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Urban forecast: An analysis of a crowdsourced mobile app for crisis management

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Urban forecast: An analysis of a crowdsourced mobile app for crisis management

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABSTRACT

People around the world have become more connected thanks to the rise of social technology. As a result, that same technology has allowed us to witness the amount of violence and disastrous events that people around the world are experiencing. Civilians in Syria are constantly caught between rebel forces and the Syrian government's army with no way of knowing where the next attack will be. People in Colorado had to wait for news updates on the wildfires of 2012 to make critical decisions on whether to evacuate or stay in their homes. A man in Mexico had all his personal belongings stolen at gunpoint when he came across a cartel-enforced blockade on his way to the grocery store. All these situations could have been avoided if those people had information about dangerous locations right away to help them make decisions. Civilians themselves who have just experienced the danger have valuable information that they can share to help other people avoid the same situation.

This thesis presents a tool called Urban Forecast that can help citizens avoid dangerous locations and events by posting it on a map in the application and having it notify every other user around that area. Initial results suggest that Urban Forecast is effective at helping people avoid dangerous situations. Future designs based on results are also presented. The focus of this thesis is not entirely on the technology, but on the impact that it has on society in a hostile environment.

CHAPTER 1 - THE PROBLEM

1.1 Introduction

Civilians around the world are facing disastrous and violent situations without any indication of where the crisis might come from. The common goal of the people is to avoid these situations, but without any way of knowing safe paths and locations, avoidance becomes a very risky and challenging plan. People today are more connected than ever with social media tools and smart phones, but there has not been an attempt to create a tool designed specifically for crowdsourcing information about dangerous locations. This thesis proposes and evaluates such a tool and the effects it has on the user.

In 2012 alone we have witnessed a tremendous amount of violence in countries like Mexico, the United States and many others (Rawlins, 2013; "U.S. mass shootings in 2012", 2012) that have led to the death of innocent victims. Egypt, Libya and Syria (Ungaro & Vale, 2011) are experiencing a tremendous amount of violence with the Arab Spring movement where the people are revolting and protesting against their government, which has turned into civil war for countries like Syria. Mexico's drug war has continued to spread throughout the country and continues to endure government interference by intimidating and corrupting government officials (Marosi, 2008). The United States saw a surprising escalation in shootings this year that took the lives of many innocent people in places where one normally visits to find peace ("U.S. mass shootings in 2012", 2012; Zornick, 2012).

Natural disasters have also been a threat to many citizens throughout the world, and managing support and keeping track of what areas are affected and which parts are still unharmed is always a challenge. Tornados can destroy entire city blocks without warning, like the one seen in New York City on September 9, 2012 (Santora, 2012). Situations like these need to take advantage of the quality of information that the public can provide to help people avoid the disaster or help keep people informed. Soliciting contributions from a large group of people instead of an internal workforce is referred to as crowdsourcing (Howe, 2006). When Hurricane Sandy hit New York City on October 22, 2012, many local and state government officials had prepared twitter accounts to disseminate important information (Stricker, 2012). There were over 20 million tweets that included the terms "sandy," "hurricane," "#sandy," and "#hurricane" that provided more details of the situation (Shih, 2012).

The challenge in a crisis situation is getting accurate and trustworthy information broadcast to the right people. Coverage and information to civilians are usually taken care of by TV news channels, newspapers or by radio, all of which will be categorized in this paper by the term "traditional media." Assuming that civilians have access to those media, then they can hope that at some point they will be informed about the details of their situation. The process of traditional media's information dissemination can be a lengthy process, and the information is often generalized to cater to a broader audience that might not be familiar exact details of the region. Traditional media providers can be vulnerable to intimidation and bribery, something that has been witnessed in Mexico (Corchado, 2010; Booth, 2010), which causes information involving certain cartels to be unmentioned or purposely inaccurate.

1.2 Research Question

This thesis describes a mobile application developed by the author called Urban Forecast that allows users to post an event with descriptive information that is added to a map that is seen by everyone using the application. Users can check the map prior to leaving the house to make an informed decision on what route to take. The objective is to help people avoid dangerous situations and thus avoid injury or even death.

This research is an application of the field of Crisis Informatics, a field that analyzes how people use social media during crisis situations to help disseminate information (Palen, Vieweg, Sutton, Liu, & Hughes, 2007). It is also related to Neogeography, which translates to "New Geography," a field that encapsulates the increase of recent web cartography applications brought by the accessibility of tools such as Google Maps (Turner, 2006; Turner 2007).

The research questions for this thesis are the following:

RQ1: Do users alter their planned route based on information received from Urban Forecast?

RQ2: Do users engage with Urban Forecast when a physical crisis is observed?

Given the various circumstances that are happening around the world and the innocent citizens that are caught in the middle, a tool that can quickly give the user information about dangerous activity around the path they plan on taking can be extremely valuable.

The emphasis of this thesis is not on the technology but how that technology could impact the behavior of users in a hostile environment for the better. This mobile application uses a common map API and map annotations and puts them in the context of crisis informatics to allow users to keep track of dangerous events, which is an application that has yet to be done. So far citizens in crisis have been using text-based tools for very visual applications (Berkman, 2013).

1.3 Motivation

1.3.1 Mexico

This particular research was inspired mainly on the current state and situation of the drug war in Mexico (Rawlins, 2013). The Mexican drug war started in December 2006 and still continues on today. The war has taken 47,500 people lives since 2006 ("Mutilated bodies found in Central Mexico," 2012) and that number keeps increasing. The Mexican government been trying to control and suppress the violence without any success, which leaves the Mexican people in the middle of a violent war.

Dangerous events can keep some people in a constant paranoid state, even causing post-traumatic stress in some cases (Thabet et al., 2002). This situation makes it harder to continue on a daily routine, and many of these could be avoided if information were spread in a quicker manner. People have been turning to whatever information sources they can find in the face of unreliable public information. Some people in Mexico have turned to social media platforms such as Twitter to take advantage of their online connections to get more information about the violence in their area than what their local news channel provides them, which is often a watered-down version if anything at all (Monroy-Hernandez, Boyd, Kiciman, De Choudhury, & Counts, 2013).

1.3.2 Arab Spring

The Arab Spring movement is another example of citizens caught in the cross fire between two opposing forces (Ungaro & Vale, 2011). 21 countries across the Middle East and Northern Africa had a series of protests. Some escalated into civil wars, between the years 2010 and 2012, with only four of the 21 countries claiming zero casualties.

Civilians in Syria have been victims of constant airstrikes ordered by the Syrian government (“Syria air strikes ‘target civilians’”, 2013). People in Syria who were against the regime but not part of the Free Syrian Army were left to fend for themselves and were not considered when planning attacks. One report says that in just the first half of September 2012, 166 civilians, including 48 children and 20 women, were killed in attacks in the northern region of Syria (“Syrians under 'indiscriminate' attack,” 2012). Giving the people a tool that would allow them to form a network and pass along any kind of information would allow civilians to come out of the dark and be able to make smart decisions about their situation.

1.3.3 Violence in the U.S.

So far the two examples above have been outside the United States, but it is not exempt from these challenges. In 2012 the United States had sixteen mass shootings that left more than 88 people dead (Zornick, 2012). The United States is infamous for shootings having fifteen of the twenty-five worst mass shootings in the last fifty years. Finland has the second highest number: two (Klein, 2012).

On July 20, 2012, a gunman interrupted a midnight showing at a movie theatre in Aurora, Colorado and opened fire to crowd of moviegoers. Twelve people were killed and fifty were injured in this incident. An interesting observation that came out of the Colorado shooting was that all the information about the shooter, victims’ status and locations were made available through the social forum website reddit.com before any other news outlet (Ferenstein, 2012). This is a testament to the power, accuracy and speed of user-generated content in times of crisis.

1.3.4 Natural Disasters

Violence is not the only type of danger that people need to worry about. Natural disasters such as hurricanes, wild fires and flooding can be just as dangerous and deadly as shootings and the event can take much longer to stabilize. The biggest challenge with these types of disasters is helping people avoid injuries.

346 homes were destroyed, and two people were killed by the Waldo Canyon wildfire that began on June 23, 2012 in Colorado (Parker, 2012). 32,000 residents of the surrounding area were forced to evacuate their homes to avoid further fatalities (Udell, 2012).

1.3.5 Gaps in current social platforms

Like the citizens of Mexico, people have turned to social platforms such as Twitter to inform the public of any events they witness or hear about. Some have blogs dedicated themselves to the dissemination of true, uncensored information such as El Blog Del Narco, which translates to the Blog of the Narc (www.blogdelnarco.com). Efforts like these are a step in the right direction in getting information out to the people as fast as possible. The problem with these platforms is that they are text-based solutions, so users must read through information they don't need to get to important information like location in order to make quick decisions. The problem with Twitter specifically in these types of situations is that you need to know who or what hashtag to follow in order to get the information you want. There can be many different hashtags that users make to create a channel where information is disseminated, and there is no easy way to publish that for everyone to see. Another problem is that the restriction of characters in each tweet makes it hard to post all the important information that people need in order to plan accordingly. Location, time, and details of the incident can take more than 140 characters to describe.

