

Tecnológico de Costa Rica

Computing Faculty

“Mobile App Prototype for Morehead State University”

Project to qualify for the title of

Computer Engineer

Baccalaureate academic degree

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The objective of this document is to explain and inform in a detailed way all the information regarding my capstone project at Morehead State University (MSU). The project consists in the development of a prototype of a prospective Morehead State University Mobile App. The process was divided into three main stages.

The first stage was to develop a consistent problem and solution definition, a preliminary visual interface and architectural design and a technology ramp-up. The second stage consisted mainly in the development of the app itself and feedback gathering from students. Finally, during the third stage the information from the feedback gathering was used to improve the prototype and the app was showcased to Morehead State University's directives.

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First Stage

Project Background

Morehead State University

Morehead State University is a public, co-educational university funded in 1887 and located in Morehead city, Rowan County, Kentucky. Enrollment for fall 2010 was more than 9,000, with the student body representing 106 Kentucky counties, 42 states and 35 foreign countries

The nearly 500-acre main campus is ranked as one of the safest campus in the US. This campus has 15 housing halls with capacity for 2600 students. Classes are offered also at regional campuses in Ashland, Jackson, Mt. Sterling, Prestonsburg, West Liberty and at other sites, including Maysville and Pikeville. Additionally, the University offers a number of distance learning courses throughout the region via the Internet and interactive videos.

Academically, the University offers 143 undergraduate degree programs, including 12 associate level degrees and 131 baccalaureate degrees in four colleges — Caudill College of Arts, Humanities and Social Sciences; College of Business and Public Affairs; College of Education; and College of Science and Technology — and 20 academic departments. A doctoral degree in education began in fall 2010.



Figure 1: Morehead State University Campus

IT background

MSU has a publicly accessible website which provides access to relevant information of the university like facilities, academic services and community. In the academic services section the visitor can access information of all the degree programs offered as well as a course catalog, requirements for applying and contact information. It also offers the option to apply online for any of their programs.

It is expected that any prospective student can enter the site, learn about the different programs and, based on this information, make the decision of whether to apply or not to one of these.

The university has also multiple information systems for allowing access to valuable information to enrolled students. These systems are integrated into a main portal where students can identify themselves with their institution's official email and get access to its registration information, courses, notes, documents and countless of other resources like campus maps, tips and many other services.

Through this portal is expected that enrolled students have access to all relevant information for successfully completing their study program.



Figure 2: Morehead State University ADUC

Problem Definition

The developer team arrived to Morehead State University on mid-August and meet the project main stakeholders: Dr. David Barnett, Dr. Christopher Miller, Dr. John Curry and Dr. Victor Ballestero, members of the Foundational and Graduate Studies in the Education faculty.

During different meetings they explained the needs that were not been fulfilled by their systems and how was that was impacting the university. This was a critical stage for understanding their issues, how their business work and, what brings value to the university.

The stakeholders identified some important information that is not been transmitted in the most appropriate way for enrolled students. It is desired, for instance, that the students can have a simple, clear and accurate access to information about their progress in their career, and the different milestones they have to complete in order to stay on track, finish on time and have success in general. However this information is showed in an unpractical and complicate way, difficult to understand. Because of that, students occasionally make mistakes in their progress evaluation and courses enrollment.

It is required, therefore, to offer a new option for the enrolled students to evaluate their career progress in a simple, fast and practical way, making them able to make the best decisions in their career and increasing the success probabilities.

Since the use of smartphones has increased in an enormous way in the last years, other universities have found that mobile apps are a really effective way to communicate critical information, offer handy tools and close the gap between the university and the student population. In MSU's particular case, virtually all of the students and professors have a smartphone but the university has not yet taken advantage of this fact.

Solution Definition

The needs and point of view of all the stakeholders were taken in count for the formulation of different strategic documents containing the vision of each solution as well as its purpose. A conceptual framework was written in these documents using objective definitions of all the important concepts as well as each concept atomic attributes.

The proposed solution is the development of mobile phone application so, through it, students can access the needed information in a handy way. The vision of the app is to be a very useful tool for the students so they can track their progress in the program or programs that they are enrolled and know what they need to do next in order to stay on track, finish on time and have success in general.

Because it is the most widely used, it was decided that the best platform for developing the mobile phone application is iOS. Furthermore, it was agreed to focus the development in an iPhone designed version but keeping compatibility with iPads.

Among the questions that the app would be designed for answering from a student perspective are:

- Which programs do I am enrolled in?
- Which courses are part of my programs and which are its requisites?
- Which courses have I take and which do I have left to take in order to complete my program?
- Which are my milestones?
- Who is or who are my advisors and how can I contact them?

The main user characteristics for this app are:

- Young people
- Need information accurate and fast
- Like simple and effortless stuff
- Will use the app in very diverse places or in movement
- Massive use of social media

According to these user characteristics, it is a requirement that the mobile application can work without Internet connection so a student can access his information in a fast way, in the place and moment that is needed. This is a non-functional requirement.

Several other meetings were held with the IT department in order to know which resources were available for the solution development and a number of drawbacks emerged during the evaluation of the different options.

First, MSU uses a lot of third party systems and the university does not have access neither to the code nor the data they hold. In the case of the owned systems the technologies used for data storage are really outdated and complicated to use. Understanding the structure and retrieving information from the data sources turned out to be very complex and completely outside the scope of the project. The IT department plans to migrate their storage systems to a modern database management system, but that option is not plausible in the short term.

