Solving Public Parking Issues with GIS:
An Exploration of Interactive Web Map and Mobile Application Development

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Introduction

This project focused on developing an interactive web map application and mobile Android application for disseminating parking restriction information with the goal of using geospatial techniques to provide a solution to this problem. The two applications were compared to assess the advantages and disadvantages of these interactive map types. Multiple field data collection methods were used to collect the parking restriction data required to build these applications. The different methods were assessed by how they impacted the development of these application. By performing this type of analysis, we were able to determine that remote data collection methods were the most effective when considering cost, time, and accuracy. After analyzing the two application types, we found that the interactive web map application was much more effective in tracking the user and providing additional functionalities. While our Android application is certainly capable of many of these functions, we were ultimately unsuccessful in getting some of them to operate correctly in the limited amount of time available to us.

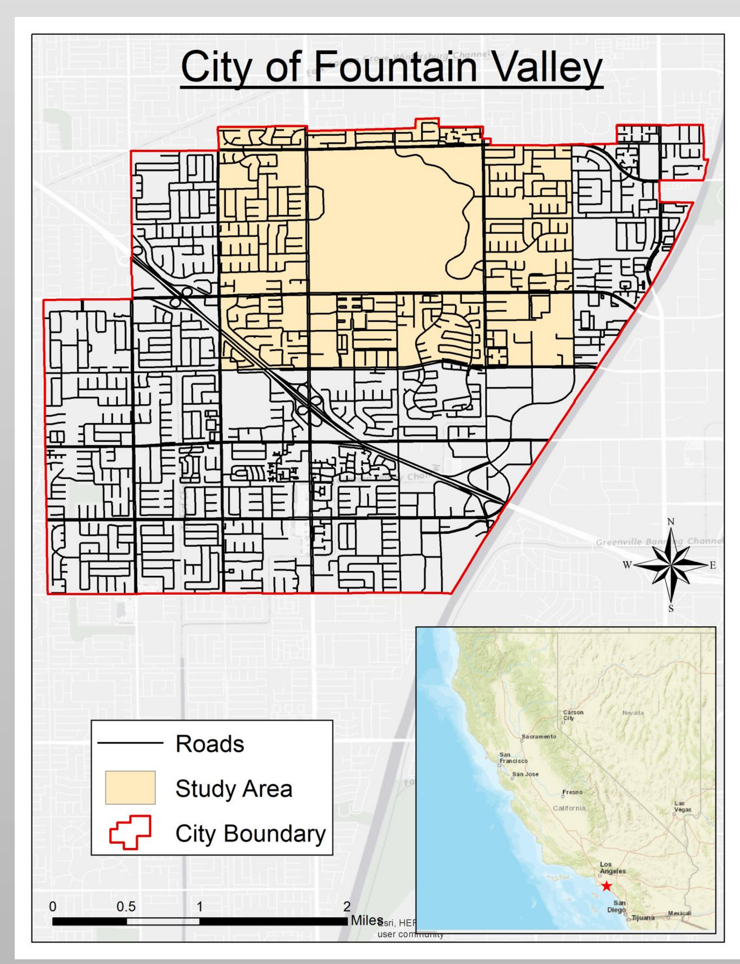

Figure 1. *Study area map showing Mile Square Park and its surrounding neighborhoods*

Data and Data Sources

Street centerlines were downloaded from the Census Bureau. This dataset was then modified using buffers to create our roads dataset. Signs and fire hydrants were collected using Esri's Collector App, ArcGIS Online, Google Earth, and Google Maps. During data collection, data was stored in ArcGIS Online. Once data collection was complete, it was downloaded and stored in a file geodatabase (FGDB).

Table 1. List of data and data sources used in the project

Dataset	Source
Street Centerline	TIGER/Line Shapefiles
Roads	Personally created
Signs	Personally collected
Fire Hydrants	Personally collected

Methodology

We initially began collecting street parking regulation data using Esri's Collector App in the field. By walking through the streets surrounding Mile Square Regional Park, we were able to collect parking restriction data. This included street signs and fire hydrants. Remote data collection methods were later utilized to simplify the process. As one team member navigated virtually through the streets using Google Earth or Google Maps, the other member collected the data using ArcGIS Online. This data was then processed using ArcMap and later displayed on a web map that we configured using ArcGIS Online. By using Esri's Web AppBuilder, we created a web map application that added additional functionality through widgets. Google's Android Studio was used to create an Android application that displays the data. In order to display our data within the Android application, we converted our feature classes into KML files. The Google Maps KML Importing Utility was used to add the layers to the map. Using this utility, we converted the KML data into geographical shapes and rendered them as a layer on top of the map.