In order to consider Urban Forecast successful it must help users avoid dangerous locations by allowing them to quickly identify areas that could put them in an unwanted situation. The user must be able to tell at a glance where the dangerous areas are instead of having to mentally translate a tweeted address or location into something of use. To evaluate Urban Forecast, a user study has been conducted to assess users' ability to use the tool and observe whether they change their paths based on information given to them by the app.

1.5 Thesis Organization

This thesis is divided into five chapters. Chapter 2 explores the literature review introducing the field of Crisis Informatics and dives into what has been done in terms of crisis management. It also offers a brief overview of sociology research on people in war zones. The Chapter 3 explores the architecture and design of the prototype. Chapter 4 explains the methodology of the research, both the process of studying and evaluating the tool as well as the technical specifications of the application itself. Chapter 5 presents the results of the study and discusses the implications. Chapter 6 concludes the study and discusses future design and limitations of this study.

CHAPTER 2 - LITERATURE REVIEW

The following chapter will provide an overview of the research findings that support the need for an application like Urban Forecast. It starts with an exploration of crisis management and the need for change brought by the field of crisis informatics. Then it discusses the findings of crisis informatics and people's role in a crisis. The chapter finishes with an examination of current tools and their challenges.

2.1 Crisis Management

Crisis management can be divided up into three states, with each state having a slightly different definition. Before a crisis, crisis management is defined as the process of minimizing risk. During a crisis, crisis management focuses on effective decision and sense making through the improvisation of key stakeholders to minimize loss. After the crisis has passed, where a crisis is a low probability event with a high impact that negatively affects the stakeholders and decisions must be made quickly, recovery becomes the main objective (Pearson & Clair, 1998). For this thesis, we are interested specifically in the stages during a crisis to gain insight on effective practices that can help inform an application like Urban Forecast.

The definition of a crisis becomes very broad when going through the literature in crisis management. It encompasses organizational crisis such as copyright infringement as well as natural disasters and shootings. For the scope of this thesis we avoid organizational crises and the challenges that come with them, such as organizational reputation and organizational image.

2.1.1 Problems with crisis management

An important characteristic of crisis management is that the responsibility of information distribution is given to a team of experts (Lagadec, 1993; Mitroff, Pearson & Harrington, 1996; Mitroff & Pearson, 1993; Pearson & Clair, 1998). The perspective this field takes on information flow is very hierarchical. Evident from the phrasing of its methods, crisis management makes a strict divide between information from the organization in charge of the response to the people experiencing the crisis. This view tends to clash with the growth of information communication technology (ICT), as will be discussed in the next section.

2.2 Crisis Informatics

The term "crisis informatics" was first coined by Hagar (2007) and expanded by Palen, Vieweg, Sutton, Liu, and Hughes (2007). Crisis informatics focuses on analyzing how people use ICT during a crisis event and how that technology can change their situation. Although still growing out of its infancy, crisis informatics has been increasing its research impact by combining information, disaster, and technical sciences. Research in this field has ranged from analyzing social networking site activity during natural disasters such as the 2005 Hurricane Katrina (Palen et al., 2007) to analyzing photos submitted to Flickr after the Virginia Tech shooting in 2007 (Liu, Palen, Sutton, Hughes, & Vieweg, 2008).

Crisis management views a crisis from the perspective of an organization managing and controlling a crisis situation keeping the public as a separate entity. Crisis informatics differs from crisis management by focusing on the people around a disaster as "first responders" (Kendra & Wachtendorf, 2006) and how the public can be leveraged as an information network. Although it is not a new concept to have the public involved in a crisis response, ICT has drastically improved what an average person can do online and ultimately strengthened the effect of that involvement. This information can prove to be useful in advancing the field of crisis management by taking advantage of the communication potential in ICT in the hands of the public and using it for emergency information dissemination (Hughes & Palen, 2009). This research expands on the idea of the public as first responders by designing and evaluating a tool that can improve the way information of crisis events is distributed and interacted with.

Research in crisis informatics has also answered several questions regarding the convergence of people during a crisis around technology and the effect technology has had during the event. These results can have an impact on the design implications of an application like Urban Forecast.

2.2.1 Observations and Findings

Analyzing and interviewing the public involved in disasters has revealed interesting details about technology and its effects on people. The following section lists some of those findings.

Quality & speed of volunteered information in a crisis

There is a common argument against volunteered information and for traditional media as the main source of dissemination that states that the quality of the information coming from the public is low. However, research in crisis informatics suggests that the accuracy of user-curated information can be as accurate as the information distributed by traditional media and can be compiled and distributed at a faster rate (Palen et al., 2007; Palen & Vieweg, 2008; Shklovski, Palen, & Sutton, 2008; Hagar, 2001). Palen et al. (2007) stated that during the Virginia Tech school shooting, a publicly curated list of names of the victims was not only 100% accurate, but was released before Virginia Tech officially announced the same information.

Although it might seem trivial that online activity spikes as soon as a crisis event occurs (Meier & Brodock, 2008; Qu, Wu, & Wang, 2009; Kendra & Wachtendorf, 2006), consider that traditional media can take time before information is released. This indicates that the community is instantly connecting to social networks and generating information very quickly.

Intake of information

In the times before the Internet, traditional media such as newspapers and television news channels were the main way to receive any kind of information. News anchors and newspaper journalists write the news and the people reading or listening receive it. Citizens can call in to report an event but that information goes through a verification process and information is released at specific times during the day. That is not the case today. People connect with their online communities and resources to verify emergency information. They are no longer satisfied with receiving it only through traditional media (Hughes & Palen, 2009; Palen et al., 2010; Shklovski et al., 2008; Hagar, 2001; Kendra & Wachtendorf, 2006); they also want to contribute to it (Palen & Liu, 2007). A dialogue between people around an affected area is now possible and is the preferred form of receiving and distributing reliable information quickly. Even when there is no channel for a community, Shklovski, Burke, Kiesler, & Kraut (2010) found that when faced with lack of information, their subjects creatively adapted technologies to find information and disseminate it to others in their community. This reaction expresses a need for a platform that can facilitate quick and reliable dissemination of information for any given community.

Change in formal emergency management process is inevitable

As mentioned above, current emergency management processes are centralized, flowing the information from the top down, which clashes with the way information is distributed by the public. This clash in perspective is causing pressure on formal institutions to reconsider their methods and leverage the vast information collection happening in more informal and public platforms (Palen et al., 2010; Palen, Vieweg, Liu, & Hughes, 2009).

Palen et al. (2010), shows the differences in information distribution between a formal and an informal response during a disaster and their relationship with one another. Informal public response is constantly being updated with new information within the community and also from the formal response organizations while the formal response organizations share information internally until they are ready to make a formal announcement to the public. This illustrates not only how information distributed between the public is helping formal crisis management institutions but also how the distribution of information has changed.

Distributed messages have similar characteristics

Even though there are many platforms and social networking sites available with different ways of distributing messages to the community, the majority of the messages follow a very similar pattern in the type of information they contain (Qu et al., 2009; Vieweg, Hughes, Starbird, & Palen, 2010). Qu et al. (2009) examined a popular Chinese forum during the 2008 Sichuan earthquake that consisted of 2,266 discussion threads and separated each discussion thread into four main categories: action-related, emotion-related, information-related, and opinion-related. Action-related posts contained messages proposing and coordinating actions that the general public could perform.

Discussions that were considered emotion-related had contributors expressing personal feelings about the crisis, some of them to the extent of calling the group to action. Information-related messages contained facts about the event or asked for specific facts from the community. There were also threads that gathered information and compiled them in one place. Threads that were considered to be opinion-related consisted of critiques of the government or of individuals or asking for opinions from the community. The researchers discovered that the top dominating thread category among online activity was information-related, meaning it contained factual information about the event. The second most popular thread category was opinion-related followed by emotion-related and then action-related.

Monroy-Hernandez et al. (2013) found that the most common contribution made by users in Mexico experiencing the cartel war was posting messages with information about crisis event locations. This observation has important design implications for crisis applications such as Urban Forecast. Limiting the event posting input fields to only the information that is commonly desired, for example, can decrease the time required for a user to post an event during a crisis and increase the experience the user has with the application. Vieweg et al. (2010) developed a model outlining the different type of situational posts that can help inform emergency systems such as preparation, hazards locations, and evacuation.

Technology use when routine is disrupted

Much research on crisis focuses on a crisis as a passing event where citizens experience the eight stages of a disaster (Dynes, 1970), but the original motivation behind this paper was to aid the people who are stuck in Dynes' impact stage. Like in Mexico, people living in the impact stage use ICT as a tool to shift back to a normal routine (Mark, Al-Ani, & Semaan, 2009; Mark & Semaan, 2008; 2009). The roads one used to take to get to work might be covered in roadblocks, making it challenging if not impossible to do something as simple as getting to work. Mark & Semaan (2008) found that citizens of Israel used cell phones to send SMS messages to find out if paths they were planning on taking were safe. This shows a need for a platform that can quickly display safety conditions around paths to help people accomplish their daily routine safely.