A second major drawback is that the integration of the different information systems often does not follow a layered design where the visual interface is separated from the data sources and the control layer (MVC design pattern). For instance, in the website responsible to show information to students about its course progress, the control and view layers were mixed. Therefore, it is not possible to reuse the data access routines from this website.

Delving into the programming of this site and modify it is very complex and delicate. Since the site is the official source of progress information for students. A minimum programming error that makes the information to be inaccurate and affect students could even cause lawsuits for MSU. All this, plus the fact that the university has no test servers for changes (any change has to be tested directly in the main online servers) makes this website modification not viable.

Taking into account the different IT drawbacks founded, a full analysis of the available options was performed and different solution approaches were discussed in order to find the one that best fitted the situation. At this point it was clear that retrieving information directly from the university data source systems was not a plausible option.

It was decided then to take a reduced scope and develop a prototype of the app without the data source connections. The objective of this reduced scope is to transmit the vision about how can mobile technology help Morehead State University to solve many current drawbacks and serve as a framework for future solutions. The plan is that this prototype can be presented and discussed with Morehead State University directives using real but incomplete (manually entered) data. After the prototype is showcased Morehead State University would decide whether or not to continue with the data connections, full-scale data population and App publication.

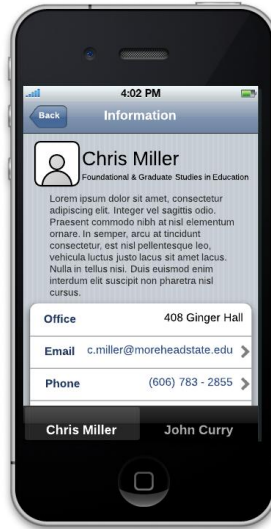
Preliminary Visual Design

A draft of the visual design was developed using an online tool called "Lucidchart". The objective of this stage was to enable the stakeholders to gain insight of the mobile app and allow the developer team to receive feedback. This design was used as a guide for the mobile phone app but it was not strictly followed, changes in the design occurred as the project requirements changed over time.

