

GUIDING BUSINESS ORIENTED  
VOLUNTEERED GEOGRAPHIC INFORMATION  
THROUGH GEOTRIGGER SERVICES:

A CASE STUDY of CROSSFIT AFFILIATES

by

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## **DEDICATION**

In memory of Elizabeth Cruz Snyder. Thank you for teaching me that we never lose our ability to learn.

## **ACKNOWLEDGMENTS**

To my husband Jay who supported me throughout this endeavor, your simple words of encouragement never went without notice. To Charlie, words cannot define your unconditional support and love. Joanne, the only other graduate student who displayed more energy than I did, thank you for making me laugh every step of the way and for completing this journey with me. I am also indebted to Tommi, whose knowledge on arrays was critical to my success. To my advisor Yao-Yi Chiang, thank you for your patience during this process. Finally, I would like to recognize the remainder of my committee and each faculty member that I have met along the way.

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## LIST OF ABBREVIATIONS

AAG	Association of American Geographers
API	Application Programming Interface
BaaS	Backend as a Service
CFHQ	CrossFit Headquarters
GDB	Geodatabase
GIST	Geographic Information Science and Technology
GPS	Global Positioning System
IDE	Integrated Development Environment
iOS	iPhone Operating System
JSON	JavaScript Object Notation
LBS	Location Based Services
OBJ-C	Objective Computing Programming Language
OCALM	Official CrossFit Affiliate Locator Map
OEM	Original Equipment Manager
OS	Operating System
OSX	Operating System 10
SaaS	Software as a Service
SDK	Software Development Kit
SMS	Short Messaging Service
SSI	Spatial Sciences Institute
URL	Uniform Resource Identifier
USC	University of Southern California

VC	View Controller
VGI	Volunteered Geographic Information
WOD	Workout Of the Day

## **ABSTRACT**

Customer feedback is a platform to share awareness about a business or service between consumers and is an excellent resource for gathering information needed to determine if that business or service is satisfying customer requirements. Yet, consumers will often fail to leave reviews if the process to do so is too lengthy, overly complicated, or if too much time has passed after visiting a business. Reading numerous reviews often requires consumers to dedicate a considerable amount of time to compose or examine and frequently provide extraneous amounts of information irrelevant to the business reviewed. Problems also arise from the use of oversimplified rating scales that lack context and become meaningless when consumers do not know what attributes scores are based on. The existence of these issues creates the demand for a tool that can collect, compile, and deliver relevant business reviews back to consumers quickly and in a user-friendly format.

The tool developed for this study consisted of a mobile application that uses the CrossFit business model and associated CrossFit affiliate locations as a case study. By using a geotrigger service, the application prompts users to provide Volunteered Geographic Information (VGI) that consists of customer feedback, in the form of a brief survey, immediately after visiting an affiliate location. The application compiles gathered survey scores and then provides them back to users in near real-time. Evaluation of the mobile application found that it assisted consumers in making more informed decisions when attempting to select which CrossFit affiliate to patronize and accomplished its intended purpose of collecting and disseminating information obtained in near real-time directly from customer feedback.

## CHAPTER 1: INTRODUCTION

The incorporation of Location Based Services (LBS) in Geographic Information Systems (GIS) has been in use for over a decade and extends GIS capabilities and spatial information processing to end users through the Internet or a wireless network (Koeppel 2000). With an ever-growing dependency on mobile devices and the constant desire to have these devices within arm's reach (Gibson 2011), the extension of spatial services that LBS offers has the potential to reach an extremely large percentage of the population. This is especially so if we consider that 91% of American adults own and use cell phones for more than just phone calls (Pew Research Center 2013). For this simple fact, many companies such as Dunkin Donuts (Dunkin Donuts 2011) and 7-Eleven (7-Eleven 2015) employ LBS as a form of mobile marketing in an effort to gain new clientele or to maintain customer loyalty. Mobile marketing practices include the earning of consumer loyalty incentives such as, promotional discounts on future purchases, coupons for current promotions, and special access to advertisements. Consumers may have the ability to use a check-in feature from their device that reports location based activity information back to social media websites (e.g., Facebook.com) or directly back to the business employing the service. Each of these approaches link the consumer to a geo-location that provides information used to interpret consumer behavior.

Traditionally, LBS technologies work by implementing a function called geofencing that signals a mobile application to transmit an alert to the device once it has crossed the geographic boundary of a virtual perimeter referred to as a geofence (Nait-Sidi-Moh, Bakhouya, & Gaber 2013). Examples of alerts can consist of an email, in-app message, or push notification, all of which promote spontaneous dialog between the application and the user based entirely on the devices geographic location. On 19 November 2013, Esri publically announced the release of

their Geotrigger Service. The service uses geofences like LBS to add location based awareness to mobile applications by triggering a device to generate push notifications that alert users to an event or notify a server to execute a custom event (Geoloji 2013). The Esri Geotrigger Service places an emphasis on minimizing battery drain, having a flexible Application User Interface (API) for expanding development of use cases beyond the simple device-to-user alert, and seamless integration into a variety of platforms, all of which are advancements over previous geofencing technologies (Esri 2015).

This thesis evaluates the effectiveness of a mobile application utilizing geotriggers as a method to aid in the collection of business oriented Volunteered Geographic Information (VGI) in near real-time. Geotriggers act as a prompt for users to submit VGI in the form of consumer surveys that inquire about CrossFit affiliates (detailed in Chapter 2).

## **1.1 Motivation**

CrossFit is a trademarked name for a corporation and a fitness program that combines high intensity interval training, Olympic weightlifting, gymnastics, plyometric, and other forms of exercise. Daily exercises, referred to as the Workout of the Day (WOD), are normally done in a group class setting concentrated around a core strength and condition program that is a broad and inclusive style of fitness (Glassman 2002).

The popularity of CrossFit has grown into an international phenomenon since its inception in 2001. Every month new locations open and as of June 2014 there were over 10,000 registered CrossFit affiliates located throughout the world as shown in Figure 1 (Beers 2014). As new affiliates continue to open, consumers have an overabundance of choices when it comes to selecting which location they should patronize. This can easily become a daunting task for consumers; especially those who are new to the CrossFit community and thus limited in their

knowledge as to what key components distinguish one affiliate as a better choice compared to the next.

Acknowledgement of these challenges necessitates the requirement for a tool that can help answer consumer questions. The goal of this application is to assist consumers in making decisions that are more informed by providing them with attribute data on affiliates obtained directly from consumer feedback. The collection, compilation, and delivery of information derived directly from customer experiences immediately after they have occurred can accomplish this. An added benefit is that affiliate owners, if they desire, can also use the collected information to improve business practices based on input from their primary consumer group. By guiding business oriented VGI to answer industry specific questions, such as the quality of the coaching staff or cleanliness of a facility, the application gives users access to information in a more focused manner as compared to the time it takes to examine numerous written reviews from resources similar to Yelp (Yelp 2015), Google+ (Google 2015), or Foursquare (Foursquare 2015).

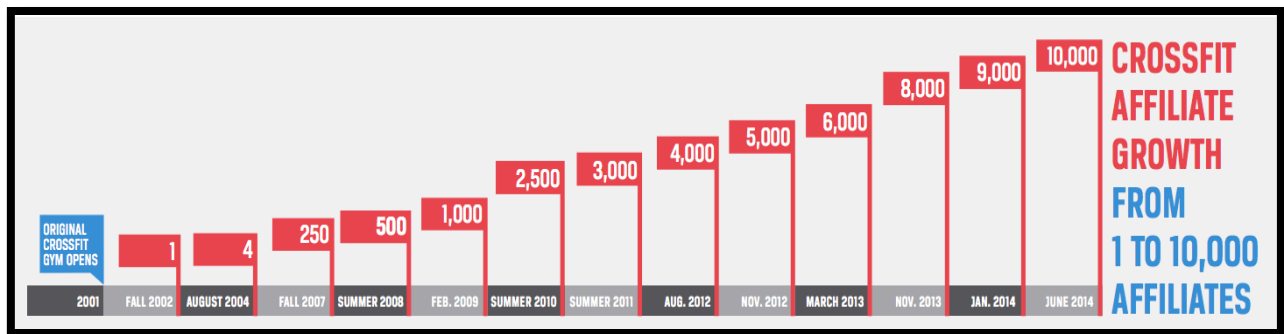


Figure 1 CrossFit Affiliate growth from 2001 to 2014. Source: Beers 2014

## 1.2 Application Overview

The SurveyWOD application built as part of this thesis, hereafter termed “app” runs on the Apple iPhone Operating System (iOS). The app prompts users to provide requested VGI via

push-notifications sent directly to the device upon exit from a designated geofence. The notification invites users to provide feedback on relevant business oriented information in the form of a short structured survey. Structured survey questions inquire about qualities determined to of relevance and of value when choosing a CrossFit affiliate.

Less influenced purely by the convenience of proximity, consumers rely more on reviews as an important factor in deciding which local business they should use (Anderson 2013). This offers an ideal setting for testing the app in a competitive market and observing how it can be of considerable value to consumers and business owners alike. Additional functions of the app allow for users to search nearby affiliates, generate driving directions, view current ratings, and rapidly identify highly rated locations within close proximity to the devices current location.

The geographic area covered by the app's spatial extents is a subset of CrossFit affiliate data points located in the North County Coastal region of San Diego, California. Cities included in this region are Encinitas, Carlsbad, San Marcos, and Vista, as seen in Figure 2. The subset of selected cities represents a relatively small geographic area moderately saturated with affiliates. For the scope of this project, utilization of a smaller sample size minimizes the time needed to compile, populate, and manage the affiliate database, but is easily extendable to an unlimited number of data points as needed. Because the mobile device needs to physically reside at each affiliate to support field-testing, the distance between furthest points does not exceed more than twenty-minutes of driving time. Like the sample size, the spatial extents of the app are expandable and can work over any geographic area.

Project objectives and design considerations for development of the SurveyWOD app include: (1) design an app that allows users to locate, select, view attribute data, and generate driving directions for affiliates within a feature database; (2) prompt users to provide VGI in the

form of a structured three question customer survey via push notifications; (3) provide compiled survey data back to the end user in real-time so that it can be accessed within the app via a graphical map display and evaluated by the user as needed.

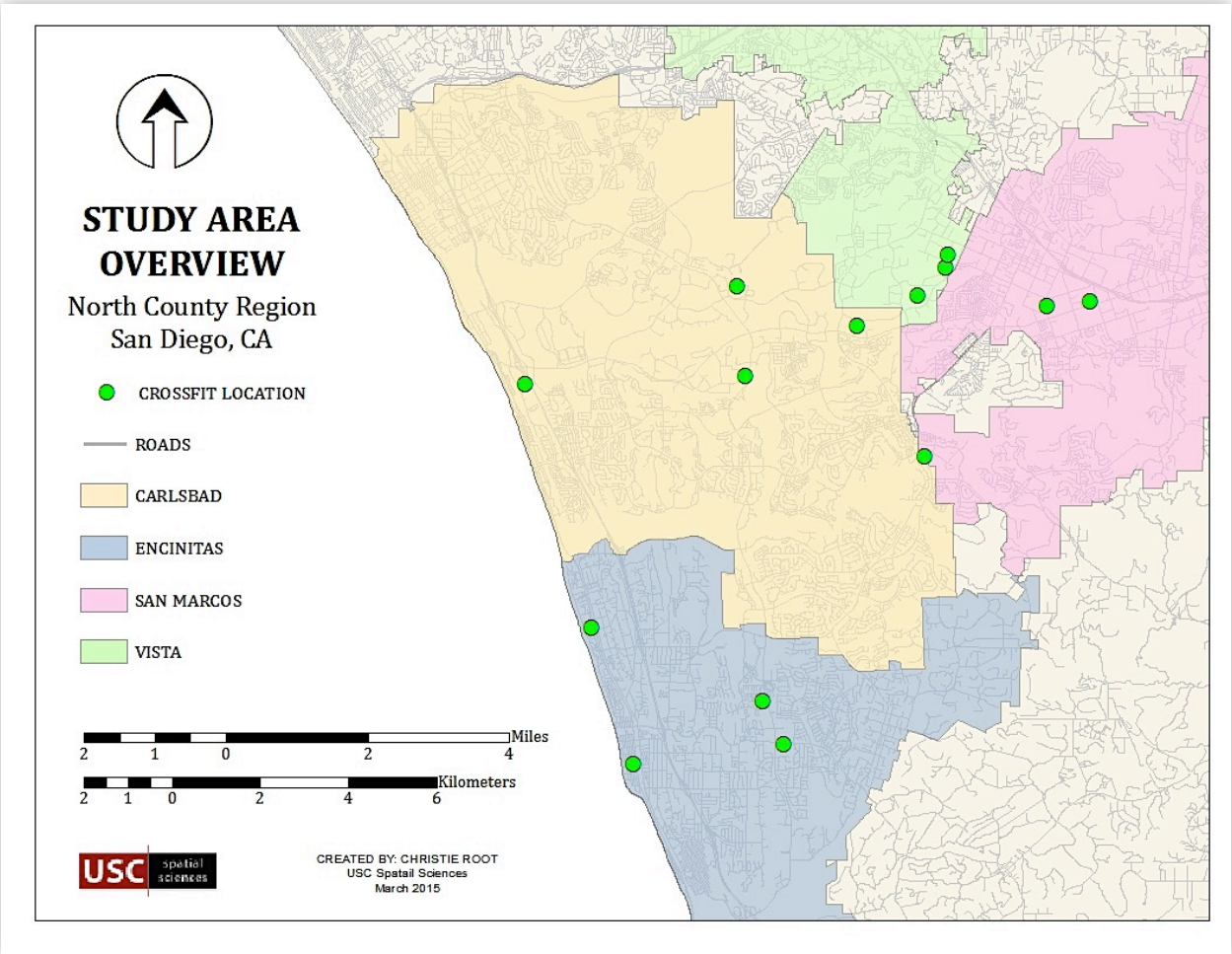


Figure 2 Geographic extents of the study area.

### 1.3 Choice of Technologies

The SurveyWOD app developed for this project operates on the Apple iOS 8 mobile platform built using the Apple Xcode 6.2 Integrated Development Environment (IDE). One reason for development using the Apple mobile platform was based on the fact that Apple still



holds a large majority of the mobile device market. According to the February 2015 report published by comScore (2015) Apple ranked as the top Original Equipment Manager (OEM) producer with 41.7 percent of the U.S. smartphone subscriber population. By developing for this market of potential users, the opportunity to reach a large target audience increases. In addition, Xcode 6.2 offers a more superior IDE in terms of its user interface, development flexibility, and debugging capability that heavily influenced development for Apple.

The app is written in the Objective-C programming language and includes several programming libraries referred to as dependencies, which integrate existing sources of code from other developers to quickly incorporate various capabilities. These dependencies include the Esri Geotrigger Service Software Developer Kit (SDK) (Esri 2015), the Parse SDK, SVProgressHUD (Veremette 2011), and Apple's MapKit and CoreLocation Frameworks. The 5-star rating iOS component entitled RatingView, developed by Hélesbeux (2013) is obtainable through the GitHub Repository. All incorporated technologies are open source and freely available for use by the public, which made them an excellent choice for development of this project. The use of the CocoaPods dependency manager for Objective-C projects, allowed for seamless integration and update of all app dependencies with minimal effort (CocoaPods 2015).

## **CHAPTER 2: BACKGROUND AND LITERATURE REVIEW**

Chapter 2 provides an introduction into CrossFit affiliates and discusses methods and resources considered during creation of the SurveyWOD app built as a part of this thesis project. Section 2.1 is a brief summary of CrossFit affiliates. Section 2.2 provides an overview of Volunteered Geographic Information (VGI). Section 2.3 examines various methods for rating consumer feedback and explains which ones did or did not meet project objectives. Section 2.4 introduces the basic functionality of Esri Geotrigger Service. Section 2.5 explores similar resources related to CrossFit currently available to the public

### **2.1 CrossFit Affiliates**

The equipment needed to complete a CrossFit workout can vary greatly, be relatively expensive to purchase, and require a sizeable amount of space to store. Because of these factors, CrossFit training typically requires the use of an established affiliate location in order to complete daily workouts.

