International Development, Community and
Environment (IDCE)

Master's Papers

5-2016

Web Application Development for Election Polling Places in the City of Worcester Area: Summer Internship with the City of Worcester

Shuhong Yan
shyan@clarku.edu

Follow this and additional works at: https://commons.clarku.edu/idce_masters_papers

Part of the Geographic Information Sciences Commons

Web Application Development for Election Polling Places in the City of Worcester Area: Summer Internship with the City of Worcester

Shuhong Yan

May 2016

A THESIS

Submitted to the faculty of Clark University, Worcester,
Massachusetts, in partial fulfillment of the requirements for
the degree of Masters of Science in the department of
International Development, Community, and Environment

And accepted on the recommendation of

Jie Tian, Chief Instructor

ABSTRACT

Web Application Development for Election Polling Places in the City of Worcester
Shuhong Yan

My summer internship is in the Technical Services, the City of Worcester, starting from June to August of 2015. My supervisor is Claire Brill who gave me guidance at each step of my internship. I devoted to customizing a web application for Election Polling Places in the City of Worcester. This application aims to provide citizens with the latest information about their related polling place and elected officials. For the project, I collected data for elected officials and transferred data for polling places, precincts, and others from the Geodatabse of the City of Worcester to a new Local Government Geodatabase I created. I published data related to the web application and customized a draft of the Election Polling Places application in the City of Worcester. This report introduces the organization of the internship, the detailed content of the program as well as my jobs and progress for this internship, and the summary for what I've learned from this internship.

Jie Tian, Ph.D.
Chief Instructor

ACADEMIC HISTORY

Name: Shuhong Yan   **Date:** May 2016

Baccalaureate Degree: Bachelor of Science

Source: Wuhan University   **Date:** June 2014

<u>Occupation and Academic Connection</u> since date of baccalaureate degree:

GIS Intern -- Clark Labs, Worcester, MA (2015)

ACKNOWLEGEMENTS

First of all, I would like to thank Prof. Yelena Ogneva-Himmelberger for her tutoring and supporting. She not only gives me guidance for my course selection and other academic questions as my academic adviser, but also teaches me necessary GIS knowledge and technologies as my professor.

Second, I would also like to thank Claire, Brill, my supervisor when was working in the City of Worcester. Thank her for giving me such a good internship opportunity and gave me lots of help through my whole internship session.

Most importantly, I would like to thank my parents who support all of my decisions and allow me to go abroad for further education. Going to Clark University is an amazing experience for my life and would improve my competition on the job market.

TABLE OF CONTENTS

CHAPTER 1. INTRODUCTION

The Geographic Information Science for Development and Environment (GISDE) Master's program at Clark University give us three tracks, research track, internship track, and portfolio to help graduate students to define their career path before graduation. As a requirement for achieving the degree of Master of Science for GISDE program, I chose an internship track that helps lay a foundation for my transition from school to a career.

My internship during the summer of 2015 took place in the Technical Service Department, a division within the City of Worcester. The Technical Service Department provides technical support, ensuring competent services to the public. I worked in the GIS section under the department to assist in developing an Election Polling Places web application. My main jobs in this project included election Geodatabase management as well as web application customization. This internship required me to work independently most of the time and allowed me enough space to express and practice my ideas into the project. By working individually and having weekly meetings with colleagues in the GIS section, my ways of thinking as well as the perspective towards GIS world have been largely broadened.

I felt so fortunate to get this internship opportunity since it allowed the application of most of my GIS technologies in a single comprehensive project. This internship not only sharpened my technology of Geodatabase management and cartography, which are my biggest interests in the GIS world, but also inspired my strong passion for programming. Additionally, the time spent with my supervisor and other staff in the Technical Service Department was an invaluable learning process. Overall, my summer internship experience was a great beginning for my career life and it proves that GIS is a very good career track to which I am willing to stick.

CHAPTER 2. DESCRIPTION OF ORGANIZATION

2.1 Goal and mission

The Technical Services Department is a division under the Department of Administration & Finance in the City of Worcester, Massachusetts. Its mission is to provide technical support and solutions to city departments and to effectively assist in municipal services to the public with higher productivity but lower costs (Technical Services, 2015). The Technical Services Department is located at Worcester Technical High School, which is located two miles southeast of the City Hall.