Degree Programs



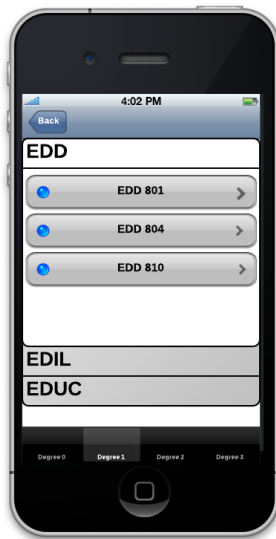
Advisors



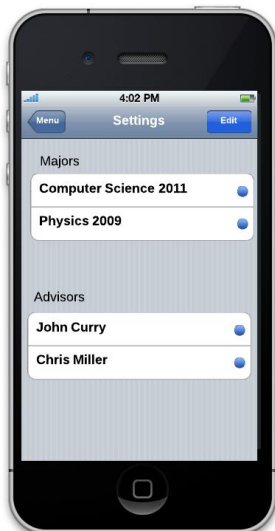
Courses



Program Progress

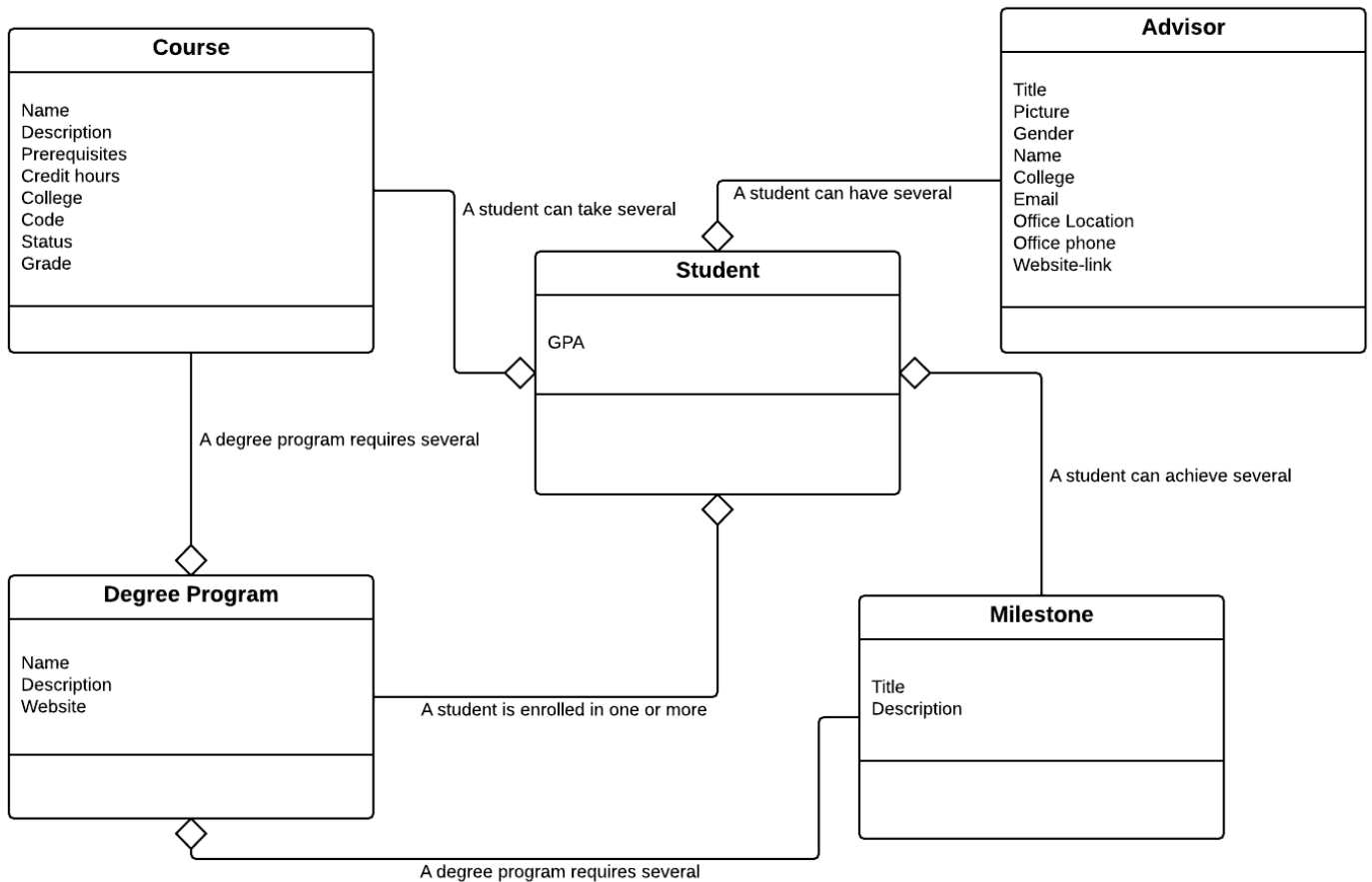


Settings



Preliminary Architectural Design

According to the project specification and the visual draft the next concepts were identified:

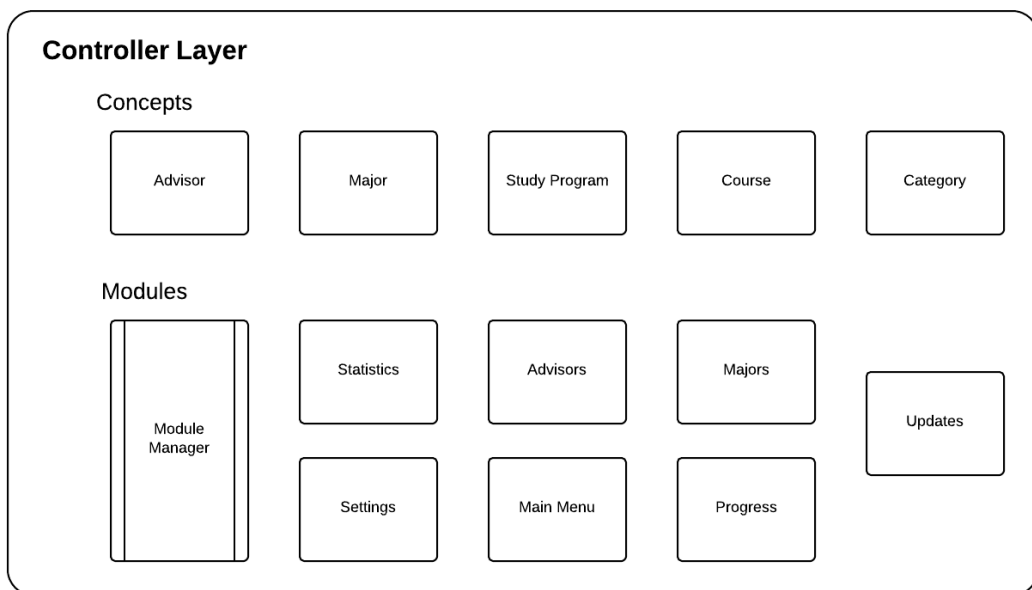
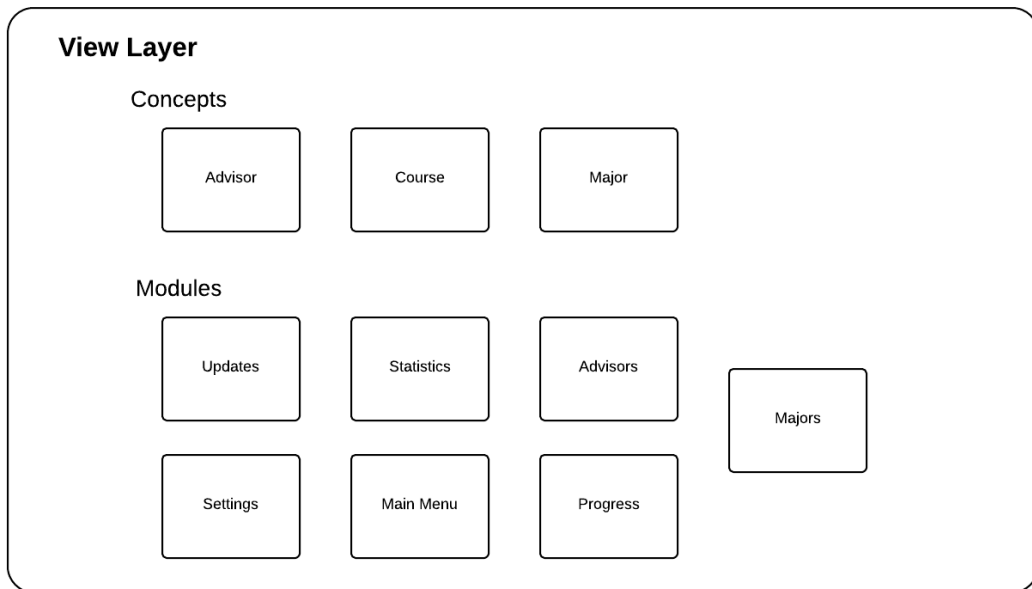


The architectural diagram was designed according to the conceptual diagram. It has main app objects and its communication. This design would be deep enough to function as a base framework for the entire app but flexible enough to allow requirements changes in the development process.