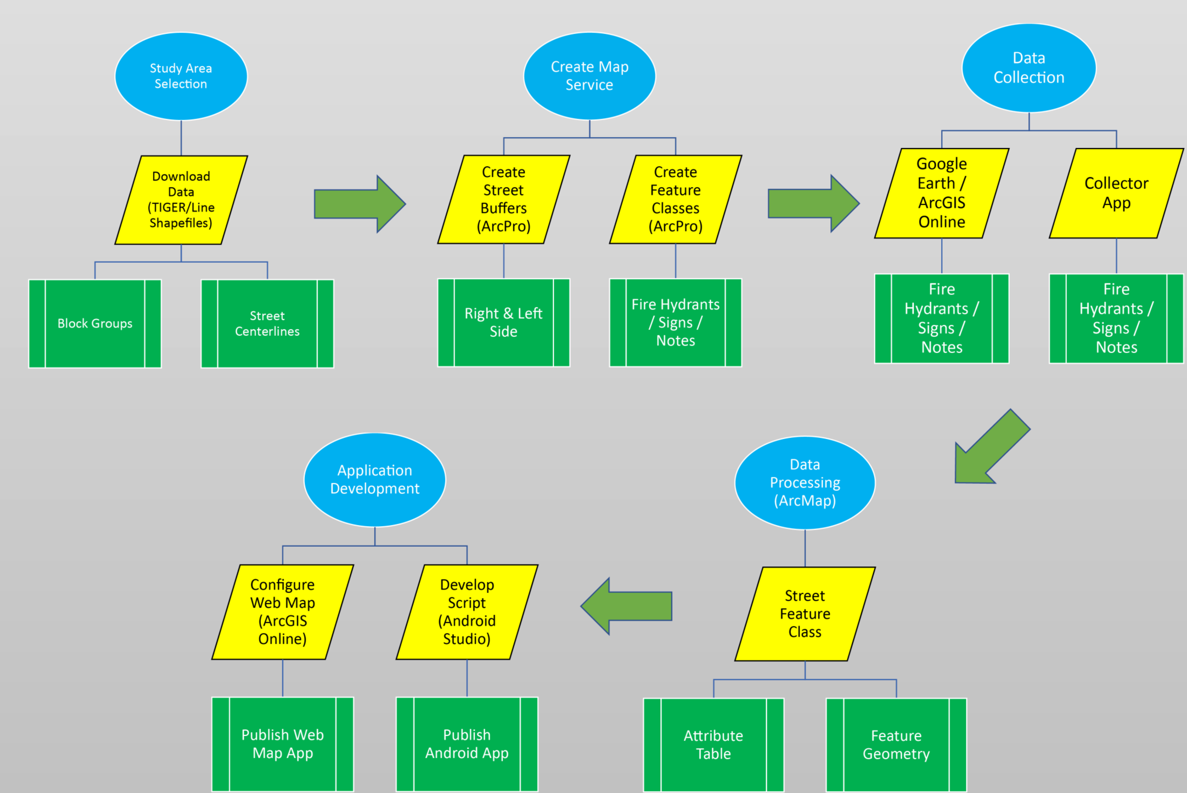

Figure 2. *Spatial model showing applied process*

Timeline

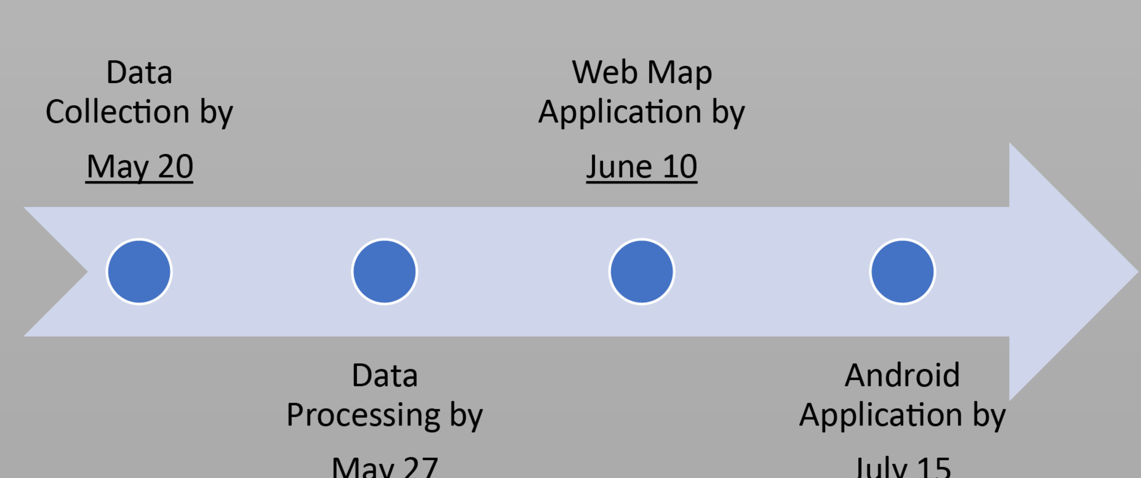

Figure 3. Project timeline showing completion dates

Results

Our data collection result is a file geodatabase containing feature classes of signs and fire hydrants. The signs feature class holds information pertaining to parking regulations and street sweeping schedules. The feature class also holds picture attachments that display the signs for validation purposes. The fire hydrants feature class holds location data for each fire hydrant collected. Our web map application (see figure 4 below) tracks the user using GPS functionality provided by an Esri Web App Builder widget. When streets are clicked, the user is presented with parking regulation and street sweeping information. When signs are clicked, the user is presented with a photo attachment of the sign for reference (see figure 5 below). When fire hydrants are clicked, the user is presented with a warning message about parking next to fire hydrants and a link to a state of California website with information about fire hydrant parking regulations. Our Android application displays the data but lacks additional functionality (see figure 6 below).

