

Scott Pollock, Faculty of Information, Museum Studies
spollock.u.toronto@gmail.com

Tony Zhou, Department of Engineering
tooniz@gmail.com

Sheng Xu, Department of Engineering
xusheng1@ecf.utoronto.ca

For Professor Jonathon Rose, ECE 1778
April 2012

Word Count = 1,963
Plus Apper Essay = 499



1. INTRODUCTION

This report summarizes the development of a mobile phone application for the museum field that brings on-line strategies of visitor engagement on-site, in the museum gallery itself. Our project team created an original mobile app, on the iOS platform, that uses augmented reality (AR) to ‘hang’ visitor comments inside the galleries they visit. Unlike other AR applications museums use to deliver content, our app is designed as a participatory experience, allowing visitors to encounter previous visitors’ commentary, respond to an open-ended statement that the previous visitor has ‘hung,’ and pose a statement to be completed by the next visitor who encounters the virtual domain.

The app provides solutions for on-site visitor engagement, breaking free of the traditional feedback systems. The app allows museum visitors to ‘see themselves’ in the exhibit, add their own insight and comments and make connections between the artifacts or artwork on display and the personal meaning each visitor constructs during their visit. For the museum visitor, it is an exercise in what Livingstone (2007) calls an “intertextual experience,” the opportunity for museums to share authority by design in their exhibits with their visitors.¹

For the museum practitioner, the app is a new visitor research tool to better understand augmented reality as a platform for visitor engagement. Curators can post an open-ended statement about the exhibition and monitor visitor responses. The app offers measurable indicators of learning success in a fun, exploratory way.

We were invited to develop the app as a pilot project for the Royal Ontario Museum’s Jane Ash Poitras: New Acquisitions of Contemporary First Nations Art Daphne Cockwell Gallery of Canada: First Peoples. Working with the exhibit’s curator and artist, we developed the app to encourage visitors to think and react to the artist’s work in ways the curator had intended.

¹ Livingstone, P. (2007). A question of truth: Writing experience into an exhibition. In *Visitor voices in museum exhibitions*. (pp. 69-72). Washington, D.C: Association of Science-Technology Centers.