Technical Services continuously provides E-Government services, which include "offering a 24x7 Online Customer Service request system, online bill payments, certificate requests and various license renewals such as Real Estate, Personal Property, Excise and Water/Sewer bill payments, certificate of municipal liens, requests for birth, marriage and death certificates, liquor license renewals, dumpster permit renewals, and others" (Technical Services, 2015).

The division is currently working to improve the quality of their products and services, to increase the numbers of its users, and to extend its supporting areas. The areas they are currently involved in are "networks and system management, production and financial operations, application support and development, Geographic Information Systems, office automation, desktop support, document imaging and internet services" (Technical Services, 2015).

Due to Technical Services remitting efforts, the city with powerful technical strength is widely recognized and awarded the Massachusetts Common Cause E-Government Award with Distinction through 2006 to 2010 (Technical Services, 2015).

2.2 Organizational structure

The Technical Services Department consists of four sections, including a Geographic Information System (GIS) section, Production Services section, Programming Services section, and Technical Support section. There are approximately 40 staff in these four sections who are U.S. citizens and come from around the country. The GIS section works on GIS consulting and Geodatabase management, where the data are used for a variety of projects. The Production Services section supports the operational processes of the city's financial systems and manages system and site security procedures as well as environmental controls (Production Section, Technical Services, 2015). The Programming Services section is responsible for the development of applications for the city user departments as well as the public (Programming Section, Technical Services, 2015). The Technical Support section is responsible for "more than 1700 computer users, 780 personal computers, 200 printers, and 50 Windows-based servers" (Technical Support Section, Technical Services, 2015). Staff members in this section provide technical services, resolve technical problems and answer related questions. The staff receives and deals with over 6000 annual user requests via the Help Desk. Additionally, they are tasked with network system management and update (Technical Support Section, Technical Services, 2015).

2.3 GIS section

Technical Services has a GIS section to support project programs concerning "Assessing, Public Health, Public Works, Election Commission and Inspectional Services" (GIS Section, Technical Services, 2015) by offering geographic data and maps, and GIS consulting. "A continuing goal of the GIS Section is providing public access to GIS data, maps, and applications." (GIS Section, Technical Services, 2015).

The key mission of the GIS section is to manage data in the geodatabase. Data and map layers are kept updated within the geodatabase. City personnel can acquire the GIS data in the geodatabase for their specific needs.

By using the data, the section also creates thematic maps and collaborates with the other three sections to develop a series of online applications for the needs of other city departments and divisions. Online maps, including street maps, district maps, property tax maps, ward/precinct maps, and zoning maps, are available to the public. Citizens can send a paid request to get access to digital data. Tour of Public Facilities application allows the visitors to view the public facilities within Worcester and acquire the information of interest. The Election Polling Places application assists Worcester residents in search of their polling location, respective voting precinct and ward, and election information. In order to improve the services provided by the web applications, staff in the GIS section builds an effective infrastructure for testing and updating the applications

In addition to support program development for the city departments and divisions, the GIS section also collaborates with GISers in other organizations such as Statewide Office of Geographic Information (MassGIS) to address projects (GIS Section, Technical Services, 2015).

CHAPTER 3. INTERNSHIP RESPONSIBILITIES

The City of Worcester aims to create an online application to help citizens to locate their polling places, obtain the information on current elected officials, and get to know the election information. The application is accessible on desktop computers, smart phones, and tablets. I was involved in this project implementing the web application of the locating polling places in Worcester, from ArcGIS Online, under the supervision of Claire Brill, who is the GIS manager in the Technical Services Department. My job mainly consists of database development and application customization. Each week I had a meeting with Claire to report my work progress and questions. She gave me guidance if I was on the incorrect track and provided me with related materials if I met any problems, to proceed with the project. After the publish of the Election Polling Places application, Claire and I talked to the web managers of the City of Worcester, David and Eric, to whom I presented the web application and discussed the layout and content of the web page. This application is a new attempt and needs to be tested and updated for multiple times. I continued updating the application based on the suggestions they gave me.