2.3 Current Mapping Tools in 2013

2.3.1 Crisis Mapping

Since the launch of Google maps API in 2005 (Taylor, 2005) people have had a platform with which they can combine any kind of location data with world class mapping software. That has allowed for mapping tools to become more popular, giving crisis mapping an opportunity to grow. Crisis mapping is the technique of overlaying crisis event information from multiple sources on a map, commonly referred to as "map mashups," in order to visually convey the crisis situation (Meier, 2012; Liu & Palen, 2010). This research will focuses specifically on the design and evaluation of the crisis mapping tool Urban Forecast.

The next sections will go into detail on three of the main crisis mapping tools that are currently being used in 2013. The final section will discuss overall challenges and how to design accordingly.

Table 2.1 - Current tools

Name	Advantage	Disadvantage
Ushahidi	Large infrastructure and network Amount of input channels Ability to “listen” to specific regions	Challenge to keep up with incoming information and mapping events
Tweak the Tweet	Uses Twitter which has a large user base	Forces users to memorize a special syntax
Map APIs	Quick and easy to make Learning curve is very low	General purpose map lacks crisis features

2.3.2 Ushahidi

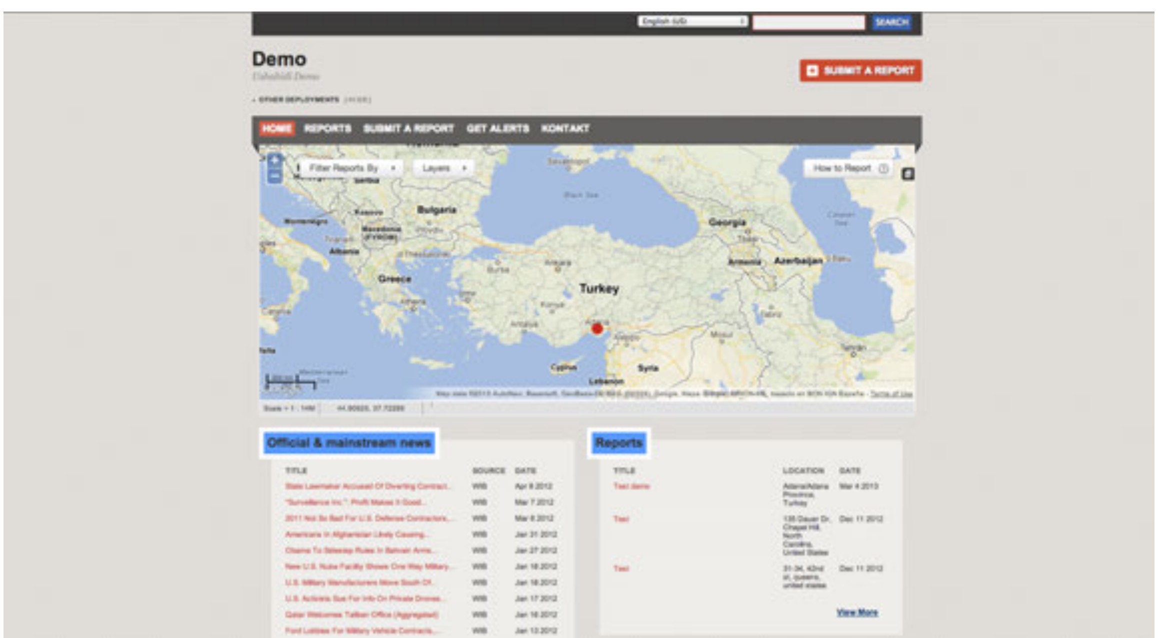


Figure 2.1 - Ushahidi Web Interface Demo

Ushahidi is a crowd sourcing software with a significant infrastructure behind it that started as a result of the post-election violence in Kenya in late December 2007 (Palen & Vieweg, 2008). It allows the user to report an event via their website, SMS text message, email and through their hotline. The reports are then aggregated onto an interactive map where users can be informed of reports around them.

Ushahidi also makes their API available which has broadened the context of use of the system to more than just a crisis-reporting tool. There are instances of Ushahidi that annotate lowest gas prices and good places to eat.

The main incident that caused Ushahidi to come into the spotlight was the Haiti earthquake. A group of student volunteers near Boston used the system to create haiti.ushahidi.com to help with the post-earthquake response (Norheim-Hagtun & Meier, 2010). Ushahidi has since been used for "election monitoring, reporting human rights violations, disease surveillance, wildlife tracking, and disaster response" (McClendon & Robinson, 2012, p. 4).

One of the main advantages Ushahidi has against all the current tools is the vast infrastructure behind the system with a network of 1,000 volunteer translators and 300 students (Norheim-Hagtun & Meier, 2010). This allows for a faster turnaround with incoming SMS messages with information about an event. This becomes particularly helpful because it is built to receive information from a variety of channels as well and a variety of languages. Volunteers from local regions of affected areas are used to translate the messages coming in and add them to the system. Another advantage Ushahidi has against its competition is it gives the user the ability to "listen" to events coming from a specific region or the user can specify a certain event criterion, and the system will send a notification when an event matching that criterion is posted (McClendon & Robinson, 2012).

Although the number of channels one can use to report an event is large, it becomes a challenge to aggregate all of the incoming information into one cohesive visual representation. Each incoming report must be manually verified and approved by Ushahidi staff (McClendon & Robinson, 2012; Okolloh, 2009) before it's annotated and displayed on the interactive map. Since most of the reports coming in are in the form of character strings, mapping the report efficiently has become a big challenge. Norheim-Hagtun & Meier (2010) states that out of 40,000 Haiti-related SMS messages, only 5% were mapped. Some reports contain geo-location information such as street names, but that requires manual translation in order to be mapped.

2.3.3 Tweak the Tweet

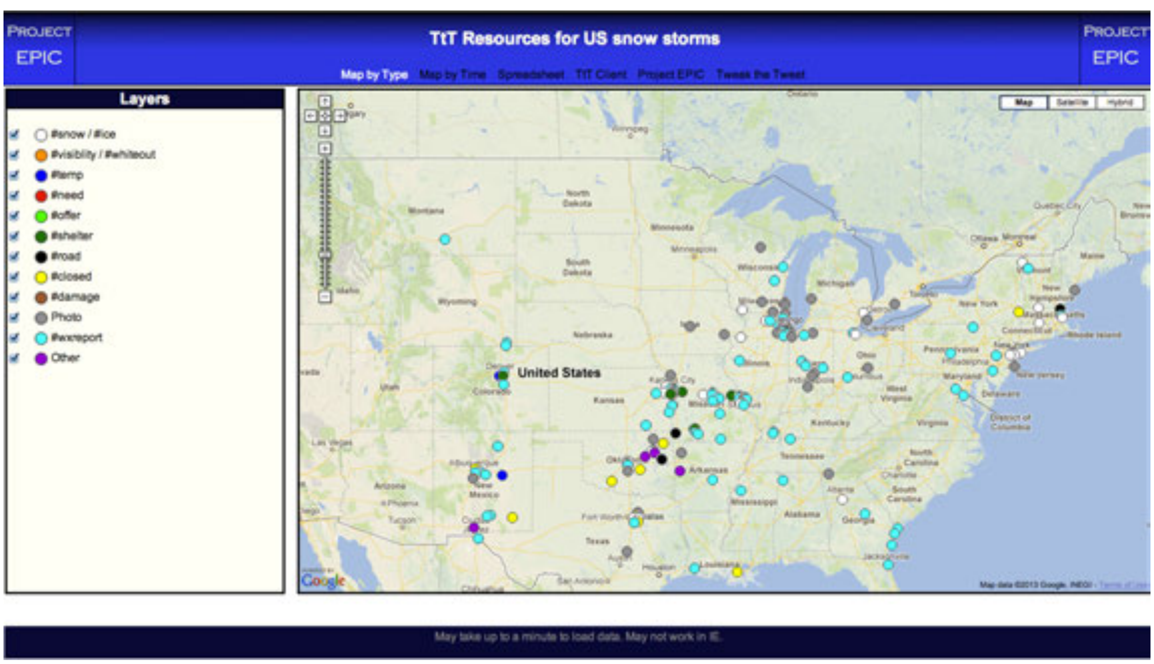


Figure 2.2 - Tweak the Tweet Web Interface

Tweak the Tweet (TtT) is an effort to use the micro blogging tool Twitter in a more efficient way by imposing a micro-syntax where users format their tweet in a specific way to make monitoring of tweets during a crisis much simpler (Starbird & Palen, 2011). The purpose of TtT was refined to promote crowdfeeding, the ability for the user providing the information to be able to access a compiled version of all the contributed information, after the team behind the system noticed the difficulty in getting users to adopt a micro-syntax during the 2010 Haiti earthquake (McClendon & Robinson, 2012). Each tweet that uses the TtT syntax is processed, analyzed, and then displayed on a map using Google Maps API.