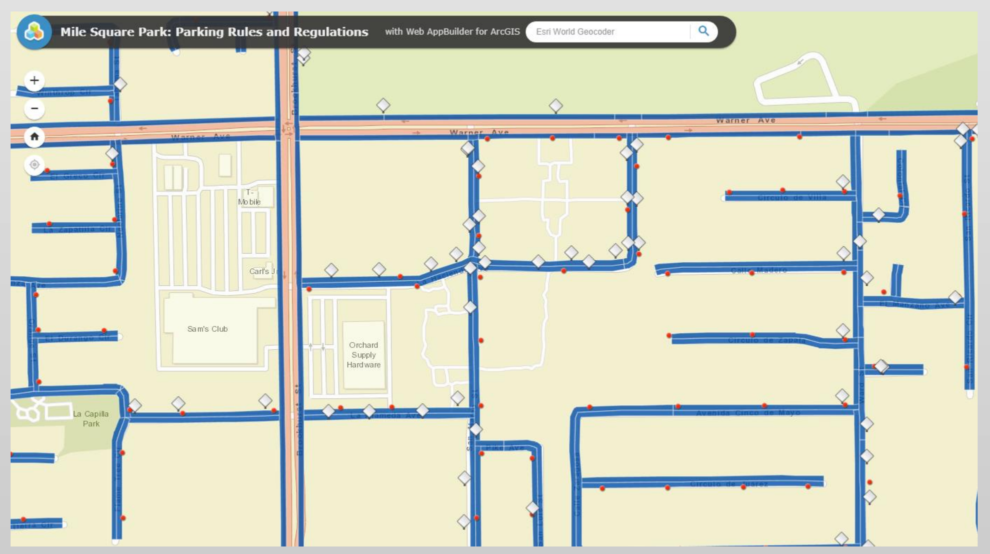

Figure 4. *Web map application*

Figure 5. (A) Sign pop-up when clicked (B) sign attachment from link in popup

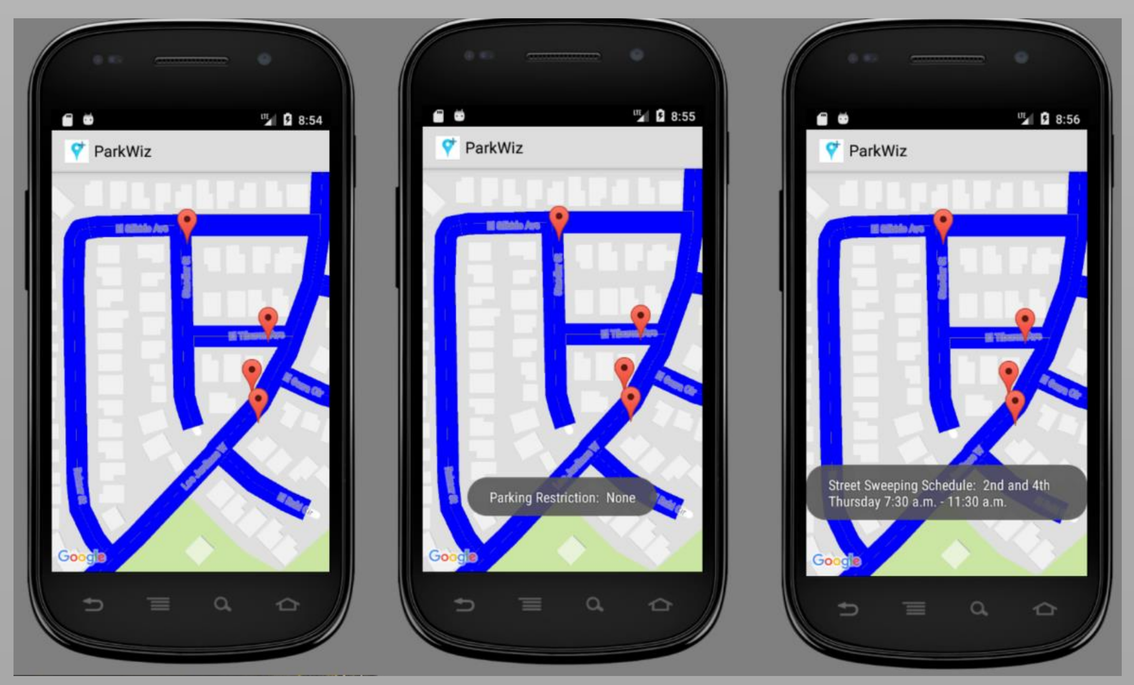

Figure 6. Zoomed in view of street features and attribute information displayed

Discussion

After testing multiple data collection methods, we found that using Google Earth, Google Maps, and ArcGIS Online to remotely collect data from our personal computers was the most effective method. A major advantage of this method is that it was the fastest, most time efficient method of all. It allowed for quick collection of data while traveling between data collection points and streamlined the process. This meant that no physical traveling was required which saved time and money (two concerns associated with collecting data in the field). Initially, we thought that data accuracy would be a concern for this method, but after validating our data in a sample size, we found that it was just as accurate as the other methods. When developing our web map application, we chose Esri's platform because it offered a wide variety of functions through its widgets. We found that the configuration process of these widgets was streamlined in their functionality. Another option was to use the qgis2web plugin in QGIS, but this application has been less user-friendly for us in the past. However, while our experience with that platform is limited, we feel that it would have been our second choice after Esri's platform. A third option was to create the web map application from scratch. However, given the short timeframe of our project and the fact that we were students with free access to Esri software at the time of this project, we decided to take advantage of what