The developer team decided to go for a modular architecture and to clearly separate the three MVC layers. The app functionality was grouped and encapsulated in modules. The identified concepts were also encapsulated in module-like objects. Each one of the modules is as independent as possible from the others. One central module manager serves as a bridge for communicating modules and concepts objects with each other.

This approach allows the app to be extremely flexible, as modifying one module will not affect other modules of the app as long as they use the established

communication manager. Adding new functionality is as simple as adding a new module and connecting that module to the module manager. Changes in the visual interface or the data source should not affect functionality either as each layer is clearly separated from each other.



Technology Ramp-Up

The team had no experience developing applications for iOS devices, so a deep technology research was needed prior the development stage. There were three main technologies to research about: Objective-C, Cocoa Touch and Core Data framework.

Objective-C

Objective-C is a general-purpose, high-level, object-oriented programming language that adds Smalltalk-style messaging to the C programming language. It is the main programming language used by Apple for the OS X and iOS operating systems. This language and C are programmed in a similar way, but the syntax is completely different. There are a lot of particularities that Objective-C has that cannot be seen in any other object-oriented programming language.

Cocoa Touch

Cocoa Touch is a UI framework for building software programs to run on the iPhone, iPod Touch, and iPad. This framework has all the User Interface components to develop iOS applications, providing tools to the developers to design the UI in an easier way. Cocoa Touch uses delegates and data sources to display the required data in the different view components. It follows a Model-View-Controller (MVC) software architecture.

Core Data

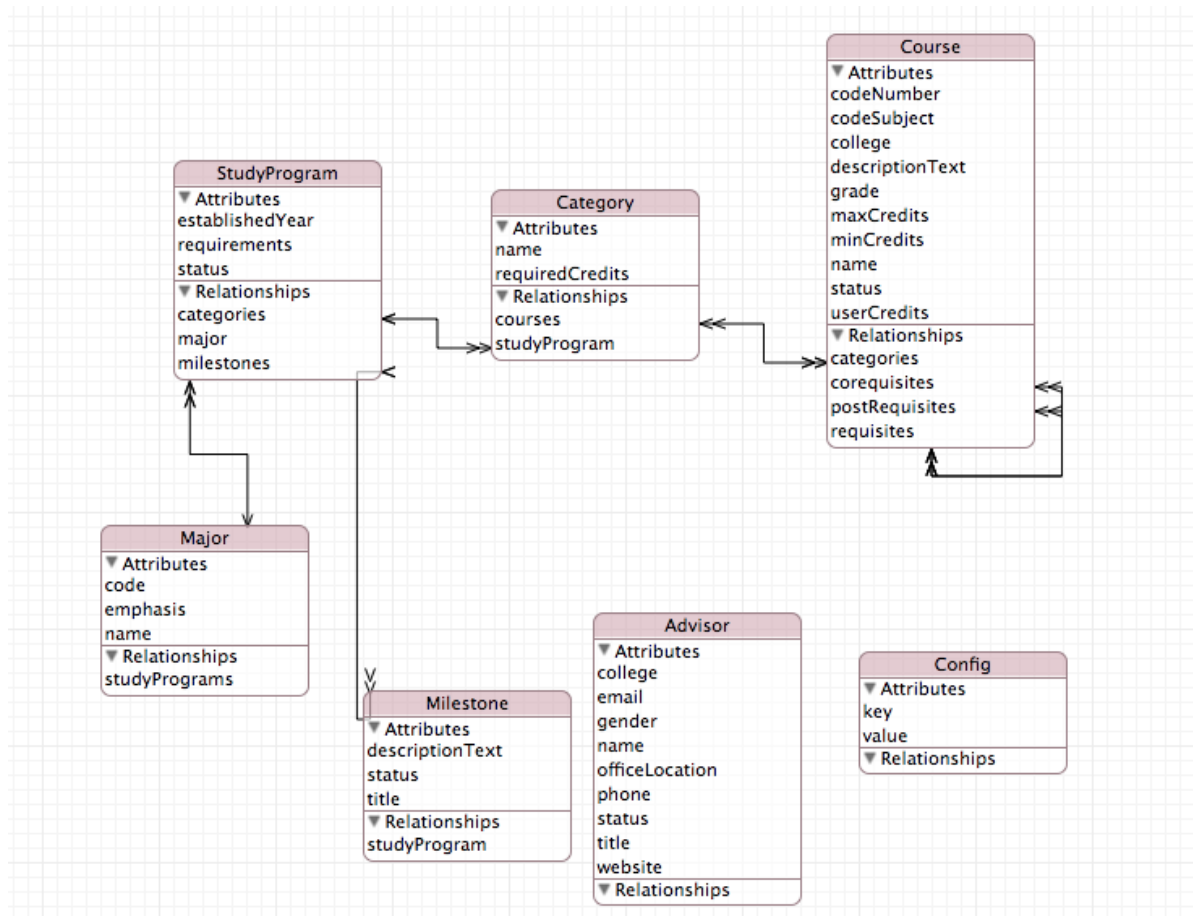
Core Data is an object graph and persistence framework that allows data organized by the relational entity-attribute model to be serialized into XML, binary, or SQLite stores. The data can be manipulated using higher-level objects representing entities and their relationships. Core Data handles the model layer in an iOS application.

