Proposal for a

Capstone in the Field of

Information Technology

In Partial Fulfillment of the Requirements

For a Master of Liberal Arts Degree

Harvard University

Extension School

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1 Tentative Capstone Title:

AnnotatAR: A spatialized annotation and text visualization platform for the mobile web.

2 Abstract

AnnotatAR is a light-weight augmented reality platform for mediating the experience of real-world events with data from online annotations. The platform will have two components: an augmented-reality mobile web site and a desktop portal to explore and archive deployments. The mobile site will utilize Twitter data in conjunction with HTML5 video and camera features to create a spatialized record of user interaction, pinning a virtual layer to a "sigil" that exists in the world. Data associated with a particular Twitter hashtag will be visualized as an overlay on a device input camera stream – this data can then be re-used to create additional works of visualization or expression. The desktop website will be an archive of interactions, and an area to explore remixes and visualizations based on the data and text analysis.

3 Capstone Project Description

3.1 Background and anchoring work

Augmented reality has been an area of ongoing development for the last several years. Groups such as ManifestAR espouse the belief that AR is a new paradigm of art that merges the real with the virtual, creating a liminal world where anything is possible and everything is participatory.

RE+PUBLIC's project, NOAD replaces advertisements on the subway with a collection of original artwork.

Figure 1: NOAD augmented reality application on the subway (http://noad-app.com/about/)

Museums have adopted AR systems for some of their collections. For example, the CHESS project has deployed applications for AR at the Acropolis.
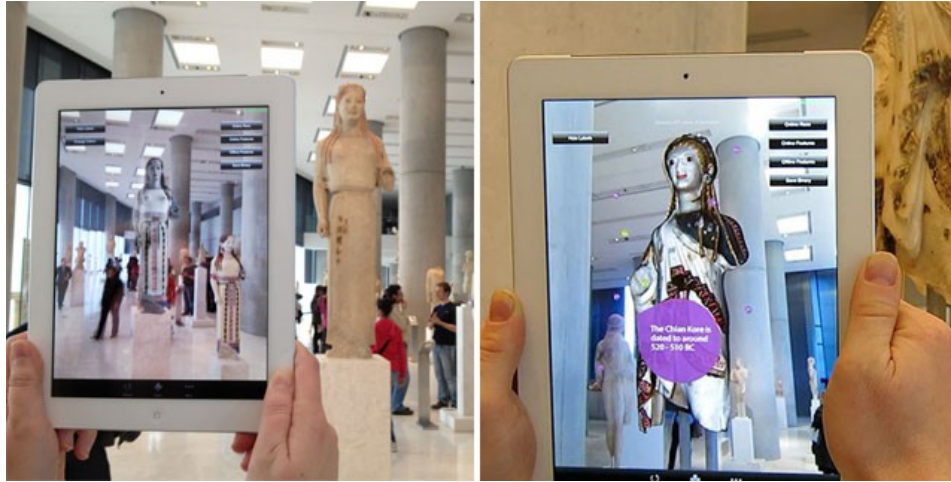

Figure 2: CHESS project at the Acropolis (http://www.chessexperience.eu/)

Priya's Shakti is a multimedia AR experience that combines 3D graphics with site-specific murals, using the platform blippAR.

Figure 3: Priya's Shakti (http://www.pbs.org/pov/blog/news/2015/01/the-making-of-priyas-shakti/)

The goal of AnnotatAR is to correlate an online space with a physical analogue – to create a pin-point or juncture which allows transmission of thoughts and ideas between these two realms. Augmented reality creates the conduit for this transmission. Existing platforms for AR are based on native applications rather than the mobile web – this has the limitation of excluding those who may have a device that does not run the supported operating system(s). AnnotatAR seeks to increase accessibility with a mobile-first development strategy.

Neglect of public spaces within the online world has been mirrored with the shrinking public space offline also [Sauter]. The pageantry of protest and dissent has been squished into smaller areas. How do people express themselves and come to terms with their human experience? Augmented reality is a nondestructive expressive layer that can be added to any substrate, enabling real-time reactions and co-curation of history.