Although affiliates carry the CrossFit brand name, locations are individually owned and operate independently of each other. This results in significant variations between each affiliate location and in an athlete's experience. This can become an issue if the services provided are inadequate or if the goals of the affiliate are not in line with the athletes. Some affiliate locations choose to concentrate more heavily on one form of fitness over another, such as Olympic lifting versus gymnastics. Many affiliates aim to create a family orientated environment while others are extremely competitive and push their athletes to perform at higher and more intense performance levels. An affiliate's coaching staff can also vary greatly dependent upon individual personalities, extent of experience and training, or their ability to motivate and connect with athletes. Considering this and that the average monthly cost for membership can run anywhere

between \$150 - \$250, consumers should ensure that the affiliate they choose is one that will meet their fitness goals and provide an enjoyable environment.

Both veterans of CrossFit and novices should recognize some of the key characteristics that distinguish one location from another. Derived from the right source and implemented correctly, consumers can use feedback to help identify these characteristics and gauge whether or not a business will meet their needs. Because we have identified that the purpose of feedback is to share awareness between consumers (Chapter 1), this makes it an excellent resource for assembling information needed to determine if a businesses is satisfying consumer requirements.

## **2.2 Volunteered Geographic Information**

VGI harnesses tools to create, assemble, and disseminate geographic data provided voluntarily by individuals (Goodchild 2007). As consumer feedback is dependent on the customers willingness to voluntarily provide input on a product or service, VGI is dependent on human volunteers acting as sensors of the environment to willingly contribute to the creation, collection, and the dissemination of geographic information. According to Arigos and Mann (2010) VGI is a specific example of a community-based information collection model that features content created by end users. In addition, the content collected provides information from a person's direct knowledge on a subject, in this case CrossFit, to assist potential consumers in making decisions.

VGI collected as part of the SurveyWOD app consists solely of information obtained from users who freely volunteered to give their opinions about CrossFit affiliates. To gather VGI, users complete a brief in-app survey for specific affiliate that inquires about items relevant to CrossFit. To ensure the effectiveness of these surveys, evaluation and research of various forms of consumer rating systems took place.

The collection of VGI for this project differs from other VGI based projects that collect customer feedback in several ways. Mobile applications like TripAdvisor (2015) collect customer feedback as written reviews or a single overall star rating. Foursquare (2015) collects reviews for a multitude of business types and only asks users if they liked or disliked a location and accepts written reviews. Each of these mobile applications utilizes LBS elements such as geoawareness and geofencing to create location aware applications. Yet, LBS is not used in these applications to solicit feedback back from users in near real-time.

Expedia (2015) currently uses a service developed by Routehappy to collect near real-time customer feedback. Routehappy is a differentiation platform designed to rate air travel comfort, which aggregates collected data and then returns estimated ratings (Routehappy 2015). On conclusion of a flight segment, a user will receive a notification in the form of an email requesting input. The notification contains a link to a short survey with questions about their recent air travel as it relates to comfort. The user rates aspects like seat comfort, inflight entertainment, and wi-fi by selecting either a happy or a sad face. The trigger to receive these notifications is based on user flights and is tied to several complex algorithms that Routehappy refers to as Flightmatch that is linked to an extensive database maintained and updated by Routehappy known as Flightpad (PRNewswire 2014). Following elements of this model, the SurveyWOD app asks industry specific questions directly related to one business or category. This strategy helps to guide users towards submitting explicitly more focused VGI with increased credibility. In addition, collected VGI is tied to predetermined geographic data points, which improves the spatial accuracy of collected VGI because the uncertainty over its geographic origins becomes diminished.

## **2.3 Rating Consumer Feedback**

Systems for collecting and rating consumer feedback are two approaches to opening dialogue between people and the particular service they seek. If done incorrectly and without forethought, the collection and rating of consumer feedback can have a biased influence and limited effectiveness. All methods of collecting consumer feedback have advantages and disadvantages and can generally operate independently or in conjunction with another method. This section examines three types of review methods commonly used to collect and rate feedback considered for this project. To meet the objectives of the SurveyWOD app, feedback method could not require an excessive amount of time to complete or use values that were not directly attributable to qualities recognized as important to the CrossFit community.

### ***2.3.1 Written Reviews***

Several online forums allow users to rate businesses by leaving opinion-based reviews about their experiences. Yelp.com is one of the more popular examples of this type of resource. Prospective consumers are able to search by a variety of means such as name, business type, or physical location. Once searched, consumers can view submitted reviews in order to begin the process of researching potential businesses. Users leave written feedback along with star rating however, these reviews do not always accurately reflect the true merit of a business. Consumers may rate a business poorly if they did not like location of the facility or if they were unable to find a good parking spot. Negative reviews, which may be completely unrelated to the business, have a tendency to sway consumer perceptions more than a positive review would. This produces a negative bias in potential customers based solely on the fact the overall theme of the review was unfavorable and not based on its actual content (Baumeister et al. 2001).

Gideon Lewis-Kraus discusses some of the additional flaws that plague the validity of reviews posted on websites like Yelp in his May 2013 article in *The New Yorker* (online edition). He argues that the practice of businesses acquiring positive reviews by any means possible, i.e. rewarding reviewers for input, as being problematic. In the case of CrossFit, most Yelp searches will reveal that nearly every CrossFit affiliate has great reviews and a 5 star rating, which could be a result of gym members being asked to submit positive feedback on behalf of the affiliate (Figure 3). Lewis-Krause also states that, “the fact that Yelp makes money by selling ads and prime placements to the very businesses it lists under ostensibly neutral third-party review” as another primary problem because it manipulates the consumers perception and undermines the ratings statistical relevance.

With so much room for external bias in written reviews and the substantial amount of time needed to read composed assessments, this method failed to satisfy app objectives outlined

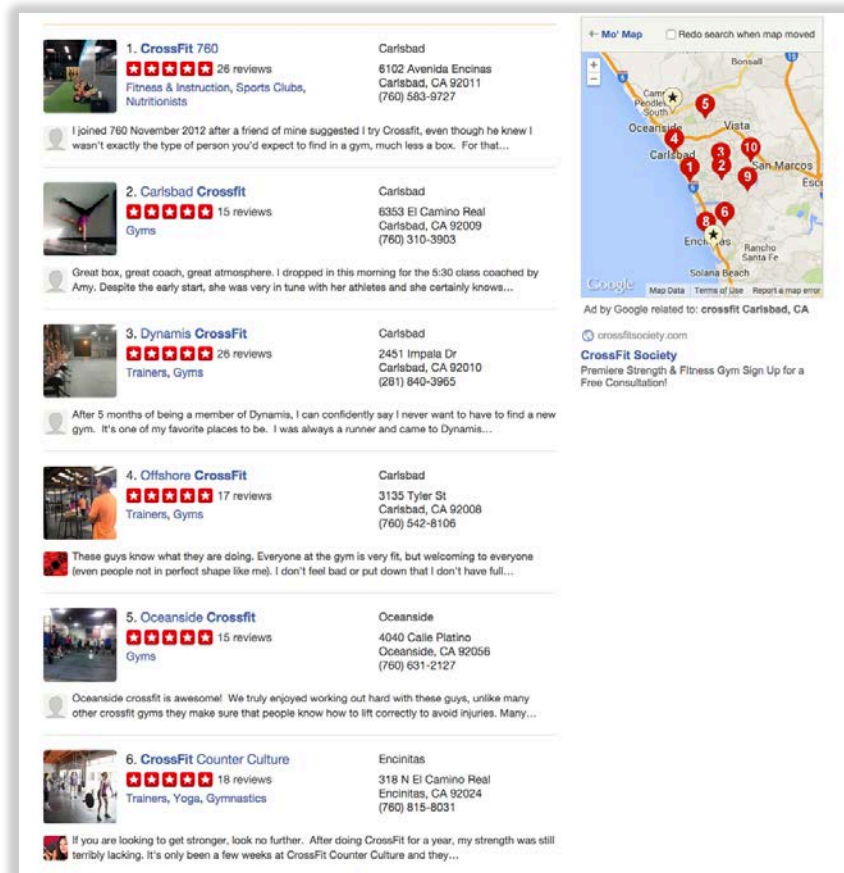


Figure 3 Yelp reviews of CrossFit Affiliates.

in Section 2.3. This project excluded written reviews entirely and went with the following two systems of review instead.

### ***2.3.2 Five-star Ratings***

A five-star rating system can measure aspects of business performance on a scale of 1 -5 and represent this measurement graphically using star icons. The advantage to this system is its ability to symbolize average scores so users can easily visualize and assess multiple ratings quickly. A potential shortfall to this system arises when consumers are unable to determine how a score is compiled. This occurs when no standard for star rating values exist because an unknown or unpublished criterion for scoring and ranking is used or made available to the public. Alternative drawbacks can transpire when used in conjunction with other methods such as written reviews. Five-star rating averages can detract consumers away from important details that could be contained within the textual portion a review.

Although star ratings appear arbitrary in nature, they are beneficial and are widely recognized as one of the most common methods of rating (Carr 2013). They have the ability to quickly inform consumers because basic inferences can be determined about a business, such as a five-star rated business will generally yield a better consumer experience as compared to a one-star rated business (Usman et al. 2010). In addition, a survey system comprised of numerically valued responses is a decidedly more efficient method for tabulating results swiftly.

Due to simplicity, the ability to quickly illustrate calculated values, and the public's familiarity with the star rating systems it is integrated in the app. To avoid concerns about what values are based on or determined, the star rating system and the structured survey are used in tandem.

### **2.3.3 Structured Surveys**

Structured surveys have the advantage of permitting examiners to maintain more control over the collection of feedback from respondents. This study used a “closed” structured survey, defined as quantitative approach to collecting user feedback where each question is predetermined and each participant receives that same survey questions (HistoryLearningSite 2011). In addition to retaining control, another advantage to the closed structured survey is how it easily combines with other methods of collection such as the five-star rating discussed in Section 2.2.2. A potential concern is the risk of selecting irrelevant survey questions or survey questions that only the examiner has determined to be of value. To help mitigate the potential for irrelevancy two articles, 13 Tips for Choosing a CrossFit Gym (Huntley 2011) and Tips for Choosing a CrossFit Gym (Jenkins 2015) functioned sources for extracting appropriate survey questions. Both articles examine various elements that make a successful CrossFit Affiliate and what potential members should consider before buying a membership.

### **2.4 Esri Geotrigger Services**

The Esri Geotrigger Service works by utilizing a mobile devices built-in Global Positioning System (GPS) to determine when a device has crossed, either by entering or exiting, the geographic boundary of an establish geofence (Tengku 2013). This service extends traditional geofencing technology with the inclusion of a variable tracking profile referred to as “adaptive.” The adaptive tracking profile automatically adjusts GPS updates to optimize location accuracy that helps minimize battery drain (Esri 2015). Both complex polygons and point radius features can represent the geographic extents of a geotrigger. In addition, a developer may create an unlimited amount of geofences hosted in the cloud whereas only a small number of geofences can be stored on a device using the Apple native geofencing capability.



The crossing of a geofence threshold causes communication between the device and the geotriggger service to begin. The device first signals the geotriggger service, which in turn prompts the app to perform an action. This action, referred to as a “trigger,” consists of a condition and an action, whereas the action informs the service to send a Short Messaging Service (SMS) push notification (Esri 2015). When attempting to engage consumers in near real-time, the benefit comes from how SMS notifications immediately start a dialog between the mobile application and the consumer during the crucial moments that they are engaging in the experience (Estopace 2014). This reduction in engagement time combined with the implementation of a brief, structured star rated survey, addresses the issues identified in section 1.2 and meets the application objectives

## **2.5 Availability of Similar Resources for CrossFit Reviews**

The availability of resources related to researching CrossFit affiliates, mobile or web based, are limited in their scope. Those that do exist typically fall into three separate categories.

The first category is comprised mostly of web based services and a small amount of mobile applications that only offer functionality such as mapping affiliate locations and providing basic information that includes phone number, address, website, and driving directions. These types of resources offer little to no insight on business practices that can alert users to the quality of the services they provide.

Resources similar to Yelp and Foursquare that provide consumers with an open forum to submit written reviews along with star-ratings (Yelp 2015) make up the second category. These sources can often be time consuming to navigate and may not always provide a true reflection of the reviewed business (Section 2.3.1).

The third category consists of applications that allow access to services used by affiliate owners to manage business aspects of their gym and offer some client features as well. An example of this is the Wodify application. Wodify delivers business functions such as billing, membership, sales, and payroll for owners while athletes are able to track workouts, nutrition, and membership dues (wodify.com 2014). While designed for CrossFit affiliates, athletes can only use this application and its accompanying features if they are paying members of an affiliate that utilizes Wodify and maintains an active subscription.

A mobile resource to search and access basic business information combined with the ability to quickly view consumer ratings based on the qualities deemed relevant for CrossFit affiliates by the CrossFit community (detailed in Chapter 3) does not exist. The application developed for this thesis resolves issues by leveraging the advantages of multiple reviewing methods to provide users with a positive experience and a necessary resource to help in their decision-making process. Another benefit of the application is that it can also be utilized by business owners who are seeking related metrics that can help them to improve various aspects of their business based directly off customer feedback.

## CHAPTER 3: METHODOLOGY

This chapter examines the design and development of the SurveyWOD app built as a part of this thesis project and discusses how the app achieves project goals and objectives outlined in Chapter 1. Section 3.1 provides a general overview of application architecture and identifies the main components of design. Section 3.2 reviews how affiliate data utilized in the app is gathered and processed. Section 3.3 explains the implementation of geotriggers. Section 3.4 reviews how application data is stored and managed. Finally, section 3.5 examines development and demonstrates the complete user experience when running the app.

### 3.1 Application Architecture

The application architecture represents a summary of significant design components for development of the SurveyWOD app (Figure 4). The first component consists of processing of affiliate business data into a readable format for the app. The second component discusses the receiving of push-notifications using geotriggers. The third component focuses on how data is

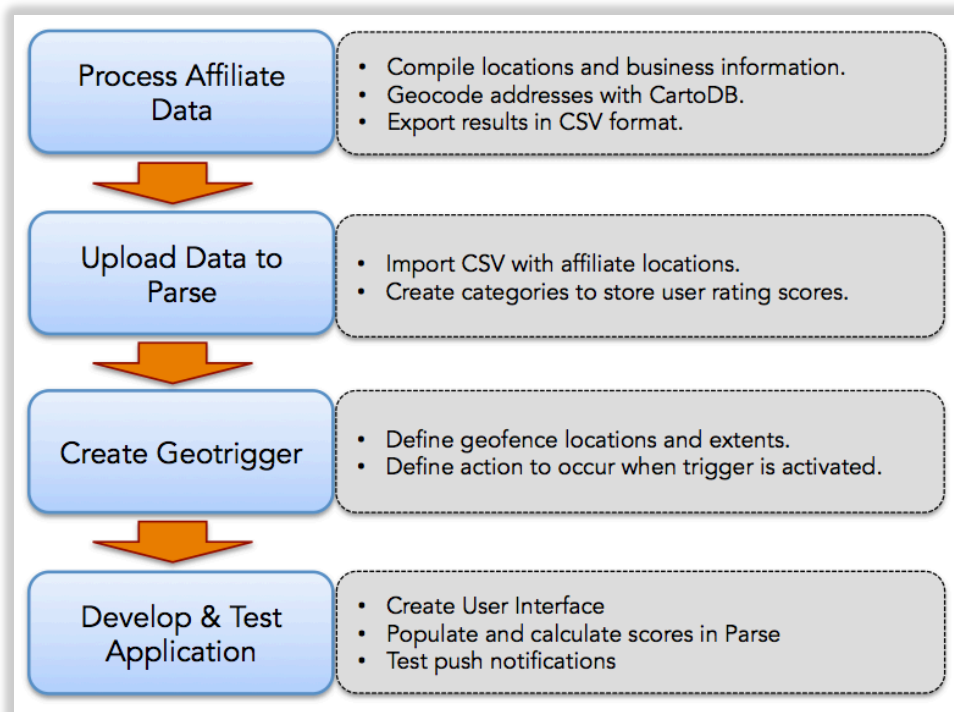


Figure 3 Components of development.

stored and managed using cloud storage. The last component reviews app development and the overall the user experience.

