University of Redlands

**VGI and Twitter for Event Feedback;
A Case Study for the Arts Council for Long Beach**

A Major Individual Project submitted in partial satisfaction of the requirements
for the degree of Master of Science in Geographic Information Systems

by

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December 2013

VGI and Twitter for Event Feedback;
A Case Study for the Arts Council for Long Beach

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by

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The report of Numa Gremling is approved.

A handwritten signature in black ink, appearing to read 'Mark P. Kumler', written above a horizontal line.

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A handwritten signature in black ink, appearing to read 'Ruijin Ma', written above a horizontal line.

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Leaves are fallin' all around, time I was on my way
Thanks to you, I'm much obliged for such a pleasant stay
but now it's time for me to go, the autumn moon lights my way

Led Zeppelin – Ramble On

Abstract

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Social networking platforms such as Twitter are playing an increasingly important role in understanding the public's involvement of social activities. Along with GIS and the volunteered geographic information movement, these technologies have great potential in shaping how urban planning can be conducted. This report will provide details about how an interactive web GIS application was used to connect the public with the Arts Council of Long Beach (ACLB), a non-profit organization. The web application provides the ACLB an effective way to evaluate public responses concerning their A LOT Initiative, a project which aims at reviving neighborhoods by hosting events on vacant urban lots. These events draw crowds and stimulate interaction among neighbors.

Table of Contents

Chapter 1 – Introduction.....	19
1.1 Client.....	19
1.2 Problem Statement	19
1.3 Proposed Solution	20
1.3.1 Goals and Objectives	20
1.3.2 Scope.....	20
1.3.3 Methods.....	21
1.4 Audience.....	22
1.5 Overview of the Rest of this Report	22
Chapter 2 – Background and Literature Review	23
2.1 Vacant Land.....	23
2.1.1 Previously Undeveloped Land	23
2.1.2 Previously Developed Land.....	23
2.1.3 The Issue of Vacant Land in America Cities.....	24
2.2 Cultural Projects as Revitalization.....	24
2.3 Volunteered GIS.....	25
2.3.1 Web 2.0	25
2.3.2 Public Participation GIS and Volunteered Geographic Information	25
2.4 Summary	26
Chapter 3 – Systems Analysis and Design	28
3.1 Problem Statement	28
3.2 Requirements Analysis.....	28
3.2.1 Functional Requirements.....	28

3.2.2	Non-Functional Requirements	29
3.3	System Design	30
3.3.1	Geodatabase	31
3.3.2	Services.....	31
3.3.3	Web Application	32
3.3.4	Twitter Search Tool.....	32
3.4	Project Plan.....	32
3.5	Summary.....	33
Chapter 4	– Database Design.....	35
4.1	Conceptual Data Model	35
4.2	Logical Data Model.....	36
4.3	Data Sources	38
4.4	Data Collection Methods.....	39
4.5	Data Loading.....	40
4.6	Summary.....	40
Chapter 5	– Implementation	41
5.1	Configuring the Database.....	41
5.2	Publishing Services	43
5.3	Developing the Web Application.....	44
5.3.1	Technologies Used.....	44
5.3.2	Asynchronous Module Definition.....	45
5.3.3	Application Interface	45
5.4	Developing the Twitter Search Tool.....	47
5.4.1	Technologies Used	47

5.4.2	Limitations of the Twitter Search API.....	48
5.4.3	Development of the Tool.....	48
5.4.4	Tool Interface.....	50
5.5	Summary.....	51
Chapter 6 – Use Cases.....		53
6.1	Web Application.....	53
6.1.1	Basic Functionality.....	53
6.1.2	Submitting to the Database.....	56
6.1.3	Querying the Database.....	58
6.2	Twitter Search Tool.....	59
6.3	Summary.....	61
Chapter 7 – Conclusions and Future Work.....		63
Works Cited.....		65
Appendix A. Web Application Code.....		67
Appendix B. Twitter Search Tool Code.....		87

Table of Figures

Figure 1-1: Empty Lot	19
Figure 1-2: Map of Study Area and A LOT Initiative Lots	21
Figure 2-1: Abandoned Store Front	24
Figure 3-1: System Design.....	31
Figure 4-1: Conceptual Model	35
Figure 4-2: Logical Data Model	37
Figure 4-3: City of Long Beach GIS Data Catalog.....	39
Figure 4-4: Inconsistencies between Imagery and Parcels	39
Figure 5-1: Initial and Final Database	41
Figure 5-2: Choosing a Primary Key	42
Figure 5-3: The ArcGIS Rest Services Directory	44
Figure 5-4: Graphical User Interface of Web Application	46
Figure 5-5: Flowchart of the Twitter Search Tool	49
Figure 5-6: Extracting Coordinates.....	50
Figure 5-7: Graphical User Interface of Twitter Search Tool.....	51
Figure 6-1: Elements of the Application.....	54
Figure 6-2: The Schedule Pane for the Central Lot	55
Figure 6-3: Submit Information Dialog	57
Figure 6-4: Query Options	58
Figure 6-5: Query Results for Carlos Ramirez	59
Figure 6-6: Twitter Search Tool	60
Figure 6-7: Heat Map Result from Searching “Thanksgiving”	61

List of Tables

Table 3-1: Functional Requirements.....	34
Table 3-2: Non-Functional Requirements	35
Table 3-3: Project Timeline	39
Table 5-1: Maximum Field Values in Table.....	51
Table 5-2: Summary of Relationship Class	52
Table 5-3: Technologies Behind the Web Application.....	55
Table 5-4: Technologies Behind the Twitter Search Tool.....	59
Table 6-1: Accuracy of Geolocation Methods.....	71

List of Acronyms and Definitions

ACLB	Arts Council for Long Beach
API	Application Programming Interface
CSS	Cascading Style Sheets
GUI	Graphical User Interface
HTML	HyperText Markup Language
IIS	Internet Information Services
NEA	National Endowment for the Arts
VGI	Volunteered Geographic Information

Chapter 1 – Introduction

This project assisted the Arts Council for Long Beach in developing two ways to track the success of its A LOT Initiative, a project that looks at the issue of vacant urban lots in the city of Long Beach. This chapter provides a broad overview of the project by introducing the client and stating the problem, as well as the solution to it. The solution is broken down into specific categories such as the goals and objectives, the scope, and the methods needed for completion of the project. Finally, this chapter introduces the audience this report is addressed to.

1.1 Client

The client for this project was the Arts Council for Long Beach (ACLB), a non-profit organization based in Long Beach, California. The ACLB's mission is the support of artists, as well as the promotion of the arts in local communities. The ACLB is recognized by numerous departments of the city, and it has strong ties to these departments, as well as to diverse corporations, foundations, and members of the Long Beach community. Dr. Marco Schindelmann and Shay Thornton were the main contact people who contributed to the successful completion of this project. Dr. Schindelmann helped defining the functionalities and the design of the application and Mrs. Thornton provided the necessary contacts at the ACLB who helped with the technicalities when developing the application.

1.2 Problem Statement

The ACLB was engaged in a project, the A LOT Initiative. The A LOT Initiative is an attempt to find a solution to the broader issue of empty urban lots in the city of Long Beach. Figure 1-1 shows a typical empty lot.

Figure 1-1: Empty Lot

Three specific empty lots in the city were identified to host events (e.g., concert, theater, comedy) that would attract a wide variety of visitors, ideally stimulating interactions among the visitors and, in the long term, improving conditions in the neighborhood (e.g., reduced crime rates, redevelopment). The project was supported by a \$150,000 grant from the National Endowment for the Arts (NEA), a grant which only nine cities across the United States had received in 2012. Because of the importance of receiving the grant, the ACLB needed an effective way to track the success of the A LOT Initiative. It was crucial that the effects of the A LOT Initiative could be evaluated so the ACLB could draw conclusions for future projects.

1.3 Proposed Solution

To track the effects of the A LOT Initiative, this project proposed two tools. First, an interactive web GIS application to provide the public an opportunity to express its opinion about specific events and submit or retrieve information from a variety of sources, such as YouTube, the press, or blogs. Second, a tool that queries Twitter databases based upon specific keywords and then maps out the resulting tweets. The number of tweets regarding a specific event was used as an indication of the event's impact.

1.3.1 Goals and Objectives

The main goal of this project was to find a way for the ACLB to apply GIS to evaluate the A LOT Initiative. To achieve this goal, an interactive web application that lets users submit and retrieve information about the A LOT Initiative was proposed. More specifically, users could post feedback about the A LOT Initiative so the ACLB would have information that can be analyzed and used in further decision making. In addition to the public application, a tool that searches Twitter databases was proposed. The tool should detect what visitors of an event were saying regarding the event.

1.3.2 Scope

This project had a three-tiered scope: geographic, temporal, and technological. Geographically, this project was confined to the city of Long Beach, California (Figure 1.1). Although the three parcels in the ACLB's A LOT Initiative take up a minimal geographic area, their implications can potentially be felt across the city, so the entire city was considered in the analysis. The temporal scope refers to the time span that the web application will be used. The A LOT Initiative is a two-year project which started in September 2013, requiring that the developed application be running until September 2015. Technologically, the main deliverable of this project was restricted to the online environment. Users will, in most cases, only come in contact with the application and its results via the internet. Although the datasets are stored in a database hosted on a server, most users will not ever see that. The second part of the technological scope was that users become an interactive part of the project, meaning that users can input information regarding ACLB-supported events. The technological scope of the second deliverable was desktop-based. The tool can only be run by the ACLB and its results are not meant to be shared in the online application.

Figure 1-2: Map of Study Area and A LOT Initiative Lots

1.3.3 Methods

The application provides ways for users to submit information about A LOT Initiative events. Information that can be submitted are personal reviews and ratings, links to blogs, links to newspaper articles, and links to YouTube videos. These pieces of information were written to an esri multiuser geodatabase, with each piece pertaining to a specific parcel and performance. After the information was written to the database, users were able to retrieve that information using predefined queries. The second part of the analysis uses Twitter to geolocate tweets specific to an A LOT Initiative event. Searching keywords and specifying a temporal scale detects relevant tweets. If available, the locations of these tweets can be mapped and used in a kernel density analysis. This provides a way to quickly visualize patterns and shows which areas of the city are most influenced by performances. JavaScript was used for all of the coding behind the web application and Python was used to develop the Twitter tool.

1.4 Audience

This report was written mainly to help the ACLB understand the technology behind the application, as well as to explore research areas that might be helpful in future projects. However, anyone who uses the website might potentially be interested in reading this document. Therefore this document is addressed to city departments, city officials from other cities, users of the application, or anyone who is curious if the A LOT Initiative has had an effect on the empty lot issue. The report is also addressed to software and web developers who might be interested in creating similar applications.

1.5 Overview of the Rest of this Report

The rest of this report provides the reader with additional information about the project. Chapter Two presents the literature review that lead to the decisions that were undertaken to build the application, Chapter Three elaborates on the design of the system, and Chapter Four explains the design of the database. Chapter Five shows how the elements from previous chapters have been used to build the actual applications. Chapter Six lays out a scenario, showing how a typical user would use the applications. The last chapter concludes this project and suggests what could have been done differently or what can be added to it in the future.

Chapter 2 – Background and Literature Review

This section presents the academic research that was important in understanding the issue of this project. This chapter is divided into three parts, each part belonging to a specific topic. Section 2.1 defines empty lots and presents the issue of empty lots in American cities, Section 2.2 shows how the arts can be used in urban revitalization, and Section 2.3 elaborates on the technologies and the movements whose understanding was essential when building the application.

2.1 Vacant Land

The main factor driving the A LOT Initiative is the empty lot issue, which has affected many cities across the United States. The following subsections will differentiate the two main categories of empty lots – previously undeveloped and previously developed lots – and then elaborate on the issue of vacant land in American cities.

2.1.1 Previously Undeveloped Land

Northam (1971) distinguished five types of vacant urban land: remnant parcels, parcels held for speculation, tracts, corporate reserves, and institutional reserves. This project focused on remnant parcels and parcels held for speculation. Remnant parcels are generally defined to be between a few hundred to a few thousand square feet in size, and characterized by an often irregular shape. Because of their inconvenient shape as well as their limited size, such parcels are often not favored for development and remain empty over time. Parcels held for speculation are parcels that will not be developed until the owner sees a clear benefit in doing so (e.g., the surroundings become popular). Northam emphasized that vacant parcels were parcels that have never been developed.

2.1.2 Previously Developed Land

One type of vacant urban land, greyfields, is often cited in urban planning literature. Greyfields, as coined in 1998 by the Congress for the New Urbanism, a non-profit organization, “can be used to describe any redevelopment project that is not significantly contaminated” (McKay, 2007, p.2). Although the term is usually used to describe larger areas, such as parcels occupied by shopping malls, it is also used to describe smaller parcels of land, such as a parcel that was occupied by a neighborhood store which has closed.