Augmented reality projects are often quite political as they can boldly overtake iconic spaces without the permission of whomever the space belongs to [Browning]. In this fashion, controversial imagery can be juxtaposed with symbols of the prevailing paradigm. In the tradition of Situationists Internationale, public or well-trodden private spaces can be détourned, or hijacked to convey the message of an artist or activist. A platform of this style can be quite useful in exploring and documenting the psychogeography of a space, and creating a more lasting archive of the experience.

The project seeks to empower people to express themselves in public spaces, specifically in relation to a time-based intervention that is happening within the space. Their reactions will be a core component of the documentation of such intervention, and provide a means for the participants to reflect on the happening as well as an experience for those who cannot be there in person.

3.2 Prior related projects

The work for AnnotatAR will be founded on the author's previous projects that exploit web technologies as well as cognitive structures, for the purposes of empowering the user / audience. AlrightEros.com is a website that was created for Digital Storytelling (Kuzmick, Spring 2014) as a narrative vehicle for experiential learning about identity theft and the importance of password hygiene.

My prior works include creating a twitter bot - @_william_james_ that emulates a famous philosopher. I have explored digital placemaking in a series of videos produced for Digital Storytelling (Kuzmick, Spring 2014). Work with the DocShop group at Harvard's metaLab, particularly the instigation of the *Notes from El Saniyya* event[1] in December 2014, has inspired the design principles of AnnotatAR.

A Twitter API project was completed as part of Creative Computing (Fall 2012) and data visualization techniques were accrued as part of Visualization (Pfister, Fall 2014).

3.3 Preliminary design

There have been some preliminary explorations with using camera as an interface. Advances in HTML5 specification have led to the ability to access a native video stream from virtually any device and display this stream in the browser.

AnnotatAR will take the form of a mobile web experience, to be seen *in situ* at a place of an intervention, and a complementary desktop website that will archive the content and allow exploration and remixing. The dynamic data for both sites will be pulled from Twitter.

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1   http://docshop0.tumblr.com/

3.4 Approach

Design Approach

This site will make use of both the D3 Javascript library for data visualization, as well as HTML5 canvas and video elements for the "augmented reality" experience of the mobile site.
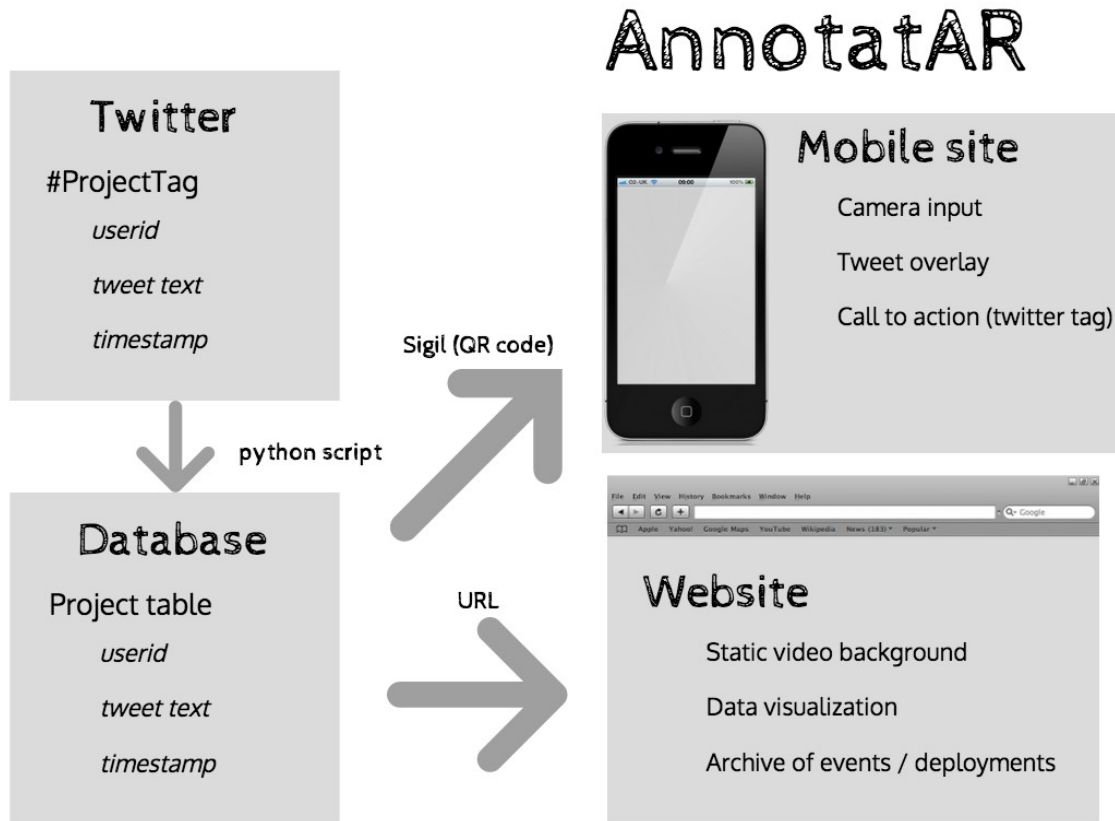