2. BLOCK DIAGRAM OF PROJECT

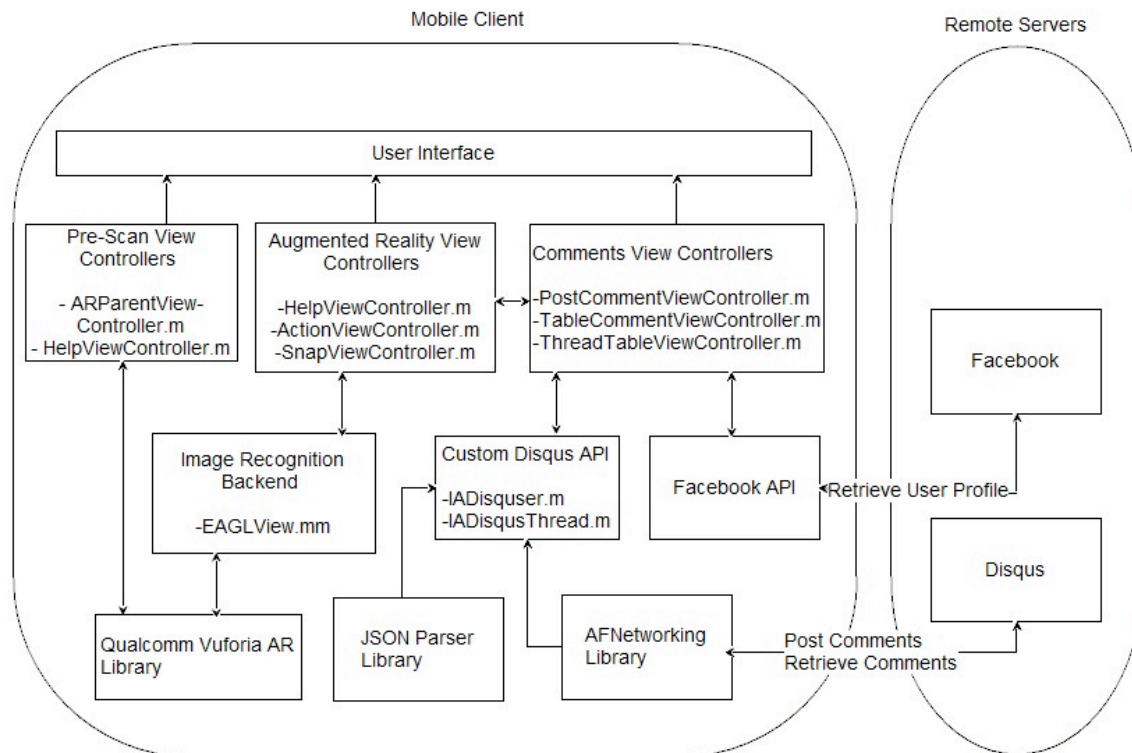


FIGURE 2.1-2.2 APPLICATION BLOCK DIAGRAM

2.1 – STRUCTURAL OVERVIEW

Our application consists of two parts, mobile client and remote servers. The mobile client is the iPhone mobile application written by our project team based on Qualcomm AR library for providing a complete augmented reality experience. The remote servers are the existing services provided by Facebook and Disqus. We used these two services to store, retrieve and manage all user data in a centralized manner. In particular, we were able to leverage the power of Disqus, an online discussion and commenting service as a central hub for moderating all of the comments submitted by our users.

Figure 2.1 is a block diagram and a hierarchical view of the internal structure of our application which includes three major components: pre-scan view, augmented reality view and comments view controllers.

2.2 – AUGMENTED REALITY AND PRE-SCAN VIEW CONTROLLERS

Augmented reality and pre-scan view controllers are a group of controllers responsible for controlling and presenting various user interface elements. It is built on the existing Qualcomm Vuforia AR library. The Vuforia AR library enabled us to recognize different museum objects through the iPhone camera and then overlay UI elements and other information on top of the camera feed. For example, we are able to display question, responses, avatars and instructions related to a specific art once the art is recognized in the camera feed.

2.3 – COMMENTS VIEW CONTROLLERS

Comment view controllers is a group of controllers responsible for displaying, posting, retrieving, and parsing user responses from Disqus as well as user profiles from Facebook. The communication between our application and Disqus is realized through JSON parser and AFNetworking library since Disqus API can only be accessed with JSON. For Facebook, we used standard Facebook iPhone API. Comments view controllers display user profiles and comments by either passing data to the augmented reality and pre-scan view controllers or by pushing views directly onto the screen.

3. STATEMENT OF FUNCTIONALITY

3.1 – APP STARTUP

While the app is loaded a splash screen (Fig. 3.1) is presented to the user, it is automatically dismissed when loading completes. Upon entering the app, a semi transparent picture of Mona Lisa is shown with text “scanning encountAR” as cues to what to do next. (Fig. 3.2).