The broken windows theory, as laid out by Kelling and Wilson (1982), emphasizes that certain factors – such as the condition of a building – greatly influence citizen behavior and crime rates. Figure 2-2 is an example of an abandoned building that has not been taken care of and is likely to make the passerby feel uneasy. In the long term, such buildings could increase crime rates, especially if the number of similar buildings multiplies in a neighborhood. The A LOT Initiative is an attempt to have neighborhoods come together. Over time this interaction can stimulate people to invest into their neighborhoods (e.g., repainting facades and planting flowers in front yards) and change their neighborhood’s appearance.

Figure 2-1: Abandoned Store Front

2.1.3 The Issue of Vacant Land in America Cities

Pagano and Bowman (2000) found that on average 15% of land in American cities was considered vacant. These findings, however, should be considered with care as they only surveyed 70 cities. Kunstler (2008) cited the American system of property taxes as the main reason why there was an abundance of vacant lots in most American cities. Buildings are taxed more heavily than the land that they are built upon, meaning that a piece of land does not become expensive until a building has been built on it. This leads to the fact that land is often held in speculation. Economically it is cheaper to build on the outskirts of a city rather than to develop existing land in the center of a city, leading to the decay of city centers while at the same time increasing urban sprawl. Kunstler suggested alternative ways that could potentially reverse the issue. One of them was the option that land should be taxed much heavier. Others argue that developing infill can confront many of a city's problems, including neighborhood revitalization (Steinacker, 2003).

2.2 Cultural Projects as Revitalization

Through different approaches artists were able to turn dilapidated areas into flourishing places that attracted investors (Stanziola, 1999). Strom (2002) argues that cultural projects had become a popular way of revitalizing urban areas. Ideally, cultural projects benefit the city by creating jobs and revenue, and by putting a city or a neighborhood back on the map. One major benefit of cultural developments is that they are often driven by non-profit organizations and therefore draw little or no opposition, as opposed to large scale projects undertaken by the city and relying on the taxpayer's money. Small organizations were viewed as more efficient and less expensive than the public sector and

they had progressively gained influence in urban decision-making (Elwood & Leitner, 2003). Strom also noted that measuring the success of revitalization projects usually became complicated as it was hard to pin down exact variables. Most notably, determining what terms like “impact” and “community” mean was commonly cited as the root of the problem (Guetzkow, 2002).

Markusen and Gadwa (2010) concluded that the use of arts in planning was often hindered by unclear goals, little input from the public, or the omission of project evaluation. Furthermore, their study suggested that higher equity could be obtained by using certain methods, such as surveys, to determine which piece of art or performance went into which neighborhood. To avoid these two common issues, the ACLB suggested an interactive web application to track the success of their A LOT Initiative. The web application would allow the ACLB to see if the A LOT Initiative is a success among the public.

2.3 Volunteered GIS

The reason the application could be built and how it accepts user input goes back to two concepts: Web 2.0 and volunteered geographic information. Both phenomena have led to the success of many well-known websites.

2.3.1 Web 2.0

As pointed out by Fu and Sun (2011), Web 2.0 enabled users to interact with a website in a way that they can submit their own content, which is different from Web 1.0 that provided exclusively read-only content. The term Web 2.0 was coined by Darcy DiNucci in 1999, but it has since become associated with the O'Reilly Media Web 2.0 Conference, which took place in San Francisco in October 2004 (O'Reilly, 2007). Many influential websites are a result of Web 2.0. For instance, reviews on Amazon, articles on Wikipedia, or products on eBay are all provided by people who were not initially engaged in designing the respective websites. Web 2.0 is also the underlying process that drives the web application developed for the A LOT Initiative. The application is entirely dependent on users who collect data and submit data to the website.

2.3.2 Public Participation GIS and Volunteered Geographic Information

Siebert (2006) pointed out that technological inventions and movements could greatly engage the public in decision-making. GIS, like previous inventions such as rural electrification and telephony, has played an important role in connecting the general citizen to those who decide the future of communities. Although GIS is sometimes considered another tool for the powerful to gain more control, and some would go as far as calling it elitist and antidemocratic, it cannot be denied that GIS has opened many doors to the public (Peng, 2001). Carver and others (2001) pointed out two important aspects of web-based participation: the fact that meetings do not have to be tied to a strict geographic location, and the fact that meetings can be joined at any time during the day. Whereas a typical town hall meeting would take place at a specific location and a specific time, most likely disabling a portion of the public to attend, the internet eliminates these concerns. Peng (2001) added that traditional town hall meetings were often dominated by

individuals who had extreme views and strive towards getting their views accepted and implemented. All in all, web-based participation has become an important player in modern urban planning and decision-making.

With the inclusion of GIS in these processes, the term Public Participation GIS, most often referred to as PPGIS, was coined in 1996 at various meetings of the National Center for Geographic Information and Analysis (Sieber, 2006). Whereas the beginning years of PPGIS focused on developing software, hardware, and training manuals, and were aimed towards people with advanced technical skills, the field has moved towards simpler solutions requiring the understanding of only basic concepts of geographic information sciences (Peng, 2001). Goodchild (2007) used the term volunteered geographic information (VGI) to describe this movement that lets people with little to no qualifications in mapping or geographic information sciences collect and distribute data. Tasks that for centuries had been reserved to official agencies can now be accomplished by average citizens. Goodchild pointed out the usefulness of VGI as it is an effective way to create data for places where it is scarce. For instance, he described the example of cities that had been lacking digital maps until the rise of VGI. Specific websites or projects, such as WikiMapia and OpenStreetMap, are entirely dependent on VGI. Their datasets are frequented by millions of users each day. Although the quality can vary, since VGI is majorly driven by people with no formal background, it can be said that most of the datasets are appropriate and qualitatively sufficient if high precision or accuracy is not required. This project relies on VGI because data will not be collected by the ACLB; all of the data is provided by public who finds an interest in feeding the application with useful information.

2.4 Summary

This chapter showed that most American cities have vacant lot issues and that there is no clear consensus about what works to revitalize urban spaces. One school of thought suggests that art could be the solution to many urban problems, which is the underlying assumption of the ACLB's A LOT Initiative. The web application that supports the ACLB in tracking the success of its project is dependent on user-created data, which is made possible by the concepts of Web 2.0 and VGI.

Chapter 3 – Systems Analysis and Design

This chapter introduces the major components of the final products. Section 3.1 provides a brief overview of the problem, followed by the requirements analysis which describes the main components of the online application and the Twitter Search tool, as well as the software needed for developing these tools. Section 3.3 presents the system's design, an explanation of the physical components of the application, and the tool. Finally, Section 3.4 reviews the project plan, a timeline that was used to complete the different parts of this project on time.

3.1 Problem Statement

The ACLB is conducting a project called the A LOT Initiative, which is attempting to look at the issue of vacant urban lots. The ACLB organized events in three empty lots throughout Long Beach, but lacked a way to evaluate the effects of these events. It is essential that the effects of the A LOT Initiative are evaluated so that the ACLB can learn how to improve future events.

3.2 Requirements Analysis

While doing research and defining the method, certain requirements were considered necessary for the successful completion of this project. There are two kinds of requirements: functional and non-functional. The former are the essential components and functions of the deliverables, and the latter are the technologies necessary for using the application and the tool.

3.2.1 Functional Requirements

Eight functional requirements were defined in this project. All of these requirements, listed in Table 3-1, describe the necessary components of the final application and tool.

Table 3-1: Functional Requirements

Web Application	
Requirement	Description
Basemap selection	Lets users change basemaps (imagery, street network)
Geocoding	Lets users enter an address and finds it on the map
User Locator	Zooms users to their position
Zoom to Parcel	Centers map around a parcel
Schedule	A calendar which displays performances per parcel
Query Parcel Information	Shows information of each parcel
User Feedback Collection	Lets users submit information (YouTube links, links to blogs, links to press reviews, personal reviews, and ratings) to tables in the database

Twitter Search Tool	
Requirement	Description
Input Fields	Lets the user specify parameters to run a search

The interactive web map is the main component that a user sees and uses to interact with the data. The map includes standard functionalities, such as panning and zooming. On the map a user can choose from two different esri basemaps: Topo and Imagery. It also includes geocoding functionality; when a user types in an address, it finds the location and zooms the map to that location. To help users position themselves on the map, locate functionality was developed. It will position the map according to the location of a user's device. The Zoom to Parcel widget centers the map and zooms to the desired parcel. Schedules are used to inform users about the A LOT Initiative events taking place. The schedules are directly connected to a server, so live updates can be undertaken. When a parcel in the calendar is clicked, the map centers around that parcel. Three interactive parcels, hosted as a feature service, provide an interface for users to interact with the database. Each parcel is related to a table containing information about events. A user has the option to submit or retrieve information for parcels and events.

3.2.2 Non-Functional Requirements

Non-functional requirements describe technological elements that are necessary to guarantee the optimal development and functioning of the final application. Five non-functional requirements were defined for this project as listed in Table 3-2.

Table 3-2: Non-Functional Requirements

Requirement	Description
ArcSDE geodatabase	Geodatabase that allows multiple users and editing in the online environment
ArcGIS 10.1	The software used to prepare data before publishing
ArcGIS for Server	Allows the data to be published
IIS	The Microsoft web server which hosts the web services
Windows 7 or later	A Windows operating system is required to run esri products

All of the data that were used in this project were stored in an esri ArcSDE geodatabase with a multiuser configuration. ArcSDE allows the geodatabase to be set up in a way that multiple users can write to it at the same time. This was an essential factor in this project, as it is likely that multiple users will enter data at the same time. To connect the datasets to the online application and to publish them to a server, ArcGIS for Server was necessary. Datasets were prepared in ArcMap and ArcCatalog, and then were published as feature services, a type of web service that allows editing. To install and run these esri components, a current Windows operating system was needed. The published datasets were hosted by Microsoft's web server, IIS (Internet Information Services).

3.3 System Design

Three major components – a database, a web server, and the user – had to be considered to develop the web application that was delivered to the client (Figure 3-1). These three components are linked to each other, and the correct functioning of the final product depends on their interaction. The web application, hosted on a server, was developed with the ArcGIS application programming interface (API) for JavaScript, using different languages and libraries, including HTML, CSS, JavaScript, Dojo Toolkit, and jQuery. The basemaps in the project were from ArcGIS Online, and all of the operational layers were stored in an esri ArcSDE geodatabase with a multi-user configuration. The information written to the operational layers was also stored in the same geodatabase. All of the operational layers from the geodatabase were published as a feature service via ArcGIS for Server and can be accessed through a REST service endpoint. Using the application, a user automatically connects to the server and the database.

Figure 3-1: System Design

3.3.1 Geodatabase

All of the data consumed by the application reside in a database. Esri offers three types of geodatabases: file, personal, and ArcSDE.

ArcSDE offers crucial features that need to be considered when communicating with an online application. Most importantly, it is the only type of database that allows editing of features or tables when connected to a web application. The two other types of databases can be used to publish data but will not allow users to change the data in any way. The second important capability is the multiuser configuration. ArcSDE allows multiple users to write to and retrieve from a database. This feature is essential when connecting to a web application because it is likely that multiple users will write to the same table at the same time. Instead of creating schema locks (locking tables because two users are trying to edit them at the same time) and potentially crashing the application, ArcSDE handles such scenarios efficiently.

3.3.2 Services

The datasets stored in the ArcSDE geodatabase were published to a web server. When publishing data through ArcGIS, different kinds of services can be created. In this project, two kinds of services were created. Any published document automatically adds a map service to a REST Services Directory; depending on which options are checked when publishing, more services can be added to the directory. A map service can be used in various desktop and web applications but its functionality is limited. Since the application was intended to allow editing, it was important that the services were also

published as a feature service, which is the only type of service that allows editing over the Internet.

3.3.3 Web Application

The web application was designed to be used primarily in Firefox. Although its look and functionality are similar to most common browsers, it will produce optimal results in Firefox. The ArcGIS API for JavaScript was chosen to develop the application because of its popularity and cross-platform characteristics. Unlike other APIs, such as those for Silverlight or Flex, it does not require any client-side plugins. Since the application would potentially reach a great number of people, it was recommended that it would be best if it ran without installing any plugins. Because the application uses several different widgets and functions, no template was readily available. It was decided to build the application from scratch, using syntax and templates from the API reference and documentation pages as guidance.

3.3.4 Twitter Search Tool

The Twitter Search tool was developed using Python and the Twitter Search API. Two libraries – ArcPy and TwitterSearch – were used. Esri’s ArcPy provides ArcGIS geoprocessing functionality to be used with Python, and TwitterSearch is an open-source library that enables the use of the Twitter Search API in Python.

