTED REALITY?

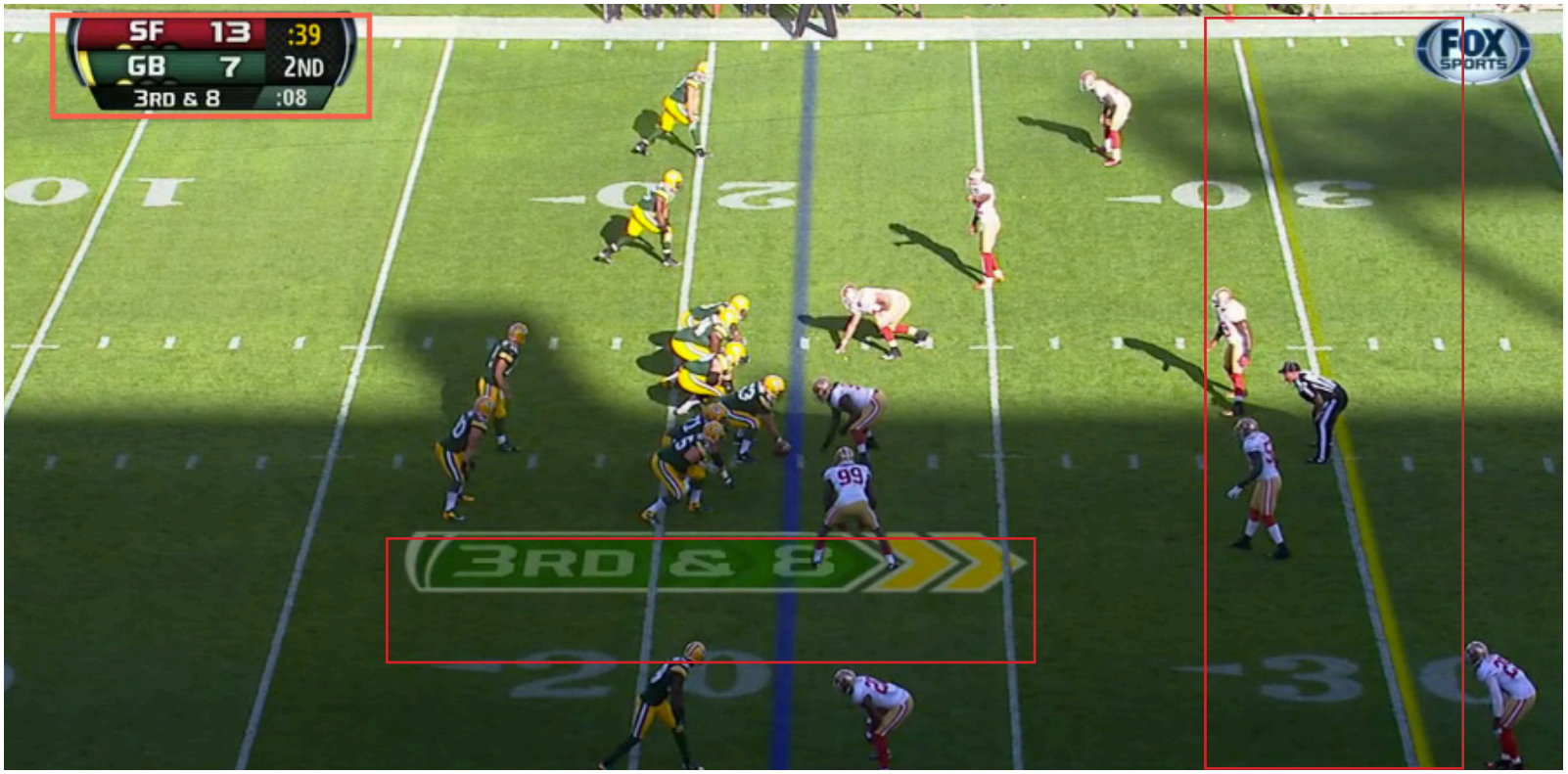
While the concept of augmented reality can be traced back to the early 1900's, it has only been in the past few decades, when computers began to boom, that augmented realities began to be actually executed. Actual hardware that could support such a complex system is only recently becoming readily available to masses with the advancement of cameras on the smartphone and tablet.

Augmented Reality is a term that has been applied to any view of a real scene that is modified, enhanced, or augmented by a computer-generated sensory input (Novak-Marcincin, 1). Augmented reality is the medium between real live environment and a virtual reality. To put it simply, augmented reality involves the embedding of a virtually existant object in a real world scene. While the most common augmentations involve visual enhancement, reality augmentation can technically take place with smell, touch, or sound. For the purposes of this thesis, I will be referring to the most commonly used augmented reality systems, which involve composite views a real environment with a virtually visible object.

While it might seem complicated to wrap one's head around the concept, we actually see augmented reality scenes all the time. For example, when watching a football game on television, you come across an augmentation almost every second. You get to see the real scene, the football players playing on the field, but you also see the scoreboard



3.1 Milgram's Reality Virtuality Continuum (Novak-Marcincin, 2012)



3.2 A screenshot of a televised football game played between the San Francisco 49ers and Green Bay Packers. Notice the computer generated scoreboard, the blue yard of scrimmage line, the “3rd & 8” graphic, and yellow first-down line. None of these images appear in real life.

or the scorebars at the bottom or top of the television screen, which display scores, time remaining, and other useful pieces of information. The combination of what the camera is capturing and computers are visually emedding is an augmented reality. The scoreboard is not really there on the field. It does not tangibly exist in real life, but it is such a useful object to have on your television screen while the actual scene is being shown.