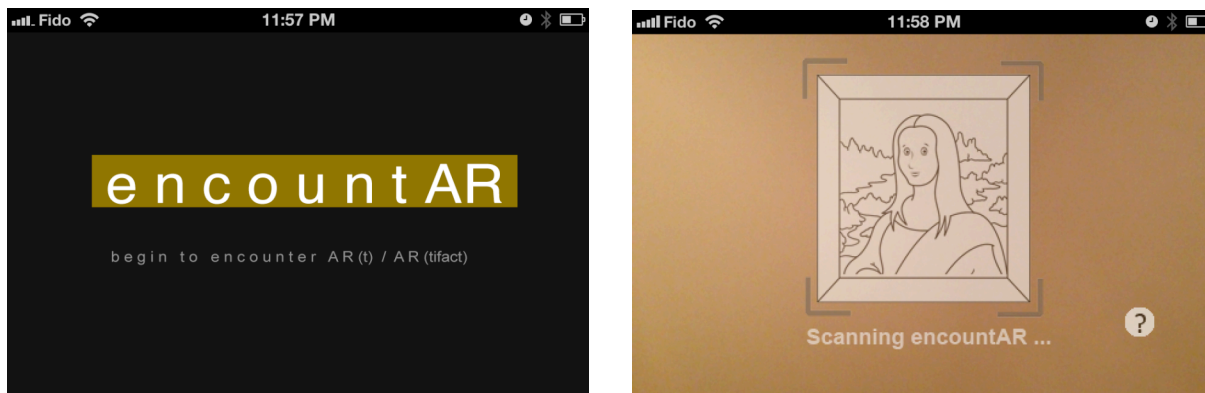


FIGURE 3.1-3.2 (LEFT) SPLASH SCREEN, (RIGHT) PRE-SCAN CAMERA SCREEN

At the same time, a question mark button is presented for user to tap, which brings up a sheet with additional help features (Fig. 3.3). Since normal operation requires only pointing the camera to target paintings at this stage, as a design choice we allowed any tap on screen to bring up this features menu. “Help” brings up more details instructions, “Torch on” turns camera LED on to assist image recognition under dark conditions, “Autofocus” and “Continuous autofocus off” allows maneuvering the camera focus in more predictable ways, and lastly “Select Gallery” (Fig 3.4) allows the user to pick different sets of images to be scanned. The sets of images are grouped under different museum exhibits.

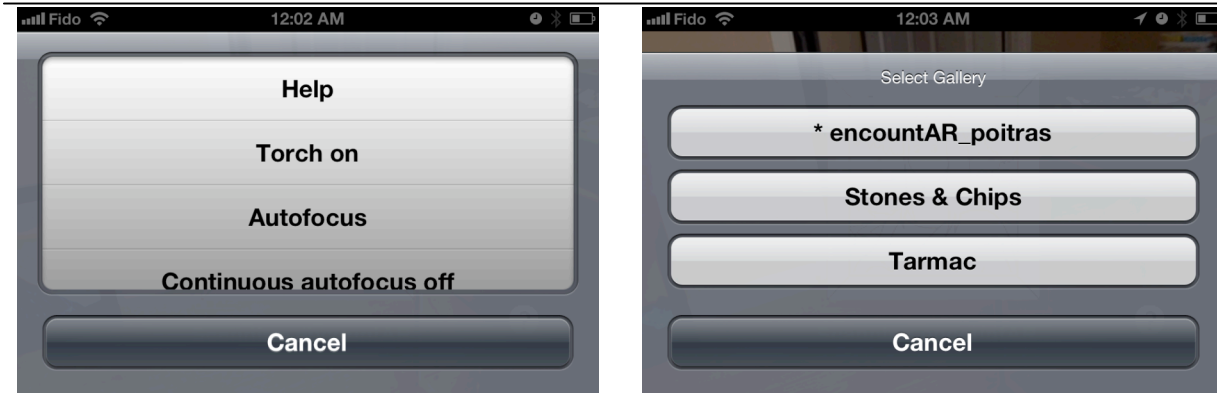


FIGURE 3.3-3.4 (LEFT) HELP FEATURES, (RIGHT) SELECT GALLERY SUBMENU

3.2 – IMAGE RECOGNITION & AUGMENTED REALITY

As user points the camera at one of the target paintings in currently selected gallery, an overlay of images, texts, and buttons appear on top of the current camera view. They dynamically track the location and orientation of the target painting as if they are post-it notes stuck on the painting. (Fig 3.5) The combined views of the camera and its target painting, and the overlay of dynamically tracking images, texts, and buttons, form the so called Augmented Reality view or AR view.

