Final Project Writeup
CSCI E-76

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Abstract

On many friezes on campuses and historical buildings, there are architectural features and artwork that oftentimes lacks sufficient context for viewers to understand their significance. A prime example of this is MIT, where there are names of scholars, engineers, and scientists carved above the entrances of many well recognized buildings. Students enter these buildings every day, not knowing anything about the carved names above. We have developed a mobile application targeted for iPhone users that students can use to gain background information on the historical figures whose names are carved into campus buildings.

Background

Killian court is a major feature of the MIT campus. Students pass through this area regularly.

Image 1. Killian Court, and The Great Dome

There are ten friezes that line buildings on the sides of Killian court. They are inescapable to a passerby.

Image 2. A Frieze Dedicated to Newton and Others

The names carved into the friezes were selected by MIT department heads in 1915 to represent major contributors to their particular fields of study. Without additional aids, the etched names are generally meaningless to observers. A tool is needed to help understand who these people were, and why they were chosen.

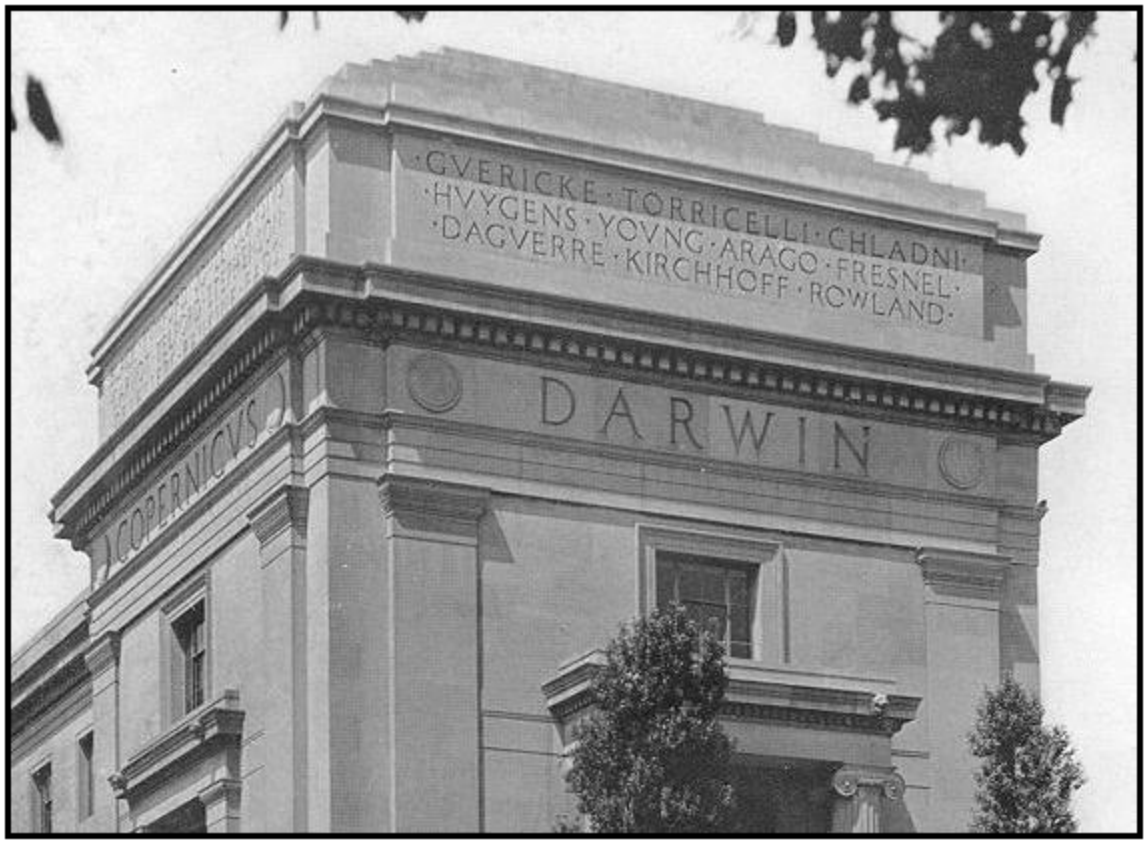

Image 3. A Frieze Dedicated to Darwin and Others

The frieze names are viewable only by a user positioning themselves appropriately in the court. The position of the friezes is such that an individual cannot view them all all at once. A mobile app will allow that.