While one can discern that the scoreboard on the television screen is not actually present on the field when watching a football game, one might be inclined to ask if the yellow “first down marker”, as shown in the picture behind the 30-yard-line, is

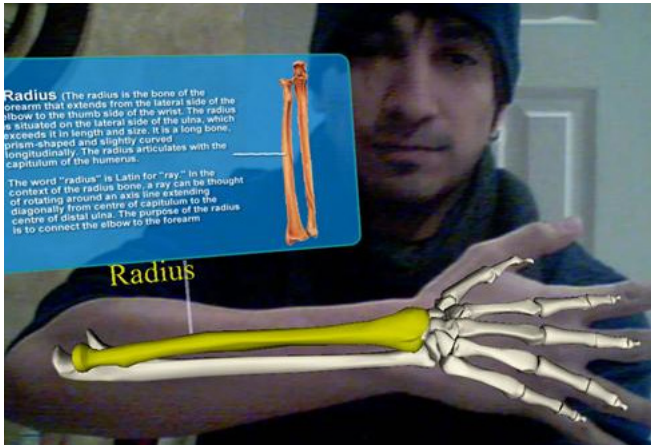
actually present on the playing field. The yellow line is positioned so well that the user can perceive the line as it is actually on the field when in fact, it is not. This “deception” is where a landscape architect can take advantage.

Augmented reality is evolving and has developed to the point where both 2D and 3D objects can morph after being embedded on the screen. 3D objects have the ability to rotate as the scene changes, creating seemingly endless possibilities for how people see things.

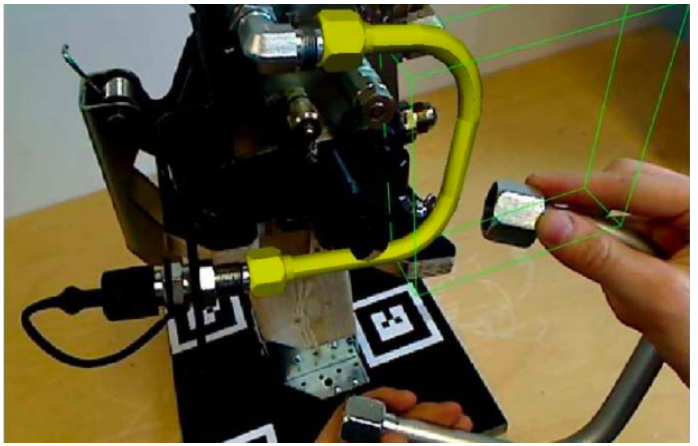
As computer generation of visual inputs gets better in visual quality and smarter means of positioning these inputs are developed, the scenes being augmented will increase in perceptive believability and usability. For the purposes of using augmented reality for scene visualization purposes, an augmentation is less effective if the sensory input has discrepancies with the actual real scene. For example, if the yellow line in the football scene was kept vertically straight on the Y-axis instead of parallel to the 30 yard line, viewers will be less inclined to believe the line could actually be there. The same concept applies to a tree input that is floating mid-air or a water bottle that is going through a table top. The effective use of augmented systems has to assume that the viewer of an augmentation has the ability to understand perceptive cues (i.e. something closer will appear larger, something further will appear smaller).

PRECEDENCE

EXAMPLES OF USE



3.3 This image shows an augmented reality scene involving an educational tool for medical purposes. The arm and hand bones are computer generated and effectively placed where a user would find them under the skin. In this particular instance, information is given on the particular bone that is highlighted. Retrieved from Technocult. (2011, 01 11). Augmented reality medical app. Retrieved from http://technoccult.net/archives/2010/01/11/augmented-reality-medical-app/



3.4 This image shows an augmented reality scene involving a tutorial for assembly. The computer generated input, the yellow piece, represents how the actual piece would look in position.

3.5 This image shows an augmented scene used by Adidas. It appears as though the man is holding the busy city block in his hand. While not necessarily believable, the scene is attractive and works for advertisement purposes.

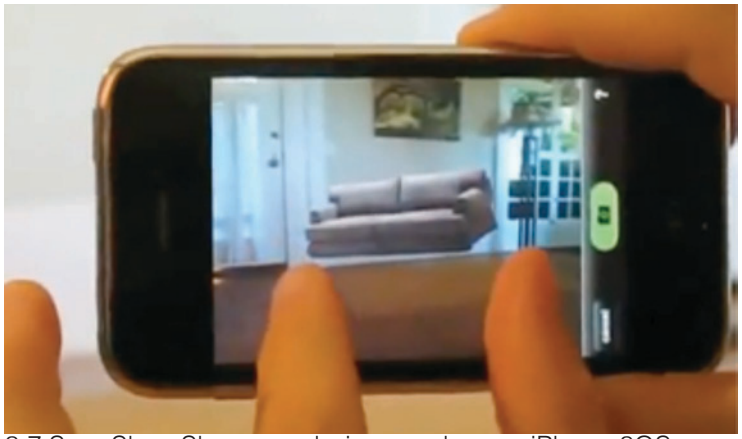
One can find many smartphone and tablet apps that use augmented reality on both the iOS and Droid platform. Most are still quite simplistic, as the technology is relatively young. However, there are a few apps that have been proven to be extremely innovative and useful, with some reaching millions of downloads.