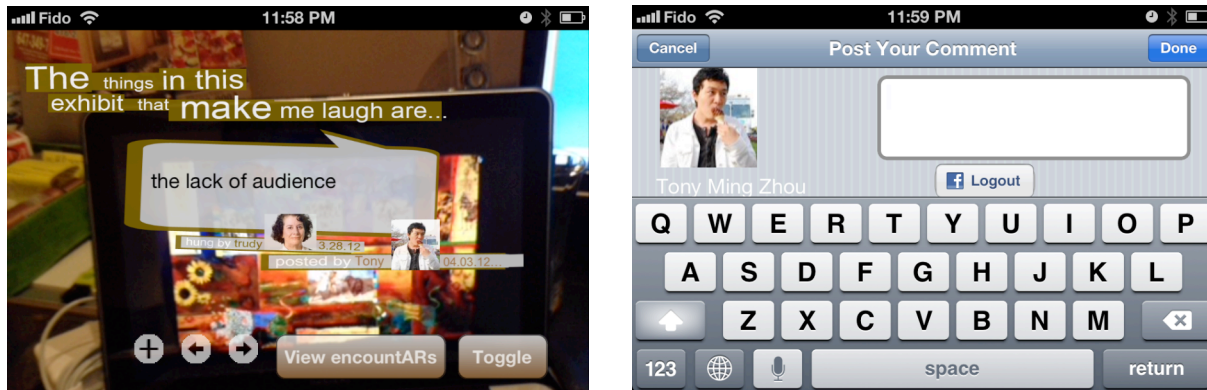


FIGURE 3.5-3.6 (LEFT) AUGMENTED REALITY VIEW, (RIGHT) ENCOUNTER RESPONSE VIEW

In the AR view, there is a variety of interactive features. An encountAR is composed of a question section and a response section. The white-background buttons with a plus sign, a back arrow, and a forward arrow are for posting a reply, viewing previous encountAR, viewing next encountAR, respectively. Each painting is attached with a number of encountARs specific to it, and users can tap the plus sign to add a response of his/her own (Fig. 3.6). Facebook is integrated in a secure and seamless fashion allowing users to log into their social profile.

3.3 – PAINTINGS, THREADS, AND COMMENTS

Users can tap “View encountARs” button on AR view to bring up a list of current encountARs of the painting (Fig 3.7) – which are analogous to threads in discussion boards. Under each encountAR, specific responses and comments can be viewed (Fig 3.8).



FIGURE 3.7-3.8 (LEFT) ENCOUNTERS VIEW, (RIGHT) ENCOUNTER THREAD VIEW

From the app curator’s point of view, the whole encountAR conversation system extends beyond the app to an external admin system called Disqus – a commercially available web service (Fig 3.9) where the curator can manage comments, setting levels of user access, and add restricted words.

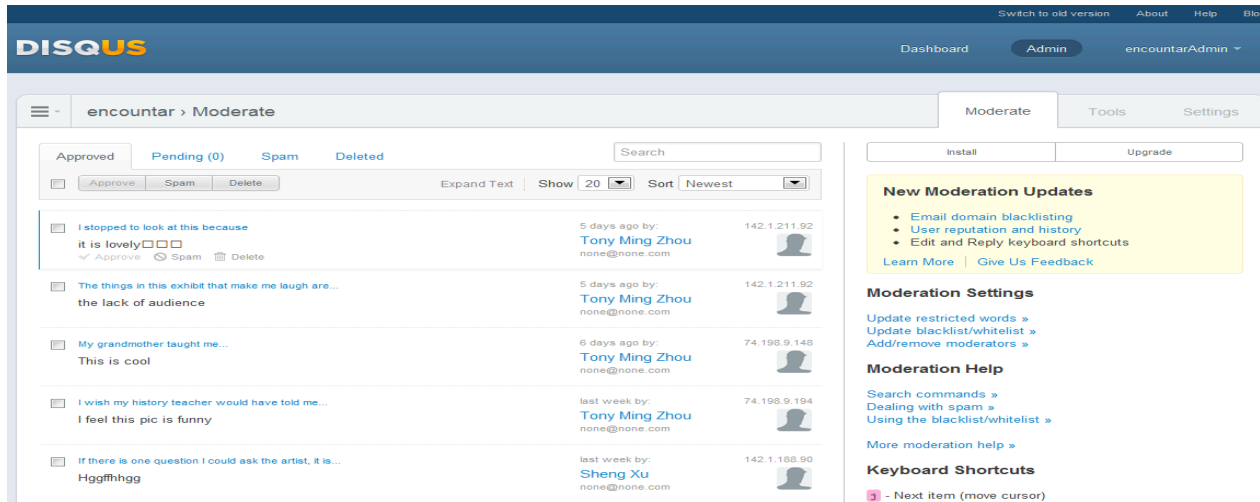


FIGURE 3.9 DISQUS ADMIN INTERFACE, MORE INFORMATION ON DISQUS.COM

3.4 – WHAT IS LACKING

All orientations of the phone – the phone needs to be positioned in landscape orientation for parts of the app to visually make sense. The main reason is due to complex calculation of 3D matrix of image recognition coordinates.

Dynamically create encountARs – current encountARs are pre-generated images. The main challenge with dynamic in-app generation is the time it takes to code the algorithm for generating an encountAR image. There are elements of randomness such as sizes, locations, and orientations of words, which help visual appeals but make coding time-consuming (Fig. 3.10).