Image 4. Location of Friezes

Implementation Notes

The application has been built so the user can easily access information about any individual listed on a frieze (see Figure 4), and provides different ways to reach this detailed information. The application will provide information on groups of figures.

Main Application Screens

Splash: There will be a splash screen for the application (see Figure 4).

Indices: There will be a top-level page from which the user can choose a way to explore the app (see Figure 5).

- **Alphabetical Index:** An alphabetical list of names is available to the user (see Figure 6).
- **Map Index:** A clickable map is available, which allows the user to select frieze groups graphically by location (see Figure 8).

- **Fields of Study Index:** This allows the user to explore which figures are affiliated with a specific field of study. This is something that is unavailable to people in Killian Court who do not have the app.

Group Page: There are ten frieze groups, one for each MIT department of study in 1915. Each group features a main figure whose name is carved in a larger font below the frieze, with other individuals selected by the department listed in smaller type above (see Image 3). This index will be organized by the main figure name, and has an image related to the grouped individuals and links to the individual detail view.

Individual Detail Page: Each individual historical figure will have a name, image, and basic biographical information, along with a link to more detailed information about the individual (see Figure 7).

At-Location Options: If the user is located in Killian Court within a specific bounding box, they gain access to an additional screen with the following features:

- Users can orient their phones at friezes from anywhere within Killian Court to see Augmented Reality images of frieze groups. When clicked, the application provides the name of the group (see Figure 13).

This 'augmented reality' view is not available to users who are not within the geographic area specified in the application.

History: Gives a brief description of Killian Court and the surrounding MIT buildings, with links to additional resources if the user wants to learn more.

References: References used in the collection of biographical information can be viewed on a separate screen.

Original Artwork

A local artist was commissioned to draw black and white caricatures of each figure and each frieze group. Color art was also created for use in the application icons and the splash screen. This gives the application a playful look and feel that is easily recognizable.

Creation of Database

For the 115 figures featured on the friezes in Killian Court, biographical information such as dates of birth and death, nationality and why their contributions to their fields of study were important. The Wikipedia url was collected for each figure and put into the database, and a script was created to generate the database in SQLite.

The SQLite database included in the app was generated by running the script with sqlite3. Along with the original artwork, this is the main intellectual property of the application. Since the user has no reason to modify the database during the use of the app, we decided to add the database to the bundle rather than create it in the user's directory.

Frameworks Used

Table 1 details the frameworks that were used in the implementation of the application.

Framework	Description
sqlite3	Data access and database creation
CoreMotion	For augmented reality: device orientation.
CoreLocation	For augmented reality: used for determining bearings between the user location and friezes.
MediaPlayer	For augmented reality: used for camera.
MobileCoreServices	Common services used throughout application.
UIKit	Used for everything in UI including gestures used to determine touch events efficiently.
Foundation	Required for iOS applications.
CoreGraphics	For layout of graphical elements.

Table 1: Frameworks Used

Class Documentation

The following documents the purpose of each major application class.