### **3.2 Process Affiliate Data**

For the SurveyWOD app to function properly it must display affiliate locations and associated business listing information to users. This requires up-to-date contact information and geographic coordinates for each affiliate. Section 3.2.1 reviews data collection methods and section 3.2.2 reviews the process of generating coordinate information.

#### ***3.2.1 Data Collection***

Data manually collected for affiliates includes business name, street address, telephone number, and website. The CrossFit Headquarters (CFHQ) Official CrossFit Affiliate Gym Locator (<http://map.crossfit.com>), populated with affiliates legally registered with CFHQ and the CrossFit trademarked name (Saran 2013), supplies this information. While the Official CrossFit Affiliate Gym Locator (OCAGL) is the definitive source for affiliate information, the data originates from an owners original affiliation application. If changes occur, information found on the OCAGL does not update automatically. Figures 5 and 6 provide a comparison of information listed by the OCAGL website compared to the corresponding business website. The yellow box on each image highlights the inaccuracy of the mismatched phone numbers. To correct for this, business listing information found on the OCAGL website is cross-referenced against each affiliates website to improve data accuracy. After validation and correction of information, it is then populated into a Microsoft Excel spreadsheet and saved as a Comma Separated Values (CSV) file (Figure 7) in preparation to be geocoded.

## Find a Local CrossFit Location

At these independently-owned CrossFit affiliate locations, you'll find all the equipment you need and get hands-on training from CrossFit trainers.

Click on the markers for more detail.

Surf the map, enter a starting location:

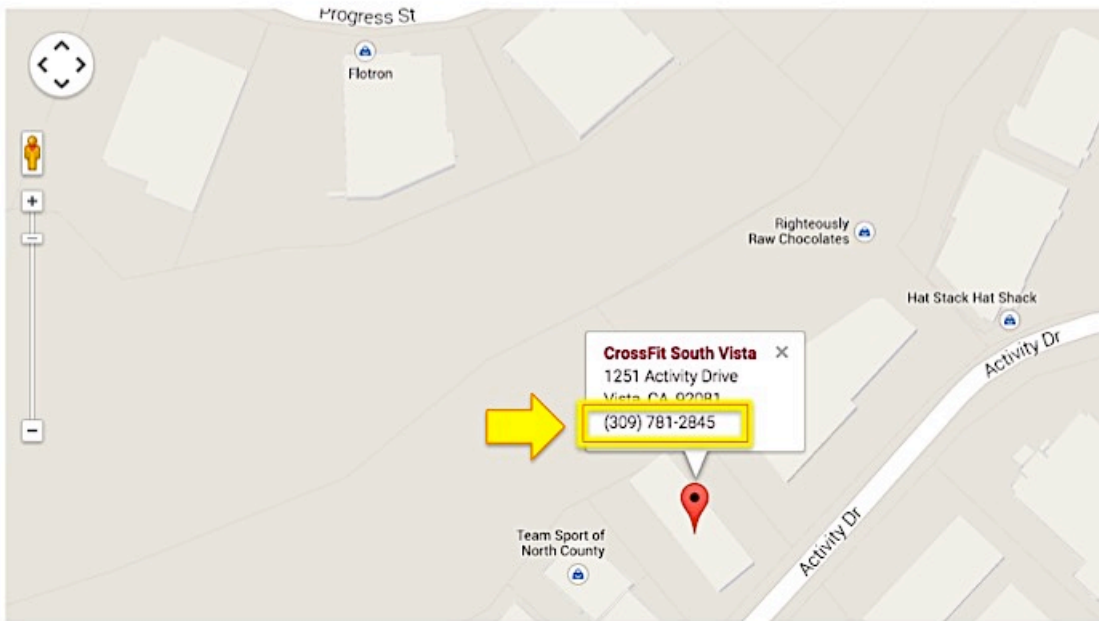
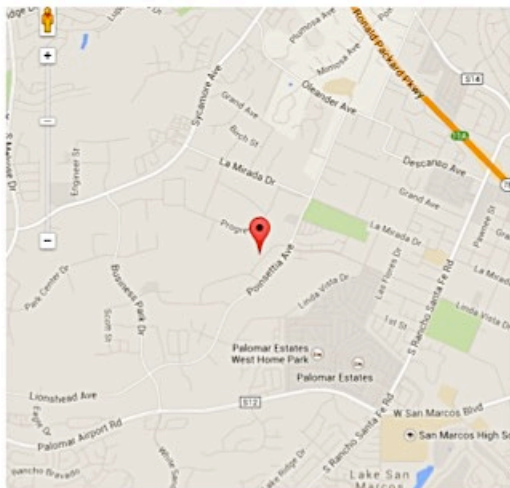


Figure 4 Official CrossFit Affiliate Locator Map showing incorrect record. (maps.cossfit.com 2015)

## CONTACT US

A YEAR FROM NOW YOU WILL WISH YOU STARTED TODAY



### REGISTER NOW FOR YOUR COMPLIMENTARY CONSULTATION

Are you ready to learn more about how you can improve your health and fitness and get the results you want from a fitness and nutrition program. Are you tired of 'spinning your wheels' and going nowhere, and are serious about getting results and reclaiming your health once and for all. Are you interested in more information about your programs, including group and exclusive coaching. Please contact us to schedule a complimentary private consultation!

Submit

Figure 5 CrossFit website with correct record (crossfithsouthvista.com 2015)

name	number	street	suite	city	state	zip	country	phone	website
House of Cro	3146	Tiger Run Court	120	Carlsbad	CA	92010	USA	(760) 805-75	<a href="http://houseofcrossfit.com/">http://houseofcrossfit.com/</a>
CrossFit Sout	1251	Activity Drive	F	Vista	CA	92081	USA	(760) 295-28	<a href="http://crossfitsouthvista.com/">http://crossfitsouthvista.com/</a>
CrossFit Trife	2588	Progress Street	2	Vista	CA	92081	USA	(858) 344-99	<a href="http://crossfittrifecta.net/">http://crossfittrifecta.net/</a>
CrossFit 760	1945	South Rancho Santa Fe	C	San Marcos	CA	92078	USA	(760) 517-63	<a href="http://www.crossfit760.com/locations/san-marcos/">http://www.crossfit760.com/locations/san-marcos/</a>
CrossFit 760	6102	Avenida Encinas	H	Carlsbad	CA	92011	USA	(760) 517-63	<a href="http://www.crossfit760.com/locations/carlsbad/">http://www.crossfit760.com/locations/carlsbad/</a>
Carlsbad Cro	6353	El Camino Real	G	Carlsbad	CA	92009	USA	(760) 310-39	<a href="http://www.carlsbadcrossfit.com/">http://www.carlsbadcrossfit.com/</a>
US CrossFit	849	Second St		Encinitas	CA	92024	USA	(760) 230-67	<a href="http://uscrossfit.com/">http://uscrossfit.com/</a>
1465 CrossFi	146	Encinitas Blvd # A	A	Encinitas	CA	92024	USA	(760) 633-19	<a href="http://teamquestencinitas.com/crossfit/3026771">http://teamquestencinitas.com/crossfit/3026771</a>
CrossFit Cou	318	N El Camino Real	B	Encinitas	CA	92024	USA	(760) 815-80	<a href="http://www.crossfitcounterculture.com/">http://www.crossfitcounterculture.com/</a>
CrossFit Leuc	1144	N. Highway 101		Encinitas	CA	92024	USA	(760) 818-90	<a href="http://www.crossfitleucadia.com/">http://www.crossfitleucadia.com/</a>
CrossFit Poin	1285	Stone Drive		San Marcos	CA	92078	USA	(760) 801-93	<a href="http://crossfitpointa.com/start.php">http://crossfitpointa.com/start.php</a>
CrossFit 2.0	844	W. San Marcos Blvd	103	San Marcos	CA	92078	USA	(760) 525-80	<a href="http://www.crossfit2-0.com/">http://www.crossfit2-0.com/</a>
CrossFit Iron	1489	Poinsettia Avenue	131	Vista	CA	92083	USA	(530) 519-40	<a href="http://www.cfirons.com/">http://www.cfirons.com/</a>
Dynamis Cro	245	Impala Drive	B	Carlsbad	CA	92008	USA	(760) 845-85	<a href="http://dynamiscrossfit.com/">http://dynamiscrossfit.com/</a>

Figure 6 CSV of compiled affiliate business information.

### 3.2.2 Geocoding of Addresses

Geocoding is the process of deriving a geographic coordinates from a physical street addresses (Warf 2010) and the next step in processing collected data. CartoDB, an online resource that accomplishes this task quickly and efficiently, is a Service (SaaS) platform that provides cloud computing tools and resources for users (CartoDB 2015).

To geocode locations the previously compiled CSV file containing affiliate business data is uploaded into CartoDB. Because the CSV file has no spatial reference, a prompt asks the user to select a method of determining geographic location. The *By Street Address* option is selected, address fields are populated, and then the geocode process in ran. After CartoDB completes this task, addresses are exported as a point shapefile occurs. The shapefile acts as an intermediate file format to store the newly added coordinate information. Figure 8 illustrates the CartoDB geocode user interface.

Following this, the shapefile uploads to ArcGIS Online as a feature layer and then immediately exported as a new CSV (Figure 9). This additional file conversion step creates a new CSV containing readable latitude and longitude information for each location, which is not

available through CartoDB. Figure 10 depicts the final CSV containing the newly added coordinate information.

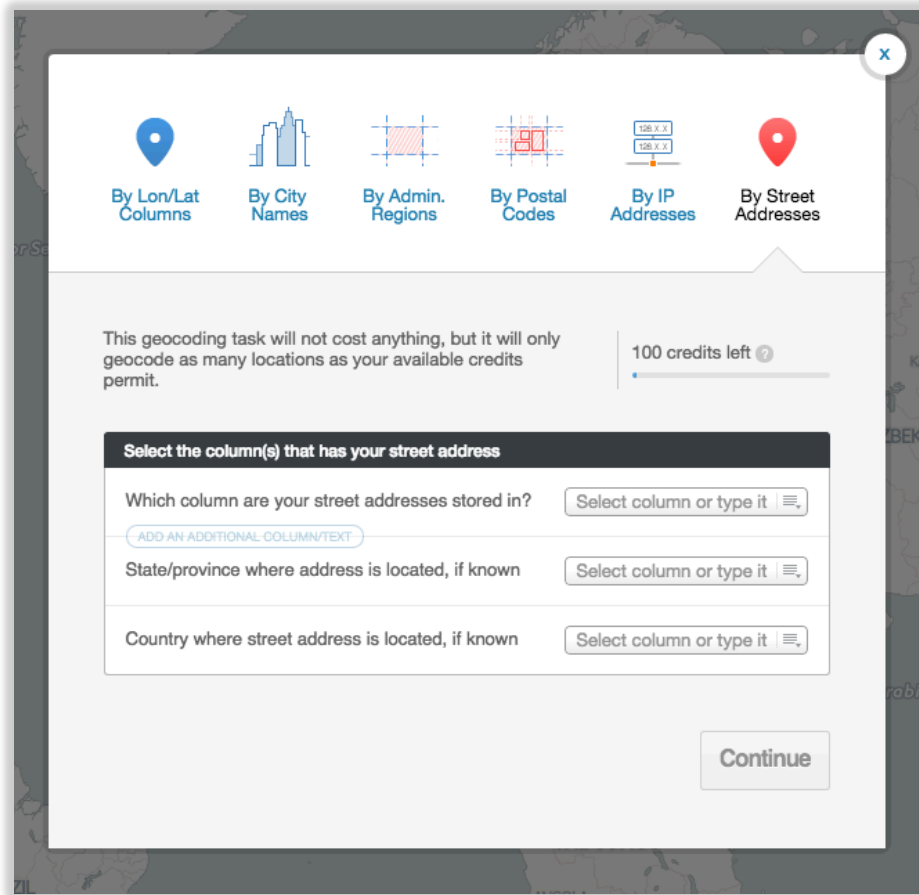


Figure 7 CartoDB geocode user interface.

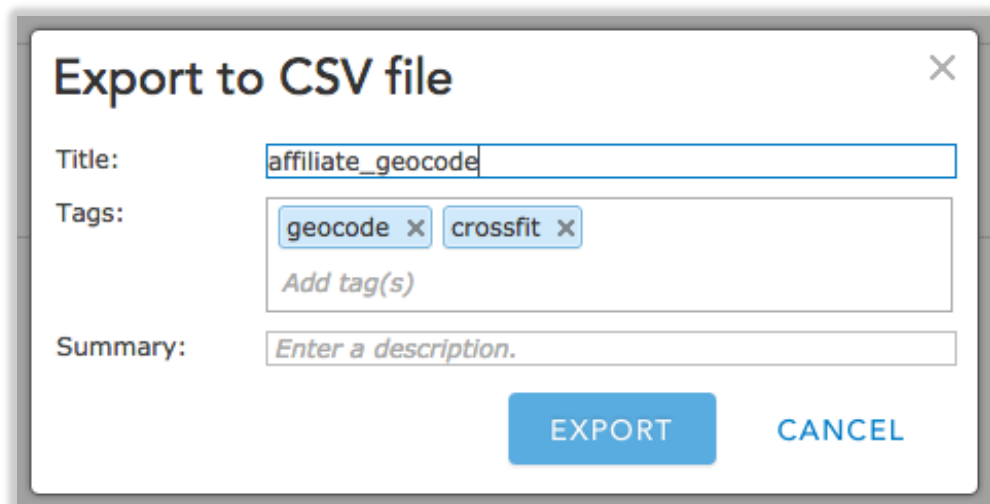


Figure 8 ArcGIS Online CSV export interface.

name	number	street	suite	city	state	zip	country	phone	website	x	y
House of CrossFit	3146	Tiger Run Co	120	Carlsbad	CA	92010	USA	(760) 805-75	http://house	-117.2698236	33.13912837
CrossFit South Vista	1251	Activity Drive	F	Vista	CA	92081	USA	(760) 295-28	http://crossf	-117.2405821	33.13111563
CrossFit Trifecta	2588	Progress Stre	2	Vista	CA	92081	USA	(858) 344-99	http://crossf	-117.2259523	33.13744768
CrossFit 760 San M.	1945	South Ranch	C	San Marcos	CA	92078	USA	(760) 517-63	http://www.	-117.2192012	33.14333195
CrossFit 760 Carlsb.	6102	Avenida Enci	H	Carlsbad	CA	92011	USA	(760) 517-63	http://www.	-117.2185957	33.14596331
Carlsbad CrossFit	6353	El Camino Re	G	Carlsbad	CA	92009	USA	(760) 310-39	http://www.	-117.2238304	33.10448426
US CrossFit	849	Second St		Encinitas	CA	92024	USA	(760) 230-67	http://uscros	-117.3210175	33.11851454
1465 CrossFit	146	Encinitas Blv	A	Encinitas	CA	92024	USA	(760) 633-19	http://teamc	-117.2676087	33.12073753
CrossFit Counter Cu	318	N El Camino	B	Encinitas	CA	92024	USA	(760) 815-80	http://www.	-117.2939185	33.04095166
CrossFit Leucadia	1144	N. Highway 101		Encinitas	CA	92024	USA	(760) 818-90	http://www.	-117.2572934	33.04542393
CrossFit Point A	1285	Stone Drive		San Marcos	CA	92078	USA	(760) 801-93	http://crossf	-117.2626525	33.05418524
CrossFit 2.0	844	W. San Marc	103	San Marcos	CA	92078	USA	(760) 525-80	http://www.	-117.3042538	33.06885796
CrossFit Irons	1489	Poinsettia Av	131	Vista	CA	92083	USA	(530) 519-40	http://www.	-117.1944547	33.13551015
Dynamis CrossFit	245	Impala Drive	B	Carlsbad	CA	92008	USA	(760) 845-85	http://dynam	-117.1837196	33.136503

Figure 9 CSV with geocoding results.