3.4 Project Plan

A project plan provided a timeline of the different tasks and when they were supposed to be accomplished. The following Gantt chart shows when tasks were accomplished in 2013 (Table 3-3).

Table 3-3: Project Timeline

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.
Acquire domain											
Acquire data											
Client meeting											
Create data											
Build deliverables											
Test											
Go public											

This project started in February, 2013, with the acquisition of a domain name by the ACLB. The A LOT Initiative website was developed after the domain name was acquired, and it was online several months before the GIS application was embedded. The basic datasets, such as the parcel data for Long Beach, were obtained from the City of Long Beach between March and May, although some of the data were created in September. It became obvious that the A LOT Initiative parcels did not entirely coincide with the official tax assessor’s parcels provided by the City of Long Beach. Therefore,

the three parcels were digitized, making sure that the boundaries matched those determined by the ACLB. Crucial to the development of the project was a client meeting at the ACLB headquarters on June 13, 2013, where everyone involved in the A LOT Initiative gathered and discussed ideas to design the web application. The web application and the Twitter Search tool were built in September and October, and testing occurred during the development, as well as in November.

3.5 Summary

This chapter described the steps that were undertaken to define what was necessary to design the final products. A requirements analysis – defining the functional and non-functional steps needed to build the application – was essential to the successful completion of this project. The requirements are the basis of the system design, which defines how the major components fit together. The following chapter elaborates on the database behind the deliverables, followed by a chapter which lays out in detail how the deliverables were built.

Chapter 4 – Database Design

This chapter presents the database that was used in this project. The database was designed to hold geographic and tabular files from the A LOT Initiative, and it was connected to both the web application and the Twitter Search tool.

Section 4.1 portrays the conceptual model. The logical model, a demonstration of each feature, field, and data type in the database, is laid out in Section 4.2. Section 4.3 discusses the data sources, and Section 4.4 explains how datasets were altered to be used in the final application.

4.1 Conceptual Data Model

The conceptual model is meant to give a broad overview of how the key elements of a project are connected (Figure 4-1). It does not provide explicit detail about files in a database, and it is designed to guide the thinking that leads to database creation.

Figure 4-1: Conceptual Model

Three main entities were considered in this project: lots, events, and people. A lot is a place where an A LOT Initiative event takes place. Each lot had a known geographic location, and therefore lots were the only inherently spatial entities in this project. Event is an overarching term to describe three categories: performance, visual, and engagement. Performances were concerts or dances, visual was used to describe the displaying of art, and engagement indicated community programs. Events were temporal: they happened at a specific point in time. An event was not spatial by itself, but because it took place in

a lot, it could be tied to a geographic location. The person was the component of the model that was used to describe someone who went to or wrote about events. A person was non-spatial in this project as its location was unknown or irrelevant. The purpose of this project was to evaluate the A LOT Initiative, and it was decided to accomplish that task by collecting feedback about events. In this model, that feedback is listed as comments. Each comment was posted or collected at a specific time, but depending on the source it could be spatial or non-spatial. For the purpose of this project a comment was what connected a person to an event. It has to be noted that this project did not keep track of people attending events, nor did it require event attendance: this project was meant to collect information about events, independent of whether the source of the information went to an event.

4.2 Logical Data Model

The logical data model presents the files that were stored in the database to implement the conceptual model. The logical model in Figure 4-2 was used to create the database in this project. It shows the files that were both used and generated.

Figure 4-2: Logical Data Model

This project used parcel boundaries only for reference, and all of the relevant information the user should see was stored in a table. Because of expected complications, the attribute tables were normalized to an extent that they did not have any information about A LOT Initiative events. Storing all of the information submitted by users in the same feature class would have created unreasonably long fields in the attribute table, slowing down retrieval of information and complicating the display of it. Considering that fields have to be defined with a specific length, it would also have led to the fact that fields would have run out of space at some point, making the application useless. Therefore it was decided to store all the user input in a table which would be related to the parcels, using a relationship class. The exact steps accomplished to create a relationship class are mentioned in Section 5.1. To capture people's comments about events, two approaches were used. The first approach allowed users to submit information to a table, and the second approach used Twitter to detect what people were saying about events.

This logical model distinguishes between three types of files: outside, temporary, and permanent. Outside files were files that were used in the web application, but never stored in the ACLB's database. Temporary files were created and used to derive final outputs. These files were automatically deleted and they were meant to be never seen by a user. Permanent files were either stored in the database from the beginning, or created when running the Twitter Search tool. These files were essential and they were not meant to be deleted at any point.

The bottom part of the logical model shows detail about the most important files that were essential when translating the conceptual model into reality. The lots were represented using parcel polygons. The events were stored in tables that were displayed as schedules. The comments that link people to events were stored in two separate files. First, a table holding user-entered information about events. Second, a table holding tweets was created each time the ACLB ran the Twitter Search tool. Running the tool also added a new record containing the summary of each search (e.g., number of returned tweets) to the existing Tweet Summary table.

4.3 Data Sources

Data for this project came from two sources. First, a list of A LOT Initiative events was provided by the ACLB in Excel format. Second, all geographic datasets came from the City of Long Beach. The City provided specific datasets for download on its website (Figure 4-3). Assessor parcels were downloaded for this project. Any other datasets that are consumed by the API, but not stored in the database, such as a geocoding service or basemaps, were provided by esri.

GIS Data Catalog		
name	preview	download
Assessor Parcels (posted 9/2013)
Bikeways (posted 9/2013)
Building Roofprints (posted 9/2013)
Centerlines (posted 9/2013)
City Boundary (posted 6/2013)
Council District (posted 7/2012)
Enterprise Zone (posted 7/2011)
Flood Zones (posted 6/2013)
General Plan (posted 11/2012)
Hardscape Lines (posted 9/2013)
Parks (posted 9/2013)
Police Reporting Districts (posted 9/2013)
Schools (posted 9/2013)
Survey Monuments (posted 8/2013)
Waterways (posted 2/2012)
Zoning (posted 9/2013)

Figure 4-3: City of Long Beach GIS Data Catalog

4.4 Data Collection Methods

The assessor parcel datasets that are officially available from the City of Long Beach, and created for tax assessment purposes, were not optimally suited for this project. Although the parcels might have been accurate, they did not line up with the imagery that was used in this project. In the web application, the assessor parcels would potentially look confusing or inaccurate to the user when viewed with the basemaps. Figure 4-4 shows how the assessor parcel boundaries from the North Lot do not entirely coincide with the boundaries on the aerial imagery. The red rectangle indicates a gap between the assessor parcel and the adjacent sidewalk. The other two parcels had similar inconsistencies.

Figure 4-4: Inconsistencies between Imagery and Parcels

To avoid these issues, and because the underlying aerial imagery cannot be moved or changed, the final boundaries were digitized on screen from the ArcGIS Online Imagery basemap, using the assessor parcels for reference only. The basemap was also used in the final application.

4.5 Data Loading

All of the datasets that were created or generated in this project were stored in an ArcSDE geodatabase. In addition to these files, the database also held the relationship class that linked the geographic and tabular datasets. More detail about these steps is provided in Chapter 5.

4.6 Summary

This chapter described the database that was used in this project as well as the logic that went into developing the database. Both the conceptual and the logical data models were used to specify the initial and final schema of the database. The chapter also explained how datasets from different sources were altered to fit the final application.

Chapter 5 – Implementation

This chapter explains how the final product was built. Section 5.1 describes the database and how it was configured. Section 5.2 discusses publishing the datasets to the online environment, and Section 5.3 talks about how the final application was developed.

5.1 Configuring the Database

A database is one of the main parts of a GIS application because it holds all of the data that will be consumed by the application. In this project, an esri geodatabase with SDE technology was used.

Because the final application is required to allow user editing, a special type of database that enables editing capabilities in the online environment had to be used. Of all the different types of geodatabases offered by esri, only one fits these requirements: ArcSDE. ArcSDE is a multiuser database, which allows the editing of records by multiple users at the same time. Multiuser functionality is essential when building a web application that allows editing, because it is common that more than one user will access and attempt to alter the data at the same time. To keep the ArcSDE database clean, the original datasets were prepared in a file geodatabase. It helped testing options and at the same time avoided introducing errors into the final database. Once the datasets were ready, they were exported to the ArcSDE database (Figure 5-1).

Figure 5-1: Initial and Final Database

All three parcels from this project were stored in the same feature class. The attribute table of the feature class was kept simple, with only the two required fields (FID and Geometry) and one additional field: Address. The Address field was added so that a user would be able to see the address when interacting with the web application. Field lengths in the feature class attribute table and other tables were allocated based on the expected maximum values a user would submit, as shown in Table 5-1. For instance, the Location field was kept to a length of eight characters because the longest parcel name in this project, Downtown, has eight characters. All fields for web links were kept to a maximum length of 150 characters, as that was considered a reasonable length for a web URL (Uniform Resource Locator). Long URL links that would slow down the web application are thereby automatically rejected. The Review field was kept to 250 characters because that gives a user enough space to say something substantial, yet brief.

Table 5-1: Maximum Field Values in Table

Field	Longest expected value	Characters
Lot	Downtown	8
Event	Long Beach Playhouse	20
Date	September 2+	12
links		150
Review		250

Because adding all of the user input to existing fields in the parcel feature class is inefficient, this project used relationship classes to solve the issue. A relationship class is a way to link geographic and tabular datasets and is determined at the geodatabase level. It is especially useful in relationships that have a cardinality other than one-to-one. An example of such a situation would be a state that has many counties. Instead of storing each county name in one field in the state's attribute table, it is much more efficient to store county names in tabular format and then link that table to the state feature. In this project one parcel hosts many events but each event only happens on one parcel, which establishes a one-to-many relationship. Using a relationship class is the ideal way to link the tabular information about events to the parcel feature. To set up a relationship class, it is essential to define a primary key in both the feature class and the table. A primary key is a value that uniquely identifies a specific record in a database. In this case the location was chosen as the primary key because this field is unique and exists in both datasets (Figure 5-2). Establishing a relationship class, therefore, makes it possible to click a parcel with a location and fetch all records from tables that are associated with that parcel.

Figure 5-2: Choosing a Primary Key

Besides defining the primary key, it is also vital to specify the origin and destination datasets, the type of relationship, and the cardinality. Table 5-2 summarizes which parameters were chosen to create the relationship between the parcels and the respective tables.

Table 5-2: Summary of Relationship Class

Origin:	Parcel feature class The feature that is used to trigger actions
Destination:	Table The table that will be retrieved or changed
Type of relationship:	Simple They are not dependent. If either one is deleted the other one will not cease to exist
Primary Key:	The parcel location The field that is used to link up both datasets
Cardinality:	1:M One-to-many: one parcel can link to many records in the attribute table, but each record is only linked to one parcel

5.2 Publishing Services

Consuming datasets that reside in a geodatabase first requires publishing these datasets as web services. ArcGIS for Server provides publishing functionality. To publish services, the datasets first had to be brought into ArcMap 10.1. For optimal results and efficient publishing, certain considerations had to be taken into account. It was very important that all basemaps were turned off by the time of publishing and transparency had to be removed from all layers. Once the files had been added and formatted and the map document was saved, it was ready for publishing. Esri offers two sharing methods: sharing as a Map Package, and sharing as a Service. In this case the datasets were shared as a service. When published, descriptions of services can be accessed from the REST Services Directory (Figure 5-3).

Figure: 5-3: The ArcGIS Rest Services Directory

As laid out in Section 3.3.2, the data had to be shared as a feature service because the datasets were used for editing. It was essential that the Feature Access option was checked before publishing the service. This option enables editing to the respective dataset that is consumed by a web application. Checking the option in the Service Editor unlocks a new interface which provides more control over which editing capabilities the service can be engaged in. Because ArcGIS for Server creates a map service by default, two services can be found in the REST Services Directory although only the feature service was used in the application. The published datasets were also registered as versioned, which enables them to be changed client-side after they have been published.

5.3 Developing the Web Application

The core of this project was the development of a user-friendly and appealing web application that can be used by anyone who is interested in the ACLB's A LOT Initiative. The following subsections discuss which languages and toolkits were used for coding, which style of coding was used, and what functionality was added to the application.

5.3.1 Technologies Used

Building the application relied on an API, coding languages, and two open-source libraries to facilitate coding. All of the GIS functionality was provided by the ArcGIS API for JavaScript by esri. HyperText Markup Language (HTML) was used as the

markup language when building the website. Styling and certain effects were accomplished with Cascading Style Sheets (CSS), and interactivity was provided by JavaScript. The ArcGIS API provides the Dojo Toolkit, an open-source library which simplifies common JavaScript tasks. This project used the Dojo Toolkit to define the very basic division of the main page into three parts, also known as content panes. The table that displays query results, and the interactive Accordion Pane on the left side of the webpage, were also built using Dojo. A second open-source library, jQuery, was imported from Google. jQuery was used to simplify mouse events, as well as the movement of certain elements on the page, such as the parcel selection dropdown menu. Table 5-3 summarizes the languages, the API and the libraries, as well as their respective versions.