Second Stage

Prototype Development

Once the team had the required knowledge and a basic design the initial development stage was started.

The first task was to design a Core Data model that specifies all the entities (objects) to be created with their respective attributes. This would cover the model layer for the application. The following is a screenshot of the Core Data model designed:



In this development stage three main modules were developed: “App Preferences”, “Explore My Career” and “Contact Advisor”.

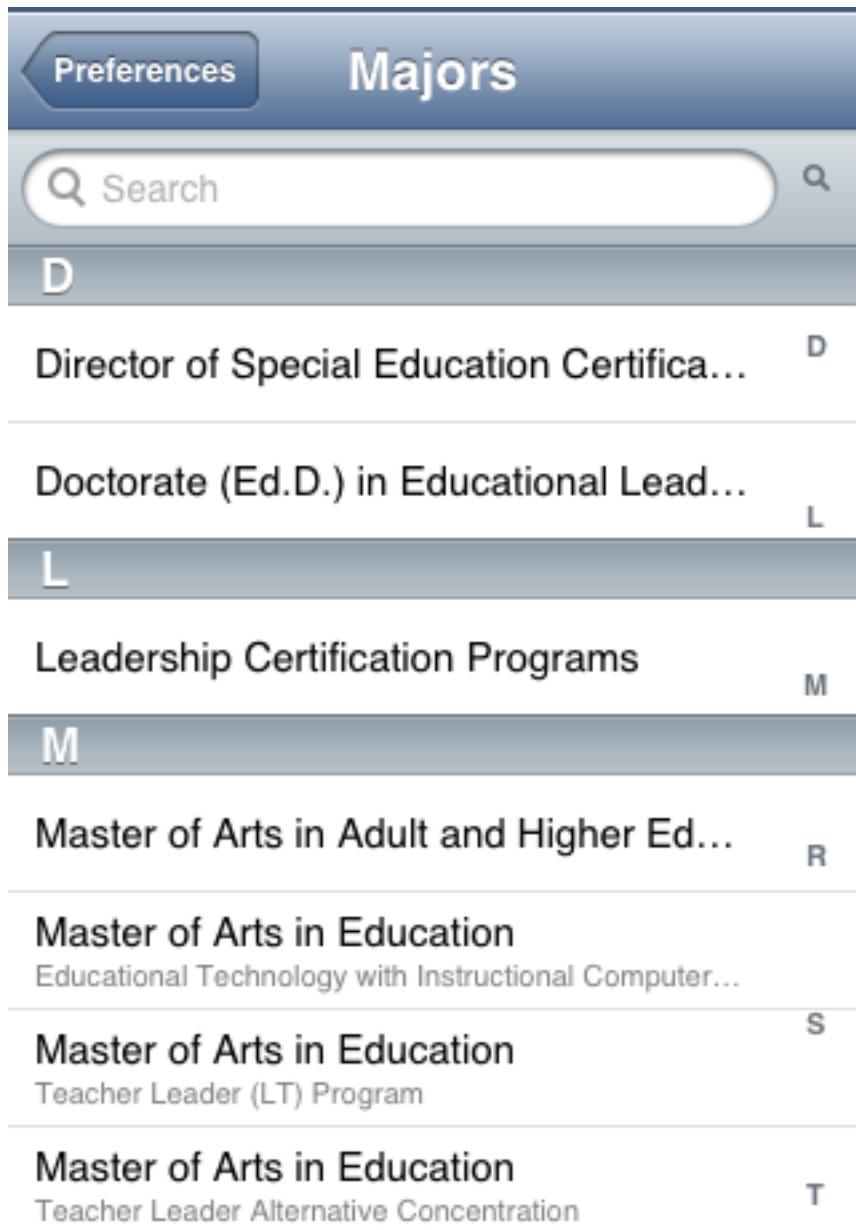
App Preferences

In this module the student can select its major(s) and advisor(s). In the first screen all the majors and advisors selected by the student are shown:



The selected major has a year that indicates the study program in which the student is enrolled.

If the student wants to pick another major, he just has to tap in the "Edit" button. There he can delete a major or tap "Add Major" and then a list with all the majors will show up so he can pick a new one:



Once the student picks a major, a pickerView will show up so he can pick the year of the study program in which the student is enrolled.

The search bar can be used to facilitate the search of the wanted major.

If the student wants to select a new advisor the process is the same, he just taps in "Add Advisor" and picks a new advisor from the list. This time a pickerView won't show up because there's no need to pick a year.