### 3.3 Establishing Geotriggers

The SurveyWOD app requires parameters for when it should send push-notifications requesting user feedback to mobile devices (Table 1). Utilizing the built in GPS to determine if a device has crossed the geographic boundary of an established geofence, the Esri Geotripper Service provides a vehicle for creating and implementing these parameters into the app.

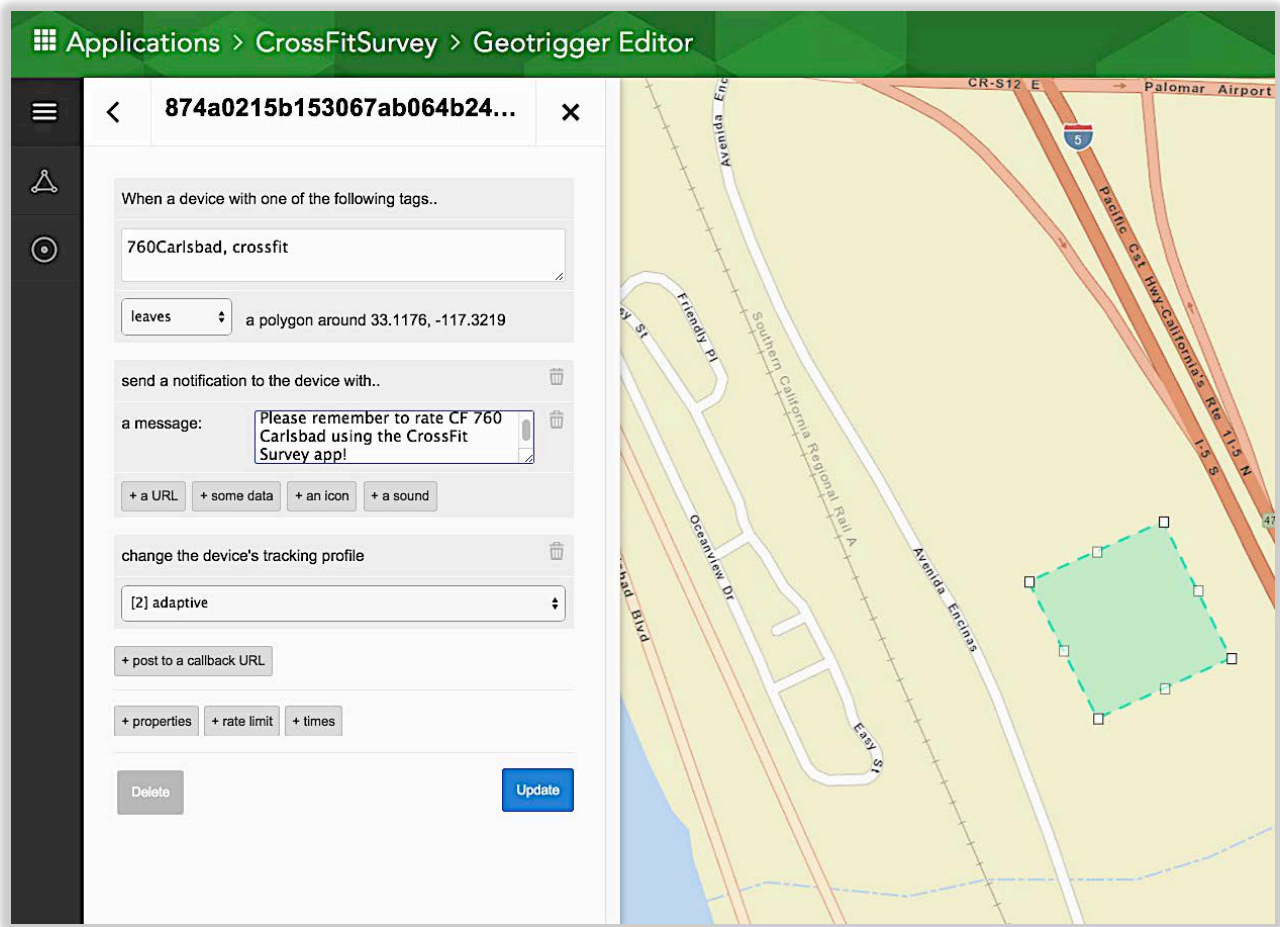
Available through the Esri Developer website, the Geotripper Editor is web-based tool to create, edit, and define trigger actions within the Geotripper Service (Esri 2015b). The process begins by entering an affiliate address in the Editors search toolbar. This causes the Geotripper

Table 1 Geotripper parameters.

Parameter	Value	Description
Exit	Upon Exit	Device must will receive notification after it has exited from a geotripper boundary.
Rate Limit	Every 90 Days	Limits how often a device can receive push-notifications
Tag	CrossFit	Only geotriggers labeled as a CrossFit will activate the trigger.



Editor map to center on the desired location. Next, drawing of either a polygon or a point radius circle on the map delineates the geotriggers geographic extents. Figure 11 provides a look at the Geotrigger Editors online user interface.



**Figure 10 Esri Geotrigger Editor web interface.**

Defining actions for each of the geotriggers is the final step to creating the geotrigger. When activated actions establish what will occur because of the geotrigger and for the scope of the project the action consists of a push-notification. Consideration of how the receiving of push-notifications may potentially affect or be interpreted by end users is necessary. According to

Tugui (2004), the concept of calm technology is the practice of informing users without overburdening them. Keeping in accordance with this concept a rate limit was set so that a device can receive a maximum of one notification once every 90 days per location.

### 3.4 Backend Data Storage and Management

Both business information and collected survey scores (discussed in section 1.2) must be accessible by all devices running the SurveyWOD application. Parse provides a straightforward solution to this requirement by offering a Backend as a Service (BaaS) that provides cloud storage (Parse 2015). Cloud storage allows for the flexibility needed to keep data and devices linked without the need to manage them locally. By importing the CSV file that contains the geocoded locations into Parse, the data becomes accessible to any device running the app. During the CSV import process, a table is automatically created within Parse to store affiliate data (Figure 12). Next, the creation of separate tables and fields needed to store scores submitted by users for the three in-app questions occurs.

<input type="checkbox"/>	objectId String	geometry GeoPoint	name String	buil...	suite Str...	street Stri...	city String	st...	zipco...	countr...	phone St...	url Stri...
<input type="checkbox"/>	5NdeamrCgJ	33.136503, -117.183...	CrossFit 2.0	844	suite 1...	W. San Ma...	San Marcos	CA	92078	USA	(760) 5...	http:/...
<input type="checkbox"/>	bzN2B60m6G	33.13551015, -117.1...	CrossFit Point A	1285	(undefi...	Stone Dri...	San Marcos	CA	92078	USA	(760) 8...	http:/...
<input type="checkbox"/>	Kd9qzrat6j	33.06885796, -117.3...	CrossFit Leucadia	1144	(undefi...	N. Highwa...	Encinitas	CA	92024	USA	(760) 8...	http:/...
<input type="checkbox"/>	H1fvmMve23	33.05418524, -117.2...	CrossFit Counter C...	318	suite B	N. El Cam...	Encinitas	CA	92024	USA	(760) 8...	http:/...
<input type="checkbox"/>	KsEvgYmDY6	33.04542393, -117.2...	1465 CrossFit	1465	suite A	Encinitas...	Encinitas	CA	92024	USA	(760) 6...	http:/...
<input type="checkbox"/>	XZ0Jd7vqAz	33.04095166, -117.2...	US CrossFit	849	(undefi...	2nd Street	Encinitas	CA	92024	USA	(760) 2...	http:/...
<input type="checkbox"/>	KF9m5u5tkB	33.12073753, -117.2...	Carlsbad CrossFit	6353	suite G	El Camino...	Carlsbad	CA	92009	USA	(760) 3...	http:/...
<input type="checkbox"/>	ZVJ06KPRv8	33.10448426, -117.2...	CrossFit 760 San M...	1945	suite C	South Ran...	San Marcos	CA	92078	USA	(760) 5...	http:/...
<input type="checkbox"/>	LinqA5kRow	33.11851454, -117.3...	CrossFit 760 Carls...	6102	suite H	Avenida E...	Carlsbad	CA	92011	USA	(760) 5...	http:/...
<input type="checkbox"/>	pcXpGqQfxt	33.14596331, -117.2...	CrossFit Trifecta	2588	Units 2...	Progress ...	Vista	CA	92081	USA	(858) 3...	http:/...
<input type="checkbox"/>	LQsVtTkLpn	33.14333195, -117.2...	CrossFit South Vis...	1251	suite F	Activity ...	Vista	CA	92081	USA	(760) 2...	http:/...
<input type="checkbox"/>	uI2ZymIYCF	33.13744768, -117.2...	CrossFit Irons	1489	suite 1...	Poinsetti...	Vista	CA	92083	USA	(530) 5...	http:/...
<input type="checkbox"/>	IMCTGTMC30	33.13111563, -117.2...	House of CrossFit	3146	suite 1...	Tiger Run...	Carlsbad	CA	92010	USA	(760) 8...	http:/...
<input type="checkbox"/>	5XQ4KICTSi	33.13912837, -117.2...	Dynamis CrossFit	2451	suite B	Impala Dr...	Carlsbad	CA	92008	USA	(281) 8...	http:/...

Figure 11 Parse table populated with affiliates data.

### 3.5 Application Development

This section reviews development of the SurveyWOD application built using the Apple Xcode 6.2 IDE and written in the Objective C programming language. Comprised of three individual views, users can search locations using a graphical map display, view detailed business information, or submit a review. Each view incorporates ancillary functionality aimed at enhancing the overall user experiences by making the app more interactive and engaging.

Before gaining access to the app's full functionality, users must agree to let the app collect their location using the devices built-in GPS capability (Figure 13). This allows the app to send push-notifications and plot user location based on the devices current position. Permission to collect user location information is required as part of Apple's policy and terms (Apple

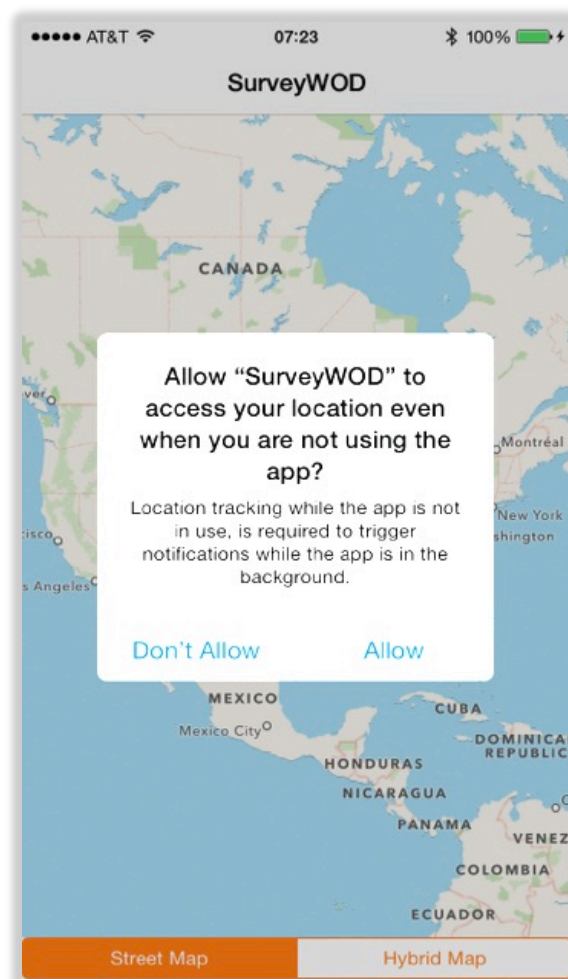


Figure 12 Authorization to collect location.

Developer 2015c). Once allowed, granting permission gives the user access to the first screen that displays the Map View.

### **3.5.1 The Map View**

Following authorization, the primary screen referred to as a Map View Controller (VC) loads and displays a location aware map. The map automatically centers on the users current location represented by a pulsing blue dot that continuously moves as it updates its position as the device transits from one location to the next. Using the Apple MapKit framework default red pushpin marker symbol, the map populates with the affiliate points stored in the Parse table (refer to section 3.4). Included functionality permits users to pan and zoom throughout the entire map display using touchscreen pinching and swiping finger gestures. Users can also toggle between a standard street map and a hybrid satellite map using the two bottoms located at the bottom of the Map VC as seen in Figure 14.

If a user selects an affiliate, a callout box appears within the Map VC. The callout box displays the affiliate name, city, and average overall rating (Figure 15). The user can tap on the map to dismiss the callout box completely or tap another affiliate to display a new callout box. Selecting the *more details* arrow from inside callout box will transition the Map VC to a new view that provides more information about the selected affiliate.



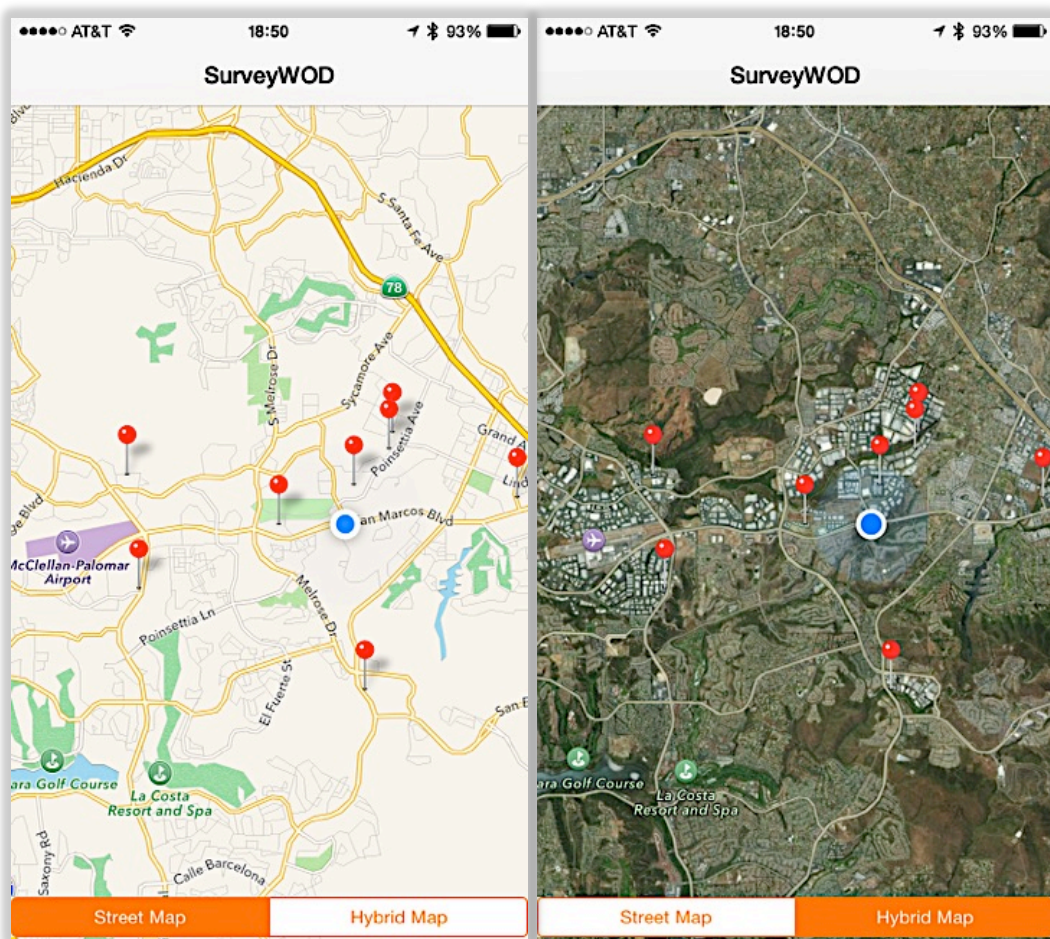


Figure 14 Map VC showing standard map and hybrid map.