Table 5-3: Technologies Behind the Web Application

Languages
Markup: HTML
Styling: CSS
Programming: JavaScript
Application Programming Interface
ArcGIS API for JavaScript 3.7
Open-Source Libraries
Dojo Toolkit 1.9
jQuery 1.10.2

5.3.2 Asynchronous Module Definition

The entire application was built using Asynchronous Module Definition, also known as AMD. AMD is a modern way of coding in JavaScript that loads modules asynchronously by default. That means multiple modules can be loaded at the same time, which was not the case in previous ways of coding, which were characterized by longer loading times. Esri recently switched from Legacy mode to AMD, most notably because Dojo, one of the major libraries the ArcGIS for JavaScript API relies on, will stop supporting Legacy code with its next version. The release of the next version is scheduled for early 2014. Using AMD in this project was useful because the version of Dojo could be replaced in 2014 by not requiring further translations. AMD first loads a module and then assigns it to an element in a callback function. Each element can then be used in the script.

5.3.3 Application Interface

Fu and others (2011, p. 45) defined user experience as the “level of satisfaction a person gets from using a product or a service” and stated that web applications should be “fast, easy, and fun to use.” That approach guided the design and interface of this web application. Figure 5-4 shows a sketch of the GUI (graphical user interface) which was used to guide the development of the web application.

Figure 5-4: Graphical User Interface of Web Application

Most users have limited technological background and their attention needs to be caught immediately via an easy-to-use interface. Therefore, the user interface was designed so that operations are easily recognizable by anyone who has used a major web GIS before, such as Google Maps.

The map was centered on Long Beach. The coordinates were obtained by calculating the centroid of the city boundary in ArcGIS 10.1. The Topo basemap from esri was chosen as the default basemap for this project. Although the map's name indicates a scientific purpose, it is a hybrid of a topographic map and a street map; streets show up when zoomed to large scales. This map was chosen because it looks appealing yet provides all the necessary details a user needs to see. A regular street map would appear too busy for this application's purpose. Because many users are used to seeing satellite imagery as well, a Change Basemap button was added which lets the user toggle between satellite imagery and the Topo map.

Users can search addresses within Long Beach using the Geolocator widget. To simplify the use of the tool, it was programmed to automatically add 'Long Beach, CA' to any user input and display a list of closest matching addresses. Although different geocoders can be used, the standard esri World Geocoder was chosen because it is compatible with esri's ArcGIS products.

The Zoom button lets the user zoom in or out of an area, although that can also be done using the mouse wheel or the touchscreen of a smartphone. The Locator button asks

users if they want to share their locations; if yes, the map will zoom to that location. This function is targeted toward users who will use the application on a mobile device and who might be attempting to find their way to a specific parcel that may not have an address in any address database since the lot is undeveloped. The Zoom to Parcel dropdown menu lets a user zoom to one of the three parcels hosting events. The choice of parcels only shows up when hovering the cursor over the label.

The schedule of the A LOT Initiative was added to the page so a user does not have to keep switching between the application and the A LOT Initiative website. Expanding the schedule of a specific parcel displays a list of events and centers the map around that parcel.

The table that was related to the parcels using a relationship class can be displayed when using the Query Database tab in the accordion pane. The pane offers different ways to query the table. A user can either chose one of the three parcels using a radio button, or can chose a performance using a dropdown menu. The returned information is displayed in a table on the bottom of the page. To enter new information about events, a user can refer to the Submit Information tab in the accordion pane. The tab guides a user through the input process by offering dropdown menus and input boxes.

5.4 Developing the Twitter Search Tool

The Twitter Search tool was developed to be used by the client only. Its purpose is to search Twitter databases based upon specific parameters. The returned results are written to a database in tabular and in geographic forms. The table holds the contents of all the tweets that were returned by a search, and the geographic files show available tweets' locations and a heat map.

5.4.1 Technologies Used

Python was used to develop the Twitter Search Tool. Among the different languages that can interact with the Twitter API, Python was chosen because it can be integrated into the ArcGIS environment. Python can not only be used to search Twitter databases but it can also be used to write to a geodatabase and create geographic features. ArcPy from esri was used to programmatically incorporate ArcGIS functionality in Python. TwitterSearch, an open-source Python library provided by the Technische Universität München, was used to access the Twitter Search API. The library simplifies tasks to connect to Twitter. Table 5-4 summarizes the technologies behind the tool.

Table 5-4: Technologies Behind the Twitter Search Tool

Languages
Python
Application Programming Interface
Twitter Search API v 1.1
Libraries
ArcPy
TwitterSearch

5.4.2 Limitations of the Twitter Search API

Twitter allows programmers to retrieve information using the API, but it has to be pointed out that it is not possible to search the entirety of Twitter using the API. To avoid overburdening servers Twitter has restricted what users can query, and therefore programmatically retrieving information from Twitter differs in many ways from a manual search.

Connecting to Twitter requires authentication. Tokens and keys to connect to Twitter can be obtained from the Twitter Developers site by creating a new application. When an application is run these tokens and keys have to be approved in order to connect to the Twitter database. This allows Twitter to keep track of potential abuse.

Rate limiting refers to how often one can connect to Twitter servers. The Twitter Search API has 15-minute rate limiting windows, meaning that one can only connect every 15 minutes. This helps Twitter reduce traffic and avoid servers crashing.

Twitter lets programmers retrieve 100 pages of tweets, each one containing about 180 to 200 tweets. This means that the maximum number of tweets that can be returned by a search fluctuates between 18,000 and 20,000. It is also important to know that only indexed tweets can be returned by the API. Twitter reserves the right to decide which tweets are indexed. This means that a manual search on Twitter might return results that cannot be returned by the API.

Finally, the time frame of the returned information is limited. Indexed tweets are generally made available for the API the day after they have been posted, and they are removed a week after they have been made available. At any point the programmer is therefore restricted to a selection of recent tweets.

5.4.3 Development of the Tool

To extract and map out relevant tweets from the Twitter database, multiple steps had to be accomplished. These steps are laid out in Figure 5-5 and are explained in the following paragraphs.

Figure 5-5: Flowchart of the Twitter Search Tool

The first step in developing an application using the Twitter Search API is creating a Twitter Developer account. The account offers different options, such as creating a new application. Creating a new application generates tokens and keys that have to be used to connect to the Twitter Search API. The tokens and keys are unique to each application and they are used by Twitter to limit the developer's behavior and become aware of potential abuse. A search order was set up to define the parameters to pass to the query that ultimately connected to Twitter. The search order included statements to search for keywords, hashtags, a page count, and a search date. The tool allows users to set all of these parameters, so the query that is sent to Twitter can be customized.

After setting up the search order, it was important to define what is returned by Twitter. This tool returns contents of tweets, the usernames who posted the tweets, the time and date they were posted, and sometimes the geographic locations of the tweets. Because certain query results were returned in a Python dictionary format, the results

could not be directly written to a geodatabase and had to be formatted to fit the esri geodatabase schema. Coordinates, for instance, are returned in a format that cannot be understood by a geodatabase, and they also include additional information that was not useful in this project. A combination of slicing, splitting, and indexing methods were therefore used to extract only the latitude and longitude information (Figure 5-6).

Figure 5-6: Extracting Coordinates

To iterate through multiple tweets, the search order had to be incorporated into a loop. Each iteration was passed to a list, which was then plugged into an insert cursor. The insert cursor was used to write the returned information to a newly created table in the database. To visualize the geographic aspect of the returned tweets, coordinates – if available – were converted to an event layer, which was then saved as a point feature class. The feature class was used to generate a kernel density raster layer. Because providing coordinates in a tweet is optional, the script calculates the count of returned tweets and the percentage of geo-enabled tweets. This information is also recorded in the geodatabase. The tool interface was designed by importing the final script into a custom toolbox in ArcCatalog.

5.4.4 Tool Interface

The tool was programmed so that a user has control over what to query from the Twitter database. The user can define keywords to directly search the content of tweets. A keyword is defined as any string that is contained in a Tweet, including hashtags and links. It has to be noted that the more keywords and hashtags are entered, the fewer results the tool will return as the Twitter API will find tweets containing all keywords. The number of returned pages and a “search until” date can also be specified. As pointed out in Section 5.4.2 the Twitter Search API does not allow searching by random time frames. Furthermore, no beginning date, but only an end date, can be set. The user can also specify the inputs and the cell size of the kernel density raster output. The Help menu, which can be toggled, explains each input field and its limitations. Figure 5-7

shows a diagram of the tool interface.

The diagram illustrates the graphical user interface of the Twitter Search Tool. It is divided into two main sections. The left section contains a vertical list of input fields, each with a label above it: 'Keywords', 'Page Count', 'Year', 'Month', 'Day', 'Database', 'Table', 'Points', 'Kernel Density', 'Units', and 'Pixel Size'. Each label is followed by a light gray rectangular input box. At the bottom of this section are two buttons: 'Run' and 'Show/Hide Help'. The right section is a large, empty rectangular area with the word 'Help' centered within it, representing the help content that can be toggled on or off.

Figure 5-7: Graphical User Interface of Twitter Search Tool

5.5 Summary

This chapter explained how the main components of the final deliverables were set up. First, it explained how the database was designed, including database-level settings, such as relationship classes and coded value domains. After the database was ready, the datasets were shared as feature services that can be consumed by a web application. The chapter also provided a detailed explanation of the technologies and style of coding behind the web application, as well as of the functionality of the application. The second part of the chapter described the technologies, functionality, and interface of the Twitter Search tool.

Chapter 6 – Use Cases

The two deliverables of this project have different uses. The web application has three uses: basic navigation to familiarize oneself with the A LOT Initiative, submitting information to the database, and retrieving data from the database. The Twitter Search tool's main purpose is to find people who talk about A LOT Initiative events on Twitter. The resulting tweets can be viewed in tabular form. If coordinates are available, the tool also creates a point layer and a heat map.

6.1 Web Application

The web application has three main purposes. It can be used to learn about when the events of the A LOT Initiative are happening and where they are located. Or it can be used to submit or retrieve information about events. All of these functionalities can be accessed by the general public and the Arts Council for Long Beach (ACLB). The following subsections will elaborate on each feature.

6.1.1 Basic Functionality

The web application offers basic functionalities that are nowadays shared by most web GIS applications. In addition, this application also includes basic functionality that is specifically tied to the A LOT Initiative. Figure 6-1 shows the web application and the labels point out the features mentioned in this paragraph.

Figure 6-1: Elements of the Application

A user might use the application to get a good idea of the A LOT Initiative and the respective events. The accordion pane on the left side of the web page includes the event schedule for each of the three lots. A user can click on a parcel header to expand a pane showing the event names as well as the dates the events are taking place (Figure 6-2). When clicking inside the pane the map will automatically center on the respective lot.

Central Lot Schedule	
9-7	Joshua Cain Madrid J.A.M. Session - Samba Dance Party Braunstein, Parker- Jeanette, and Familian- Who's She? Cornerstone Theatre
9-28	Pony Box Dance Theatre Cambodian Cultural Performance
10-12	Patrick Williams J.A.M. Session - Hip Hop Dance Jazz Angels Long Beach Opera - Queenie Pie
10-26	P.O.P.'D Regina Klenjowski Long Beach Playhouse

Figure 6-2: The Schedule Pane for the Central Lot

If a user wants to see the location of a parcel without opening the schedule, the user can use the Zoom to Parcel button. Once zoomed in the user might want to change the basemap. If a user is vaguely familiar with the neighborhood, then satellite imagery might be more helpful than a street network. A user can use a button to toggle between the street network and the satellite imagery. The icon on the button displays the basemap type that the user can change to when clicking. For instance, if the street network is activated then the button will display a satellite image. A user can find out his or her location in relation to the parcel using the Locator button. Clicking the button will zoom to a user's location on the map. This feature uses HTML 5 Geolocation functionality to obtain the user's position. The tool triggers an interface that asks for the user's consent to share location, and the accuracy of the location is determined by the device of the user. For instance, the location is more accurate on a smartphone using GPS than on a desktop computer using Wi-Fi. Table 6-1 summarizes the accuracy of geolocation methods.