The micro-syntax used in TtT is made up of a series of hashtags that emphasize information about the location and the event. For example the hashtag #loc followed by the street name of the incident can be used to indicate the location. The #loc hashtag makes it easier to process the text next to it as a location.

TtT was first deployed during the 2010 Haiti earthquake. It then received attention for their involvement in the response to the 2010 Fourmile Canyon fire and then later during the 2011 Joplin tornado. It has now been deployed for over twenty major cities (McClendon & Robinson, 2012).

The main advantage of TtT is that it leverages a platform that most people already use which means that people don't have to download or learn another system. They can continue with the one they already know.

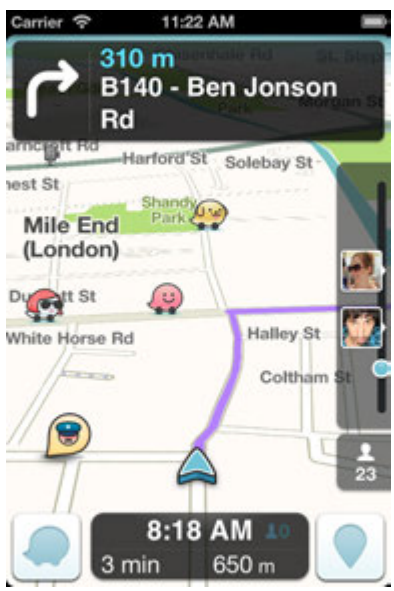
The limitations of Twitter, such as character limit and privacy issues, can also be said about TtT since it completely relies on it for reporting. Another argument against TtT is that it forces users to memorize a specific syntax in order for their message to be properly parsed instead of letting users use the platform as they normally would. The design of the interface lacks in visual aesthetics, which can have an effect on whether users trust the information provided. This topic will be discussed further below.

2.3.4 Customizable Map APIs

The advancement of web technologies and the accessibility of the Internet have opened the world of web cartography to the public to create and annotate their own maps (Liu & Palen, 2010; Tsou, 2011). Customizable Map APIs like Google's MyMaps and OpenStreetMap are common mapping tools that have been used in response to disasters in order to distribute event information to the community quickly.

The downside to these mapping tools are that they are usually for generic purposes so they lack specific features that can help during a crisis situation.

2.3.5 Google Waze



Waze is a navigation application for mobile phones with a social component that gathers information submitted by users to display traffic delays or accidents. It won the Best Overall Mobile app award (Hoffman, 2013) and was acquired by Google in 2013 (McClendon, 2013; Chan, 2013) indicating that the need for user generated location information is present.

Waze has very similar functionality to Urban Forecast but it has different priorities and the application is presented in a different context. The primary focus of Waze is to be a navigation app that guides users from point A to point B. The secondary focus is to provide the user with crowdsourced route information. The primary focus of Urban Forecast is to display user generated location information.

Like the slogan "Outsmart traffic" suggests, Waze is a solution to traffic. Their cartoon design makes the app feel fun and friendly to help counter the frustration that comes with traffic, which is not something that would translate well into a context where lives could be at risk. It also has great tools specific for driving like cheapest gas station and one tap navigation to Facebook events. These features would not be a priority to a user looking for crisis information. It does, however, contain features that could be beneficial for users of Urban Forecast such as learning frequent destinations, commuting hours and preferred routes.

2.3.6 Design Considerations Based on Current Tool Challenges

Based on the states of the current tools the two common challenges that were expressed in the literature were the ability to map incoming information and establishing trust amongst users (Liu & Palen, 2010; McClendon & Robinson, 2012; Okolloh, 2009).

For the tools that aggregate data from existing text-based technology such as tweets, SMS messages, online forms, etc., translating the information into mappable coordinates become a major challenge. Ushahidi reported that only 5% of the 40,000 SMS messages were automatically mapped. McClendon & Robinson (2012) points out that we cannot assume that the other 95% had no geospatial information that code manually be translated into coordinates. The interaction and development of Urban Forecast aims to address this problem and will be discussed in the next chapter.

As with any information gathered from unknown sources, credibility and trust are always an issue. This is an ongoing challenge in crowdsourced information that will be discussed further in the next section.

It would be impossible to replicate the infrastructure behind Ushahidi for this research, but the ability to "listen" for events in a particular region or for specific criteria is something that can be implemented and very useful. Automation is what the Ushahidi lacks because of the need for manual translation of locations to mappable coordinates. If Urban Forecast can automate the mapping, then software development time can be spent working on support to improve the application.

One of the advantages mentioned for TtT is its use of the Twitter platform and the vast amount of people using it to supply event information. Using Twitter to populate a map will pose the same problems in mapping as the rest of the current tools. One way to leverage the number of users in a social platform like Twitter without solving the mapping problem is to facilitate the sharing of data from the mapping application to the social platform instead of the other way around. A good example of an application that uses this method is Instagram. Instagram is a native mobile application that uses the mobile phone's camera to take pictures and add them to a user profile. The main interaction happens through the mobile application, but the photos can also be seen and linked through the web. This allows for the sharing of an Instagram picture by just attaching a URL to a tweet or a Facebook status.

Like the customizable map APIs, the Urban Forecast application should have a low learning curve to allow for any type of user to use it. But unlike the map APIs, Urban Forecast should be specific to crisis situations and have features designed to help users avoid danger. The specificity of the design will make the role of the user clear and prevent people from using it as another "check-in" map service like Foursquare.

2.4 Online Trust

Achieving trust from users has been noted to be a common challenge among implementations of current crisis map mashups as noted in the previous section. The low learning curve for mapping tools such as Google maps and the amount of people who have access to these tools have created an information overload that has made credibility and trust a very valuable characteristic. This section will explore what it means to have online trust and how to design for it.

2.4.1 Trust in expertise

It is easy to trust someone who is considered an expert on the subject. Research shows that expertise is linked to credibility (Corritore, Kracher, & Wiedenbeck, 2003; Metzger, 2007). This becomes a challenge in applications that rely on crowdsourcing their content. Flanagin & Metzger (2008) argue that in situations where there is no need for expertise, in this case reporting a witnessed crisis, an average person with local knowledge is as credible as the expert.

2.4.2 Trust in Reputation

Creating a level of reputation either for the application itself or individual users creates a metric people can use to develop trust (Corritore et al., 2003; Flanagin & Metzger, 2008; Metzger, 2007; Shneiderman, 2000). Reputation of the application can come in the form of history of accurate and inaccurate reports made which will allow users to assess how well the tool is doing. Reputation of individual users can be similar to that of eBay's user ratings where each user carries a score that represents how trustworthy that person is and helps users decide if they would like to conduct business with them. The level of transparency forces the user to consider the effect their actions might have on their rating, which results in quality interactions.

In the case of an application like Urban Forecast, this issue becomes problematic. The more information a user gives, the easier it is to establish credibility, but the harder it is to promise privacy, which in turn can diminish trust. Finding a way to be able to calculate reputation without disclosing any other user information will help build trust around the application. This can also help calculate the overall accuracy of the tool.

2.4.3 Trust in design

Good design is the easiest way to incorporate a sense of trust in a system because design is the one attribute that can be controlled. Design, in this case, not only refers to visual aesthetics of the application but also the structure of the website including navigation and what people describe as "ease-of-use" (Shneiderman, 2000; Nielsen, Snyder, & Farrell, 2000; Kim & Moon, 1998). Urban Forecast will need to take the following design attributes into consideration: a well-organized structure, clear and intuitive interface, and visually pleasing aesthetics.

A well-organized structure in an application can promote a sense of trust by making it easy for the user to get from one place in the app to another and satisfying the user's expectation. A clear and intuitive interface will help the user understand their role and interaction with the application avoiding any negative experiences that may result from a confusing interface.

CHAPTER 3 – APPLICATION DESIGN

In order to test how people would use a crisis application, a prototype was developed with limited features that would allow for testing of the basic functions. The prototype allowed the user to view all events previously posted, post their own event to the database with description and level of danger, and view predefined locations such as "work" or "home." This chapter describes the components of the prototype and their function as well as the design process.

3.1 Iterative Design

The first approach at creating Urban Forecast envisioned it as strictly a web application using html5, PHP, Google Maps, and MySQL (see Figure 3.1). A mobile phone would have to access it through the browser and interact with it as it would any other website. This is the route all the current tools have taken.