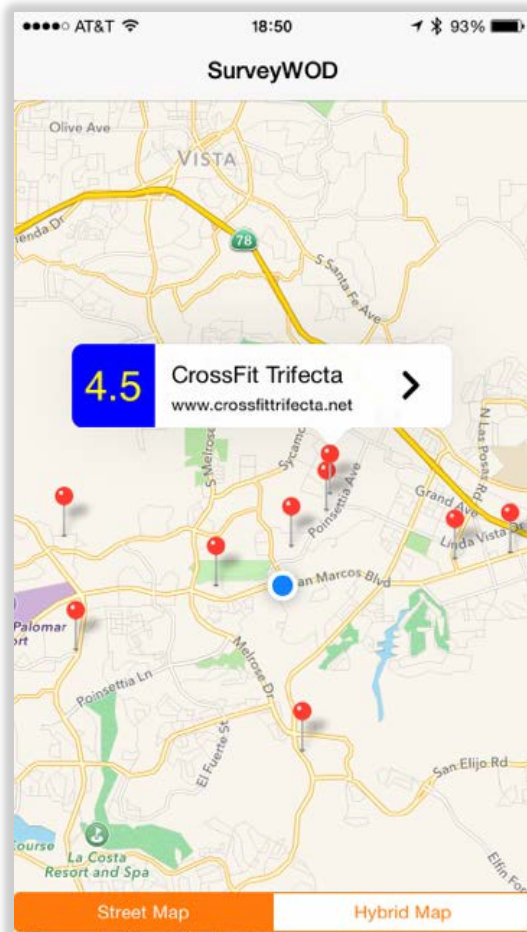
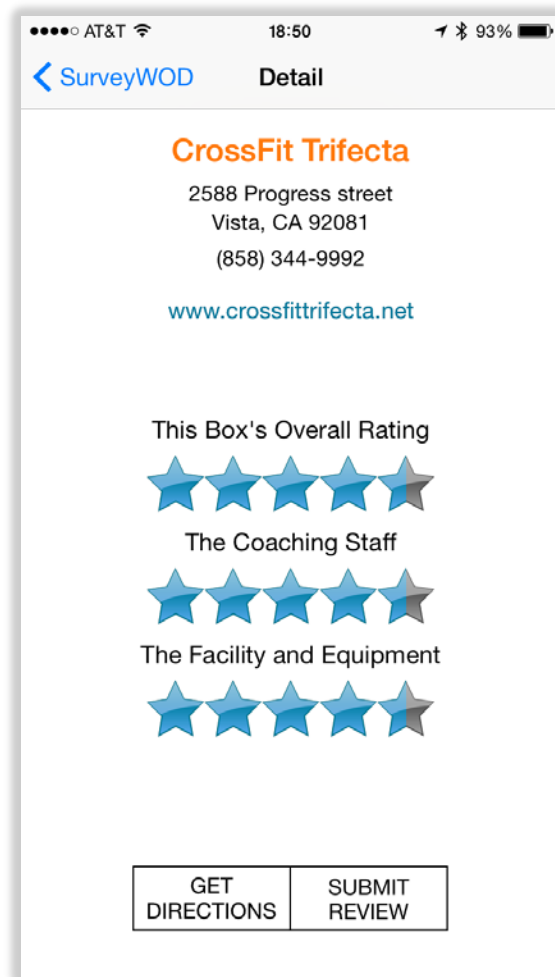


Figure 15 Map VC with affiliate callout box.

### 3.5.2 Detailed Information View

The detailed information view referred to as the Detail VC, displays business contact information and supplementary feedback questions along with their scores as shown in Figure 16. From this view users can select the provided URL, which will display the selected affiliates website by launching the devices native browser, Safari. A user may also generate driving



**Figure 16 Detailed View Controller.**

directions by selecting the *Get Directions* button that launches the devices native mapping application, Apple Maps. If desired, the *SurveyWOD back arrow* located in the top left corner of the screen will return the user to the previous Map VC.

### 3.5.3 Submitting Reviews

Selection of the *Submit Review* button from within the Detail VC transitions the app to the third and final screen, referred to as the Review VC. This view contains three survey questions and a star rating system to score each of the questions (Figure 17). To score a question the user taps directly on a specific star or they can swipe from right-to-left to pick the star value they feel is an appropriate response.

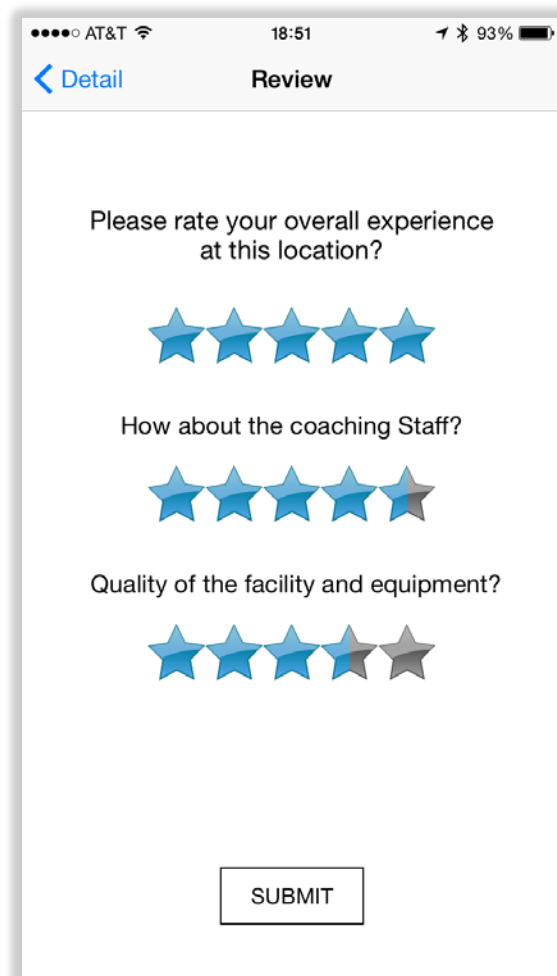


Figure 17 Review View Controller.

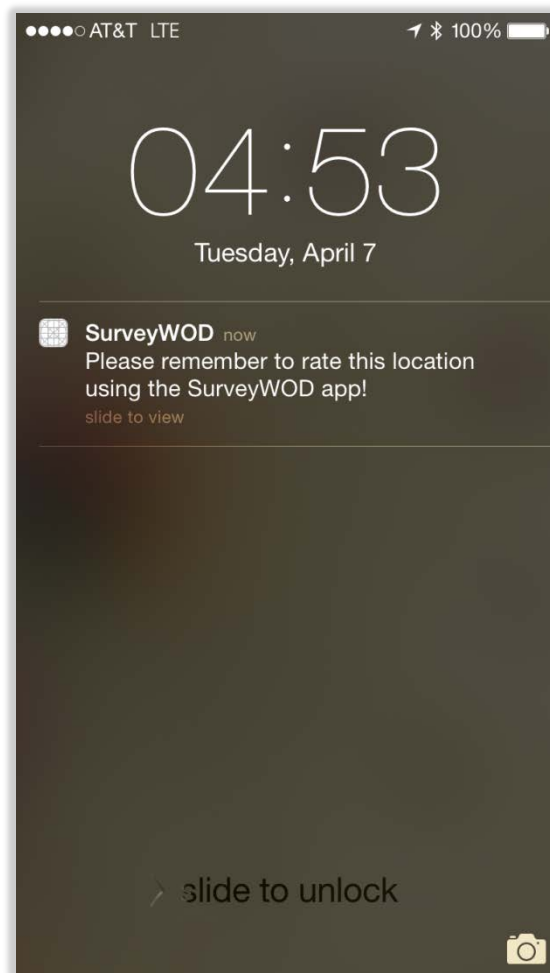
The app features a 5-star rating system that gives each affiliate a rating between 1 and 5 stars. Affiliates with 5 stars signifies an affiliate considered as having a quality above average and affiliates with 1 star signifies an affiliate considered to have a quality below the average. There is one overall rating for each affiliate and a separate rating for the following two items: (1) knowledge, capability, and overall quality of the coaching staff (2) quality, condition, accessibility, and cleanliness of both the facility and equipment. By associating each quality with a 5-star rating, it helps mitigate the issue of having an oversimplified rating system with undefined characteristics because values correlate directly to qualities that consumers can interpret.

To calculate scores, each question links back to a Parse table that stores all scored feedback values. Pressing the Submit button causes the averaging of entered scores with previously entered values stored in their respective Parse table so that average values are cumulative totals. Using Parse allows survey results to update and immediately be viewable by any device running the app in real-time and addresses the third design objective outlined in Section 1.2.

#### ***3.5.3.1 Push-Notifications***



If a device crosses a geotrigger boundary a push-notifications will appear regardless if the app is open or closed (Figure 18). When a push-notification requesting user feedback is received, users follow the same review process discussed in section 3.5.3. The only difference is that the user must launch the app manually if it is not currently open and then select the corresponding affiliate they would like to review.



**Figure 18 Offline push-notification.**

## CHAPTER 4: APPLICATION EVALUATION

This chapter examines field-testing and user evaluation of the SurveyWOD app built as a part of this thesis project. Section 4.1 provides a general overview of the solicitation and selection process followed by basic demographics of evaluators. Section 4.2 reviews the standards for app evaluation and the steps evaluators took during testing. Section 4.3 discusses the collecting of evaluator feedback related to app functionality and provides a breakdown of survey questions and a summary of results.

### 4.1 Selecting Evaluators

Published on the social media website Facebook.com during the month of April 2015, a request for potential evaluators went out. Criteria for selecting of evaluators considered if potential candidates reside in or are able to travel to the North County Coastal region of San Diego, ability to participate in a CrossFit class (no experience necessary), and their ability to complete an online survey upon conclusion of testing the application. Eleven people responded and volunteered to test and provide feedback on the app between 25 April and 2 May 2015. Selected evaluator's are all residents of San Diego County with limited knowledge of geospatial system and concepts, but each stated that they were comfortable working with mobile applications used for mapping purposes. Of the eleven evaluators, six attend a CrossFit gym on a regular basis, one did CrossFit regularly at home, one tried CrossFit but does not attend a gym regularly, one did CrossFit infrequently at home or at an affiliate, and the remaining two have never tried CrossFit before using the app.

To test the app, Apple offers the use of an Ad-Hoc provisioning license option that lets the developer load the app on a limited number of devices without uploading to the Apple iTunes App Store (Apple Developer 2015b). For this project, the app only existed on one mobile device,

an Apple iPhone 6 provided to evaluators to conduct field-testing. In addition to using the same device, evaluators followed a similar workflow while testing the app. The guidelines presented to evaluators guarantees exploration of each function within the app and lends to producing more comparable user experiences to measure derived feedback.

## 4.2 Evaluation Process

Before commencement of the assessment process, each evaluator receives a handout with a list of tasks to complete during testing (Figure 19). Having each evaluator complete similar steps ensures all available functionality within the app is tested and it yields a more comparable user experiences to help normalize post evaluation feedback.



**Figure 19 Evaluator task list.**

Starting at a geographic location independent of an affiliate location, testing begins by launching the app on the provided mobile device. The initial map display centers on the devices current location and immediately populates with affiliate locations. The evaluator then chooses

an affiliate of their liking in which they will visit and complete a CrossFit class to provide feedback for.

From the map display, the evaluator selects their chosen affiliate to view the name and current rating via the callout box. Next, additional business information screen appears when the evaluator taps the *more details* arrow. The complete address, phone number, website, and survey results are displayed for the evaluator to review. Launching of the affiliates business website from the app is available but is an optional step because it does not utilize core application functionality to perform the task. Following the provided task list, evaluators generate driving directions to their chosen affiliate by selecting the *Get Directions* button that launches Apple maps (Figure 20). Although this function uses Apple maps to generate driving directions, it helps

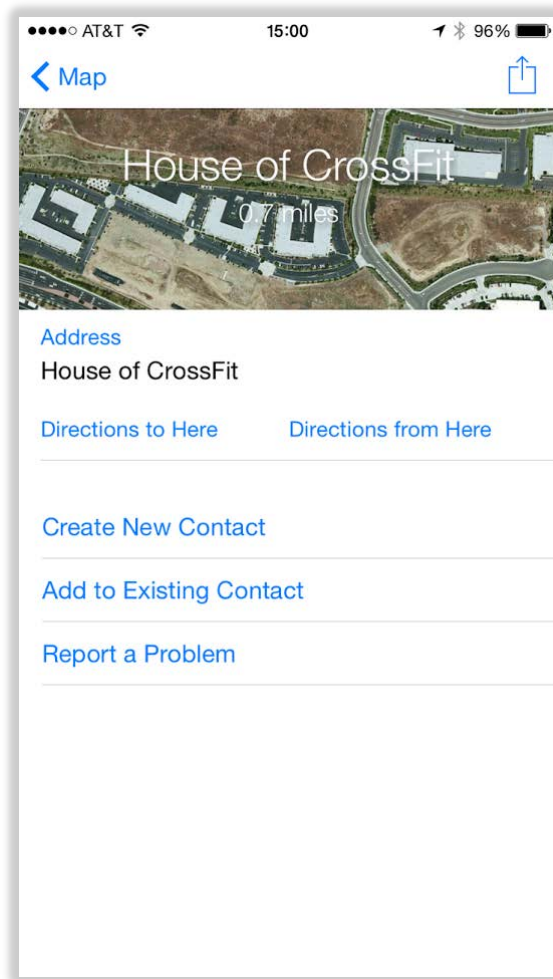
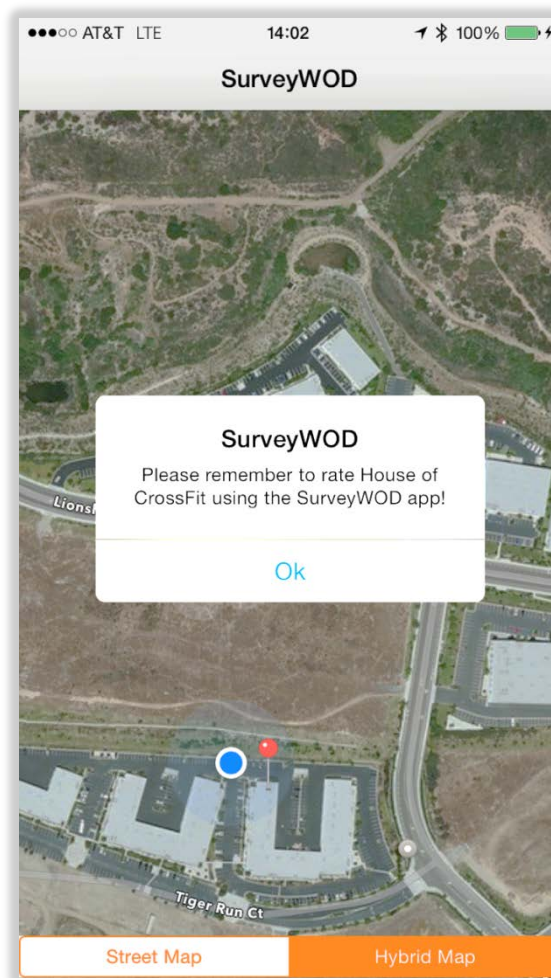


Figure 20 Apple Maps driving direction.

evaluate the accuracy of geocoded affiliate addresses. Using the calculated directions, evaluators then travel to the affiliate where they participate in an hour-long CrossFit class. During the duration of the class, the app remains open and running.