Main Navigation Classes

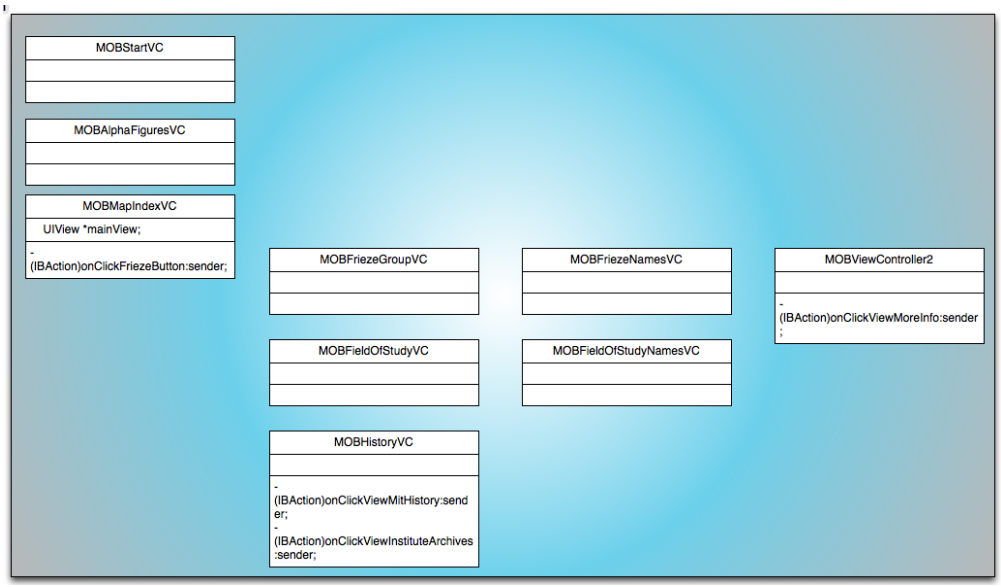

Figure 1: Main Navigation Class Diagram

Class	Purpose
MOBStartVC	Implementation of the main navigation menu.
MOBAlphaFiguresVC	Alphabetical list of figures by last name.
MOBMapIndexVC	Implementation of the interactive map of Killian Court.
MOBFriezeGroupVC	Listing of Frieze Groups by main figure name.
MOBFieldOfStudyVC	Listing of figures by their field of study.
MOBFriezeNameVC	Listing of figure names for a specific frieze group.
MOBFieldOfStudyName	Listing of figure names for a specific field of study.
MOBViewController2	Detail view for an individual figure.
MOBHistoryVC	Displays a brief history of Killian Court, with navigation links to additional resources.

Table 2: Main Navigation Classes

Augmented Reality Classes

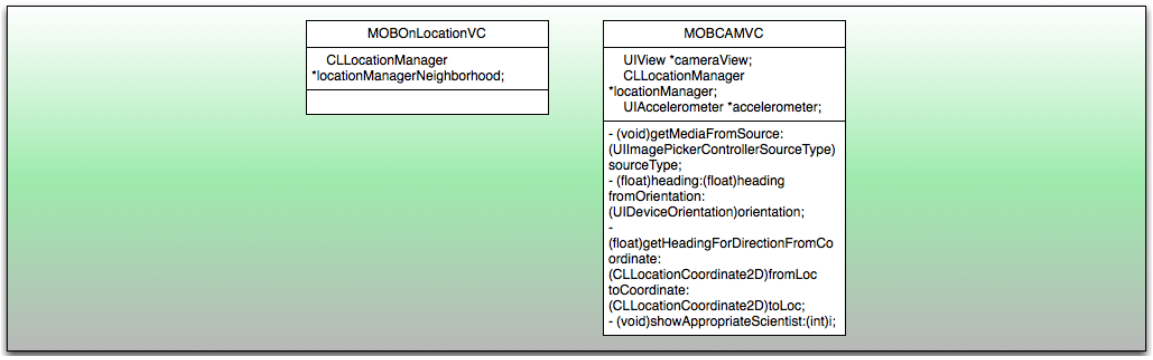

Figure 2: Augmented Reality Class Diagram

Class	Purpose
MOBOnLocationVC	Determines device location and whether or not to enable the Augmented Reality view.
MOBCAMVC	Implementation of the Augmented Reality View.

Table 3: Augmented Reality Classes

Supporting Classes

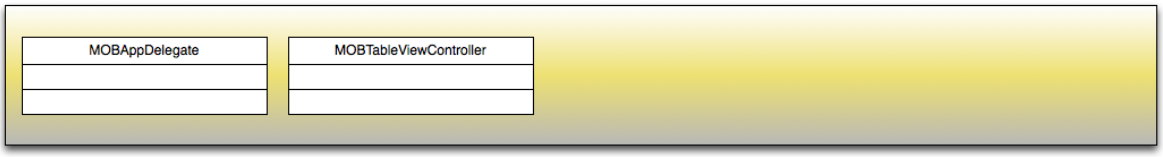

Figure 3: Supporting Class Diagram

Class	Purpose
MOBAppDelegate	Entry point of application.
MOBTableViewController	The data in the application was tabular, this was the best choice for the data we were representing.

Table 4: Supporting Classes

Specification Changes from Project Proposal

The submitted project proposal stated that both an iPhone and iPad variant of the application would be created. We decided to not produce the iPad variant of the application for the following reasons:

1. We felt the experience of the augmented reality screen is best experienced when holding the device with one hand.
2. A main use case of this application was the following scenario: a user in Killian Court looks up, reads the names on a nearby frieze, and does not know the significance of a particular name. We decided that this experience would be best served using the phone form factor: when on the move, the user would not want to reach into their bag to pull out their tablet. The phone would be far more convenient.