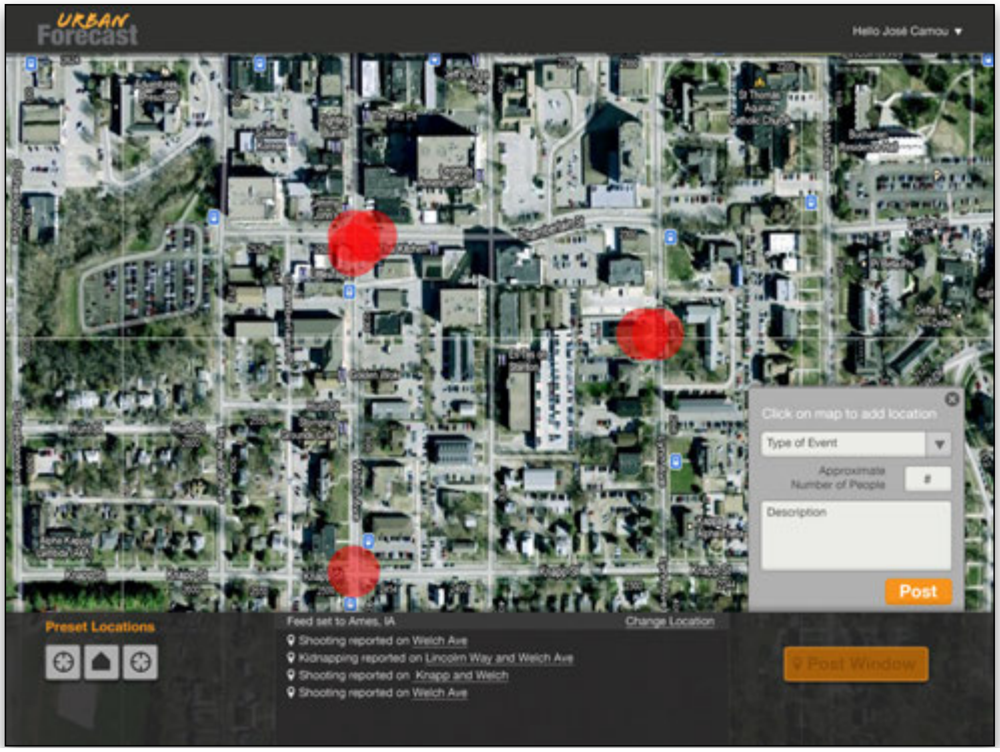


Figure 3.1 – Early design mockup of Urban Forecast as a web app

After considering the ability to leverage the iPhone's capabilities through native programming and the large amount of iPhone users, we made the decision to make Urban Forecast a native iOS application. Making Urban Forecast a native application gives us the ability to incorporate more features using the core hardware accessories of a mobile phone, which are important to an application designed for use while the user is moving. Features like picture uploading of crisis event, accessing contacts in case of emergency, and the level of trust that comes with being part of a marketplace are all possibilities that wouldn't be available through a web app. The user experience of a native application is still far superior to that of a web application (Gruber, 2013). But the vision for the end product is to be a mix of both native and web application; much like the approach Instagram has taken where the contribution and main functions of the tool are accessed through the mobile application but the product of those contributions can be shared through a web interface.

3.1.1 High Fidelity Decision

The decision to create a working prototype rather than a low to medium fidelity prototype was mainly because simulating the interaction and the technology, as the low to medium fidelity prototypes do, would only test the concept of the design instead of the system as a whole. The goal of the research was to see how effective the user interface, the frameworks, and technology available would be in helping the user avoid danger. Lim, Pangam, Periyasami, and Aneja (2006) found that fully-functional or computer-based prototypes help users identify issues such as "physical handling and operation, comments on the concept itself, comparison with other similar products, and performance-related issues" where the low-fidelity prototypes did not.

The earlier iterations of Urban Forecast were taken through low fidelity and paper prototype testing and critiqued by participants. That feedback helped establish a concrete layout. Interaction and functionality were the main focus of the prototype. Figure 3.2 shows what the interface looked like in the first version. Three initial pilot testers were used to provide feedback on the initial design.

Figure 3.2 - First version of UI

A common critique was that the white header and bottom bar were taking too much space and making the map feel "claustrophobic". They also mentioned that it was not apparent to them that the icons in the bottom bar were buttons. The redesign has each button in its own corner within a circle to make the button more obvious. The crisis event icons in the first iteration did not have the different colors for different danger levels. That was also changed based on feedback gathered from the pilot testers.

3.2 Development

The development of the prototype can be divided into three separate parts: Urban Forecast application code (created by the author), iOS frameworks, and vendor plugins (Figure 3.3).

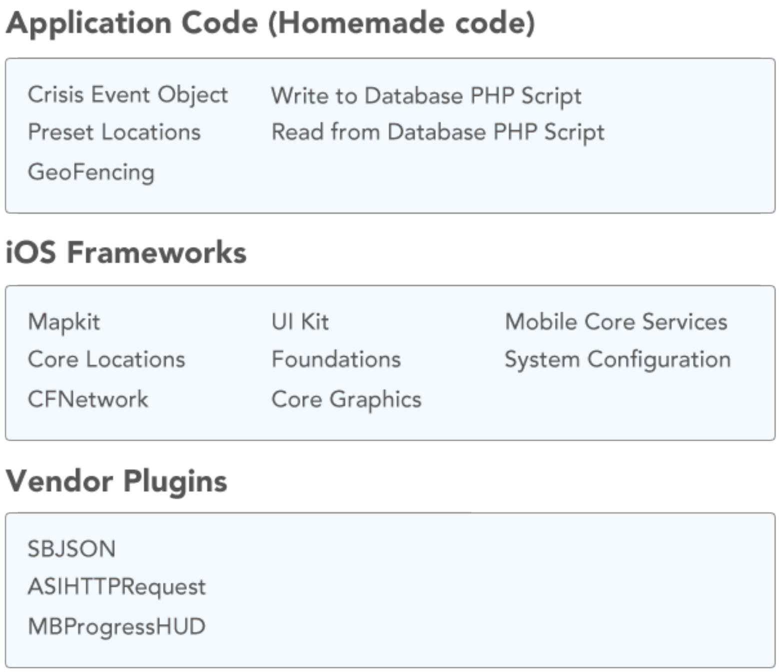


Figure 3.3 – Components of the Urban Forecast Prototype

3.2.1 Urban Forecast Application Code

The prototype was built in objective-c in order to work with the iPhone hardware. The application holds two types of location objects: crisis events and preset locations. Crisis events are the main part of Urban Forecast. The crisis event object was designed to hold the coordinates, event name, event description, user ID, timestamp, and danger level of the post. Each time a user posts an event, a crisis event object is created.

Preset location objects hold the coordinates, name, description, and icon type of a preset location set by the user. The purpose of these objects is to allow the user to save important locations to decrease the time it takes to find dangerous areas around locations important to the user, such as home or office. These objects are stored locally on the phone.

Real-time loading of events was simulated in the prototype by having the interface refresh events stored in the database every two minutes and after the user posted an event. This approach worked fine since there were no simultaneous sessions of participants posting events.

Annotating the map with an event requires the use of a "long-tap" gesture (holding your finger on the screen for at least one full second). Once the long-tap is triggered, the annotation icon is displayed with a button asking the user if he or she wishes to post an event. If the user clicks on the button, a form appears where the name, description, and danger level of the event can be added. If the user chooses not to click on the button, then that annotation is never stored in the database and will disappear as soon as the map is refreshed.

In order to communicate with the database to post and load crisis events, the application calls on a PHP script that formats the information into a JSON string. JSON, an alternative to XML, stands for JavaScript Object Notation and is used for serializing information through a network. To store the information, the PHP script uses MySQL and stores each item in the right cell. The Urban Forecast database was built using MySQL and is stored in a web server in order to be accessed by any mobile device. The table in the database currently stores the longitude, latitude, user ID, name of event, description of event (optional), and the timestamp of when the event was posted.

iOS Frameworks

iOS frameworks are APIs that Apple provides developers through Xcode that give the application more functionality and more access to the iPhone hardware. This approach helps the developer using the framework avoid wasting time by writing code that has already been written and tested by someone else.

One of the most important pieces of the prototype was the Mapkit framework. The Mapkit framework provided the application with the Apple map and information. This allowed the user to zoom in and out of a detailed world map and view the map as either a satellite image or a solid map image with landmark details. Unfortunately, the Apple map has less content and information than the Google map that was originally generated with the use of the Mapkit framework such as sidewalks and local building information that can be useful to users. To accommodate for the missing information, the map was set to satellite view, which provided images of the sidewalks and the actual buildings that were missing from the solid map view.

The core locations framework was used to keep an updated report on the user's location. It was also used to monitor a specific region around the current location to warn the user of any crisis event postings around them. However, because the minimum distance the core location framework can accurately calculate is 200 meters (656.158 feet) from the specified location, monitoring a particular region became useless because of the small area covered in the study. This feature would have to be tested using a larger space.

The CFNetwork framework was used to provide the application with web communication functionality. This framework was needed to use the ASIHTTPRequest plugin, which will be discussed in the next section. Other frameworks that were included in the application were UI Kit, Foundations, Core Graphics, Mobile Core Services, and System Configuration.

3.2.2 Vendor Plugins

Like iOS frameworks, vendor plugins are also APIs that help add functionality but are not provided directly by Apple. These plugins can be obtained from third party developers.