Table 6-1: Accuracy of Geolocation Methods, adapted from Duvander (2010, p. 158)

Method	Accuracy
GPS	Within feet
Wi-Fi	Within a block
Cell towers	Within a few miles
IP address	ZIP-or city-level

This feature is especially helpful when the application is used on a mobile device. The current location can then be used in a routing application to navigate to one of the parcels. If a user is interested in finding an address within Long Beach, the geocoder widget can be used. When typing, an autocomplete function will compare user input to the five closest matching addresses in the geocoding service. Because the geocoder is meant to be used exclusively in Long Beach, it will automatically add “Long Beach, CA” to any input address, which helps the autocomplete process. After zooming to the location, a marker will show up. The application also supports several types of zooming and panning: a user can use the zoom buttons, mouse, keyboard, or touchpad to zoom.

6.1.2 Submitting to the Database

A user who returns home from an A LOT Initiative event might like to share his or her opinion about the event. Another user might have stumbled upon an article or a video about an event, and decide to share it with the Arts Council. The application was primarily built for data collection purposes, and it allows users to add four pieces of information: links to news articles, links to videos, links to blogs, and personal reviews. For each piece of information, a user can specify the event name and date.

A user can access the submission dialog by clicking on the Submit Information tab in the accordion pane (Figure 6-3). To limit typographic errors and the submission of nonexistent artists, dates, and locations, users are provided with a selection of predefined values.

Submit Information

Help us evaluate A LOT Initiative events by sharing your personal **reviews** and **ratings**. Or did you find a **video**, a good news **article**, or an interesting **blog post**? If so, please share it with us.

Lot

North

Event

A LOT General

Date

September 7

Rating

3 - OK

Review

Please limit your review to 250 characters...

YouTube

http://

Press

http://

Blog

http://

Submit Information

Figure 6-3: Submit Information Dialog

6.1.3 Querying the Database

The general public or the ACLB might be interested in retrieving the submitted information. The Query Database tab in the accordion container can be used to search the database and return specific sets of information. To simplify the searching process, a user is offered a set of options to launch the query (Figure 6-4). Instead of typing information, a user can choose to return all the information associated with a parcel by clicking one of the three radio buttons. The user can also use the dropdown menu to return all information related to a specific event.

The screenshot shows a web form titled "Query Database". It contains two main sections for selecting search criteria. The first section, "Select a lot location to launch a search:", has three radio buttons labeled "North", "Central", and "Downtown". The second section, "Or select an event:", features a dropdown menu. The dropdown is currently open, displaying a list of event names. "Carlos Ramirez" is highlighted in blue. The list includes: A LOT General, Angela Willcocks, Angkor Dance, Carlos Ramirez, Cornerstone, CSULB Dance, Cyrus and Terry, Donna Sternberg, JAM Session, Jazz Angels, Joshua Cain Madrid, Katina Mitchell, Lisa Desmidt, Long Beach Opera, Long Beach Playhouse, McLean Fahnestock, P.O.P. Price, Pony Box Dance, Portable Potholes, and Regina.

Figure 6-4: Query Options

After clicking a radio button or selecting an event, the table on the bottom of the page will populate with information retrieved from the database. Figure 6-5 shows a part of the table that has been populated after a user has chosen to see all of the information submitted for Carlos Ramirez.

Lot	Event	Date	Rating	Review	YouTube	Pre
Downtown	Carlos Ramirez	September 28	5	My favorite A LOT event so far! Let Carlos play again next year and you will attract a large crowd!	http://www.youtube.com/watch?v=x71uD9ybrzk	http://cultl.it-m
Downtown	Carlos Ramirez	September 28	5	This was awesome; Carlos rocked it! Wow!	http://www.youtube.com/watch?v=o1s7DTwHqsl	http://foru.qualarts

Figure 6-5: Query Results for Carlos Ramirez

6.2 Twitter Search Tool

The Twitter Search tool lets the user specify a number of parameters to search Twitter databases. The returned tweets will be written to a geodatabase and mapped out if the location is enabled. Unlike the web application, this tool is intended to be used only by the client.

Supposed that the ACLB wants to find out what people tweeted in reference to Donna Sternberg's performance, as shown in Figure 6-6, the user can specify a number of parameters to detect tweets. In this case the user decides to search for tweets that contain "Donna Sternberg", "event", "concert", and "Long Beach". The user also wants to check for two hashtags: "ALOTInitiative" and "ALOTLongBeach". The user submits 100 for the Count field. Count refers to the number of tweet pages that will be returned, and the default is 100, with about 200 tweets per page, or a total of approximately 20,000 tweets. The user then specifies the cell size at which the raster will be created, as well as the area units of the output density values. After pointing to the correct databases, the tool can be run.

Figure 6-6: Twitter Search Tool

In this case the tool did not return any results. This suggests that either no one tweeted about that event or it suggests that the user should query using different keywords. The fewer words the user enters and the more talked-about a word is in a given period of time, the more results will be returned. For instance, using “Thanksgiving” as a keyword in mid-November returns over 17,900 tweets, although only about 400 of these tweets had a location attached to them. Figure 6-7 shows the resulting kernel density raster, brought into ArcMap and laid on top of a basemap. The user now has a visual representation of the distribution of tweets. It suggests that Thanksgiving is an especially popular topic to tweet about in the Northeast and the Southwest of the United States.

Figure 6-7: Heat Map Result from Searching “Thanksgiving”

6.3 Summary

This chapter showed how the two deliverables of this project can be used in real-world scenarios. Section 6.1 elaborated on the uses of the web application, which has three main purposes: familiarizing oneself with the A LOT Initiative, submitting information, and retrieving information. Section 6.2 showed how the Twitter tool can be used to return and map out specific tweets from Twitter databases.

Chapter 7 – Conclusions and Future Work

This project was accomplished for the Arts Council for Long Beach (ACLB), a non-profit organization based in Long Beach, California. The ACLB is involved in a cultural project, called A LOT Initiative. The A LOT Initiative is an attempt to reverse the issue of empty urban lots in the City of Long Beach. Over a period of two years the ACLB hosted events in three lots across the city. This project resulted in two deliverables – a web application and a tool to search Twitter databases – which both helped the ACLB track the success of its A LOT Initiative.

A wealth of information about many of the A LOT Initiative events is available on the internet. It was impossible for the ACLB, however, to gather all that information by itself. A web application was built that lets users submit relevant information to a database. The user was able to submit links to blogs, links to news articles, links to YouTube videos, as well as personal reviews and ratings. Anyone who is passionate about the A LOT Initiative can now easily look up or share valuable information with the ACLB.

Based on specific keywords, the Twitter Search tool searches tweets from Twitter databases. The resulting tweets are written to a database, and if locations are available, they are mapped. The rationale behind the Twitter Search tool was that the ACLB could query Twitter databases after an event to see what people tweeted about it. Ideally all of the returned tweets contain geographic location, which would help the ACLB visualize where in Long Beach specific events had an impact. It turned out that it can be difficult to use Twitter to find such specific and local information. To make the tool useful, the ACLB could ask visitors to share their location of events to use a specific hashtag when tweeting about the A LOT Initiative (.e.g., #ALOTInitiativeLongBeach).

Future work could consist of combining the deliverables, such that the Twitter tool could be accessed from the web application. By opening the tool to the public and keeping track of the entered keywords, the ACLB would find out which events users are, or were, most interested in. The ACLB would know which artists should be hired again, and which areas in Long Beach should be invested in more. It would be interesting as well to have a map that is connected to Twitter using the Twitter Streaming API.

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Appendix A. Web Application Code

```
<!DOCTYPE html>
<html>
<head>
<title>A LOT Initiative Map</title>
<meta http-equiv="Content-Type" content="text/html; charset=utf-8">
<meta http-equiv="X-UA-Compatible" content="IE=7, IE=9, IE=10">
<link rel="stylesheet"
href="http://js.arcgis.com/3.7/js/dojo/dojo/resources/dojo.css">
<link rel="stylesheet"
href="http://js.arcgis.com/3.7/js/dgrid/css/dgrid.css">
<link rel="stylesheet"
href="http://js.arcgis.com/3.7/js/dgrid/css/skins/claro.css">
<link rel="stylesheet"
href="http://js.arcgis.com/3.7/js/dojo/dijit/themes/claro/claro.css">
<link rel="stylesheet"
href="http://js.arcgis.com/3.7/js/esri/css/esri.css">
<style type="text/css">
    /*Grid needs an explicit height by default*/
    #gridDiv {
        height: 15em;
    }
    #borderContainer {
        height: 100%;
        visibility: hidden;
    }
    .dijitBorderContainer #bottomPane {
        padding: 0
    }

    #grid { height: 100%; }
    .dgrid { border: none; }
    .field-id { cursor: pointer; }

    html, body, #mapDiv {
        width: 100%;
        height: 100%;
        margin: 0;
        overflow: hidden;
    }

    #mapDiv {border-radius: 5px;padding:0}

    #title {
        color: white;
        font: bold 26pt Helvetica;
        text-align: center;
        text-decoration:none;
    }

    a:link {
        text-decoration:none;
    }
```

```

a:visited {
    color: white;
    text-decoration:none;
}/* visited link */

a:hover {
    color: white;
    text-decoration:underline;
}/* mouse over link */

a:active {
    color: white;
    font: normal 26pt Helvetica;
    text-align: center;
    text-decoration:none;
}/* selected link */

#header {
    background-color: #EF4A4A;
    border-radius: 5px;
}

#borderContainer {
    width: 100%;
    height: 100%;
    background-color: green;
}

#leftPane {
    width: 22.5%;
    padding: 0;
}

#rightPane{padding: 0;border-radius: 5px;}

#accordionPane{height:685px;}

#borderContainer, #leftPane, #header {
    background-color: #EF4A4A;
    border-color: blue;
    border-width: 0px;
}

#userLocDIV {
    z-index: 2;
    position: absolute;
    top: 100px;
    left: 20px;
}

#parcelZoomDropdownDIV{
    position: absolute;
    text-align: center;
    z-index: 2;
    right:150px;
    top: 20px;
}

```

```

}
#parcelZoomDropdownDIV: hover {
    cursor: pointer;
}

#addressFindDIV {
    display: block;
    position: absolute;
    z-index: 1;
    left: 0px;
    top: 0px;
}

#addressFindDIV :focus {
    color: #258;
}

.simpleGeocoder .esriGeocoder {
    left: 80px;
    top: 28px;
    position: absolute;
    z-index: 2;
    border: 2px solid #EF4A4A;
    width: 240px;
}

.simpleGeocoder .esriGeocoder input, .simpleGeocoder
.esriGeocoder input: focus {
    color: #EF4A4A;
    width: 180px;
}

.simpleGeocoder .esriGeocoderResults {
    left: 80px;
    top: 61px;
    background: none repeat scroll 0 0 #000000;
    border-color: #EF4A4A;
    width: 240px;
    opacity: 0.8;
}

.simpleGeocoder .esriGeocoderResult {
    cursor: pointer;
    display: block;
    padding: 5px;
    text-overflow: ellipsis;
    white-space: nowrap;
    color: #EF4A4A;
}

.esriScalebar {
    position: absolute;
}

.esriScalebarLabel {
    color: #EF4A4A;
    font-size: 90%;
}

```

```

        margin-bottom: 5px;
    }

    #basemapBTN {
        border: solid 2px #EF4A4A;
        position: absolute;
        z-index: 2;
        right: 20px;
        top: 20px;
        box-shadow: 0 0 10px #666;
        height: 68px;
    }

    #basemapBTN:hover {
        box-shadow: 0 0 10px #799007;
        cursor: pointer;
    }

    #inputQueryDIV:focus {
        box-shadow: 0 0 10px #799007;
    }

    #inputQueryDIV {
        padding: 1px;
    }

    #northRB:focus, #centralRB:focus, #downtownRB:focus {
        box-shadow: 0 0 5px pink;
        cursor: pointer;
    }

    #northRB:hover, #centralRB:hover, #downtownRB:hover {
        box-shadow: 0 0 5px pink;
        cursor: pointer;
    }

    .resultsGridLeft {
        height: 400px;
    }

    .resultsGridLeft .dgrid-cell {
        border: none;
    }

    .boxInput {
        margin-left: 5px;
        width: 250px;
    }

    .dgrid-cell {
        width: 10px;
    }

    .dropdownInput:focus {
        cursor: pointer;
    }