The web page of the application I customized is in Figure 1. A welcome page will firstly show up that introduces the information this web page provides and the basic operations citizens can do. On the web page, citizens can locate their address through three ways: one is to enter the full address in the address search box on the top right of the web page; another is to click an interested location on the map directly; the other is to obtain the current location by clicking the "Locate" button next to the "Address search" box. Once their address is located, the related ward and voting precinct with a label to which this address belongs will show up and the related polling place where the citizens go to vote will be marked on the map. Panels displaying information about associated polling places and elected officials will also show up in the bottom

of the web page (Figure 2). The polling place panel contains the details of the polling place, the election date, related information about voters, and contact information. The election officials panel contains detailed information about the elected representatives at different administration levels. By clicking a polling place icon that is represented by a yellow star, a pop-up on the map will be displayed showing the information about this polling place (Figure 3). On the right top of the web page, there is a toolbar that includes not only address search and locate boxes, but buttons of Base map, Share, and Help. Citizens can choose their preferred reference map or share the application to other media software such as Twitter and Facebook. Citizens can also open the help page for further instructions if they meet any problem about using this application.

3.1 Data preparation of the application

Data collection and management is the first step of publishing the Election Polling Places application. Data required for this application include polling places, voting precinct, wards, and elected officials at different administration levels (Table 1). Claire introduced me to the Geodatabase in the City of Worcester and other related data links for the development of the web application. The Geodatabase I created was based on the Local Government Information Model, a geodatabase schema provided by ESRI to local governments to assist all kinds of application development. All associated shapefile data in the Geodatabase in the City of Worcester and data obtained from websites were transferred to the dataset "ElectionAdministration" in the Local Government Information Model, and within the Geodatabase a table PrecinctPollingPlaces was created to represent the relationship between voting precincts and polling places. According to the election data about the City of Worcester data, some feature classes and their fields in the Geodatabase were modified or deleted and some were newly added. Most of the field information in feature classes including polling places and elected officials would be displayed

on the web page in different panels. After data migration and processing, the Item Description metadata were revised as well.

Based on these data in the Geodatabase, two map documents were created, called PollingPlaces and Precincts. One map document PollingPlaces (Figure 4) contains a single layer Polling Places and a table PrecinctPollingPlaces. The other Precincts (Figure 5) contains nine layers that are Voting Precincts, Ward, School Committee, Councilor-At-Large, District City Council, State House Elected Representatives, State Senate Elected Representatives, US Congressional Districts, and US Senate Districts, respectively.

These two map documents were then published as hosted feature services, required for the Election Polling Places application, via ArcGIS Server of the City of Worcester. A geometry service used was also from the ArcGIS Server of the City of Worcester. Additionally, the web application requires reference maps. I added two types of base maps, a topographic map and a satellite imagery from Data and Maps for ArcGIS.

3.2 Application customization

The Election Polling Places application is a JavaScript application that was designed by the City. HTML, CSS, and JavaScript were required for developing the application. The whole application and its scripts are open to the public for reference. In order to customize our own application, I had to read and interpret all of the files of the HTML, CSS, and JavaScript and then developed our application by revising the reference scripts. Before configuring the application for the City of Worcester, I used the sample data provided by the City. In this case, I could learn the process of application customization more easily.

The main difference between the example application and the application we were developing is the data. At the beginning of customizing the application using data of the City of Worcester, I found and modified the scripts which were used for loading data to the web page. Map services of reference maps, polling places, and precincts as well as geometry service were loaded to the scripts via their associated URLs that then replaced the original URLs in the example script correspondingly. A proxy file that shares the location of the services to the application was also modified by adding the URL of each ArcGIS Services Directory. Since our application has more layers, not only were the original URLs replaced correspondingly but new URLs for newly added map services such as ward and School Committee were added.

When the data replacement was settled up, the first draft of the Election Polling Places application in the City of Worcester was published by the technical staff via the web server of the City of Worcester. The layout and map content types of the first draft are exactly identical to those of the application in the City. By discussing with Claire, and web managers, several changes had to be made for the application. The changes I have made were listed in the Table 2. All of these changes for the layout and web content were realized by modifying the script files of HTML, CSS, and JavaScript.