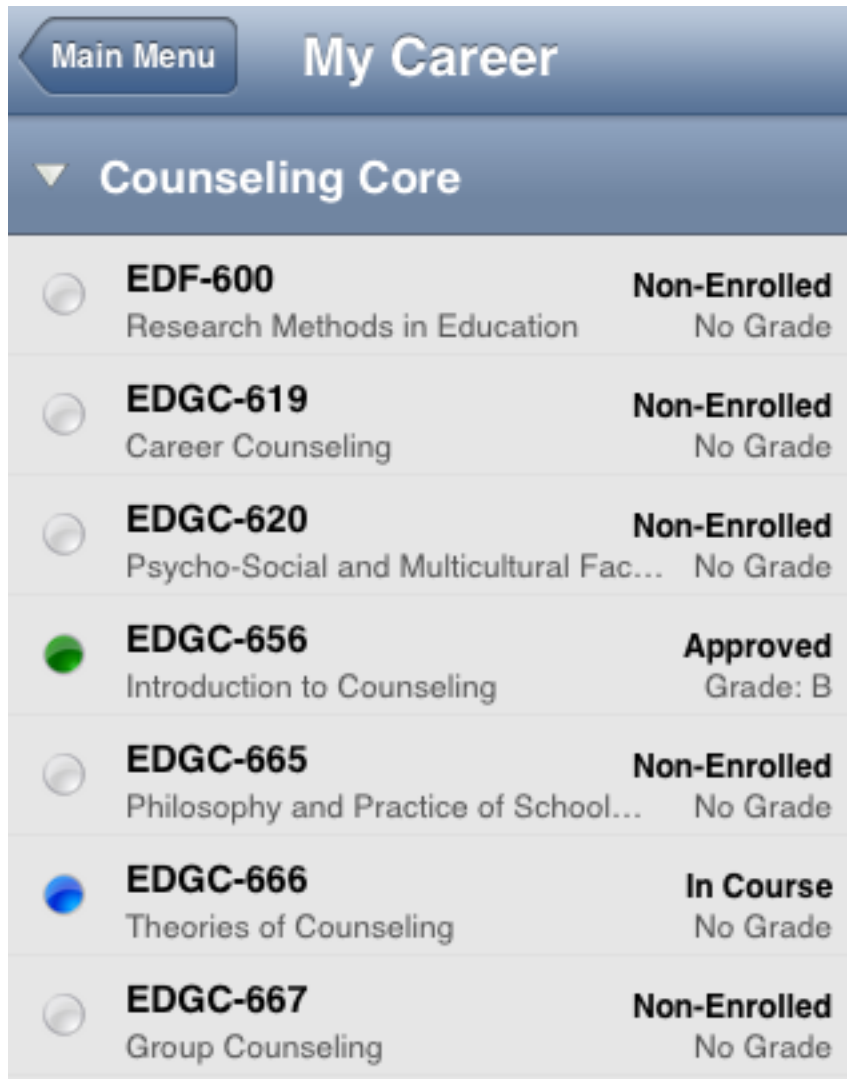
The user can pick a maximum of four majors and four advisors.

[Explore My Career](#)

This module is the application core. It shows all the progress that the student has accomplished in his major.

The information showed depends on the student's major. This means that in order for this module to show the career's progress the student must go to the preferences module and pick a major.

Its main screen shows all the courses required for the enrolled major(s) grouped in categories.



The screenshot shows a mobile application interface for 'My Career'. At the top, there is a 'Main Menu' button and the title 'My Career'. Below this is a section titled 'Counseling Core' with a downward arrow. A list of seven courses follows, each with a circular status indicator, the course ID, the course name, and the current status and grade.

Course ID	Course Name	Status	Grade
EDF-600	Research Methods in Education	Non-Enrolled	No Grade
EDGC-619	Career Counseling	Non-Enrolled	No Grade
EDGC-620	Psycho-Social and Multicultural Fac...	Non-Enrolled	No Grade
EDGC-656	Introduction to Counseling	Approved	Grade: B
EDGC-665	Philosophy and Practice of School...	Non-Enrolled	No Grade
EDGC-666	Theories of Counseling	In Course	No Grade
EDGC-667	Group Counseling	Non-Enrolled	No Grade

It also shows information about the courses' status, displaying if the course was taken, if it is currently enrolled or if it hasn't been taken yet.

The student can see more course information or change the status by tapping in the desired course. There you check a course description, the course credits, if it has prerequisites, if it has co-requisites, the course status and the grade (when it applies).

 **Approved**

Introduction to Counseling

Education (Counseling)

History, philosophical principles, and development of guidance movement; place of specialist; guidance and the teacher; present status of guidance meeting needs of individual school; objectives, types, and scope of guidance.

Credits	3
Prerequisites	No Prerequisites
Corequisites	No Corequisites
Status	Approved > Grade: B

If the user taps in the Status cell then he can change the course status. A preferable case would be that the grade could be pulled from Morehead's data sources but a direct connection with these services was not plausible at this time.

Contact Advisor

In this module all the user's advisors' contact information is shown.

Ed.D.

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David Barnett

Testing Data Population

Once the prototype development was in a mature stage, real data population was required in order to assure the application quality and showcase it.

The data was taken from the Education department course catalogue and the faculty directory. Hundreds of registers were manually inserted, one by one, by code. The following is a sample of the code used to insert the testing data:

Advisors

```
philip_krummrich = [[Advisor alloc] initWithTitle:@"Ph.D." College:@"International and Interdisciplinary Studies" officeLocation:@"Honors House" Name:@"Philip Krummrich" Email:@"p.krummrich@moreheadstate.edu" Website:@"http://www.moreheadstate.edu/content_template.aspx?id=1056" Status:nil Gender:@"M" Phone:@"6067832726"];
```

```
john_curry = [[Advisor alloc] initWithTitle:@"Ph.D." College:@"Foundational and Graduate Studies in Education" officeLocation:@"408 Ginger Hall" Name:@"John Curry" Email:@"j.curry@moreheadstate.edu" Website:@"http://www.moreheadstate.edu/content_template.aspx?id=8429" Status:nil Gender:@"M" Phone:@"6067839053"];
```

Majors

```
master_arts_adult_and_higher_education = [[Major alloc] initWithCode:@"001" Name:@"Master of Arts in Adult and Higher Education" Emphasis:@""];
```

```
master_arts_counseling = [[Major alloc] initWithCode:@"002" Name:@"Master of Arts in Counseling" Emphasis:@""];
```