Use Case Testing

Our main use case would be that anyone from any position in Killian Court would be able to use the augmented reality portion of the application. For this reason, we decided to use bearing rather than distance to a frieze group. The augmented reality portion of the application was tested by both team members on-site at Killian Court on multiple nights. Explanations of our ad-hoc testing activities were given on demand to MIT security personnel. Other than the following use cases were tested:

1. Users can access the application from an iPhone. iOS 6.1.3 was specifically tested on an iPhone 4S.
2. A user can quickly navigate to date in the app using a the following indices:
    - Alphabetical index of all Figures
    - Frieze Group Index
    - Fields of Study Index
    - Killian Court Interactive Map
3. Individual and Group screens are populated dynamically based on external assets. The data for the application is provided through a sqlite database, and all graphical assets are deployed with the app.
4. From within Killian court at MIT, a user will be able to use the camera on the mobile device to view augmented reality images in relation to position and phone orientation, and use it to navigate within the app.

a. While in the augmented reality view, a custom compass indicator is overlaid on the screen to help the user orient themselves in the court.

User's Guide

The following are in-application screen captures for most major screen types in the app.

Splash Screen

The user is presented with a splash screen at application startup (see Figure 4). Touching anywhere on the screen brings the user to the main menu.

Figure 4: Splash

Main Menu

Dismissing the splash screen, the user is transitioned to the application's main menu (see Figure 5). From here, a user can begin to explore the figures alphabetically, by frieze group, or by field of study. Screens with a history of Killian Court and a list of references used to collect the biographical information about each figure is also accessible from the main menu.

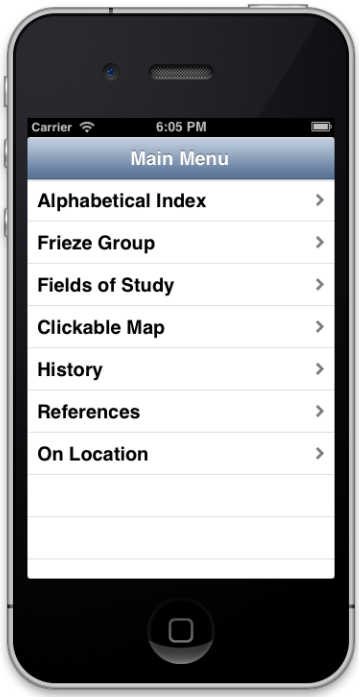

Figure 5: Main Menu Indices

Explore the Figures Alphabetically

Clicking on the Figures menu will bring you to a complete list of names of every figure listed in Killian Court. We made the decision not to implement an alphabetical categorization list in this view since there are only 115 names in total.

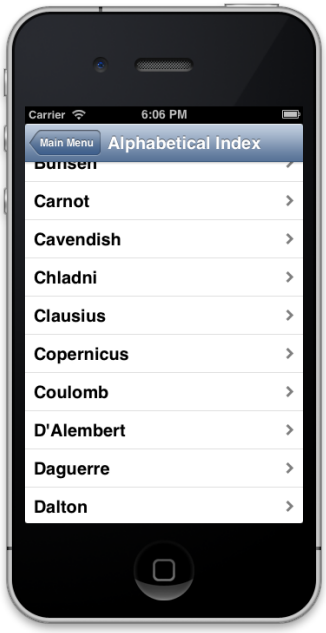

Figure 6: Alphabetical Index

View Detailed Information About an Individual Figure

Viewing detailed information about a figure is the main purpose of the application, and is the endpoint of nearly all exploratory navigation in the app. The data displayed for each figure was compiled from a number of sources, listed in the References screen and supplemented by encyclopedic sources such as Wikipedia where necessary. The 'View More Information' button for each figure uses Safari to navigate to the figure's mobile Wikipedia page.