3.6 SnapShop Showroom Icon

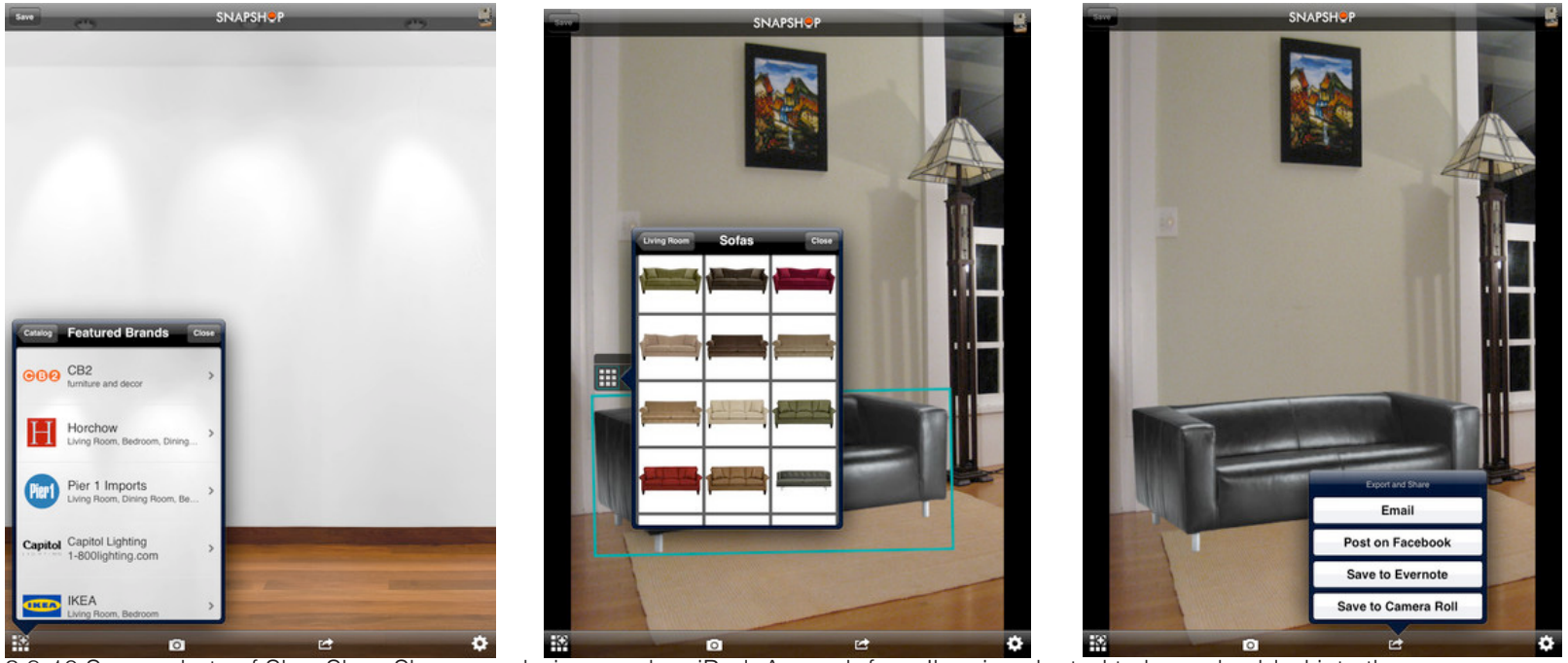
SnapShop Showroom

SnapShop Showroom is a free app available for download on devices using the iOS mobile operating system (iPhone, iPad, iPod) and devices using the Android operating system. Developed by SnapShop Inc., the app is a great example of a simple augmented reality app meant for scene visualization. Its purpose is to help users visualize how various pieces of furniture would look in their homes. It's slogan "NO NEED TO IMAGINE" pretty much says it all.

A user opens the app and is first presented with a welcome screen. From the welcome screen, a user is able to do two things. The first button option allows a user to browse through a catalog of living room, bedroom, and dining room furniture which include sofas, chairs, tables, storage cabinets, lamps, light fixtures, and more. All these



3.7 SnapShop Showroom being used on an iPhone 3GS



3.8-10 Screenshots of ShapShop Showroom being used on iPad. A couch from Ikea is selected to be embedded into the scene

items can be found at reputable stores like Ikea and Pier 1 Imports. The user will select an item of their choice, and upon selection, a picture of the piece of furniture is brought onto the screen. Information on the item is also given, such as its description, its price, its dimensions, its color, its material, and where it can be bought. After reading through the product information, a user can tap the camera button to give them a view of the real scene in front of them. The user can then scale, flip, and rotate the picture according to what is being shown on the camera screen to make the scene realistic. Once the perspective looks believable, the user takes a snapshot of the screen and is given a JPEG of his augmented reality. This picture can then be saved and even uploaded to various social media sites.