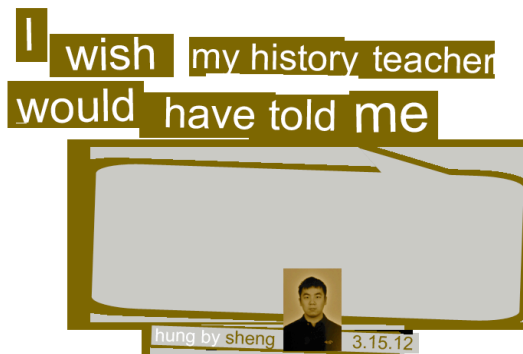


FIGURE 3.10 AN ENCOUNTER QUESTION-PORION CONSISTS OF RANDOMLY POSITION TEXT AND A PROFILE

4. TEAM ENCOUNTER



TONY ZHOU - PROGRAMMER
FACULTY OF ELECTRICAL & COMPUTER ENGINEERING

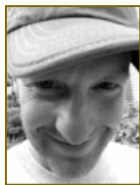
- Research on Qualcomm Vuforia SDK Research on Qualcomm SDK and alternative solutions.
 - Research and compared IQ Engines, Qualcomm Vuforia, and native OpenCV
- Image Recognition of the app through Qualcomm SDK
 - Fine tuned the recognition features already available and respond with required 3D matrix data.
 - Tested with 20 images of different sizes, patterns, contrast levels.
- Help menu and additional features
 - Help screen consisting of a view controller displaying user instructions
 - Torch consisting of turning on and off back camera LED assisting camera visibility in dark rooms
 - Autofocus capabilities
 - Gallery Selection where user can switch between different datasets
- Graphics design for the interactive screens of the app

- Used photoshop for creating most of graphics on scanning screen and augmented reality screen
- Also produced in-app special effects – manipulation of alpha/transparency, drop shadows, gradient buttons.



SHENG XU - PROGRAMMER
FACULTY OF ELECTRICAL & COMPUTER ENGINEERING

- Research on Qualcomm Vuforia SDK
 - Understand Vuforia architecture and its “QCAR” library
- Facebook integration
 - Research and understand the Facebook iPhone API
 - Create a login system that allows the users to sign in with their Facebook accounts
 - Retrieve user profile including name, email address and display picture from Facebook
- Comment system and Disqus integration
 - Research and understand the general Disqus API
 - Create custom Disqus API for iPhone using JSON parser for retrieving and storing user information, question and comments on Disqus
 - Designed comment system hierarchy to meet the comment storage needs of our application
 - Create UI for displaying comments and questions.
 - Integrate with Facebook so that user can post with Facebook profiles
- Splash screen and icon
 - Use Photoshop to create our application’s main splash screen and icon



SCOTT POLLOCK - APPER
FACULTY OF INFORMATION - MUSEUM STUDIES

- Concept and UI design
 - Research mobile and AR applications specific to museum sector
 - Research participatory models of communication featured in app
 - Coordinate user feedback from on-site tests and presentation at museum studies conference to influence app’s functionality
- Liason with Royal Ontario Museum staff
 - Share project development, obtain artist permission and coordinate in-gallery testing of app
- Project Manager
 - Assign tasks, write and submit project reports

- Design, develop and manage presentations
- Coordinate scheduling for meetings
- encountAR development
 - Use Photoshop/inDesign to design and create graphics for encountARs
 - Use Photoshop to design help screen

5. LESSONS LEARNED & REFLECTIONS



TONY - “I learned that feature prioritization is important. Our initial brainstorm contained two to three times the features we have now. By project proposal we have already reduced them to a much smaller amount, but we had not given priorities to all features. We should have divided each week to smaller units of work to ensure we always had scheduled enough time to meet required features first then proceed with opportunistic ones.”



SHENG - “I learned that design is very important for any applications. We have made a lot of design changes during the development process. Therefore, it is important to make the code as flexible as possible. This means it is better to write everything in multiple reusable functions rather than a huge block of code. For example, our codes were written in the way so that it can be easily modified to accommodate any changes in the comment system design.”



SCOTT - “I learned how important it is to clarify the user experience from the start. Many of the features I envisioned for the app could have been more clearly presented to the developers early on. From here, we could have prioritized our tasks better and set a manageable schedule to develop our targeted features more fully (and let others go).”