```

```

        .dropdownInput: hover {
            cursor: pointer;
        }
    }
</style>
<script src="http://js.arcgis.com/3.7/"></script>
<script
src="http://ajax.googleapis.com/ajax/libs/jquery/1.10.2/jquery.min.js">
</script>
<script>
    //-- List of modules that will be loaded --
    require([
        "dojo/ready",
        "dgrid/OnDemandGrid",
        "dgrid/Selection",
        "dojo/store/Memory",
        "dojo/_base/array",
        "dojo/dom-style",
        "dijit/registry",
        "esri/map",
        "esri/symbols/SimpleFillSymbol",
        "esri/symbols/SimpleLineSymbol",
        "esri/renderers/SimpleRenderer",
        "esri/lang",
        "dojo/_base/Color",
        "dijit/TooltipDialog",
        "dijit/popup",
        "dojo/query",
        "esri/layers/FeatureLayer",
        "esri/dijit/Scalebar",
        "esri/dijit/LocateButton",
        "esri/dijit/Geocoder",
        "dijit/form/Button",
        "esri/layers/GraphicsLayer",
        "esri/symbols/PictureMarkerSymbol",
        "esri/symbols/SimpleMarkerSymbol",
        "esri/InfoTemplate",
        "esri/tasks/QueryTask",
        "esri/tasks/query",
        "dojo/_base/declare",
        "dojo/number",
        'dojo/_base/lang',
        'dojo/parser',
        "esri/graphic",
        "dijit/layout/BorderContainer",
        "dijit/layout/TabContainer",
        "dijit/layout/ContentPane",
        "esri/SpatialReference",
        "dijit/form/DropDownButton",
        "dijit/DropDownMenu",
        "dijit/MenuItem",
        "esri/toolbars/edit",
        "esri/tasks/RelationshipQuery",
        "esri/layers/ArcGISTiledMapServiceLayer",
        "esri/dijit/editing/Editor",
        "esri/dijit/editing/TemplatePicker",
        "esri/config",
    ]

```

```

"esri/request",
"dojo/on",
"dojo/dom",
"dojo/dom-class",
"dojo/dom-construct",
"dojo/domReady!"]],
//-- Anonymous callback function --
/-- it fires once all modules have loaded
/-- variable names refer to each loaded module
function(
    ready,
    Grid,
    Selection,
    Memory,
    array,
    domStyle,
    registry,
    Map,
    SimpleFillSymbol,
    SimpleLineSymbol,
    SimpleRenderer,
    esriLang,
    Color,
    TooltipDialog,
    dijitPopup,
    query,
    FeatureLayer,
    Scalebar,
    LocateButton,
    Geocoder,
    Button,
    GraphicsLayer,
    PictureMarkerSymbol,
    SimpleMarkerSymbol,
    InfoTemplate,
    QueryTask,
    Query,
    declare,
    dojoNum,
    lang,
    parser,
    Graphic,
    BorderContainer,
    TabContainer,
    ContentPane,
    SpatialReference,
    DropDownButton,
    DropDownMenu,
    MenuItem,
    Edit,
    RelationshipQuery,
    ArcGISTiledMapServiceLayer,
    Editor,
    TemplatePicker,
    esriConfig,
    esriRequest,
    on,

```



```

        dom,
        domClass,
        domConstruct) {
    //-- the actual callback code begins here
    ready(function(){
        parser.parse();

    //--use proxy page--
    esriConfig.defaults.io.proxyUrl =
    "http://localhost:36351/MSGIS_Numa/proxy/proxy.ashx";
    //-----
    //-- Create Map --
    //-----
    var mainMap = new Map("mapDiv", {
        basemap : "topo",
        center : [-118.161, 33.8045], // center on Long Beach
        zoom : 10,
        sliderStyle : "small",
    });
    mainMap.on("layers-add-result", initEditing);
    //-----
    //-- Change Basemaps --
    //-----
        // grab basemap button
    var mapButton = query("#basemapBTN");
        // create a function that changes basemaps
    function changeMap() {
        // grab value of current basemap
        var currentMap = mainMap.getBasemap()
        // change to other one
        if (currentMap == "topo") {
            mainMap.setBasemap("satellite");
        } else if (currentMap == "satellite") {
            mainMap.setBasemap("topo")
        }
    }

        // fire function when basemap button is clicked
    mapButton.on("click", changeMap);
    //-----
    //-- add the parcels to the map --
    //-----
    var parcelsAll = new FeatureLayer("http://msgis-webdev-
    1.spatial.redlands.edu/arcgis/rest/services/numa_gremling/ALOT_FinalFil
    es/FeatureServer/0", {
        mode : FeatureLayer.MODE_ONDEMAND, //only pull data from server
        when it is within the viewer's extent
        outFields : ["*"],
        id: "parcelsALL"
    });
    mainMap.addLayer(parcelsAll);
        // define symbology for parcels
    var parcelSymbology = new SimpleFillSymbol(
        SimpleFillSymbol.STYLE_SOLID,
        new SimpleLineSymbol(
            SimpleLineSymbol.STYLE_SOLID,
            new Color([0,0,255,1]), 3 // outline of the parcel [R,G,B,
opacity], outline width

```

```

    ),
        new Color([239,74,74,0.5]) // inside of the parcel
    );
    // add symbology to parcels
    parcelsAll.setRenderer(new SimpleRenderer(parcelSymbology));
    mainMap.infoWindow.resize(245,125);
    //-----
    //-- define symbology for selected parcel --
    //-----
    var highlightSymbol = new SimpleFillSymbol(
        SimpleFillSymbol.STYLE_SOLID,
        new SimpleLineSymbol(
            SimpleLineSymbol.STYLE_SOLID,
            new Color([239,74,74,1]), 3 // outline of the parcel
        ),
        new Color([0,0,255,0.5]) // inside of the parcel
    );
    //-----
    //-- create function to edit event table ---
    //-----
    function initEditing() {
        var parcelsALL = mainMap.getLayer("parcelsALL");
        var relatedQuery = new RelationshipQuery();
        relatedQuery.outFields = ["*"];
        relatedQuery.relationshipId = 4;
        parcelsALL.on("click", function (evt) {
            graphicAttributes = evt.graphic.attributes;
            relatedQuery.objectIds = [graphicAttributes.OBJECTID];
            relatedQuery.relationshipId = 0;
            parcelsALL.queryRelatedFeatures(relatedQuery, function
(rerelatedRecords) {
                var fset = relatedRecords[graphicAttributes.OBJECTID];
            });
        });
    }
    //-----

    //-- enable mouse events on parcels when map has loaded --
    //-----
    mainMap.on("load", function(){
        mainMap.graphics.enableMouseEvents();
        mainMap.graphics.on("mouse-out", closeTooltip); // when leaving
        parcel call closeTooltip function
    });

    // create tooltip
    parcelTooltip = new TooltipDialog({
        id: "tooltipDialog",
        style: "position: absolute; width: 250px; font: normal
normal normal 10pt Helvetica;z-index:100;"
    });
    parcelTooltip.startup();
    // function to close tooltip
    function closeTooltip() {
        mainMap.graphics.clear();
        dijitPopup.close(parcelTooltip);
    }
    // fire event when entering a parcel, and display tooltip

```

```

        parcelsAll.on("mouse-over", function(evt){
            // define text and fields shown in tooltip
            var popupContent = "<b>Parcel Location:</b>
${Name}</b><hr><b>Address: ${Id} <br/></b>Oh hello<br>";
            // populate the tooltip
            var tooltipContent =
esriLang.substitute(evt.graphic.attributes,popupContent); // put
content into a variable
            var highlightGraphic = new
Graphic(evt.graphic.geometry,highlightSymbol); // put highlight
symbology into variable
            mainMap.graphics.add(highlightGraphic);
            // make the feature highlight
            parcelTooltip.setContent(tooltipContent);
            // add content to tooltip
            // make tooltip show up where the mouse cursor is
            domStyle.set(parcelTooltip.domNode, "opacity", 0.85);
            dijitPopup.open({
                popup: parcelTooltip,
                x: evt.pageX, //pageX is x position of cursor
                y: evt.pageY //pageY is y position of cursor
            });
        });
    });
//-----

//-- Create Bottom Grid; Set up the Query to populate it --
//-----
    // Create Bottom table
    window.bottomGrid = new (declare([Grid, Selection]))({
        selectionMode: "single",
        bufferRows: Infinity, // make sure all rows from table show up
        // specify the display names
        columns: {
            "locationField": "Lot",
            "eventField": "Event",
            "dateField": "Date",
            "ratingField": "Rating",
            "reviewField": "Review",
            "youtubeField": "YouTube",
            "pressField": "Press",
            "blogField": "Blog",
        }
    }, "bottomGridDIV");
    // when map loads:
    mainMap.on("load", function (evt) {
        // add the bordercontainer that holds the grids
        domStyle.set(registry.byId("borderContainer").domNode,
"visibility", "visible");
        // fire queries to populate schedule grids
        populateNorthGrid();
        populateDowntownGrid();
        populateCentralGrid();
    });
    // attach functions to user selecting a radio button
    // each radio button will change the paramters of the query and
    fire it
    on(dom.byId("northRB"), "click", function(){

```

```

        var userInput = "North"
        queryTable(userInput);
    });
    on(dom.byId("centralRB"), "click", function(){
        var userInput = "Central"
        queryTable(userInput);
    });
    on(dom.byId("downtownRB"), "click", function(){
        var userInput = "Downtown"
        queryTable(userInput);
    });
    // attach function to user choosing a performance in the
dropdown
    // fire query based upon chosen event
    on(dom.byId("eventID"), "change", function(){
        var dropdown = dom.byId("eventID");
        var userInput =
dropdown.options[dropdown.selectedIndex].value;
        queryTable(userInput);
    });
    // Put Review Table into variable and define outfields
window.parcelURL = "http://msgis-webdev-
1.spatial.redlands.edu/arcgis/rest/services/numa_gremling/ALOT_FinalFil
es/FeatureServer/4";
window.outFields = ["Lot", "Event", "Date", "Rating", "Review",
"YouTube", "Press", "Blog"];
    // Create function that populates the bottom grid
function queryTable(userInput){
    var parcelQueryTask = new QueryTask(window.parcelURL);
    var query = new Query();
    query.outFields = window.outFields;
    // build query based on user input
    query.where = "        Lot = '" + userInput + "'        OR Event = '" +
userInput + "'        OR Date = '" + userInput + "'        ";

    // execute the query task
    parcelQueryTask.execute(query, function(results) {
        if(results.features.length > 0){
            mainMap.graphics.clear();
        }
        // create object that grabs data from records
        var tableData = array.map(results.features, function(feature) {
            return {
                // the fields in order as they are shown on the attribute
table
                "locationField":
feature.attributes[window.outFields[0]],
                "eventField":
feature.attributes[window.outFields[1]],
                "dateField":
feature.attributes[window.outFields[2]],
                "ratingField":
feature.attributes[window.outFields[3]],
                "reviewField":
feature.attributes[window.outFields[4]],
                "youtubeField":
feature.attributes[window.outFields[5]],

```

```

        "pressField":
feature.attributes[window.outFields[6]],
        "blogField":
feature.attributes[window.outFields[7]]
    };
    });
    // create new memory store to hold data
    // use tableData object to populate it
    var memoryStore = new Memory({ data: tableData });
    window.bottomGrid.set("store", memoryStore);
    });
}
//-----

//-- Create Schedule Grid for each Parcel and Populate it --
//-----
    // --- North Parcel ---
window.northParcelSched = "http://msgis-webdev-
1.spatial.redlands.edu/arcgis/rest/services/numa_gremling/ScheduleTable
s/MapServer/1";

function populateNorthGrid() {
    // create query task
    var queryTaskNorth = new QueryTask(window.northParcelSched);
    // create query
    var queryNorthTable = new Query();
    queryNorthTable.where = "1=1"; // SQL Query: 1=1 means that
everything will be returned
    queryNorthTable.outFields = ["Date", "Event", 'OBJECTID'];
    queryNorthTable.spatialReference = new SpatialReference({wkid:
102100 });
    // execute the query task
    // create an object that holds the data from table
    queryTaskNorth.execute(queryNorthTable, function(results) {
        var northTableData = array.map(results.features,
function(feature) {
            return {
                "dateField": feature.attributes.Date,
                "eventField": feature.attributes.Event,
                "id": feature.attributes.OBJECTID
            };
        });
    // create new memory store to hold data
    var northMemoryStore = new Memory({ data: northTableData,
idProperty: 'OBJECTID' });
    // create the grid that displays the schedule
    var northSchedGrid = new (declare([Grid, Selection]))({
        bufferRows: Infinity, // make sure all rows from
table show up
        columns: {
            "dateField": "Date",
            "eventField": "Event"
        },
        store: northMemoryStore,
        class: 'resultsGridLeft',
    }, "northSchedGridDIV");
    northSchedGrid.startup();