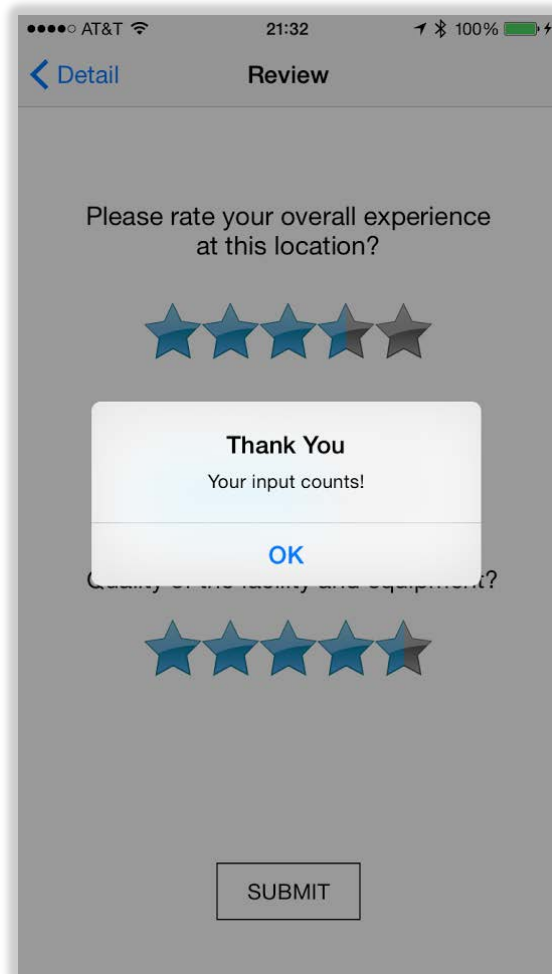
Upon conclusion of the CrossFit class and exit from the facility, the mobile device receives a push-notification prompting for user feedback (Figure 21). Taking less than one minute, push-notifications arrive almost immediately after evaluators exit the geotrigger

The final step in field-testing the app requires evaluators to go back into the app, open the Detail VC for the affiliate they visited. From there, they select the *Submit Review* button that takes them to a survey where they can review the affiliate. Based on their experience while



**Figure 21** Push-notification requesting user feedback.

attending the CrossFit class, evaluators score each of the three provided questions and select *Submit* to enter their final survey scores. After submission, the app displays a notification that thanks the user for the offered input and to confirm submission (Figure 22). Completion of the survey concluded the evaluator testing of the app.



**Figure 22 Survey submission confirmation.**

### **4.3 Post-Evaluation Surveys**

Immediately following completion of field-testing, each evaluator receives a web link that grants them access to an anonymous online survey created using SurveyMonkey (SurveyMonkey 2015). The post-evaluation survey has a total of nine questions for evaluators to answer. The first asks about each evaluator's experience with CrossFit, followed with six questions that ask about details specific to app functionality to determine if the project goals and design objectives were achieved, while the final two questions ask the evaluator to rate the app overall and to provide any recommendations for improvements. Evaluators have the option to respond with either *Yes*, *No*, or *Somewhat* to the six questions concentrated on project objectives. To rate the app overall, evaluators can score the app on a scale of 0 - 10, where 0 is considered below average and 10 is considered above average. Lastly, an open text field permits user to recommendations or improvements for the app.

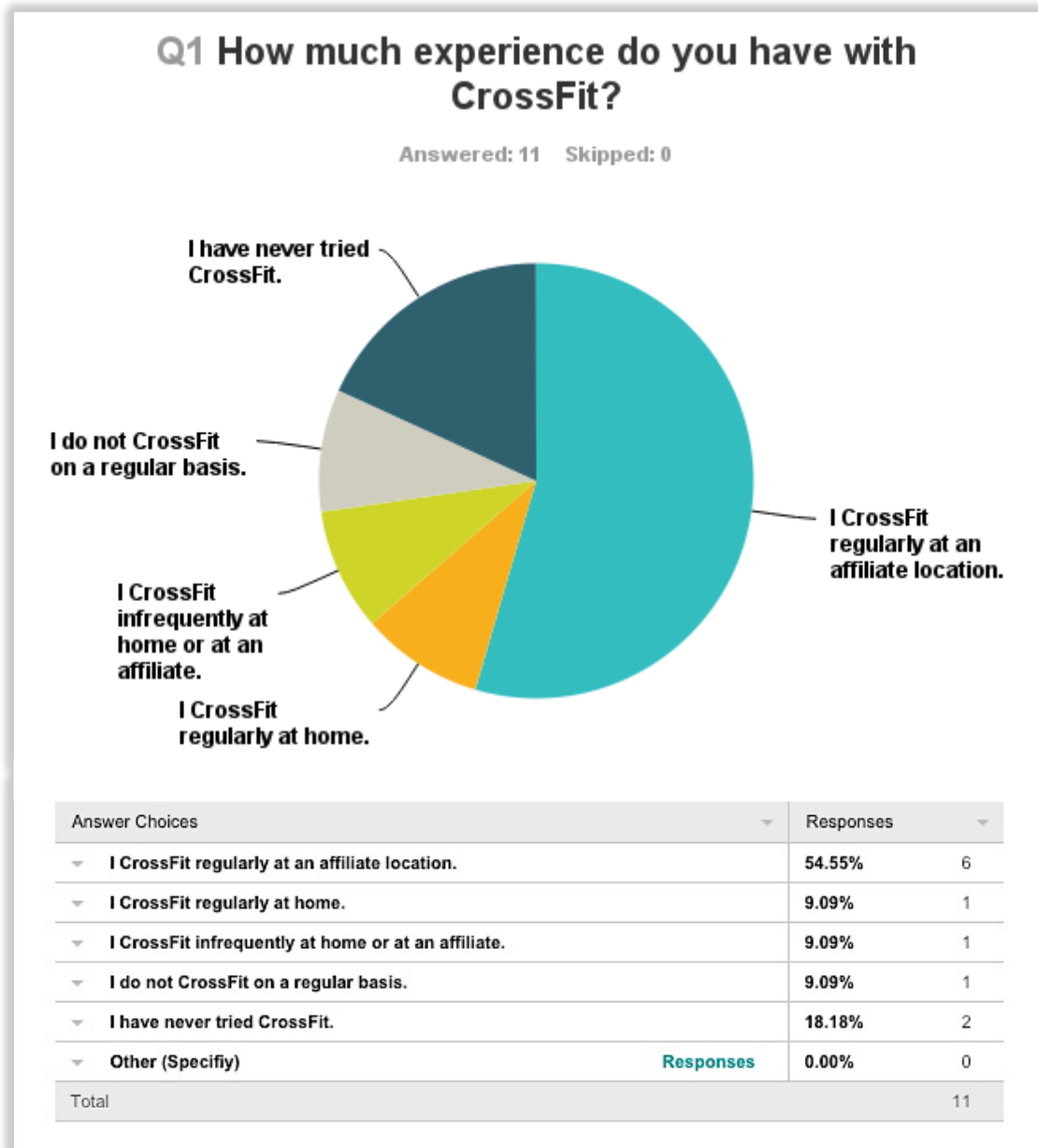
#### ***4.3.1 Examination of Survey Questions***

The following section provides a detailed breakdown of each survey question answered by evaluators. Each summary includes with an associated graph of analyzed results that illustrates the distribution of percentages of evaluator responses.

##### **Q1: How much experience do you have with CrossFit?**

The only demographics collected as part of the post-evaluation survey enquired about the level of exposure each evaluator had with CrossFit. Six respondents making up 54.55% stated that they CrossFit regularly at an affiliate location, two respondents at 18.18%, stated that they had never tried CrossFit, while the three remaining respondents fell into a three separate groups. At 9.09%, each of the three respondents chose that they did not CrossFit regularly, did CrossFit

infrequently at home or an affiliate, or that they did CrossFit regularly at home. Figure 23 illustrates the percentages associated with Question 1.

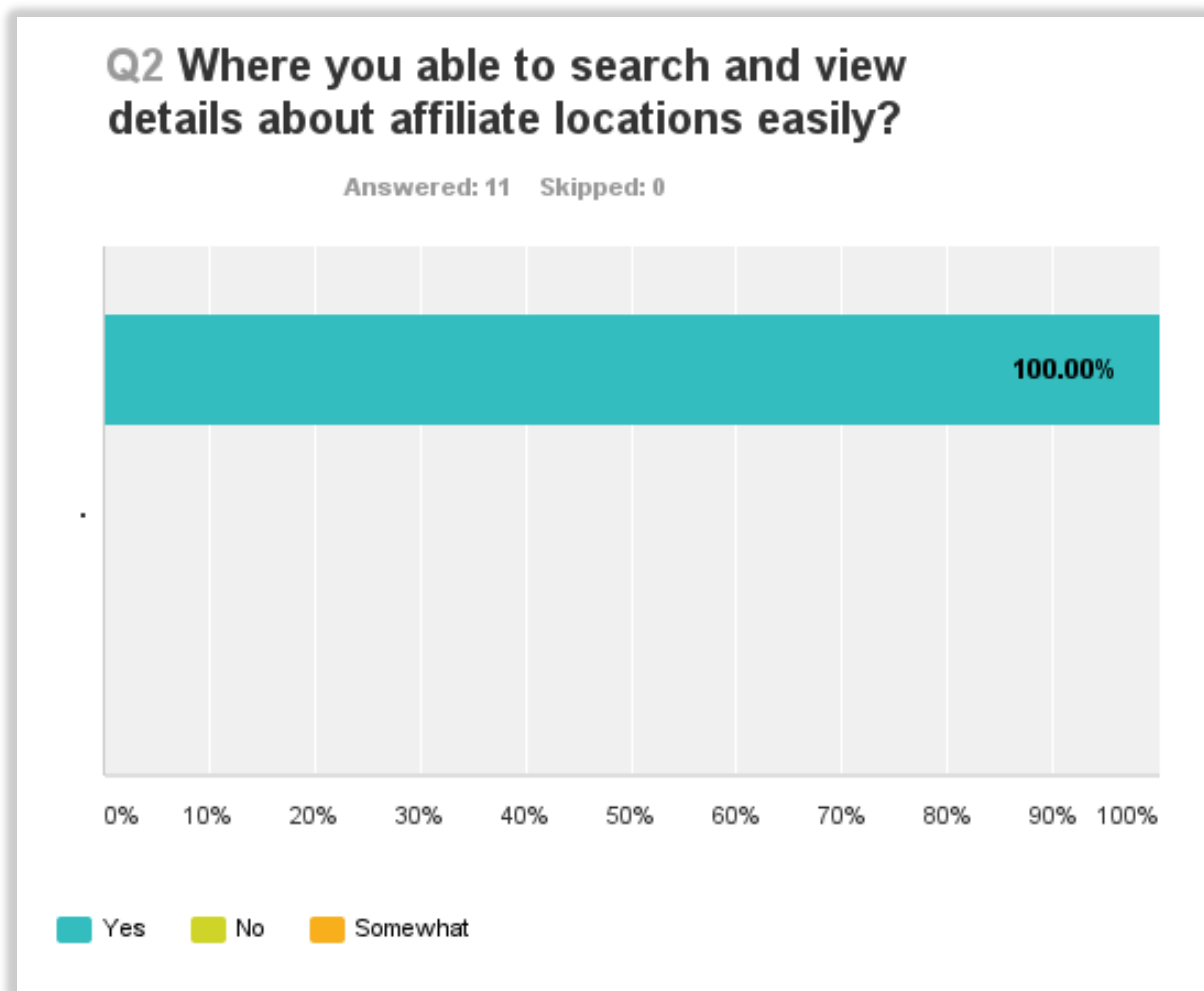


**Figure 23** Pie chart and percentage table of Question 1 results.  
Image source: SurveyMonkey (2015)



**Q2: Were you able to search and view details about affiliate locations easily?**

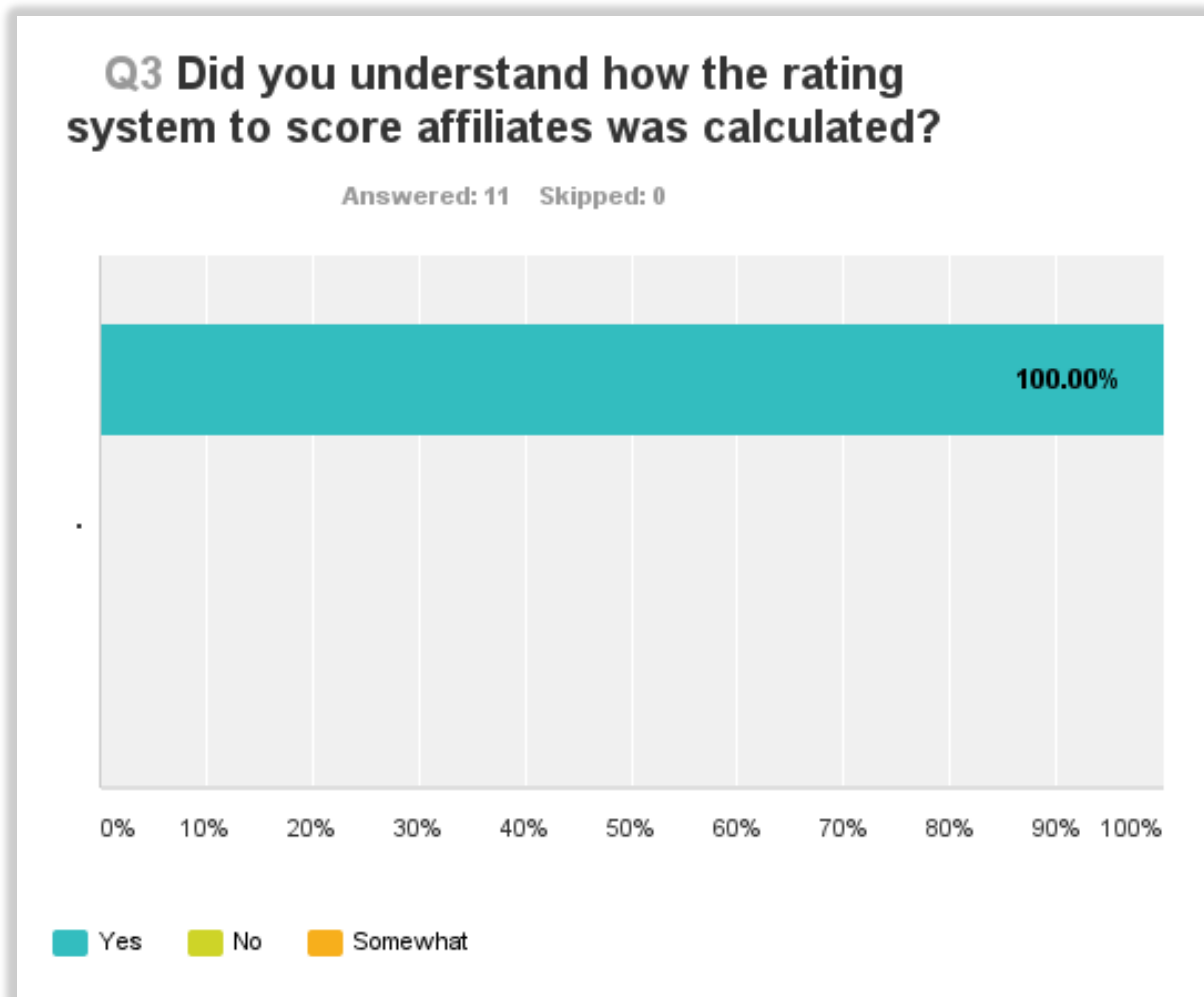
Of the eleven respondents, 100% indicated that they could search and view business details for available affiliates with no issues (Figure 24). These results confirm successful accomplishment of this projects objective of creating an app that allows users to locate, select, view attribute data.



**Figure 24 Bar graph of survey Question 2 results**  
Image Source: SurveyMonkey (2015)

**Q3: Did you understand how the rating system to score affiliates was calculated?**

Of the eleven respondents, 100% indicated that they understood how the rating system used to score affiliates was calculated (Figure 25). These results reinforce that the rating system used in the SurveyWOD app was not oversimplified and that evaluators comprehended the context of the rating system used in this project.



**Figure 25 Bar graph of survey Question 3 results.  
Image Source: SurveyMonkey (2015)**

#### Q4: Did you find the in-app review questions to be relevant and of value?

Ten respondents comprising 90.91% of evaluators believed that the in-app reviews questions about affiliates were relevant and of value while only one respondent, 9.09% only found them of somewhat relevance and value (Figure 26). The one respondent that stated questions were only somewhat of value came from the evaluator who do CrossFit regularly at home and therefore conditions of equipment and coaching staff are possibly of less value to them.

These results demonstrate that appropriate survey questions were chosen and the threat of selecting irrelevant survey questions or survey questions only the examiner determined to be of value as discussed in Section 2.3.3 did not occur in this project.