The web application I created is a draft. This project will continue and other staff in the Technical Services department will revise and update the web application so that it can be finally used by the citizens in the City of Worcester during the election period.

CHAPTER 4. INTERNSHIP ASSESSMENT

The summer internship in the City of Worcester taught me a lot. When Claire, my supervisor in the City of Worcester, had an interview with me, I presented my capabilities of database management and spatial analysis and then got this internship opportunity. During this internship session, I used my skill of Geodatabase management and cartography for a practical project as well as learned new knowledge and technologies for ArcGIS Online and programming, including HTML, CSS, and JavaScript.

My courses at Clark more focus on spatial analysis and cartography. I seldom manage a large number of datasets in a Geodatabase although I have the adequate theoretical knowledge about Geodatabases. Most of my course projects didn't involve a large amount of data. When in the Technical Service Department, I got access to the local government Geodatabase in the City of Worcester and knew how the datasets in the Geodatabase were used by other departments to support the government services. In addition, in order to know more about local government Geodatabase, I joined a forum called ArcGIS for Local Government where I could get access to a variety of latest news and technologies related to Local Government Geodatabase and GIS. The forum not only provided me with the information I need for the Election Polling Places application, but also gave me a new path to see the world of GIS. On the other hand, the knowledge of how to collect data and transfer them between Geodatabase, learned at school, was applied to build the Geodatabase for the Election Polling Places application. Also, processing vector data and revising attribute tables were also used for this practical project. Therefore, I spent relatively less time on Geodatabase management than on web application customization.

After publishing the drafts of the web application, I introduced this application to the web managers in the City of Worcester, who then gave me some suggestions such as changing the layouts, logo, adding new layers and displaying more information. Claire and I thought the skill of Python was enough for this project, but then we found HTML, CSS, and JavaScript were required to improve and update the web application, which was a big surprise for me because I had no idea about HTML, CSS, and JavaScript. In order to create a best web Election Polling Places application for the City of Worcester, I started learning the HTML, CSS, and JavaScript by myself online while reading and revising the scripts of the application. Beginning a new programming language was a really difficult thing. To test whether a new function for the application worked or not, I spent much time publishing the draft of the application and revising the scripts again and again. However, as I got more familiar with the new programming languages and application, the time to realize a new function was shortened greatly. I have never thought I was able to learn a new programming skill by myself before I got this internship, but because of it I developed a strong passion for the programming languages of HTML, CSS, and JavaScript.

Another vital skill I learned from school as well as from this internship is the capability of self-learning. At school, Professors cover most theoretical knowledge in class while also provide lots of readings and tutorials for us to broaden our views and gain skills, which requires us to learn and interpret by ourselves after class. For this project, I searched on the websites for tutorials for ArcGIS Online as well as programming skills and on the forums for some specific programming problems. I really appreciate my supervisor Claire, who provided me a variety of related materials when I met difficulties, which gave me a good orientation on proceeding the project.

The three-month internship is a very short time session within which it is hard to complete such a big web as well as mobile application. At the end of the internship, I wrote a summary document to report what I changed and how I changed the web application. Thank to Claire's guidance, this report was finally readable and become a reference for continuously working on this application after I finished my summer internship in the City of Worcester.

If there are GIS internship opportunities open in the Technical Service Department, City of Worcester next year, I will strongly recommend GISDE students at Clark University to apply for it. Claire gave students enough freedom to express and practice their thoughts to the project. Students are able to try various ways to test their approaches from which they conclude the best way as well as obtain new experience. Students may meet a big challenge that they didn't know before, which, however, is just the most interesting point. I appreciated this internship opportunity in the City of Worcester.