Figure 4: AnnotatAR site architecture

This project will focus on making the platform available as widely as possible via the mobile web.

The design can be prototyped by using a Twitter tag that has been used for other work or interventions. The AnnotatAR platform will be re-usable and made available for others to work off of and deploy on their own server.

AnnotatAR will display a layer of twitter data, with visual cues for timestamps. The mobile site will overlay these tweets on a camera feed from the hand-held device, creating an "augmented" layer on what's happening in real time. On the desktop site, a pre-recorded video will be used instead, and the tweets will be visualized based on sentiment, with an interactive "scrubber" to explore the temporal dimension.

Figure 5: AnnotatAR mock-up of mobile site

User experience

A mobile site user – this end user is at a public park where there are a number of performers enacting a scene from Shakespeare. Near the scene, they see a sign with a QR code and "#Shakes2015" written on it. They scan the QR code with their phone. Their browser opens and they are prompted to allow the website to access the front-facing camera. The site shows them a video feed of exactly what's in front of them – with an overlay of balloons of text. The user taps on a balloon and it expands, to reveal the full Tweet message and an attached photo of someone who had been in the park as the theater company had been setting up for the performance. The user clicks through a few of these tweets, then decides to contribute to the

archive; they open their Twitter client and post a selfie of themselves with the play in the background.

The desktop site – A patron of the arts is subscribed to the Twitter feeds of theatrical performances in the area; they receive a notice about the "#Shakes2015" performance as part of this list. This user has other obligations and doesn't make it to the performance, but finds the desktop AnnotatAR website from the troupe's Twitter feed. They visit the site on the day after the performance, and see a looping video of the park and actors, with tweets from "$Shakes2015" overlaid. There are a few interactions. They can change the spatial arrangement of the tweets based on sentiment. The tweets' opacity is based on timestamp; the user can scrub through a timeline, changing the tweet transparency.

Web technologies

AnnotatAR will utilize the extant social media framework and API for Twitter as the data input / interaction system. Twitter is ideal because it is already well-developed and mature as a social media platform and will facilitate sharing the projects in the larger online world. The Twitter API is accessible via HTTP GET and POST requests that respond with JSON data. A server-side script in Python can mine the Twitter data stream for a particular user or tag.

An HTML5 / CSS3 / Javascript website will be built using the database of collected tweets. The website will be two-fold: the mobile site will provide a low-tech "augmented reality" experience overlaid onto a stream from the mobile device's camera; the full website will display other visualizations of the tweet data.

A database-driven web application platform will be used to generate the site. Meteor is an ideal candidate. It is a Javascript platform that has a robust community and compliment of modules for UI, database queries, authentication, and APIs such as JSON parsing and Twitter API and authentication. Meteor also has a Javascript client-side HTML rendering that anticipates database queries. Its server-side database is MongoDB, and allows for programing client and server scripts within the same Javascript program. Test deployment is available on meteor.com. There are Meteor modules for generating native mobile apps from the same code base as the mobile site.