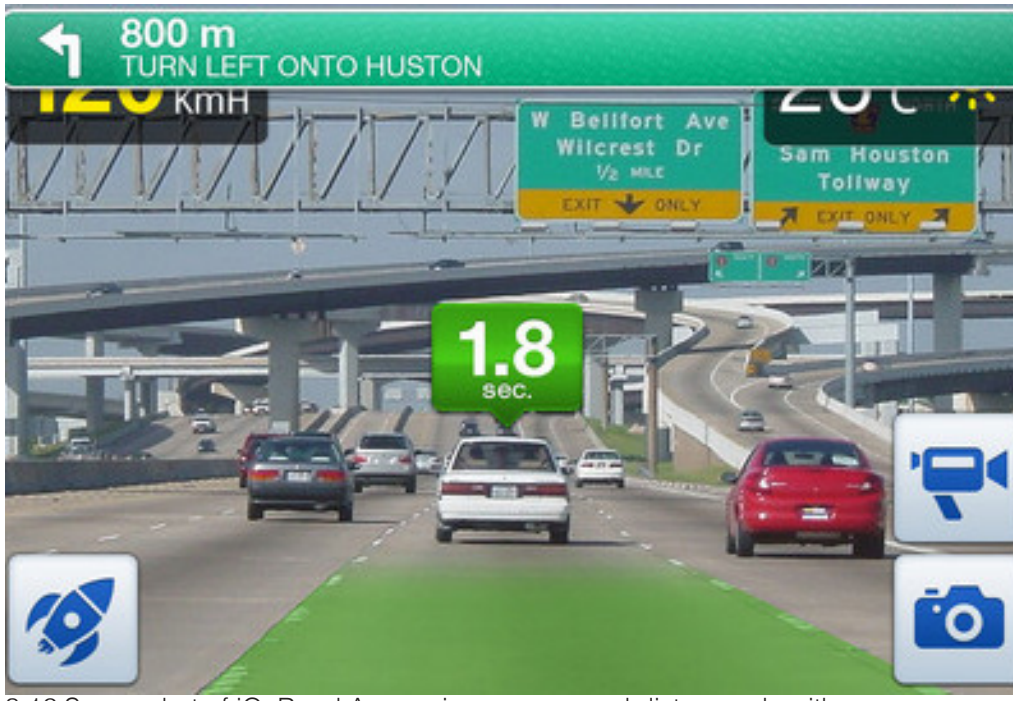
SnapShop Showroom is a great example of the use of augmented reality for environmental visualization purposes. It is easy to use and, in my opinion, quite effective. I personally downloaded the app and saw how my living room would look with a full furniture makeover. It is, however, a very simple app and there is much room for improvement. Aside from the fact that some of the objects were not kept up to date (some of the furniture options are no longer being sold by Ikea and Pier 1 Imports, while some objects had price drops), I had an issue with the overall functionality of the app. The problem is that the pictures of the items are all 2D and are all from one viewpoint. This means that a user has to point his or her mobile device at a specific angle and the lighting had to come from a specific direction in order for the augmented reality scene to pass as realistic. This limits the use of augmented reality if there are only particular perspectives to be seen.

3.6 iOnRoad Icon 3.11

iOnRoad

iOnRoad is a revolutionary app available for download on devices using the iOS mobile operating system (iPhone, iPad, iPod) for $4.99, and is free for download on devices using the Android operating system. Sold by iOnRoad Ltd. since 2011, the app effectively uses augmented reality technology to make one's smartphone or tablet into a vehicle collision detection system.