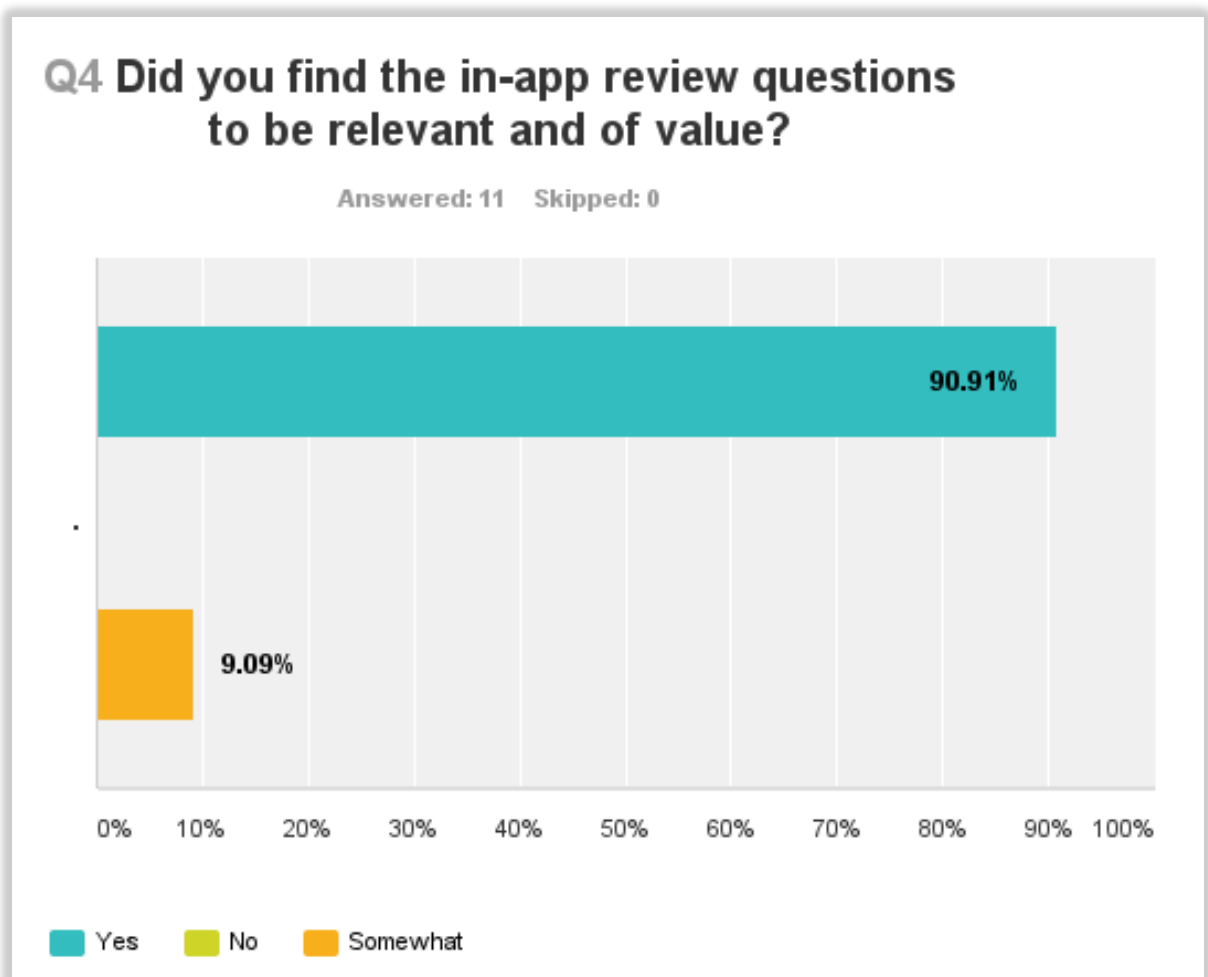


Figure 26 Bar graph of survey Question 4 results.  
Image Source: SurveyMonkey (2015)

**Q5: Did the push-notification help or hinder your decision to immediately leave feedback?**

Seven respondents, 63.64% of evaluators stated that the push-notification helped in their decision to provide feedback immediately after exiting the affiliate (Figure 27). The remaining four, 36.36%, stated that it only somewhat persuaded their decision to provide feedback. These responses could have occurred due a users negative inclination towards completing surveys or that they simply did not feel a desire to leave a review after receiving the push-notification. A possible means to persuade users towards completing surveys could come from the use of incentives. Because the app is not specific to one business, incentives would have to come from outside sources. These outside sources would include vendors that already target the CrossFit community such as companies that make sell nutrition supplements or apparel companies.

A primary goal of this project is the app's ability to influence users to provide VGI in the form of feedback. Either fully or partially, all evaluators were inclined to give feedback, which confirms achievement of the objective.

### Q5 Did the push-notification help or hinder your decision to immediately leave feedback?

Answered: 11 Skipped: 0

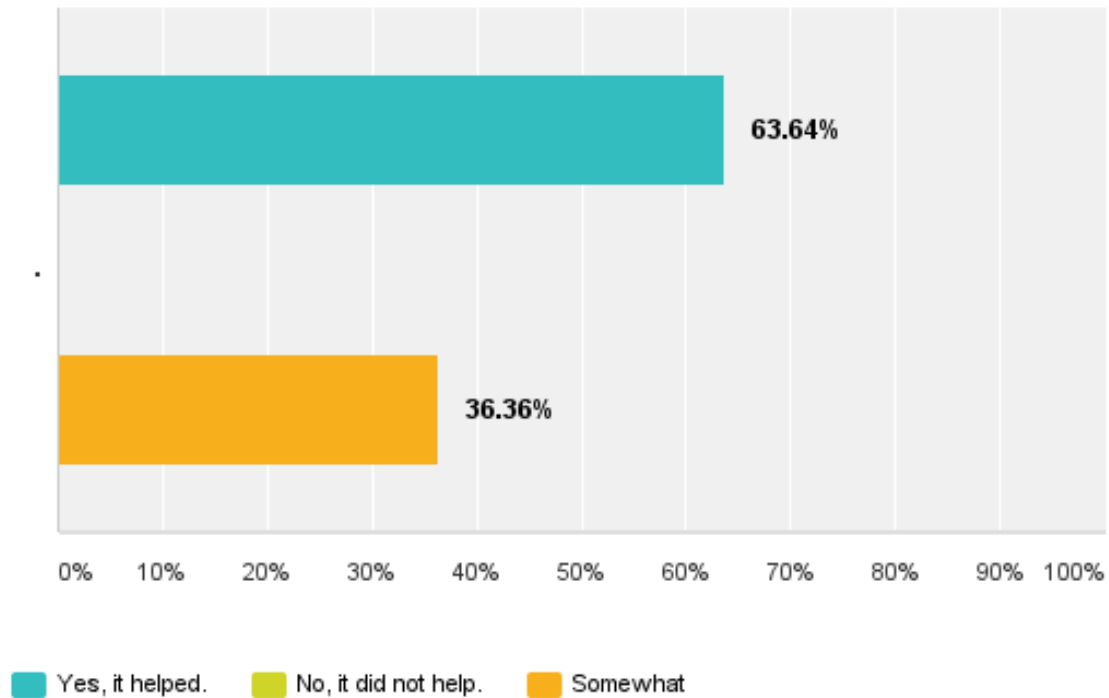


Figure 27 Bar graph of survey Question 5 results.  
Image Source: SurveyMonkey (2015)

### Q6. Did you find the SurveyWOD app to be useful?

Ten respondents, 90.91% of evaluators, found the SurveyWOD app to be helpful in searching, viewing, and overall functionality with only one respondent, 9.09%, found the app somewhat useful (Figure 28). The one respondent that stated the app was somewhat of value came from the evaluator who did CrossFit infrequently at home thus the app may seem less appealing because it would not be used on a regular basis. Overall, the results indicate that app met its goal of creating a useful tool to determine which affiliate they should patronize and that collects, compiles, and delivers relevant business reviews back to consumers quickly and in a user-friendly format.

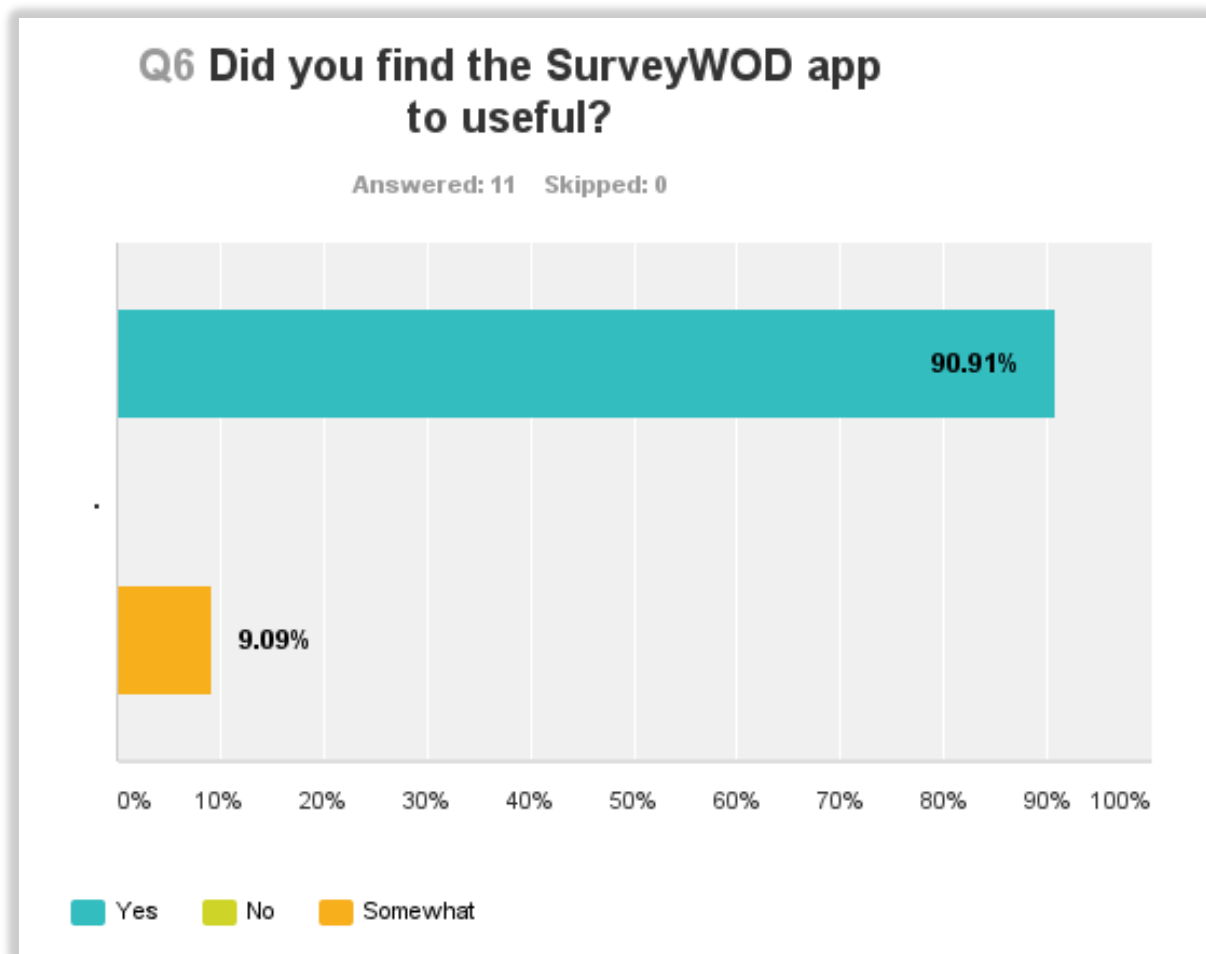


Figure 28 Bar graph of survey Question 6 results.  
Image Source: SurveyMonkey (2015)

### Q7. Did the SurveyWOD app function as expected?

Ten respondents, 90.91% of evaluators, verified the SurveyWOD app functioned as intended and without issue. One respondent at 9.09% of verified the app only somewhat functioned as intended (Figure 29). During field-testing of the app, one evaluator did not receive a push-notification after exiting an affiliate location, which explains the one response of “no”. After researching the issue, it was determined that the size of the geotrigger boundary did not meet minimum size requirements recommended by the Esri Developer site (Esri 2015). After increasing the geotrigger boundary, the app could successfully send push-notifications to the mobile device.

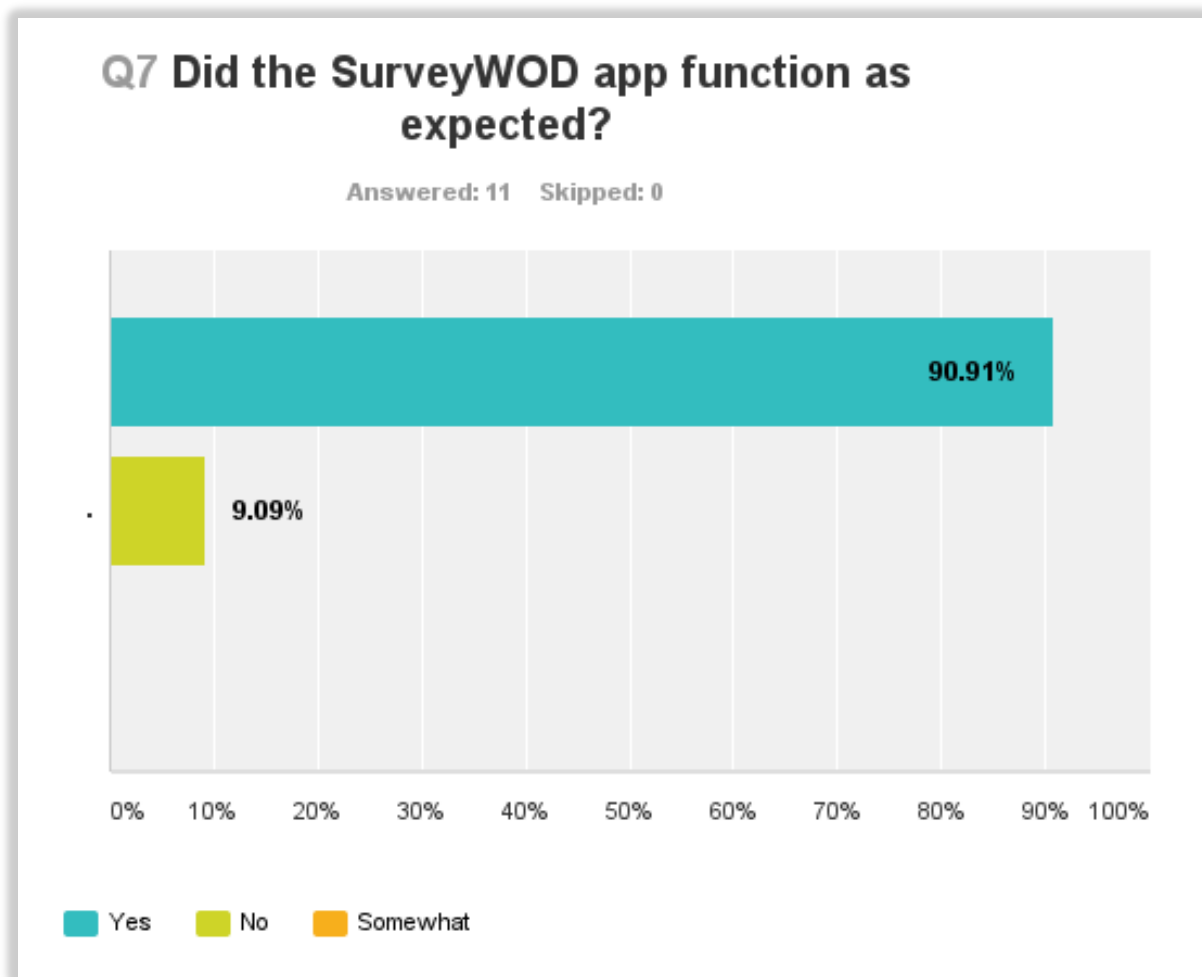
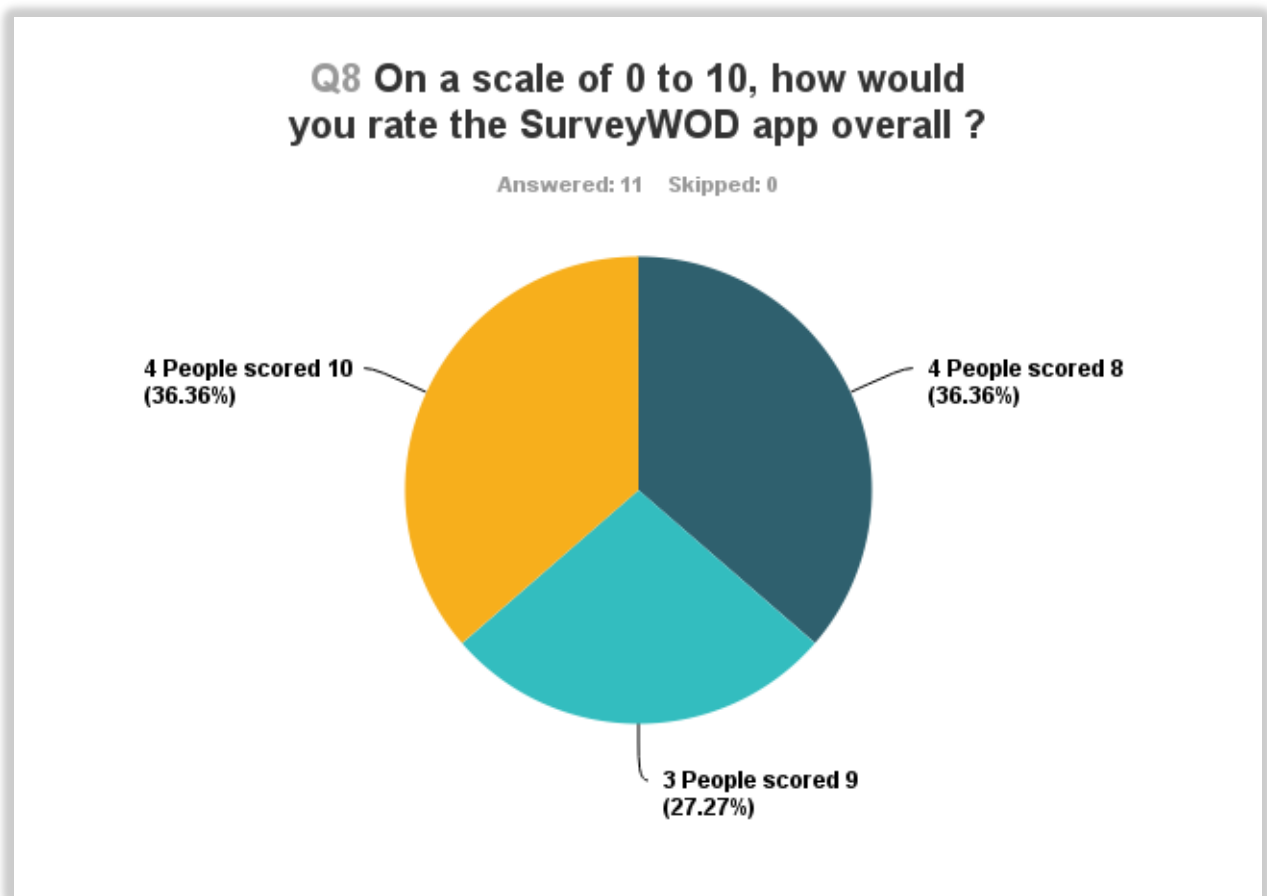