Further explorations of the data will be created using natural language processing toolkits such as NLTK and Pattern Python modules, whose output will be visualized with D3 Javascript.

4 Work Plan

AnnotatAR will be ready for beta-testing at an event in September, collecting tweets from a hashtag and displaying them on a mobile site. Once preliminary user data has been collected, the main website can be developed utilizing data visualization and text analysis to explore the collected interactions. The mobile site will be iterated on to streamline its aesthetics, reliability, and automation.

The capstone project will focus on expressive refinements, as well as compatibility testing for a range of device platforms. Data visualizations of the language might explore sentiment analysis, word frequencies, and connections between users or groups. The emphasis will be on creating a living archive, that can exist in parallel to more traditional records.

Further directions include geo-locative functionality as part of a mobile app, using HTML5 geolocation API. Additionally, AnnotatAR might utilize the same framework built in HTML5/CSS/JS using Meteor to export the application as both iOS and Android native apps. However, it is preferable to utilize mobile web technologies and make the site as accessible as possible.

4.1 Assumptions, Risks and Alternatives

Existing AR platforms, such as Vuforia and Junaio, work as native applications – they provide a web server framework for developers as well as computer vision image recognition to "stitch" content into a video stream. These platforms typically exist as a paid subscription service to host the content on a media server. AnnotatAR takes a different approach: the site data is quite minimal (text from Tweets) and the augmented layer will be served on a mobile site.

Visualizing the data as an augmented layer may be jarring to the end user. The tweets may be difficult to read on a small screen. Rapid prototyping and iteration is planned to develop an appealing and functional design.

There may be performance issues from this approach, depending on the end users' device profile. Site analytics may have insight into this, for further iterations and optimization.

4.2 Preliminary Schedule

Stage / Milestone	Work plan	Output	Dates
Stage 0: Input data	Learn Meteor and scrape Twitter data	Alpha website displaying tweets	July 2015
Stage 1: Exploration	Scrape Twitter data for extant tags for interventions	Text database, ipython notebook of basic analytics	August 2015
Stage 2: Mobile site beta	Build a mobile app that prototypes the AR framework	Beta website with AR tweet overlay	August 2015
Stage 3: Mobile deployment	Create QR code and deploy at Lara Baladi's intervention	Beta-test – written description of usability and next steps for design	September 2015
Stage 4: Main site build	Generate data visualization from beta test	Ipython notebook of analysis, Data visualization sketches	September 2015

Stage / Milestone	Work plan	Output	Dates
Stage 5: Refinement	Incorporate user feedback and refine the mobile experience	Version 1 of mobile site	October 2015
Stage 6: Documentation	Deploy full AR + non-mobile framework	Version 1 of data vis desktop site	December 2015

5 Glossary

Augmented Reality (AR) - a live direct or indirect view of a physical, real-world environment whose elements are augmented (or supplemented) by computer-generated sensory input such as sound, video, graphics or GPS data.

CouchDB – A document-oriented NoSQL database that uses JSON to store data, JavaScript as its query language using MapReduce, and HTTP for an API (from wikipedia[2])

D3 – A Javascript library for data-driven visualizations

Git – An open source program for tracking changes in text files (from github.com[3])

JSON – Javascript Object Notation

LAMP – An abbreviation for the commonly-used suite of software for serving webpages: Linux / Apache / MySQL / PHP

Meteor - a complete open source platform for building web and mobile apps in pure JavaScript

Model-view-controller (MVC) – Software architecture commonly used in website development, wherein functional parts of the back end are separated by task: *Model* represents the website database; *View* represents the information request to the database; *Controller* represents the commands to modify the database

SQLite – Open-source database engine favored by Django installations

Twitter - Twitter is an online social networking service that enables users to send and read short 140-character messages called "tweets." (from wikipedia[4])

User experience – A person' behaviors, attitudes, and emotions about using a particular product, system, or service (from wikipedia[5])

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2   https://en.wikipedia.org/wiki/CouchDB

3   https://help.github.com/articles/github-glossary/#git

4   https://en.wikipedia.org/wiki/Twitter

5   http://en.wikipedia.org/wiki/User_experience

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