CHAPTER 5. CONCLUSION

Since this is my first internship working outside of the campus, I felt much honored to be offered such a wonderful opportunity to work with Claire Brill, my supervisor, and other talented staff of the Technical Service Department in the City of Worcester. This internship allowed me to apply most of my knowledge and technical skills learned at Clark University to a practical project, which greatly heightened my understanding of a variety of GIS related concepts including geodatabase management and map visualization. I was introduced to an integrated geodatabase and how this geodatabase was used to support other departments in the City of Worcester. In addition, through this internship, I learned new knowledge about ArcGIS Online and web mapping programming skills which also stimulated my interest of programming. I

extremely enjoyed the self-learning process. This internship is a nice experience to consolidate my knowledge as well as master new skills, and it further strengthened my determination to pursue GIS as my career.

FIGURES AND TABLES
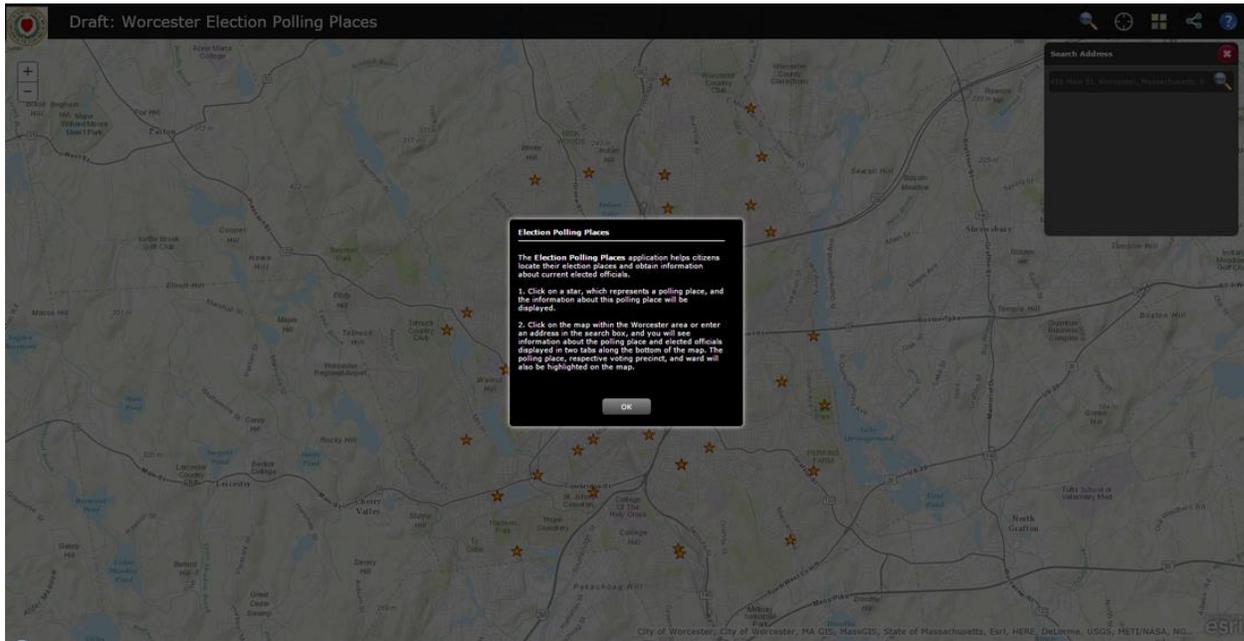
Figure 1 Welcome page of the web application
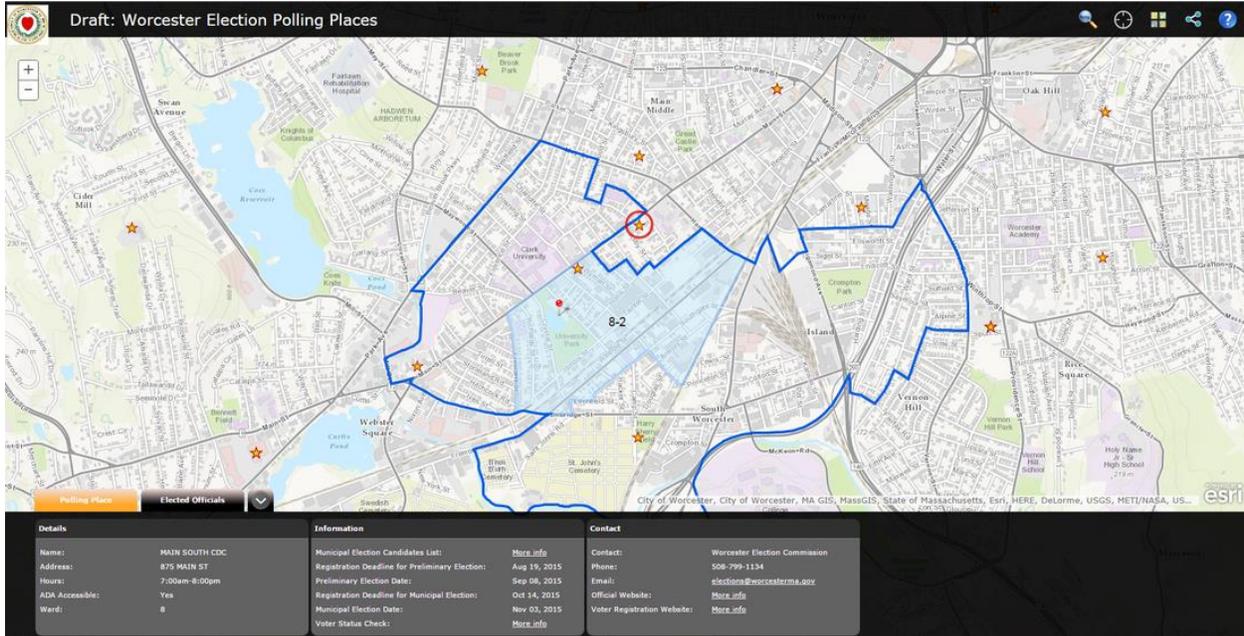
Figure 2 Display of voting precincts and wards
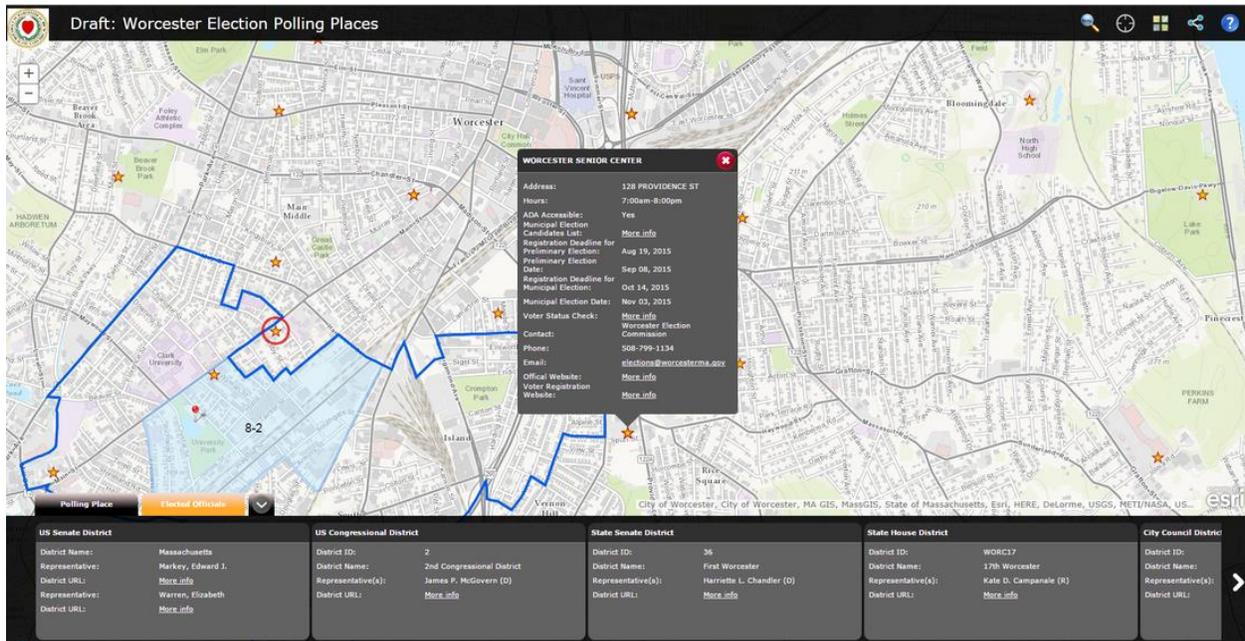
Figure 3 Display of detailed information about the polling places and elected officials
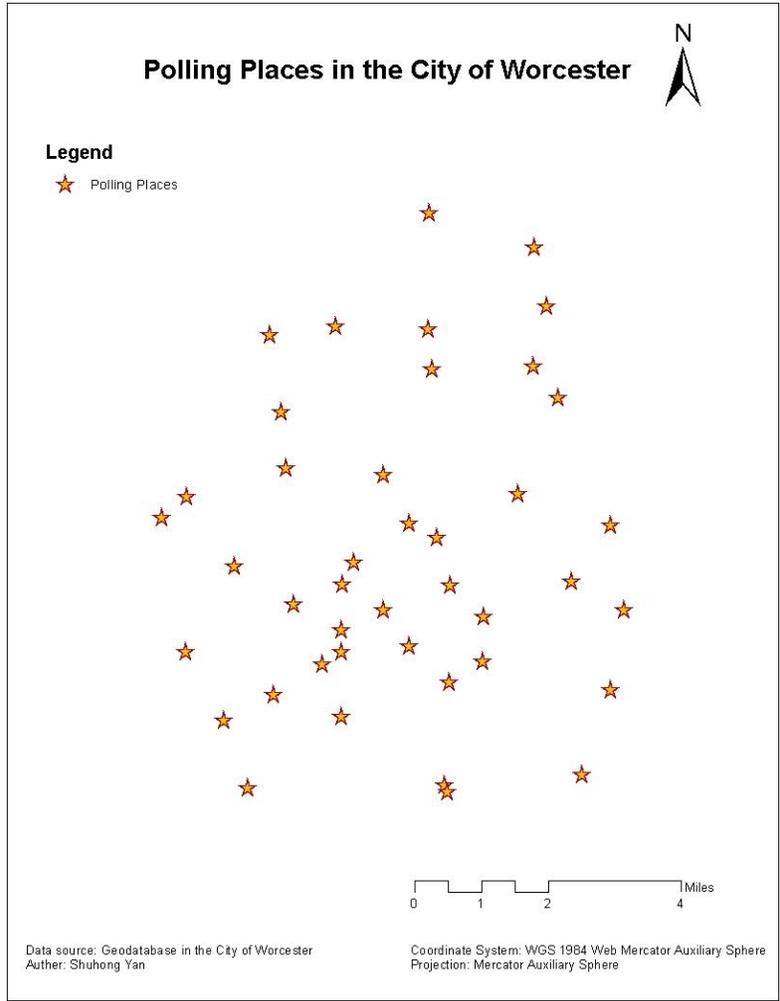
Figure 4 Polling places in the City of Worcester
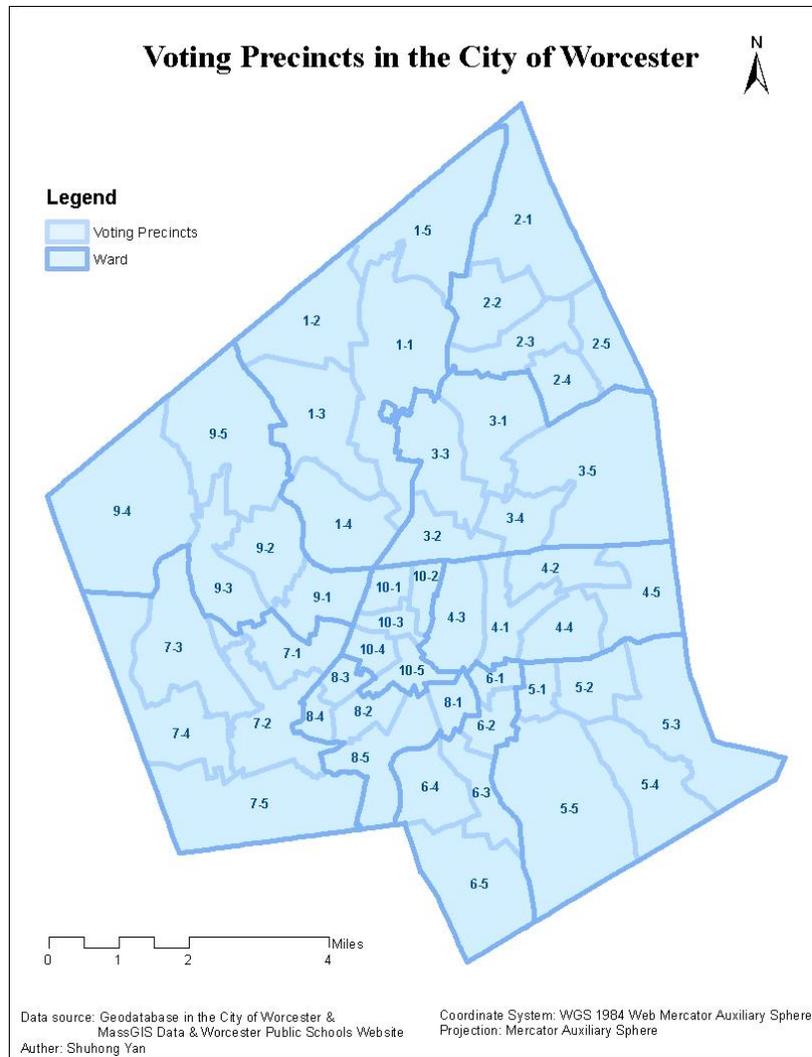
Figure 5 Voting precincts in the City of Worcester