Figure 29 Bar graph of survey Question 7 results.  
Image Source: SurveyMonkey (2015)

**Q8. On a scale of 0 to 10, how would you rate the SurveyWOD app overall?**

Evaluators were asked to score the SurveyWOD app on a scale of 0 – 10 where below average would receive a score of 0 and above average would receive a score of 10. Four respondents, 36.36%, scored the app at a 10, three respondents, 27.27%, scored the app at a 9, and the remaining four, 36.36%, scored the app at an 8 (Figure 30). Reaction to the app was overwhelmingly positive and evaluators scored the app higher than anticipated which concludes that the app developed as part of this project met each of its objectives.



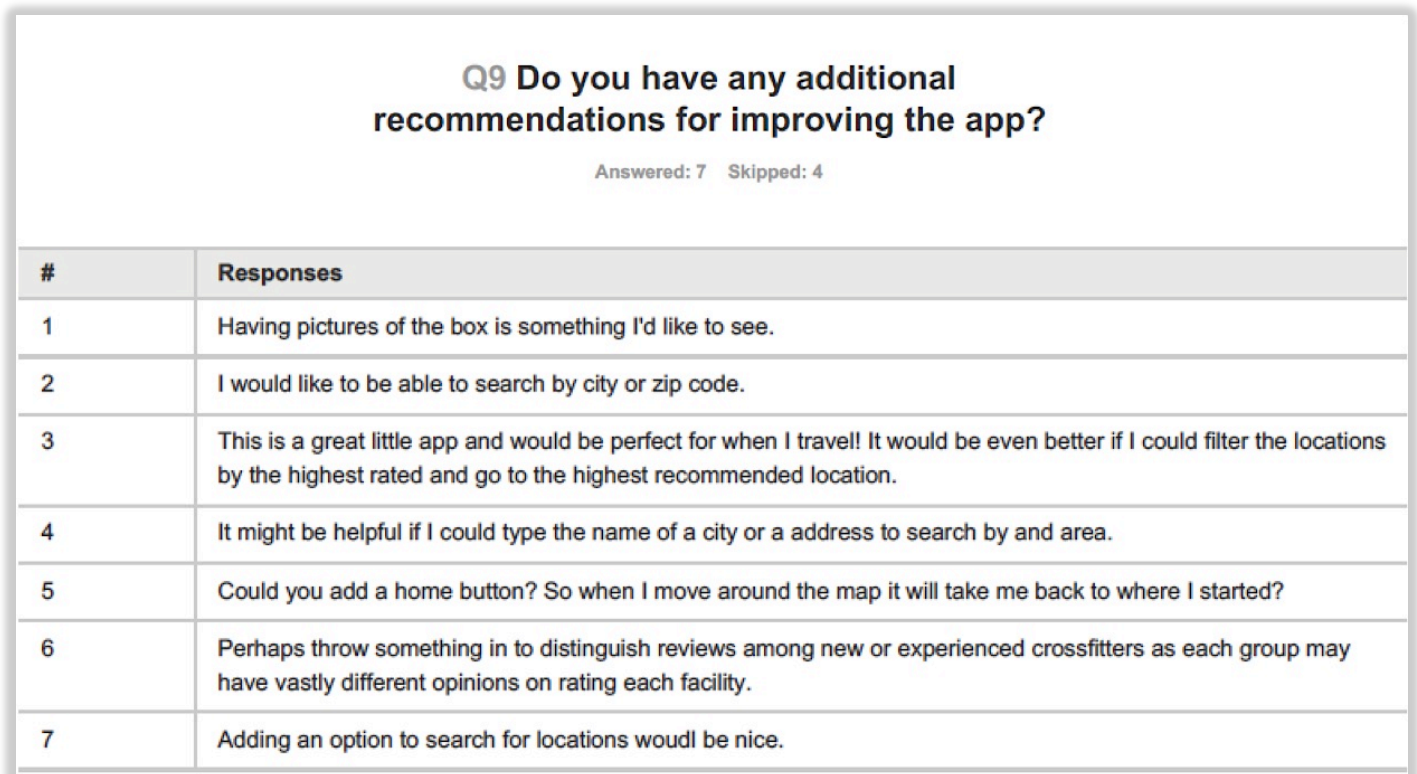
**Figure 30 Pie chart of survey Question 8 results.  
Image Source: SurveyMonkey (2015)**



### Q9. Do you have any additional recommendations for improving the app?

The final post-evaluation survey question asked evaluators to provide recommendations for future improvement from evaluators. This open-ended question received input from seven of the eleven evaluators. Figure 31 provides a list of recommendations submitted by evaluators.

The capacity to search affiliates by address, city, or zip code was the most common request that came from three of the evaluators. Incorporating a search toolbar would add a more dynamic user experience, would allow users to have more control over how they operate within the app, and could lend itself to users looking to research affiliates outside of their geographic area. The next request, to incorporate a filtering system to sort either affiliates or reviews, came from two evaluators and could enhance user ability to search affiliates. One suggestion included asking that to allow users the ability to upload photos. Having photos could influence and assist users select an affiliate to attend and is supported by the Parse SDK.



The image is a screenshot of a SurveyMonkey survey result. At the top, the question is displayed: "Q9 Do you have any additional recommendations for improving the app?". Below the question, it indicates "Answered: 7 Skipped: 4". The main part of the screenshot is a table with two columns: "#", representing the number of responses, and "Responses", representing the text of the recommendations. There are seven rows of data in the table, each corresponding to one of the seven answers.

#	Responses
1	Having pictures of the box is something I'd like to see.
2	I would like to be able to search by city or zip code.
3	This is a great little app and would be perfect for when I travel! It would be even better if I could filter the locations by the highest rated and go to the highest recommended location.
4	It might be helpful if I could type the name of a city or a address to search by and area.
5	Could you add a home button? So when I move around the map it will take me back to where I started?
6	Perhaps throw something in to distinguish reviews among new or experienced crossfitters as each group may have vastly different opinions on rating each facility.
7	Adding an option to search for locations would be nice.

Figure 31 Survey Question 9 list of improvement recommendations.  
Image Source: SurveyMonkey (2015)

#### **4.4 Summary**

This project successfully evaluated the effectiveness of a mobile application utilizing geotriggers to prompt for and aid in the collection of business oriented VGI in the form of consumer surveys. Evaluator responses were especially positive regarding this functionality and the ability of the app to address consumer concerns when selecting an affiliate. Survey results validate the applicability to the SurveyWOD app to add value to CrossFit community or those interested in CrossFit.

## CHAPTER 5: CONCLUSION

This chapter discusses usefulness of the SurveyWOD app and how it met each of the project objectives outlined in Chapter 1. Section 5.1 reexamines project goals and how this project addressed them. Section 5.2 discusses future design considerations and improvement of the app. Section 5.3 briefly covers how this app contributed to the study of VGI and Section 5.4 examines the lessons learned during this project.

### 5.1 Responding to Project Objectives

The app collected business oriented VGI in near-real time for CrossFit affiliates with the help of the Esri Geotripper Service. VGI consisted of surveys that held scores for particular qualities unique to CrossFit. Aggregated scores were average and then used to generate ratings for individual CrossFit affiliates. Users of the app can view and rapidly search through the affiliate database to identify locations that scored highest or are within close proximity to the devices current location. Through these functions, the app was successfully able to achieve each of the key project goals outlined in Chapter 1.

Using the Esri Geotripper Service, users successfully received push-notifications when the mobile device exited a designated geofence. Received push-notifications were effective in their ability to encourage users to submit VGI as consumer surveys. The gathered business oriented VGI from all users fed directly back into the app and accomplished the primary goal of this project. Using Parse cloud storage to retain affiliate data and Apple native frameworks such as MapKit to display affiliate locations, accomplished two additional projects goals. The first being to design an app that allows users to locate, select, view attribute data, and generate driving directions for affiliates within a feature database. The third, to provide survey data back

to the end user in real-time from within the app via a graphical map display and evaluated by users as needed.

## **5.2 Future Design Considerations**

Throughout the entire design and development process, future improvements for the SurveyWOD app were considered. The first of which includes increasing the affiliate dataset size to include the entire United States and eventually to a worldwide affiliate feature dataset.

Affiliate data maintained by CFHQ is not readily available for download but through the process of web scrapping, the technique of extracting information from existing websites, geographic coordinate information is accessible. Coordinate information would need to undergo a reverse geocoding process. Unlike standard geocoding that extracts coordinates from a physical address, the reverse geocoding process extracts a physical address from given coordinates. Once complete, data would be added to the existing Parse table. This would give users access to a much larger database and the app could collect reviews regardless of geographic location. In-app solicitation for users to suggest corrections, deletions, or additions would be the most efficient and timesaving approach to accomplish validation of affiliates.

Other excellent recommendations for improvements that came from evaluators include adding the ability to upload user pictures and adding the option to filter the map display of locations based on affiliate rating could improve the app and create a more interactive user experience. Both recommendations would require modification to application code but could be accomplished by with minimal effort from a proficient developer familiar with the Objective C programming language.

Other considerations for improvement would focus on implementation of additional survey methods aimed at collecting more statistically accurate data from users. Potential methods

could include the use of a Likert scale, similar to a 5-star rating but with less ambiguity in relation to scoring. The Likert scale uses anchors that respondents can reference when completing surveys (Babbie 2010). In addition, research conducted at the Massachusetts Institute of Technology implies that having users compare products in pairs offers a more accurate representation of consumer preference (Jagabathula and Shah 2011), which is a viable option as well. Users could also benefit by knowing how many other people have left reviews. This would help to authenticate review validity in terms of knowing that a four star review based on a 100 response versus carries more weight than a five star review based on one review.

After implementing functional improvements, further development would demand the app to be platform independent. This means that that the app could run on any mobile device, not just Apple. The ability to reach a larger consumer base and potentially influence a wider cross section of the population would then exist. More importantly is to recreate the same functionality found within the app on the web, which would help further collection and delivery of reviews to users instead of rely solely on the mobile app. A key benefit of having a web presence would permit for implementation of a mechanism to launch affiliate consumer surveys directly from received push-notification via a web browser. This would eliminate the need for users to re-launch the app, search for the affiliates, and navigate to review screen would no longer exist.

Overall, the development and methodology behind the SurveyWOD app presents a valuable tool for the collecting user feedback. Fully expandable beyond the scope of this project, the app can easily use any business model, geographic area, or feature dataset size. Because all technology used in this project is opens source, a potential developer could certainly follow the guidelines presented in Chapter 3 to reconstruct the app to their liking.

### **5.3 Contribution to VGI**

This thesis and the SurveyWOD app contribute to VGI through the incorporation of geotriggers to prompt users for VGI in near real-time. This approach to collecting VGI presented a means to improve data credibility and accuracy by guiding the collection of VGI through two primary methods. The first method uses structured surveys with questions related directly to a business or service. This enables users to provide VGI concentrated on one specific topic. The second method of using predetermined geographic data points (of business locations) helps users to identify a specific business for submitting their reviews.

### **5.4 Lessons Learned**

During early planning and development of this project issues arose that directly affected app implementation. Initially the SurveyWOD app was designed for the Android mobile platform using the Eclipse IDE. The Eclipse failed to provide an intuitive user environment especially when it came to debugging. An example includes the error messages that Eclipse uses to notify when the developer when a problem has occurred. These notifications are often cryptic and somewhat confusing because they can require that the developer have a very clear understanding of code structure often lacking in a less experienced developer. Unlike Apple that seamlessly integrates a multitude of native frameworks, Android requires more effort from the developer to integrate resources. Xcode also uses a graphical interface builder that helped to in the design process because it could fill in sections of code simply by adding objects to the display. Lastly, Xcode uses an instinctive syntax builder that helped with proper code composition. Each of these reasons made development for the Apple platform an exceedingly better choice.

After verifying that Apple would be the target platform, the choice to use the newly released Swift programming language seemed an obvious choice. Unfortunately, issues arose from that fact that the Esri Geotrigger SDK was written in Objective C. Even after coordination with the Esri Portland Research & Development Office that developed the Esri Geotrigger SDK, complications continued to plague the development process while trying to integrate the SDK into a Swift project. By switching the to the previous industry standard of the Objective C programming, no further issues were encountered that were related to the Esri Geotrigger Service.

Once the Esri Geotrigger began to function properly, all other aspects of development, fell into place. Only minor coding challenges arose that and remedied by using web resources such as Stack Overflow (2015). Stack Overflow is a community blog where users post questions regarding issues they have encountered, which are then answered by fellow peers. This resource helped address coding questions that were beyond my skillset but linking me with various professionals.

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