The plugin SBJSON allowed the application to create and parse through JSON objects that are used to send information to and from the database. In this case, JSON objects containing information about events such as location coordinates and event name were serialized and sent from the server the Urban Forecast is on back to the mobile device using the application.

ASIHTTPRequest was used to enhance the functionality of the CFNetwork API. It allowed for the application to communicate with the webserver and retrieve as well as send JSON information through the network. The plugin made a request every time the user posted an event or loaded events from the database.

The MBProgressHUD was a plugin used specifically to enhance the experience by posting an animation or a message when certain actions were triggered. Specifically when event information was being loaded from the database, MBProgressHUD displayed a loading animation.

3.3 Design

What the user sees and interacts with is just as important as the components in the background. Figures 3.4 – 3.16 show screenshots of a common sequence of the participants testing the working prototype. The first time the application is loaded the user is greeted by a tutorial screen (Figure 3.4) that explains the basic functions of the prototype and gives some meaning to the main icons. Once the user taps out of the tutorial screen the app is loaded with crisis events posted by other users (Figure 3.5).

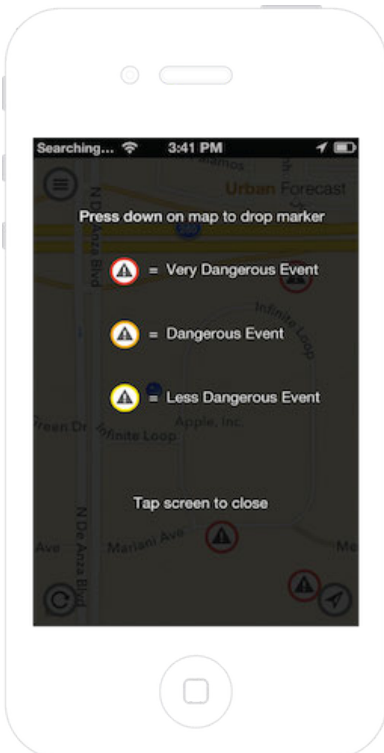


Figure 3.4 - Tutorial Screen

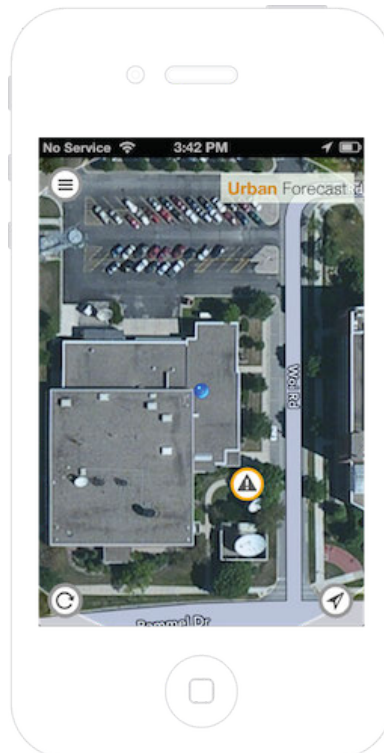


Figure 3.5 - Application with current location and 1 crisis event

Figure 3.6 shows the post button that is displayed after the user taps on the map in order to add an event to a location. The crisis event post form (Figure 3.7 & Figure 3.8) asks the user for the name of the event and has a larger text field where more detailed information can be added. The number and content of the text fields was based on the type of information gathered by Monroy-Hernandez et al. (2013).

Figure 3.6 - Post event button

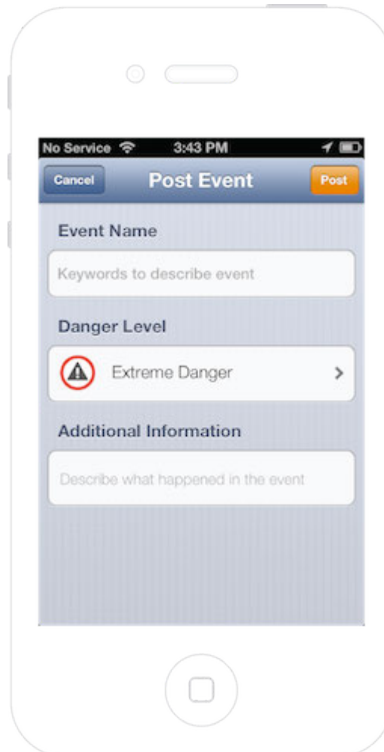


Figure 3.7 - Post event form

The user is also able to choose the level of danger of the event (Figure 3.9). Once the user posts the event, the data will be stored in the database and will be seen by all the other Urban Forecast users (Figure 3.10).

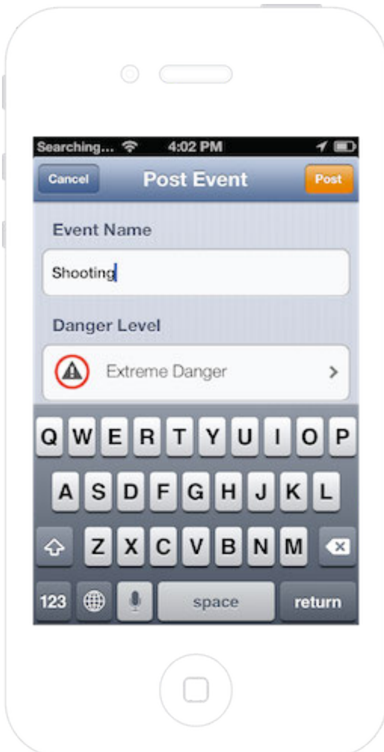


Figure 3.8 - Typing name of event

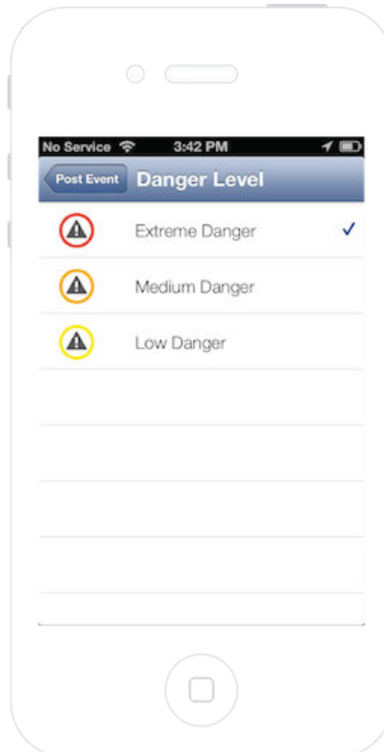


Figure 3.9 - Choosing danger level

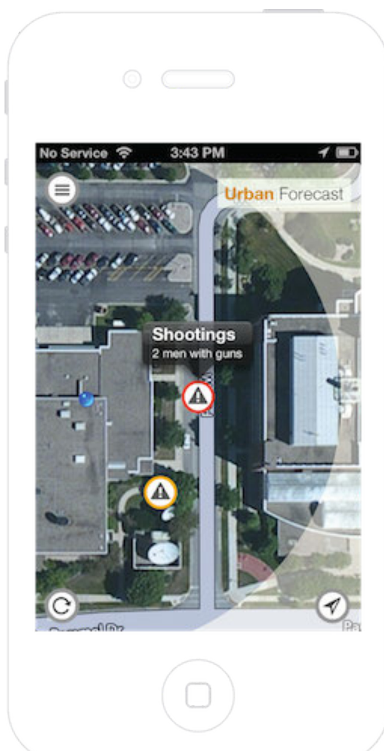


Figure 3.10 - Crisis event posted

The prototype allows the user to store preset locations in a menu (Figure 3.11) where they can quickly be accessed. Clicking on a preset will take you to that location (Figure 3.12). This was based on Ushahidi's ability to "listen" to specific locations.

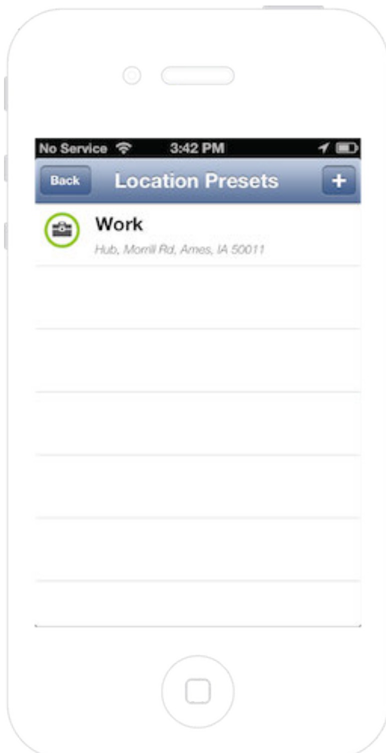


Figure 3.11 - Preset menu

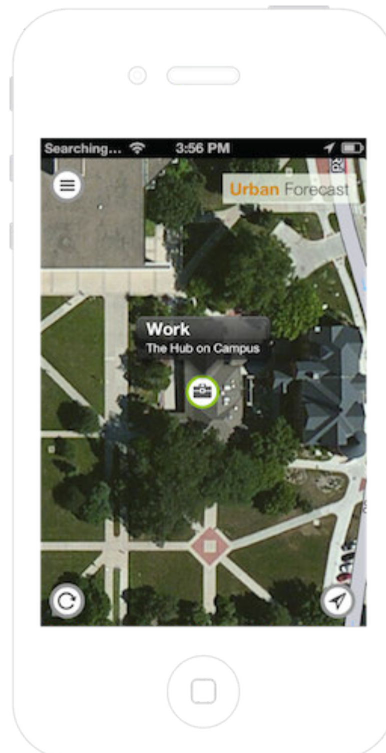


Figure 3.12 - Preset location loaded

The user can also add their own presets by filling out a preset location form (Figure 3.13, 3.14, & 3.16) and adding a specific icon (Figure 3.15) to help them personalize the app and differentiate each preset.