Table 1 Data for the web application

Data Categories	Data Type	Source	Description
Council At-Large Elected Representatives	Polygon	Geodatabase in the City of Worcester	Council At-Large elected representative in the City of Worcester
District Council Elected Representatives	Polygon	Geodatabase in the City of Worcester	District Council elected representative in the City of Worcester
Polling Place	Point	Geodatabase in the City of Worcester	A Place where voters cast their ballots in elections
School Committee Members	Polygon	Geodatabase in the City of Worcester & Worcester Public Schools Website	School committee members in the City of Worcester
State House Elected Representatives	Polygon	MassGIS Data	State House elected representative districts.
State Senate Elected Representatives	Polygon	MassGIS Data	State Senate elected representative districts.
US Congressional Districts	Polygon	MassGIS Data	US Congressional elected representative districts.
Voting Precincts	Polygon	Geodatabase in the City of Worcester	A precinct is generally the smallest level of geography established for purposes of conducting elections. Each precinct has a specific location where its residents go to vote.
Ward	Polygon	Geodatabase in the City of Worcester	There are five wards in the City of Worcester. Each ward contain ten precincts.
Precinct Polling Place	Table	Geodatabase in the City of Worcester	Relationship between polling places and voting precincts. One or more voting precincts are associated to a single polling place.

Table 2 Changes made for the application

Data Display	Polling places information in the pop-up dialogue
	Polling places information in the bottom panel
	elected officials' information in the bottom panel
Precinct and Ward Display on the Map	Precinct display with labels
	Ward display
Address Search	Default content
	Address search box default display
Help Page	Content change
Welcome page	Content change
	Message window size adjustment
Other Changes	Warning message
	Header and image
	Open up extent
	Ballot information disabled

BIBLIOGRAPHY

Technical Services department [online]. Available from:

http://www.worcesterma.gov/finance/technical-services [Accessed 21 September 2015]

Geographic Information Science (GIS) section [online]. Available from:

http://www.worcesterma.gov/finance/technical-services/gis [Accessed 21 September 2015]

Production Services section [online]. Available from:

http://www.worcesterma.gov/finance/technical-services/production-services [Accessed 21 September 2015]

Programming Services section [online]. Available from:

http://www.worcesterma.gov/finance/technical-services/programming-services [Accessed 21 September 2015]

Technical Support section [online]. Available from:

http://www.worcesterma.gov/finance/technical-services/technical-support [Accessed 21 September 2015]