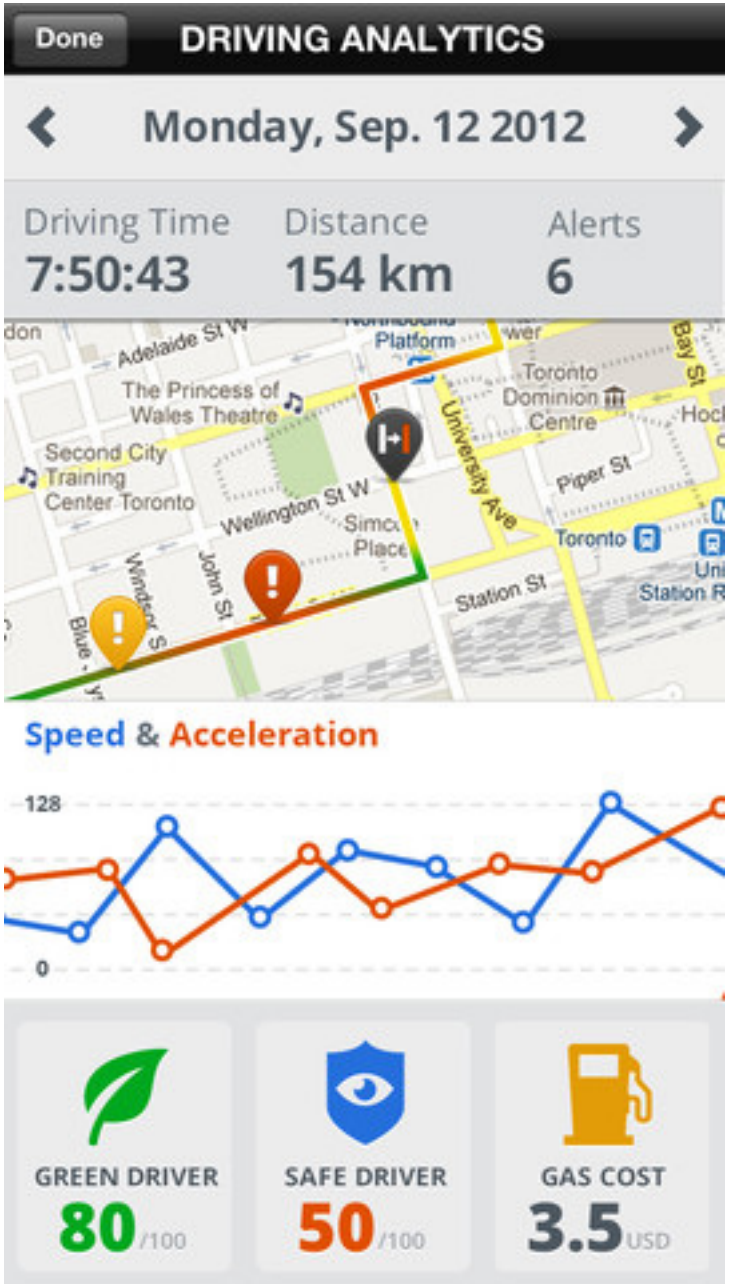
In my opinion, this app is quite a success. By downloading the app and mounting the mobile device with a car dock above a car's dashboard, the app effectively uses mobile devices' camera to detect cars



3.12 Screenshot of iOnRoad App, using camera and distance algorithms

in front of the user. Using several algorithms, that app then can determine how much distance is between other cars and the user's vehicle, and will present the user with helpful information in real time. Upon activation of the app, a green strip appears on the screen and covers the detected headway space in the lane that the car is using. As the user accelerates, the green strip gets shorter between users' cars and the cars immediately in front of them, and the distance shown on the screen decreases. As the user brakes, the distance increases. Whenever users start to become dangerously close to the car in front of them, the mobile device will make a beeping sound to alert the driver that he or she needs to create more room.

One of the features that the app boasts is its ability to provide a log of driving habits, and can present a user with driving analytics. A user can see how long they have been driving, how far they have been driving, and impressively, how many times on the current trip they have been alerted for driving to close to cars in front of them. Using algorithms, the app even gives the user scores for the way they are driving. If users effectively maximize their car's MPG's (miles per gallon), the app will give users a



3.13 Screenshot of iOnRoad App, showing driving analytics

high “Green Driver” score. If users drive long distances without having to be alerted for driving too close, they will receive a high “Safe Driver” score. This app serves not only as a collision detection system, but also serves as a promoter for smart driving.

The app does well and is well worth the money spent for the services it provides. Moreover, I find it really useful that the app has the ability to use other actively running apps to supplement the app experience. The app can be used in cooperation with a mapping and GPS navigation app, and even has an option to see and change music playing from the mobile device. It would be interesting to find out the algorithms being employed to make the app run so smoothly. One should note that in rainy conditions, the app loses effectiveness as the camera is less able to detect lanes and headway space, but otherwise, the app is a success.

4_iPERSPECTIVE

_THE APP

INTRODUCTION

In this portion of the project, I will be showing my plans to develop an augmented reality app for the iOS platform that I have named “iPerspective.” Although the target demographic for this app will be for landscape architects, anyone interested in visualizing site intervention will be able to use the program. This app has a few particular goals in mind. First, it will hopefully bring attention to landscape architecture as an essential part to how our world looks and feels. Second, it will hopefully bring light to the amazing advancements in technology and create a dialogue about the future these advancements have for any design profession. Lastly, it will hopefully raise awareness of the importance of proper design decisions.