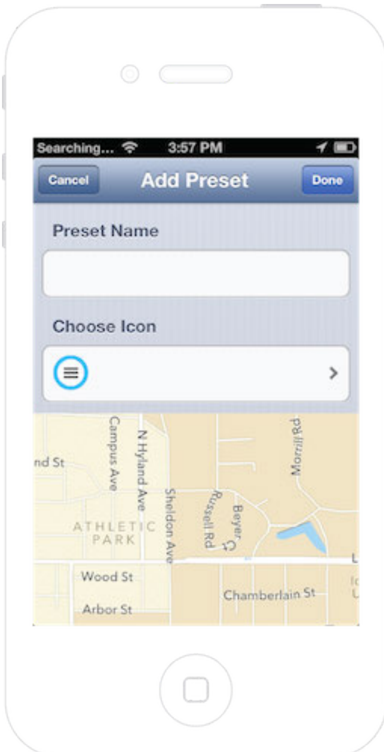


Figure 3.13 - Add preset form

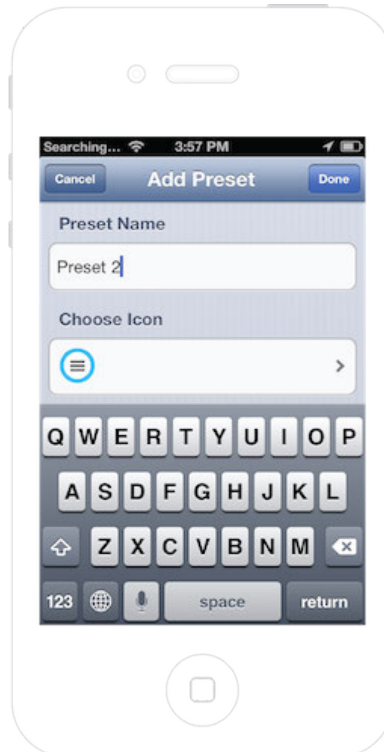


Figure 3.14 - Typing preset name

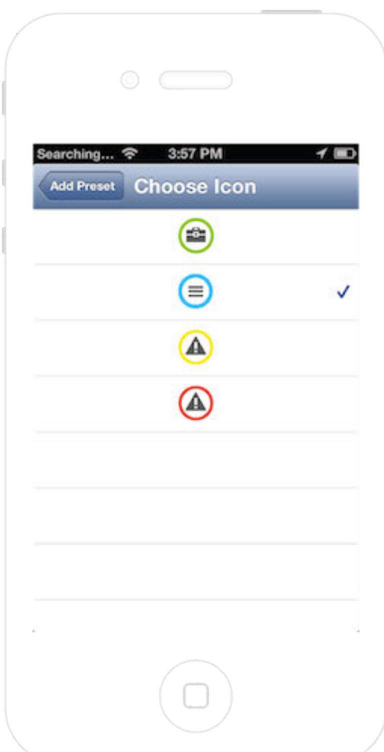


Figure 3.15 - Choosing preset icon

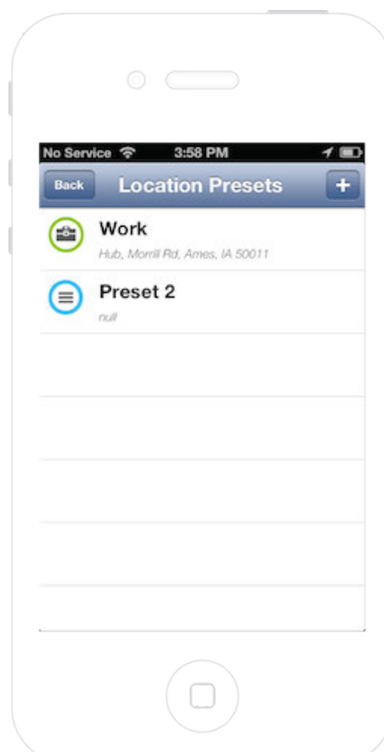


Figure 3.16 - Preset saved

3.3.1 Icons and Colors

Using specific icons in situations where the different type of users from different cultures have a shared context, in this case the context would be a crisis, can create a clear representation and meaning that can help Urban Forecast be used by different cultures (Nordin & Singh, 2011; Bourges-Waldegg & Scrivener, 1998). In this prototype exclamation point icons are used to represent crisis events and the color around each icon represents the level of danger with red being the highest level and yellow being the lowest. To add to the representations in the application, colors are used to convey meaning to the user as well. To make a more effective and consistent interface, warmer colors, such as reds and yellows, are used to represent notifications and warnings while cool colors, such as greens and blues, represent items the user owns such as preset locations (Shubin, Falck, & Johansen, 1996).

The final product is a working prototype built using frameworks and a MySQL database that offered users the ability to see dangerous areas as well as post dangerous areas they come across. This prototype enabled the evaluation of the Urban Forecast approach and the results helped inform the design of the next iteration.

CHAPTER 4 – METHODOLOGY

In order to evaluate whether the prototype could help people avoid crisis situations, and to assess the usability of the prototype, participants were asked to go through a simulated scenario using the prototype to help them avoid "dangerous areas" and reach their final destination. Physical markers made out of posters (see Figure 4.1) were placed around the Iowa State University campus were used to represent crisis events. Questionnaires were used to assess each participant's spatial ability and measure the ease of use of the application.

4.1 Participants

There were a total of 16 participants: 11 recruited via SONA, a research pool made up of psychology majors at Iowa State University, and five recruited via word of mouth. Participants recruited through SONA received one class credit as compensation while participants recruited through word of mouth received $10.00 for their participation.

There were 11 male and five female participants between the ages 18 – 35. Three of the participants were non-native English speakers. This is important to point out since a design goal for the prototype was to cross the language barrier and have the application work in various cultures.

All participants' identities were kept anonymous. Participants were allowed to withdraw from the study at any time.

4.2 Measures

Table 4.1 lists all of the data collected in the study and the questions they are meant to address. The pre and post map path can be found in Appendix C and was used to compare the participants' assumed path with their actual path after they were exposed to the application. The demographic questions can be found in Appendix D.

Table 4.1 - Data collection methods and purpose

Data Collected	Question Addressed
Usability Survey	System usability and user satisfaction
SBSOD	Analysis of individual differences in spatial ability
Pre & Post Map Path	Effectiveness of app helping user avoid danger
Verbal observations (Think-Aloud Protocol)	System usability
Demographic questions	Analysis of individual differences

Santa Barbara Sense of Direction Scale (SBSOD)

The SBSOD (Hegarty, Richardson, Montello, Lovelace, & Subbiah, 2002) is a self-reported survey that assesses environmental spatial ability. For this study, the SBSOD is used to assess the participants' ability to orient themselves on a map. There are fifteen questions. Each question is based on a seven point Likert scale with responses ranging from "Strongly Disagree" to "Strongly Agree."

Usability Survey

The usability survey used in this study is based on the SUS which is a ten-item questionnaire developed by John Brooke (1996) that has been widely used to assess the usability of a system. The questions ask about the effectiveness and efficiency of the system as well as the satisfaction of the user with the system. Questions are based on a seven point Likert scale with responses ranging from “Strongly Disagree” to “Strongly Agree.”

4.3 Procedures

Participants were asked to go to the Virtual Reality Application Center (VRAC) at Iowa State University to start the study. Upon arrival, a participant was given a consent form (Appendix F) to read over and sign, followed by the SBSOD. Once the two forms were completed, participants were given a detailed explanation about the study. They were allowed to ask questions during the briefing and to opt out of the study if they were uncomfortable with taking part after hearing the full details. Participants were given a scenario where they needed to find a safe path to get to work. They were allowed to use Urban Forecast to gather information about dangerous paths around campus. A copy of the script can be found in Appendix G. Reading through the entire script took approximately five minutes. After being briefed with the study details, participants were given a map (Appendix C) of the campus and were asked to draw the path they would normally take from their current location to the final destination.

Once they had drawn their map path, participants were given a maximum of two minutes to explore the Urban Forecast prototype on an iPhone 4S provided to them. Once they indicated they felt comfortable with the application, or the two minutes were up, they were asked to walk towards the final destination and were encouraged to use the think aloud protocol (Lewis, 1982), that is, voicing their thoughts out loud as they walked. The researcher walked slightly behind the participant to avoid guiding him or her in a certain direction. Notes were taken during the walk to document any comments made by the participants.