ArcGIS Online had to offer. In developing our mobile application, we chose Google's Android operating system over Apple's iOS due to its larger user base, developer community, and lower cost services. We also chose Google's Android Studio over Esri's AppStudio because of its open source nature. As students, we had free access to Esri's AppStudio, but we knew that this would change once we graduated, so using Google's option was more appealing to us given that we could continue our work beyond graduation.

Conclusion

This project has been successful in many ways. Our data collection methods have allowed us to gather useful information that is valuable to the user. Our web map application development was successful in displaying our data through ArcGIS Online and has produced great results. In contrast, our experience with Android Studio has been a challenging process, and we feel that Android was limited in its functionality with our data. When considering future work, adding more data to our application can help it reach a greater audience. On a smaller scale, our app can benefit the City of Fountain Valley in a much more impactful way if we were to complete data collection for the entire city rather than just the surrounding neighborhoods of Mile Square Regional Park. This can be done by crowd-sourcing our application to enable more users and developers to access, add to, and edit the data.

Submitted in partial fulfillment of the requirements of the Masters of Science in Geographic Information Science(MSGISci), August 12, 2017.

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To view web map application, please visit the following address: http://csulb.maps.arcgis.com/apps/webappviewer/index.html?id=fcbb89e3d4d94291993bbfab9414a704