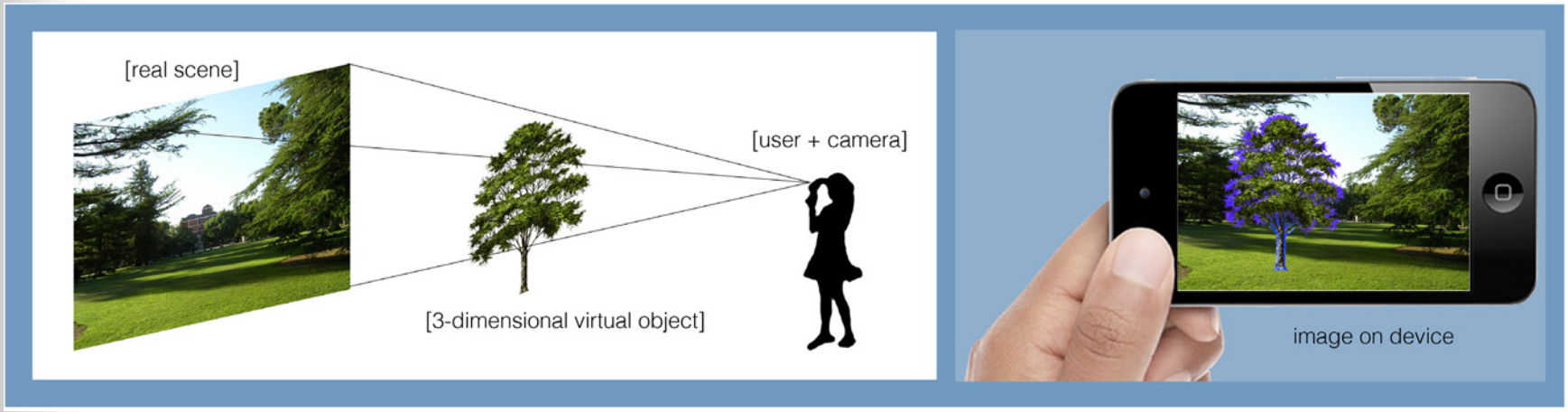
THE AUGMENTATION SYSTEM

This app will be using an augmentation system that will have the ability to embed objects such as trees, benches, and light fixtures into real, live scenes. These objects will be built in three dimensions, giving users the ability to have the objects rotate in accordance to where the user is positioned and where the device’s camera is pointing.

This app will be using several techniques to make the augmentation system. The camera on the

4.1 Graphic of iPad panning while using iPerspective App

mobile devices will be used to view the real environment and register features of the scene. Techniques Involving motion tracking and video tracking will also be used to set up a combination of reference points that will allow users to freely walk around with their device, keeping the objects anchored on the screen. These objects will rotate and either enlarge or scale down in accordance to the reference points set.



4.2 Graphic of iPerspective Augmentation System

PROGRAMMING & DESIGN

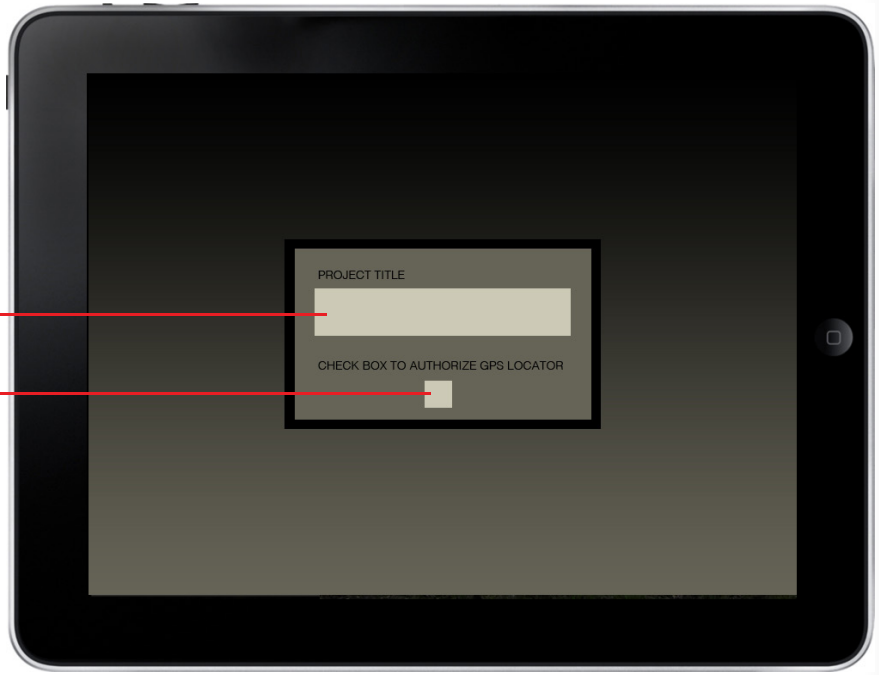
Several coders are necessary to build this program. We will be using Apple's developer software XCode 4.6.2 to build the program for iOS devices, with the focus being on iPad development. Design of the program has been set and screenshots of the program are shown in the following pages.