```

```

    });
}

// --- Central Parcel ---
window.northParcelSched = "http://msgis-webdev-
1.spatial.redlands.edu/arcgis/rest/services/numa_gremling/ScheduleTable
s/MapServer/3";

function populateCentralGrid() {
    var queryTaskCentral = new QueryTask(window.northParcelSched);
    var queryCentralTable = new Query();
    queryCentralTable.where = "1=1";
    queryCentralTable.outFields = ["Date", "Event", 'OBJECTID'];
    queryCentralTable.spatialReference = new SpatialReference({wkid:
102100 });
    queryTaskCentral.execute(queryCentralTable, function(results) {
        var centralTableData = array.map(results.features,
function(feature) {
            return {
                "dateField": feature.attributes.Date,
                "eventField": feature.attributes.Event,
                "id": feature.attributes.OBJECTID
            };
        });
        var centralMemoryStore = new Memory({ data: centralTableData,
idProperty: 'OBJECTID' });
        // create the grid that displays the schedule
        var centralSchedGrid = new (declare([Grid, Selection]))({
            bufferRows: Infinity,
            columns: {
                "dateField": "Date",
                "eventField": "Event"
            },
            store: centralMemoryStore,
            class: 'resultsGridLeft',
        }, "centralSchedGridDIV");
        centralSchedGrid.startup();
    });
}

// --- Downtown Parcel ---
window.downtownParcelSched = "http://msgis-webdev-
1.spatial.redlands.edu/arcgis/rest/services/numa_gremling/ScheduleTable
s/MapServer/2";

function populateDowntownGrid() {
    var queryTaskDowntown = new
QueryTask(window.downtownParcelSched);
    var queryDowntownTable = new Query();
    queryDowntownTable.where = "1=1";
    queryDowntownTable.outFields = ["Date", "Event", 'OBJECTID'];
    queryDowntownTable.spatialReference = new SpatialReference({wkid:
102100 });
    queryTaskDowntown.execute(queryDowntownTable, function(results) {
        var downtownTableData = array.map(results.features,
function(feature) {
            return {
                "dateField": feature.attributes.Date,
                "eventField": feature.attributes.Event,

```

```

        "id":feature.attributes.OBJECTID
    });
    var downtownMemoryStore = new Memory({ data: downtownTableData,
idProperty:'OBJECTID' });
    // create the grid that displays the schedule
    var downtownSchedGrid = new (declare([Grid, Selection]))({
        bufferRows: Infinity,
        columns: {
            "dateField": "Date",
            "eventField": "Event"
        },
        store: downtownMemoryStore,
        class: 'resultsGridLeft',
    }, "downtownSchedGridDIV");
    downtownSchedGrid.startup();
});

}
//-----
//-- Create Scale Bar --
//-----
var scalebar = new Scalebar({
    map : mainMap,
    scalebarStyle : "line",
    scalebarUnit : "dual"
});
//-----
//-- Create Locate Button --
//-----
var userLocation = new LocateButton({
    map : mainMap
}, "userLocDIV");
userLocation.startup();
//-----
//-- Create Geocoder --
//-----
// add graphics layer to display geocoding results
mainMap.addLayer(new GraphicsLayer({
    id : "results"
}));
// create geocoder
var geocoder = new Geocoder({
    map : mainMap,
    autoComplete : true,
    arcgisGeocoder : {
        suffix : " Long Beach, CA",
        name : "Esri World Geocoder",
        placeholder : "find address within Long Beach"
    },
}, "addressFindDIV");
geocoder.startup();
// create new PictureMarkerSymbol object using a JSON object
var symbol = new PictureMarkerSymbol({
    "angle" : 0,
    "xoffset" : 0,
    "yoffset" : 10,
    "type" : "esriPMS",

```

```

        "url" :
"http://static.arcgis.com/images/Symbols/Shapes/BluePin1LargeB.png",
        "contentType" : "image/png",
        "width" : 24,
        "height" : 24
    });
//-----

//-- Add Zooming Functionality to Schedule and Bookmarks --
//-----
    // define parcel locations
    var northLoc = [-118.185, 33.8748];
    var centrLoc = [-118.172, 33.782];
    var downLoc = [-118.192, 33.7750];
    // define zoom functions for each location
    function northZoom() {
        mainMap.centerAndZoom(northLoc, 18);}
    function centrZoom() {
        mainMap.centerAndZoom(centrLoc, 18);}
    function downZoom() {
        mainMap.centerAndZoom(downLoc, 20);}
    // grab parcel text in schedule pane
    var northPrcPane = query("#northParcelPane");
    var centrPrcPane = query("#centralParcelPane");
    var downPrcPane = query("#downtownParcelPane");
    //attach functions to onclick events for schedule
    northPrcPane.on("click", northZoom);
    centrPrcPane.on("click", centrZoom);
    downPrcPane.on("click", downZoom);

    // --- Create Bookmarks Menu ---
    // create new dropdown
    var parcelZoomDropdown = new DropDownMenu({ style: "display:
none;"});
    // create a new menu item and attach a function to it
    var menuItemNorth = new MenuItem({
        label: "North Parcel",
        onClick: function() {mainMap.centerAndZoom(northLoc, 18);}
    });
    parcelZoomDropdown.addChild(menuItemNorth);
    // create a new menu item and attach a function to it
    var menuItemCentral = new MenuItem({
        label: "Central Parcel",
        onClick: function() {mainMap.centerAndZoom(centrLoc, 18);}
    });
    parcelZoomDropdown.addChild(menuItemCentral);
    // create a new menu item and attach a function to it
    var menuItemDowntown = new MenuItem({
        label: "Downtown Parcel",
        onClick: function() {mainMap.centerAndZoom(downLoc, 20);}
    });
    parcelZoomDropdown.addChild(menuItemDowntown);
    // create the button that holds the dropdown
    var button = new DropDownButton({
        label: "Zoom to Parcel",
        dropDown: parcelZoomDropdown,
        id: "parcelZoomID"
    });

```



```

});
dom.byId("parcelZoomDropdownDIV").appendChild(button.domNode);

    // -- Function and Require end here --
    });
    });
    //-----

//-----
//-- Function that Edits the Review Table --
//-----
function updateRelatedTable() {
    require([
        "esri/layers/FeatureLayer",
        "dojo/on",
        "dojo/dom",
    ], function (FeatureLayer, on, dom) {
        // get value from YouTube input box
        youtubeLink = document.getElementById('youtubeInputID').value;
        // get value from Blog input box
        blogLink = document.getElementById('blogInputID').value;
        // get value from Review input box
        reviewText = document.getElementById('reviewInputID').value;

        // get value from Press input box
        pressLink = document.getElementById('pressInputID').value;

        // get value from selected Event in dropdown
        var eventDropdown = dom.byId("eventInputID");
        eventInput =
        eventDropdown.options[eventDropdown.selectedIndex].value;
        // get value from selected Parcel Location in dropdown

        var locationDropdown = dom.byId("locationInputID");
        locationInput =
        locationDropdown.options[locationDropdown.selectedIndex].value;
        // get value from selected Date in dropdown

        var dateDropdown = dom.byId("dateInputID");
        dateInput =
        dateDropdown.options[dateDropdown.selectedIndex].value;
        // get value from selected Rating in dropdown

        var ratingDropdown = dom.byId("ratingInputID");
        ratingInput =
        ratingDropdown.options[ratingDropdown.selectedIndex].value;
        // array that holds user input
        alert("Updating...");
        var comments = {
            attributes: {
                Lot: locationInput,
                Event: eventInput,
                Date: dateInput,
                Rating: ratingInput,
                Review: reviewText,
                YouTube: youtubeLink,
                Press: pressLink,
            }
        }
    });
}

```

```

        Blog: blogLink
    }
    };
    // Insert user input into new row in related table
    var eventInfoRelatedTable = new FeatureLayer("http://msgis-
webdev-
1.spatial.redlands.edu/arcgis/rest/services/numa_gremling/ALOT_FinalFil
es/FeatureServer/4");
    eventInfoRelatedTable.applyEdits([comments], null, null,
        function (addResults) {
            alert("Updated successfully");
        }, function (err) {
            alert(err);
        }
    );
});
}
//-----
//-- Extra Functions --
//-----
// --- Erases Content of an Input Box ---
function eraseOnFocus(target){
    target.value= "";
}
// --- Toggle Basemap when Clicking Button ---
// run jQuery when all elements in document are loaded
jQuery(document).ready(function($) {
    // change basemap button text when clicked
    $("#basemapBTN").click(function() {
        var isTopo = $("#mapToggler").attr('istopo');
        if(isTopo == 'true'){
            var mapToggler =
$("#mapToggler").attr('src','http://www.arcgis.com/sharing/rest/content
/items/6e03e8c26aad4b9c92a87c1063ddb0e3/info/thumbnail/topo_map_2.jpg')
;
            $("#mapToggler").attr('istopo','false');
        }
        else {
            var mapToggler =
$("#mapToggler").attr('src','http://www.arcgis.com/sharing/rest/content
/items/86de95d4e0244cba80f0fa2c9403a7b2/info/thumbnail/tempimagery.jpg'
);
            $("#mapToggler").attr('istopo','true');
        }
    });
});
</script>

```

```

<body class="claro">
<div id="borderContainer" data-dojo-type="dijit/layout/BorderContainer"
data-dojo-props="design: 'headline', gutters: true,
liveSplitters:true">
<div id="leftPane" data-dojo-type="dijit/layout/ContentPane" data-dojo-
props="splitter:true,region: 'left'">
<div id="header" data-dojo-props="region:'top'" data-dojo-
type="dijit/layout/ContentPane">

```

```

<div id="title">
<strong><a href="http://alotlongbeach.org/" target="_blank">A LOT
Initiative Map</a></strong>
</div>
</div>

<div id="accordionPane" data-dojo-
type="dijit/layout/AccordionContainer">
<div data-dojo-type="dijit/layout/ContentPane" data-dojo-
props="title:'<b>Welcome</b>',' selected:true">
<br/>
</div>

<div data-dojo-type="dijit/layout/ContentPane" id="northParcelPane"
data-dojo-props="title:'<b>North Parcel Schedule</b>'">
<div id="northSchedGridDIV"></div>
</div>

<div data-dojo-type="dijit/layout/ContentPane" id="centralParcelPane"
data-dojo-props="title:'<b>Central Parcel Schedule</b>','
selected:true">
<div id="centralSchedGridDIV"></div>
</div>

<div data-dojo-type="dijit/layout/ContentPane" id="downtownParcelPane"
data-dojo-props="title:'<b>Downtown Parcel Schedule</b>','
selected:true">
<div id="downtownSchedGridDIV"></div>
</div>

<div data-dojo-type="dijit/layout/ContentPane" data-dojo-
props="title:'<b>Query Database</b>',' selected:true">
<div id="queryDIV">
Select a parcel name to launch a search:
<form>
<input id="northRB" type="radio" name="parcelCB"> North<br>
<input id="centralRB" type="radio" name="parcelCB"> Central<br>
<input id="downtownRB" type="radio" name="parcelCB"> Downtown<br>
</form>
<br>
Or select an event:
<br>
<form>
<select id="eventID" name="locationsDropDown1" class="dropdownInput">
<option value="A LOT General">A LOT General</option>
<option value="Angela Willcocks">Angela Willcocks</option>
<option value="Angkor Dance">Angkor Dance</option>
<option value="Carlos Ramirez">Carlos Ramirez</option>
<option value="Cornerstone">Cornerstone</option>
<option value="CSULB Dance">CSULB Dance</option>
<option value="Cyrus and Terry">Cyrus and Terry</option>
<option value="Donna Sternberg">Donna Sternberg</option>
<option value="JAM Session">JAM Session</option>
<option value="Jazz Angels">Jazz Angels</option>
<option value="Joshua Cain Madrid">Joshua Cain Madrid</option>
<option value="Katina Mitchell">Katina Mitchell</option>

```

```

<option value="Lisa Desmidt">Lisa Desmidt</option>
<option value="Long Beach Opera">Long Beach Opera</option>
<option value="Long Beach Playhouse">Long Beach Playhouse</option>
<option value="McLean Fahnestock">McLean Fahnestock</option>
<option value="P.O.P. Price">P.O.P. Price</option>
<option value="Pony Box Dance">Pony Box Dance</option>
<option value="Portable Potholes">Portable Potholes</option>
<option value="Regina">Regina</option>
<option value="Toaster Music">Toaster Music</option>
<option value="Wikigong">Wikigong</option>
<option value="Other">Other</option>
</select>
</form>
</div>
</div>
<div data-dojo-type="dijit/layout/ContentPane" data-dojo-
props="title:'<b>Submit Information</b>',' selected:true">
Help us evaluate A LOT Initiative events by sharing your personal
<b>reviews</b> and <b>ratings</b>.
Or did you find a <b>video</b>, a good news <b>article</b>, or an
interesting <b>blog post</b>?
If so, please share it with us.<br /><br />
<b>Lot</b>
<form>
<select id="locationInputID" name="locationsDropDown2"
class="dropdownInput">
<option value="North">North</option>
<option value="Central">Central</option>
<option value="Downtown">Downtown</option>
</select>
</form><br>
<b>Event</b>
<form>
<select id="eventInputID" name="eventsDropDown" class="dropdownInput">
<option value="A LOT General">A LOT General</option>
<option value="Angela Willcocks">Angela Willcocks</option>
<option value="Angkor Dance">Angkor Dance</option>
<option value="Carlos Ramirez">Carlos Ramirez</option>
<option value="Cornerstone">Cornerstone</option>
<option value="CSULB Dance">CSULB Dance</option>
<option value="Cyrus and Terry">Cyrus and Terry</option>
<option value="Donna Sternberg">Donna Sternberg</option>
<option value="JAM Session">JAM Session</option>
<option value="Jazz Angels">Jazz Angels</option>
<option value="Joshua Cain Madrid">Joshua Cain Madrid</option>
<option value="Katina Mitchell">Katina Mitchell</option>
<option value="Lisa Desmidt">Lisa Desmidt</option>
<option value="Long Beach Opera">Long Beach Opera</option>
<option value="Long Beach Playhouse">Long Beach Playhouse</option>
<option value="McLean Fahnestock">McLean Fahnestock</option>
<option value="P.O.P. Price">P.O.P. Price</option>
<option value="Pony Box Dance">Pony Box Dance</option>
<option value="Portable Potholes">Portable Potholes</option>
<option value="Regina">Regina</option>
<option value="Toaster Music">Toaster Music</option>
<option value="Wikigong">Wikigong</option>
<option value="Other">Other</option>