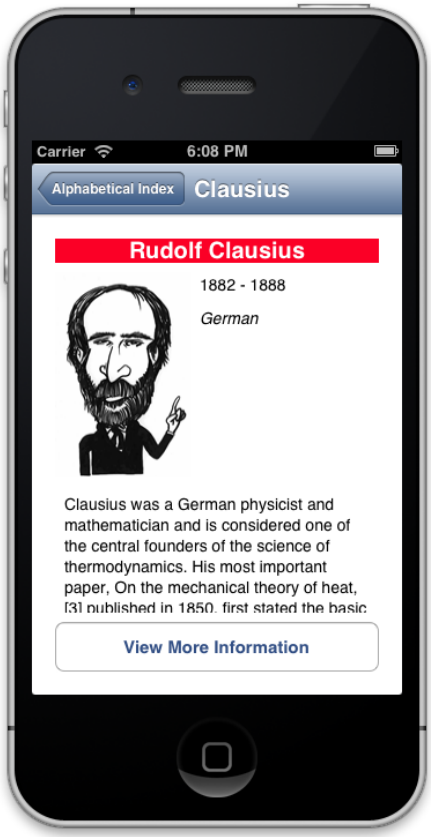

Figure 7: Figure Detail

Interact with a Map of Killian Court

The user is presented with a top down view of the court and is allowed to browse the individuals grouped in the frieze. Numbers were overlaid on the map representing the frieze groups in order to give the user a target to select. The buttons were made invisible; the visible numbers are part of the map graphic. This is an alternate method of navigating to the frieze group listing.

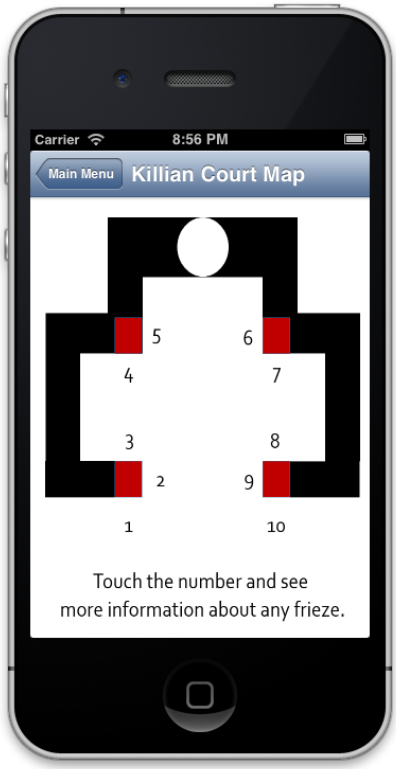

Figure 8: Killian Court Interactive Map

Explore Figures by Frieze Group

Similar to the interactive map view, the user can select to search through the ten friezes using the frieze group listing (see Figure 9).

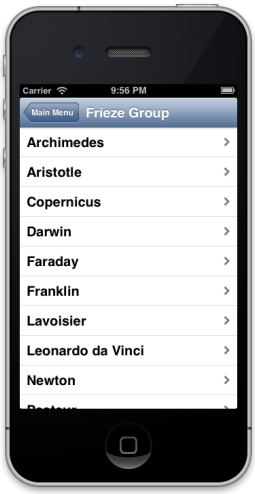

Figure 9: Listing of Frieze Groups

Selecting a Frieze Group will display a complete list of names of all figures in the frieze group with a caricature of all group members posing together (see Figure 10).

Figure 10: Frieze Group View

History and Reference Views

These simple views are simple scrollable text fields listing the references used to collate biographical information about the figures and a brief history of Killian Court.

On Location: Augmented Reality View

When a user is nearby Killian Court, buttons and instruction text appear which allow the user to enter an augmented reality viewing of the buildings. The area is defined by longitudes and latitudes encompassing the court, portions of the surrounding buildings, in a rectangle extending to the Charles River. If the user decides to enter the mode, and then faces the camera at any of the friezes around Killian Court, a graphic of the group of historical figures appears. If clicked on a user can see the name of that group, for instance Darwin. This is handy since the friezes are often partially occluded by trees, and people with limited vision can still get an understanding of what group is present.

One expected use case for the app is for graduates participating in commencement ceremonies; MIT holds their commencement in Killian Court. Anyone seated for the ceremony can now get information on what groups are associated with which buildings, and use the app to further investigate those groups!

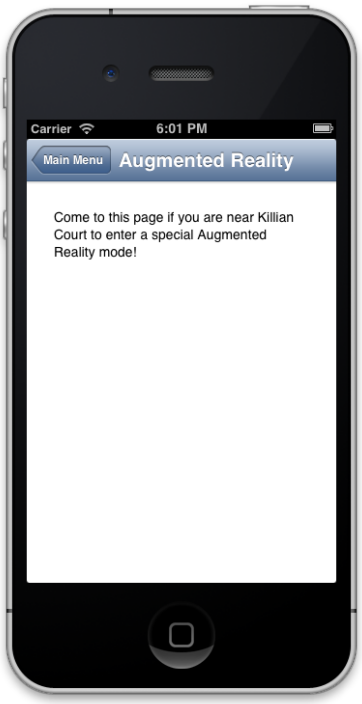

Figure 11: Appearance of launch screen when not within the geographic bounding box