4.3 iPerspective Icon

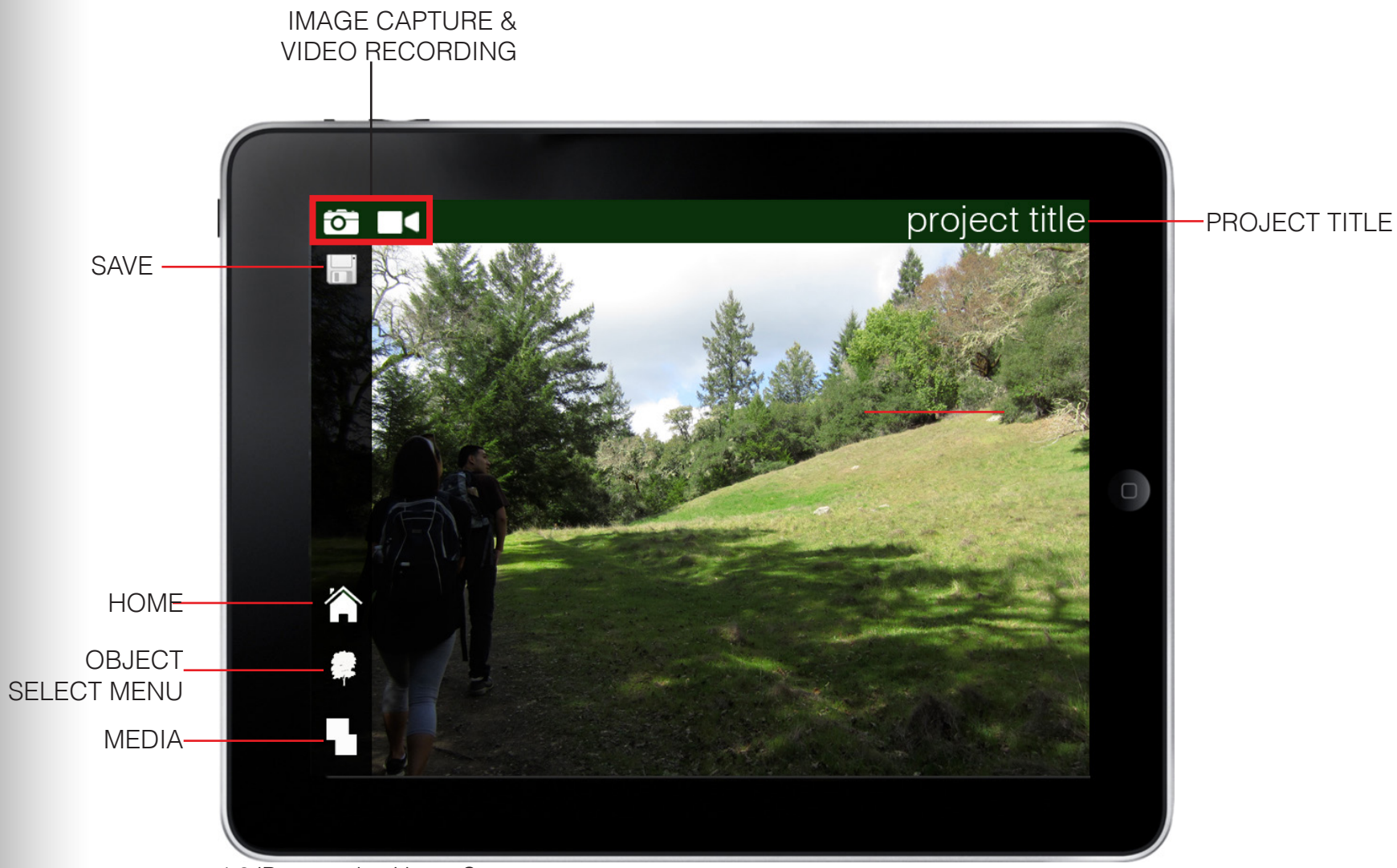
4.4 iPerspective Loading Screen

USER WILL BE ABLE TO ENTER THEIR PROJECT NAME

GPS CAN BE USED TO IDENTIFY WHERE THE SITE INTERVENTION WILL BE TAKING PLACE



4.5 iPerspective Project Name screen



4.6 iPerspective Home Screen

Upon tapping the iPerspective iCon on the iPad/iPhone home screen, the user will be presented with a loading page. Once loading is complete, the user will be presented with a screen that will allow them to name the new project. The user will use the on screen keyboard to enter the name. They will be able to check a box that will allow the app to use GPS to triangulate their location, and the app will save the information for future use.

The app will then bring up the home page. This home page has several buttons placed in one horizontal toolbar and one vertical toolbar. The camera will be active at this point and show the real scene for augmentation.

Upon pressing the Object Select Menu button, a menu will pop up on to the screen. This menu separates three sets of objects to be selected--trees, benches, and lights.

TREES

In this screen shot, the tree menu has been selected. Various trees and their common names are displayed. A user can scroll down using the “swipe up” gesture with a finger to view more trees.

4.7-8 iPerspective object selection menus

A user can tap on a tree name to get more information on the specific tree. Upon tapping, a window pops up giving the user the tree's scientific name, family name, and common name. More importantly, the user will be given information that explains growing conditions, and native areas that the tree can be found. This information will hopefully educate users with proper plant selection. Tapping the "more info>" button will close the program and switch to the device's web browser to do a search of the specific tree in a search engine.

The "INSERT" button will close the menus and place the tree in the scene. The tree will be highlighted and placed in the center of the screen. Simple swipe, pinch, and tap and drag gestures will change how the tree appears on the screen.

4.8-9 iPerspective object information select, object insertion

A user can place and anchor the object anywhere on the screen. A simple tap, hold, and drag gesture will place the object at a desired location. Once the user lets go of the object and the camera is stabilized, the user can double tap the object to anchor. The app will fnd anduse the reference points at this point, and the object will no longer be highlighted.

4.10-11 iPerspective tree placement sequence

BENCHES

A user will be able to keep previously anchored objects on the screen while selecting a new object to be placed. In this screenshot, the benches menu is shown. The window that pops up will allow for the user to select from a selection of benches according to type. A user will be able to color the object and even adjust the brightness.