Study Programs

```
_2012_13_master_arts_counseling = [[StudyProgram alloc] initWithMajor:master_arts_counseling EstablishedYear:[NSNumber numberWithInt:2013] Status:[StudyProgram STATUS_NON_ENROLLED] Categories:nil Requirements:nil];
```

```
_2012_13_master_arts_education_teacher_leader_program = [[StudyProgram alloc] initWithMajor:master_arts_education_teacher_leader_program EstablishedYear:[NSNumber numberWithInt:2013] Status:[StudyProgram STATUS_NON_ENROLLED] Categories:nil Requirements:nil];
```

Categories

```
required_core_2012_13_master_arts_adult_and_higher_education = [[Category alloc] initWithName:@"Required Core" RequiredCredits:[NSNumber numberWithInt:12] StudyProgram:_2012_13_master_arts_adult_and_higher_education Courses:nil];
```



```
electives__2012_13_master_arts_adult_and_higher_education = [[Category alloc]
initWithName:@"Electives" RequiredCredits:[NSNumber numberWithInt:9]
StudyProgram:_2012_13_master_arts_adult_and_higher_education Courses:nil];
```

Courses

```
edah_644 = [[Course alloc] initWithCodeSubject:@"EDAH" CodeNumber:@"644"
College:@"Education (Adult and Higher)" DescriptionText:@"This course provides an
overview of higher education as it exists in the United States, to include its historical
development, current purposes, functions and issues in the field, and general
directions for the future." Name:@"Principles of Higher Education" Grade:nil
minCredits:[NSNumber numberWithInt:3] maxCredits:[NSNumber numberWithInt:3]
Status:nil Requisites:nil Postrequisites:nil categories:[NSSet setWithObjects:
required_core__2012_13_master_arts_adult_and_higher_education,
nil]
corequisites:nil];
```

```
edah_647 = [[Course alloc] initWithCodeSubject:@"EDAH" CodeNumber:@"647"
College:@"Education (Adult and Higher)" DescriptionText:@"This course provides an
overview of adult education as it exists in the United States, to include its historical
development, current purposes, functions and issues in the field, and general
directions for the future." Name:@"Principles of Adult Education" Grade:nil
minCredits:[NSNumber numberWithInt:3] maxCredits:[NSNumber numberWithInt:3]
Status:nil Requisites:nil Postrequisites:nil categories:[NSSet setWithObjects:
required_core__2012_13_master_arts_adult_and_higher_education,
nil]
corequisites:nil];
```

Feedback Gathering

Once the team had a functional prototype the next step was to show the application to faculty members and students to test the application. This step was very rewarding for the team. I

This was a key process because it allowed the developer team to see the application from a different perspective and spot any design flaws as well as how could be improved and what functionality could be added.

This step responded to the team's efforts to be user oriented and solve the students' wants and needs. Letting the users test the application gives different insights that couldn't be obtained any other way.

From the obtained feedback the developers gathered important information to start the next step of the project: Prototype Enhancement.

Third Stage

Prototype Enhancement

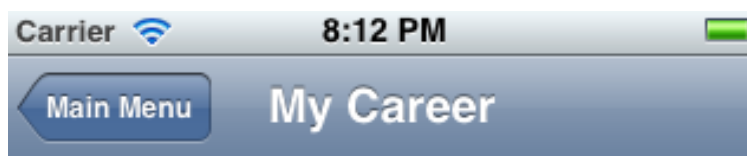
After the very first prototype, a lot of details like text captions, buttons positioning and App-User interaction itself were modified according to the students feedback so they could easily understand how to work with the app.

Among the various ideas the volunteer students gave us when trying out the prototype we pick two very important ones that we had never thought of them before and decided to develop them. The development of the app main menu was also performed in this stage.

Statistics Module

The statistics module allows students to calculate the most important statistics in their program like GPA, approved credits and number of credits left for graduation.

There two types of statistics. Career statistics shows information related only to one major.

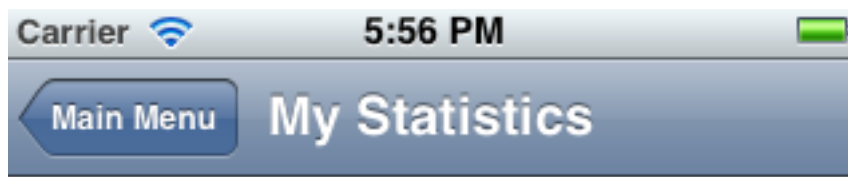


Major's Statistics

Courses Currently Enrolled	0
Courses Passed	0
Courses Failed	0
Courses Taken	0
Earned Credits	0



General Statistics on the other hand, shows information regarding all the majors enrolled. It also automatically calculates and shows the Grade Point Average (GPA) of the student.