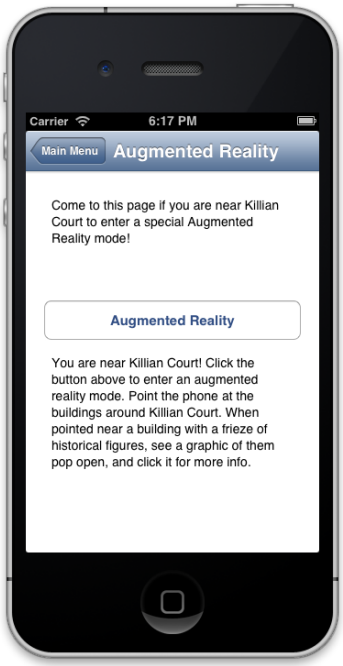

Figure 12: Appearance of launch screen when within the geographic bounding box

When in Killian Court, the user holds the iPhone in front of him. The app activates the camera, and paints a compass overlay in the upper-left portion of the screen to allow the user to understand how they are oriented in

the courtyard. If the camera bearing lines up with a frieze group, the group picture is displayed (see Figure 13).

Figure 13: Augmented Reality View

Known Issues

During final testing on site, one major issue was identified with the Augmented Reality View. As submitted, the user is unable to exit the view and return to the application. We have left our code fragments showing how we attempted to solve this problem in the .m file.

Code Attribution

1. Kyle Roche, Pro iOS5 Augmented Reality. Portions of the augmented reality view were taken from this book and reworked for our app.
2. Ray Wenderlich, multiple sources. http://www.raywenderlich.com/ Database usage concepts, etc.
3. Beginning iOS5 Development, Apress. Programmatic segue and navigation samples.
4. Stackoverflow.com - various code snippets, reworked for our application.

Challenges and Workarounds

We decided to not to use a framework such as Cocos2D AR to implement the augmented reality view, and decided to piece out interacting with location, device orientation, and camera with dynamic overlays manually. We feel this was a good decision because we gained valuable experience working with the device sensors using the core APIs.

Our initial rough-out implementation had implemented all of the major navigation menus using plists. For the final project submission we converted these to be completely data-driven. This gives us the flexibility to swap out the database with a completely new set of friezes if we wanted to make a similar application for another area.

Project Responsibilities

This application had three major phases of development; the first phase spent in the collection and organization of application data and content. The second portion of development will involve the creation of the major functional parts of the application, with one team member concentrating specifically on the augmented reality view and the other focusing on data access and the coding of the main application navigation flows. The third phase consisted of integrating the two projects, testing the completed application on-site at MIT's Killian Court, and project write up.

Shared Responsibilities:

The back end of the application is data-driven, which involves the collection and proofing of biographical information and the creation of graphical elements. We used public-domain information for this information, beginning with the MIT Institute Archives. A specific view with all resources used was added to the application to provide proper citation to our information sources. During this, we decided to put an in-app link to the mobile Wikipedia entry for each figure on the detail view in the event the user wanted more complete information about an individual.

The biographical information was collected, formatted, and input into a SQL script that was used to create a SQLite database that is deployed with the application. The in-app images were commissioned by a local artist, scanned, and appropriately sized for the iPhone format. Due to time constraints, no additional artwork was created for Retina displays. The in-app artwork associated with a figure or group is loaded dynamically into a fixed layout on the *Individual Page* and *Group Page*, respectively.

Individual Responsibilities:

Kaminski: Phone position and coordinates related to locations; augmented reality and At-Location options. Software project integration. Bulk of on-site testing in Killian Court. Resizing images for iPhone display.

Goodsell: Coding of SQL script to create database. Map Index. Dynamic Individual and Dynamic group pages. Alphabetical, Group, and Fields of Study indices. Splash screen and map art. Documentation and writeup.

What we have learned from all this

We completely enjoyed working on this project, this idea stemmed from a project that Matt thought up years ago, and we are happy to see this through to completion. We plan on submitting this to the App Store following some cleanup and addition of some extra bells and whistles, but we feel this is a useful app in its current form.

We hope that this application will be used by graduating seniors sitting in the court; for this reason we specifically decided not to add any sound effects to the application.