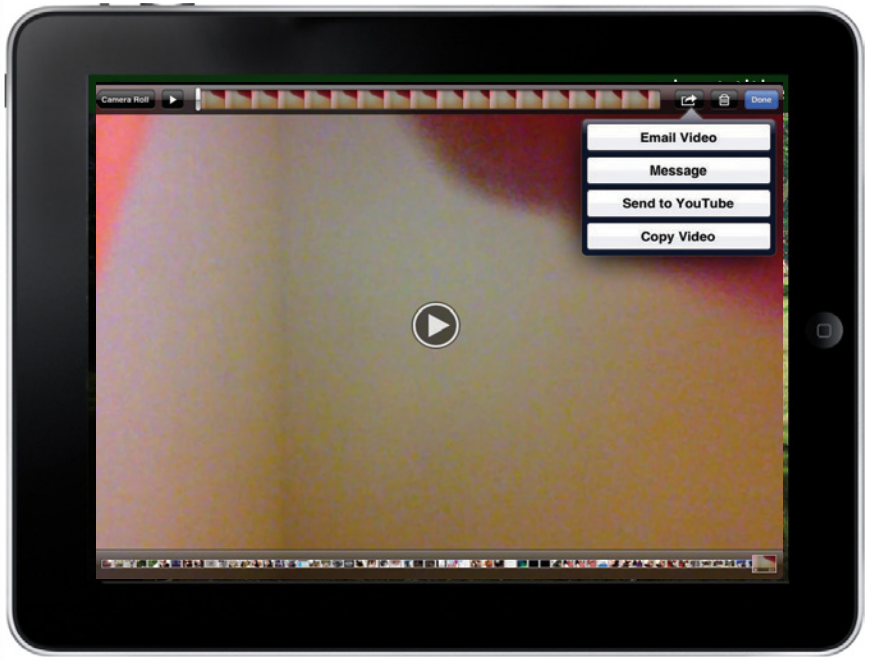
Upon selection and color customization, the bench will be can be inserted and the user will be able to place it anywhere on the screen

4.12-14iPerspective bench selection and placement sequence

LIGHTS

The same process is used for light post selection and placement. The user will be able to select, insert, tap, drag, an anchor.

4.15-18iPerspective light selection and placement sequence



_RECORDING & SHARING

At any point in the process, a user will be able to tap the two camera icons in the top left of the screen. By tapping the image capture button, a still image of the scene will be taken, and by tapping the record button, a video of the scene will be taken. A user will be able to walk around with the device and find that the objects stay anchored in accordance to the reference points set.

Both pictures and videos will be saved to the “Camera Roll” in the Photos app. From there, users will be able to mail, message, or post the media, as they would regularly with other sorts of pictures and videos.This presents a quick and easy way to communicate design ideas between professionals and their clients.

4.19 Record/Capture
4.20 Photos App, with sharing options window

_FINAL THOUGHTS

This app should be highly successful if programmed and marketed properly. Because there is a no current augmented reality app on market that is tailored to the needs of landscape architects, I expect the response to this app to be quite positive upon completion. As shown in the screenshots within this document, I hope to make the app clean, clear, and easy to use. Just as tablets and smartphones are not meant to replace computers, this app is not meant to replace the plethora of computer programs the profession uses. This app is simply meant to supplement what already exists and hopefully advance the profession further.

I expect development to take place within 18 months and be placed in Apple's App Store for purchase.

_REFERENCES

Abhishekh, D., Ramakantha Reddy, B., Raja Kumar, R., Rajeswarappa, G. (2013). Retrieved from http://www.ijser.org/researchpaper%5CInteractive-Learning-in-Education-Using-Augmented-Reality.pdf

Azuma, R.T. (August 1997). A Survey of Augmented Reality. Presence: Teleoperators and Virtual Environments 6, 4. 355-385

Ching-Sheng, W., Ding-Jung, C., Yi-Yun, H. (2012). 3D Augmented Reality Mobile Navigation System Supporting Indoor Positioning Function. Retrieved from http://ieeexplore.ieee.org/xpl/articleDetails.jsp?reload=true&arnumber=6381618&contentType=Conference+Publications

Fukuda, T., Zhang, T., and Yabuki, N. (2012). Availability of Mobile Augmented Reality System for Urban Landscape Simulation. 1-8

Landscape Forms (2010). ROUNDTABLE REPORT: Leaders in Landscape Architecture Assess the Profession. 1-11

Novak-Marcincin, J., Janak, M., Barna, J. (2012). AUGMENTED REALITY TECHNOLOGY APPLICATIONS. Proceedings in Manufacturing Systems, Volume 7, Issue 2, 2012. 1-4

Tal, Daniel (2013). ASLA INTERVIEW WITH DANIEL TAL, RNL DESIGN, ON TECHNOLOGY FOR LANDSCAPE ARCHITECTS. Retrieved from http://www.asla.org/ContentDetail.aspx?id=20096

Technocult. (2011, 01 11). Augmented reality medical app. Retrieved from “http://technoccult.net/archives/2010/01/11/augmented-reality-medical-app/”

SnapShop Inc. (2011) SnapShop. Retrieved from “http://www.snapshopinc.com/”

iOnRoadLtd. (2013) iOnRoad Smart Phone Smarter Driver. Retrieved from “http://www.ionroad.com”