```

```

</select>
</form><br>
<b>Date</b>
<form>
<select id="dateInputID" name="datesDropDown" class="dropdownInput">
<option value="September 7">September 7</option>
<option value="September 20">September 20</option>
<option value="September 21">September 21</option>
<option value="September 22">September 22</option>
<option value="September 28">September 28</option>
<option value="October 5">October 5</option>
<option value="October 12">October 12</option>
<option value="October 20">October 20</option>
<option value="October 26">October 26</option>
<option value="Other">Other</option>
</select>
</form><br>
<b>Rating</b>
<form>
<select id="ratingInputID" name="ratingDropDown" class="dropdownInput">
<option value="1">1 - Terrible</option>
<option value="2">2 - </option>
<option value="3" selected>3 - OK</option>
<option value="4">4</option>
<option value="5">5 - Amazing</option>
</select>
</form><br>
<b>Review</b><br>
<textarea name="" id="reviewInputID" class="boxInput"
onfocus="eraseOnFocus(this)">Please limit your review to 250
characters...</textarea><br><br>
<b>YouTube</b><br>
<input type="text" id="youtubeInputID" class="boxInput"
value="http://"><br><br>
<b>Press</b><br>
<input type="text" id="pressInputID" class="boxInput"
value="http://"><br><br>
<b>Blog</b><br>
<input type="text" id="blogInputID" class="boxInput"
value="http://"><br><br>

<button type="button" id="SubmitAllBTN"
onclick='updateRelatedTable()'>Submit Information</button>

</div>
</div>
</div>

<div id="rightPane" data-dojo-type="dijit/layout/ContentPane" data-
dojo-props="splitter:true,region: 'center'">
<div data-dojo-type="dijit/layout/BorderContainer">
<div id="mapDiv" data-dojo-type="dijit/layout/ContentPane" data-dojo-
props="region: 'center'">
<div id="userLocDIV"></div>
<div id="parcelZoomDropdownDIV"></div>
<div id="basemapBTN"><img id="mapToggler" istopo="true" height="68"
width="100"

```

```
src='http://www.arcgis.com/sharing/rest/content/items/86de95d4e0244cba8
0f0fa2c9403a7b2/info/thumbnail/tempimagery.jpg' /></div>
<div id="addressFindDIV"></div>
</div>
<div id="bottomPane" data-dojo-type="dijit/layout/ContentPane" data-
dojo-props="region: 'bottom'">
<div id="bottomGridDIV"></div>
</div>
</div>
</div>
</div>
</body>
</html>
```

Appendix B. Twitter Search Tool Code

```
#-----
# The TwitterSearch Library was downloaded from GitHub
# Documentation:
# https://twittersearch.readthedocs.org/en/latest/basic\_usage.html
# https://dev.twitter.com/docs
#-----

# Import libraries
from TwitterSearch import *
import datetime
import time
import arcpy
from arcpy import env
from arcpy.sa import *

# Make sure Spatial Analyst is enabled
arcpy.CheckOutExtension("Spatial")

# Overwrite Output
arcpy.env.overwriteOutput = True

# Get date of when the script is run
runDate = str(datetime.date.today()) # get date when script was run
runTime = str(time.strftime("%H:%M:%S")) # get time when script was run
(24 hour format)
scriptRun = runDate + " " + runTime
arcpy.AddMessage("Script run on: " + str(scriptRun))
arcpy.AddMessage("-----")

# The parameters as specified by the user
keywords = arcpy.GetParameterAsText(0)
pageCount = arcpy.GetParameterAsText(1)
year = arcpy.GetParameterAsText(2)
month = arcpy.GetParameterAsText(3)
day = arcpy.GetParameterAsText(4)
inputDatabase = arcpy.GetParameterAsText(5)
outputTable = str(arcpy.GetParameterAsText(6))
outputPathPoints = arcpy.GetParameterAsText(7)
outputPathKernel = arcpy.GetParameterAsText(8)
kernelUnits = arcpy.GetParameterAsText(9)
kernelCell = arcpy.GetParameterAsText(10)

arcpy.AddMessage("-----")
arcpy.AddMessage("You searched: " + str(keywords))
arcpy.AddMessage(" 1) Parameters Set")

#Create new table
newTable = arcpy.CreateTable_management(inputDatabase, outputTable)

# Add fields to the table
arcpy.AddField_management(newTable, "Username", "TEXT", 15)
arcpy.AddField_management(newTable, "Time", "TEXT", 21)
arcpy.AddField_management(newTable, "Coordinates", "TEXT", 50)
```

```

arcpy.AddField_management(newTable, "Latitude", "FLOAT")
arcpy.AddField_management(newTable, "Longitude", "FLOAT")
arcpy.AddField_management(newTable, "Tweet", "TEXT", 201)

arcpy.AddMessage(" 2) Table Created")

    # Create a cursors to change tables
cursorTweets = arcpy.da.InsertCursor(newTable, ("Username", "Time",
"Coordinates", "Latitude", "Longitude", "Tweet"))
cursorSummary =
arcpy.da.InsertCursor("E:\Redlands\MIP\Files\Twitter.gdb\TwitterSummary
", ("RunOn", "Returns", "Keywords"))

    # Initiatlize counters
tweetCount = 0
coordinatesYES = 0
coordinatesNO = 0

arcpy.AddMessage(" 3) Cursor Created")
    # start an edit session
editSession = arcpy.da.Editor(inputDatabase)
    # start editing
editSession.startEditing()
    # start an operation
editSession.startOperation()
try:
    # create a TwitterSearchOrder object
searchOrder = TwitterSearchOrder()
    # enter keyword here
searchOrder.setKeywords([keywords])
    # only return 2 pages
searchOrder.setCount(int(pageCount))
    # and don't give all entity information
searchOrder.setIncludeEntities(False)
    # set language
searchOrder.setLanguage('en')
    # retrieve most recent tweets
searchOrder.setResultType('recent')
    searchOrder.setUntil(datetime.date(int(year), int(month),
int(day)))

    arcpy.AddMessage(" 4) Search Order Set")

# --- Create a Twitter Search API Object --- #
# each part of the TwitterSearch object is copied from a Twitter
Application account from the Twitter Developer Site
# these keys should not be shared with the public, and therefore have
been removed
ts = TwitterSearch(
    consumer_key = 'REMOVED',
    consumer_secret = 'REMOVED',
    access_token = 'REMOVED',
    access_token_secret = 'REMOVED'
)

arcpy.AddMessage(" 5) Search Object Created")
arcpy.AddMessage("    Writing tweets to database...")

```



```

# Search tweets as defined on top
for find_tweet in ts.searchTweetsIterable(searchOrder):
    username = str(find_tweet['user']['screen_name']) # extract
user name
    userCoordRaw = str(find_tweet['coordinates'])      # get
coordinates information

    if userCoordRaw == "None" or userCoordRaw=="":
        userCoordReturn = 0
        lat = 0
        long = 0
        coordinatesNO +=1
    else:
        # slice coordinates return to extract lat and long
        userCoordReturn = userCoordRaw[37:-2]
        # split coordinates and put into a list
        userCoordList = userCoordReturn.split(",")
        # extract lat (second element in list)
        lat = float(userCoordList[1])
        # extract long (first element in list)
        long = float(userCoordList[0])
        coordinatesYES +=1

    # get time tweet was created
    postTimeRaw = str(find_tweet['created_at'])
    # slice to discard useless information
    postTime = str(postTimeRaw[:20])
    # extract tweet content
    tweetText = str(find_tweet['text'].encode('utf-8'))
    # only accept tweets that are up to 200 characters long
    tweetLength = len(tweetText)
    if tweetLength > 200:
        continue
    # write acceptable tweet to table
    else:
        tweetList = (username, postTime, userCoordReturn, lat ,
long, tweetText)
        cursorTweets.insertRow(tweetList)
        tweetCount += 1

        # Calculate statistics
        percCoordinatesYES = (float(coordinatesYES)/tweetCount)*100
        percCoordinatesNO = (float(coordinatesNO)/tweetCount)*100
        # Print summary of search
        arcpy.AddMessage(" 6) Table Populated")
        arcpy.AddMessage("    Number of tweets returned by this search: " +
str(tweetCount))
        arcpy.AddMessage("    Tweets with coordinates enabled: " +
str(coordinatesYES) + " (" + str(percCoordinatesYES) + "%)")
        arcpy.AddMessage("    Tweets with coordinates not enabled: " +
str(coordinatesNO) + " (" + str(percCoordinatesNO) + "%)")
        # stop operation and delete cursor
        editSession.stopOperation()
        del cursorTweets

# stop operation

```

```

editSession.startOperation()
    # Update Summary Table
summaryList = (scriptRun, tweetCount, keywords)
cursorSummary.insertRow(summaryList)
# stop operation, delete cursor, stop editing
editSession.stopOperation()
del cursorSummary
editSession.stopEditing(True)
arcpy.AddMessage(" 7) Summary Table Updated")

# Create temporary point layer with available coordinates
    # Define input parameters
inputTable = newTable
xLong = "Longitude"
yLat = "Latitude"
outputLayer = "tweet_pts"
    # Create layer with above inputs
arcpy.MakeXYEventLayer_management(inputTable, xLong, yLat,
outputLayer)
arcpy.AddMessage(" 8) Event Layer Created")

# Save the event layer as a feature class
arcpy.FeatureToPoint_management(outputLayer, outputPathPoints)
newFeatureClass = outputPathPoints      # put feature class into
variable to set projection
print("-----")
print("Feature Class Created")
arcpy.AddMessage(" 9) Point Feature Class Created")

#Define projection of point feature class
    # The WKID 4326 refers to GCS_WGS_1984
spatialRefDef = arcpy.SpatialReference(4326)
arcpy.DefineProjection_management(newFeatureClass, spatialRefDef)
print("Projection Defined")
arcpy.AddMessage("10) Projection Defined")
# Project feature class
    # The WKID 54030 refers to Robinson
spatialRefPrj = arcpy.SpatialReference(54030)
outFc = str(newFeatureClass) + "_prj"
outRename = newFeatureClass
prjFc = arcpy.Project_management(newFeatureClass, outFc,
spatialRefPrj)
arcpy.AddMessage("11) Projected")

# Select rows that do not have a location
    # First make a temporary feature layer
arcpy.MakeFeatureLayer_management(prjFc, "tempLayer")
    # Select rows using the temporary layer
    # Select features with latitude and longitude of 0

arcpy.SelectLayerByAttribute_management("tempLayer", "NEW_SELECTION", '"L
atitude" = 0 and "Longitude" = 0')
    # Delete selected rows
if int(arcpy.GetCount_management("tempLayer").getOutput(0)) > 0:
    arcpy.DeleteRows_management("tempLayer")

# Calculate Kernel Density

```

```

        # Define input parameters
        inPoints = outFc
        populationField = "NONE"
        cellSize = float(kernelCell)

        # Run Kernel Density
        tweetKernel = arcpy.sa.KernelDensity(inPoints, populationField,
        cellSize, area_unit_scale_factor = str(kernelUnits))
        # Save Kernel Density
        tweetKernel.save(str(outputPathKernel))
        print("Kernel Density Created")
        arcpy.AddMessage("11) Kernel Density Created")

# Deal with exceptions
except TwitterSearchException as e:
    print(e)
    arcpy.AddMessage("-----")
    arcpy.AddMessage(e)

arcpy.AddMessage("-----")
arcpy.AddMessage("Script Finished Running")
arcpy.AddMessage("-----")

```