General Statistics

Total Courses Currently Enrolled	1
Total Courses Passed	1
Total Courses Failed	0
Total Courses Taken	1
Total Earned Credits	3
Total Grade Points	12
Cumulative GPA	4.00

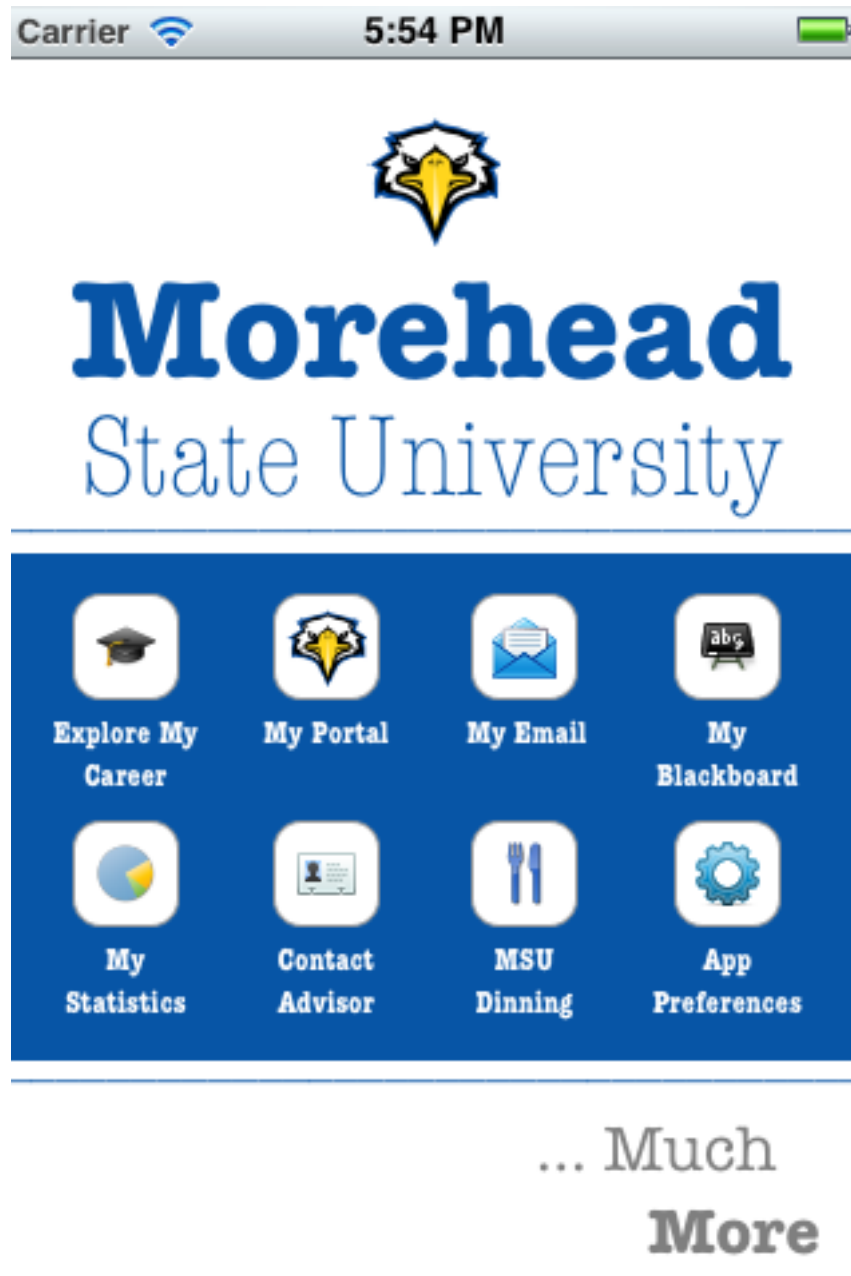
Useful Links

For accessing different useful portals students often required to take several steps on MSU's website that are very inconvenient. It was decided to add new modules for each one of those portals so students could quickly check valuable information without having to navigate and login several times.

The new modules allow easy access to My Morehead State Portal, Students Email accounts, Blackboard Accounts and Morehead State Dining Services.

Main menu

The development of the app main menu was delayed until this stage. The idea was to wait until the team has a more precise idea of the app final functionality. This way no time would be wasted designing several initial menus that would have to be heavily modified or discarded over the development and enhancement processes.



Strategic Meetings

Once the prototype was improved as a result of the students' feedback it was ready to be presented to different departments inside the university. The first step was to meet with people from the marketing department. We installed the software on their tablets and they reviewed and approved the visual design.

A presentation meeting with people for the Graduate and Foundational Studies Department was also scheduled. We met with Dr. Victor Ballesteros, Dr. David Barnett, Dr. Christopher Miller and Dr. John Curry. They reviewed the work and found it very valuable for the university.

Next, we received a new request from the College of Education Dean, Dr. Cathy Gunn, for attending the College of Education Chair's Meeting. They also found the prototype to be very useful in transmitting this new vision of how could mobile technology help the university to achieve a better communication with students.

A new meeting was scheduled this time with Morehead State University President Dr. Wayne D. Andrews. We showcased the prototype and transmitted our vision about this technology as a framework for making communication with students much more effective and its flexibility to adapt and solve future drawbacks.

Finally, we had our last strategic meeting with the university's vice-president and closed the presentation stage very satisfied about the usefulness of the prototype and the feedback received.

Project conclusions

Even though the application wasn't published in the Apple App Store, the clients found the application very useful in the sense that they discovered technological problems that need to be solved in order to implement any modern technology, in this case a mobile application.

In the future this prototype can be used as a published application once Morehead has the technology to make the required data accessible. Also this prototype can be a useful design for another developed software for similar purposes in the university.

The project team found the experience very rewarding in all the senses. The experience acquired helped the developers to understand: how external factors can affect a project performance, the importance of a good application visual design, how to discover the requirements of a problem that hasn't been solved (in this case the requirements for an academic application) and the importance of developing using an agile methodology in projects in which requirements can change easily.

The project was considered to be a success regarding its main objective, which was to transmit the vision about how can mobile technology help Morehead State University to solve current drawbacks and serve as a framework for future solutions.