6. APPER REFLECTION

Developing encountAR was an opportunity to contribute to the ROM’s growing investment in new mobile technologies. The museum launched its mobile app available on iStore just over a year ago. Users can access additional information about its collection, use it to find their way around the museum, and download free audio tours. The museum is developing a SCVNGR app to encourage visitors to interact with collections across the galleries (generally, ROM visitors only visit 2-5 of the 30+ galleries during their visit). And in just over a month, the ROM will be the first major museum in North America to launch an integrated marketing and interpretive experience using augmented reality. Visitors will be able to use their iPhones to ‘reskin’ dinosaur skeletons in the exhibition hall.

While all these initiatives increase visitor interaction with the collections, they still lack an opportunity to encourage dialogue or socialization between museum visitors or staff.

As museum visitor advocate, scholar and enthusiast, David Carr wrote, “when a cultural institution invites its users to bring original experiences and questions to each other, it

recognizes the truths that we are never finished becoming, and that we need to speak to each other.”² The encountAR app is influenced by Carr’s notion that as public learning domains, museums need to encourage their users to think together more freely, encourage dialogue and participate in the act of becoming something, together.³

encoutAR gave me the opportunity to sit and talk with Trudy Nicks, the ROM’s ethnology curator. She wanted to know how “in the hell” (her words, not mine) this “Twitter” stuff can help visitors better understand the exhibits she spends so much time developing. “Don’t we give them enough to read?”

Trudy and I met a number of times in the galleries she develops, talking about technology and its place in the museum. Most importantly, we sat and watched scores of visitors walk right on by her work, without ever stopping.

When I first proposed encountAR, she was pessimistic (to say the least). However, when I suggested she use it to ask visitors what they found ‘funny’ or ‘interesting’ about her exhibits, she quickly came around. All of a sudden, she cared about what visitors had to say and encountAR was her tool to listen. Within a day, Trudy became an advocate and provided a half-dozen possible encountARs for our project. All over technology.

For the first time, both the institutions we support and the users who visit them are on equal footing. We have the technology at our disposal to understand how these objects influence us and find a way to make meaning of them, together. We have the common language, in 140 characters or less, to learn not only about the objects we encounter, but the individuals we share these spaces with.

We no longer need to regulate these conversations on-line. With the technology available, we can bring these conversations in side the walls of the museum. It’s time to think differently. It’s time for encoutAR.

7. FUTURE WORK

For future development, we would propose the following changes or additions:

- Datasets are not required to be local to the app, they could be downloaded from an external site instead. Having the dataset stored externally decouples dataset updates from app updates, which enables the flexibility for rapid dataset updates.
- Following best practices of mobile applications, one could replace many texts with graphics. This is extremely important for localization of apps in general.
- More social integrations – in addition to Facebook, sign in with Twitter, G+; Broadcast encountARs to multiple social networks to promote social engagement.

² Carr, D. (2011). Bertha Bassam Lecture, Faculty of Information, University of Toronto. April 14, 2011. Unpublished lecture notes.

³ Carr, D (2010). *Variable thinking, variable knowing*. Keynote address, Visitor Studies Association Conference, Phoenix AZ, July 29 (to be published in *Visitor Studies*).

- The open ended questions/statements portion of EncountARs are currently images, an algorithm can be used instead to generate them on-the-fly, which again adds flexibility.
- Certain artworks travel around the world, location tags can be added to user inputs. This allows museums to find out more about the conversations, and at the same time enables communication of audiences across different sites.
- On screen buttons were at times difficult to use. User gestures such as swipes can be integrated into the app instead for a better user experience.
- Build a separate mobile application for the museum curator to remotely upload arts and moderate comments instead of going to both Qualcomm and Disqus websites on a desktop computer.
- Design a more user-friendly comment system user interface. One possible improvement is to display all questions and comments on one page instead of using two separate table views.

NOTE: ENTREPRENEURIAL DEVELOPMENT

EncountAR would be open to entrepreneurial development to help museums and cultural institutions with their interpretive and audience engagement strategies. The app could be localized, developed for specific exhibits and museum projects (and take on different names/personalities by design). Alternatively, it could be developed as a global network that museums around the world could create ‘channels’ for. The Royal Ontario Museum has expressed interest in using the app beyond pilot for an upcoming photography exhibition, Observance and Memorial: Photographs from S-21, Cambodia (August 11, 2012 - March 17, 2013).