Before the study, two crisis event markers (Figure 4.1) representing crisis events were placed around campus. Figure 4.2 shows the positions of the two markers. Because the study was done during the winter months in Iowa, snow and wind made it sometimes challenging to keep the marker posters and their easels to remain standing. The easels were placed alongside a chain link fence to keep them from falling. Crisis events that were not represented by markers were also posted on the application prior to the study to simulate events posted by other users.

Figure 4.1 - Crisis Marker, a poster board of 24” x 36”

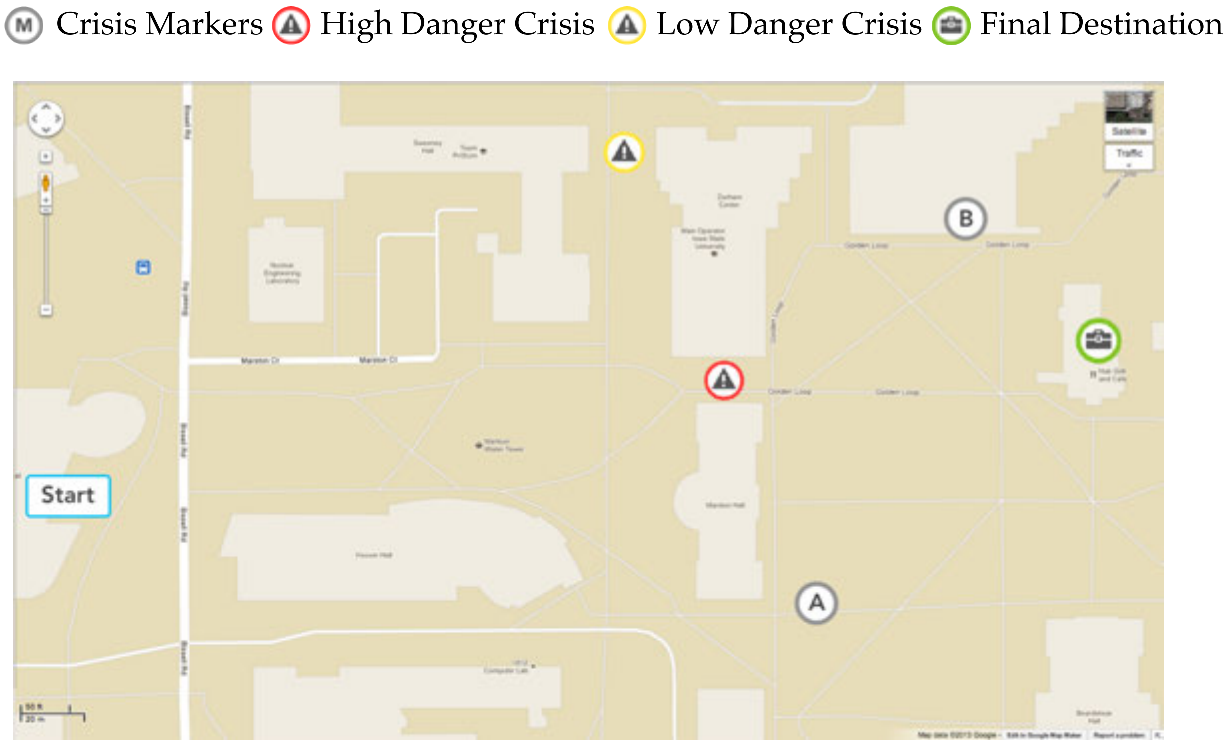


Figure 4.2 - Study setup showing position of the physical marker posters, crisis icons on the app, and the final destination.

During the walk, participants checked the path for crisis events marked on the application in order to steer away from any danger. The simulated crisis events were strategically placed so that participants would come across a point where they would have to choose an alternative path.

When participants came across a crisis event marker, they notified the researcher that they had spotted the marker. The researcher had scripted different scenarios for each of the markers. For marker A, the participant was told that there was a roadblock along the path. For marker B, the participants were told they had spotted a collision with multiple injuries. Once the participants were told about the scenario, they were to post it using the prototype and continue walking.

These actions during the walk were categorized into five tasks. Table 4.2 describes the tasks.

Table 4.2 - Task events and description

Task	Description	Possible Iterations
Task A	The participant deviated from his/her planned path, regardless of the reason.	Minimum = 0 Maximum = ∞
Task B	The participant saw a virtual marker and altered course. The participant was able to receive information from the app and make a decision.	Minimum = 0 Maximum = 2
Task C	The participant saw a physical marker and asked about that marker as instructed.	Minimum = 0 Maximum = 2
Task D	The participant saw a physical marker and posted it in the app.	Minimum = 0 Maximum = 2
Task E	The participant altered course after seeing a physical marker.	Minimum = 0 Maximum = 2

Tasks A and B informed whether the first research question, "Do users alter their pre-planned route based on virtual markers in Urban Forecast" is true or not. Tasks C and D informed whether the second question "Do users engage with Urban Forecast when a physical crisis is observed" is successful. Task E was used to measure how serious the participant took the study.

Once participants reached the final destination, they were asked to draw the path they actually walked on a clean copy of a campus map. After the post map path was drawn, they were given a post-survey that included demographic questions, questions about their technology use, experience in crisis, and the usability survey. When participants were done with the post-survey, they were either given a participation receipt if they were recruited using the psychology research pool or they were escorted back to VRAC where they were compensated with $10.00. This procedure took 50 minutes or less for each participant.

4.3 Predictions

Given the list of data collected in the study, hypotheses can be made about the correlation between the results of each individual measure. The design of the application and the interface are the main components with which the user interacts. A bad design would result in a low SUS score and confusion about what to do next during the task. One aspect of this information can be seen by comparing the pre and post maps to see if there are any differences between them. A good design would produce the opposite effect.

A participant with a low SBSOD score and difficulty in orienting to the map interface will indicate a lower spatial ability, which should affect the usage of Urban Forecast. If there is no correlation between the difficulty in orientation and SBSOD score then the participant's spatial ability is not related to the Urban Forecast usage. If the application doesn't successfully convey where the dangerous areas are, then the participant's pre and post map paths will be the same. A participant who is confused or critical of the application will provide more feedback during the study, and that fact will be shown in the notes. If a participant's success in Urban Forecast is related to their familiarity with smart phone devices, Google maps, etc., then a correlation between those variables will be revealed in the demographic data.

Chapter 5 – Results & Discussion

5.1 Demographic Information

Of the 16 participants, eight were between the ages of 18 – 20 (50%), four participants between 21 – 24 (25%), three participants between 25 – 30 (18.6%), and one participant between 31 – 35 (6.2%). Eleven participants were male (68.8%) and five participants were female (31.2%). There were seven participants who considered themselves of Asian ethnicity (43.6%), six participants who considered themselves white (37.5%), two participants who considered themselves Hispanic (12.5%), and one participant who chose other and wrote down Middle Eastern (6.2%). Table 5.1 shows these data.

Table 5.1 - Demographic questions

Participant	Age	Gender	Ethnicity
1	18 - 20	Male	Asian
2	18 - 20	Male	White
3	21 - 24	Male	Asian
4	18 - 20	Male	White
5	18 - 20	Male	Asian
6	18 - 20	Male	Asian
7	31 - 35	Female	White
8	18 - 20	Female	Asian
9	18 - 20	Male	Asian
10	21 - 24	Female	Asian
11	25 - 30	Female	White
12	18 - 20	Female	Middle Eastern
13	21 - 24	Male	White
14	25 - 30	Male	White
15	25 - 30	Male	Hispanic
16	21 - 24	Male	Hispanic

Participant Experience Questions

Table 5.2 shows the experience question results. When participants were asked if they had experienced any kind of crisis situation, nine participants answered no (56.3%) while seven participants circled one or more crisis situations (43.6%) (see Appendix D for crisis situation choices).

Table 5.2 – Participant Experience Questions

Participant	How often do you use Google Maps?	Twitter?	Experience with smartphones?	Have you ever experienced a crisis situation?
1	Less than once a month	Never	Yes	No
2	2-3 times a month	2-3 times a week	Yes	No
3	Daily	2-3 times a week	Yes	No
4	2-3 times a week	Daily	Yes	Shooting; Wild Fire
5	Less than once a month	Daily	Yes	Hurricane or Severe Storm
6	2-3 times a month	Never	Yes	Hurricane or Severe Storm
7	Less than once a month	Never	Yes	No
8	Once a month	Daily	Yes	Riot
9	2-3 times a month	Never	Yes	Riot; Hurricane or Severe Storm
10	Once a month	Never	Yes	No
11	2-3 times a week	Never	Yes	No
12	Daily	Daily	Yes	No
13	2-3 times a month	2-3 times a week	Yes	No
14	Daily	2-3 times a month	Yes	Riot; Hurricane or

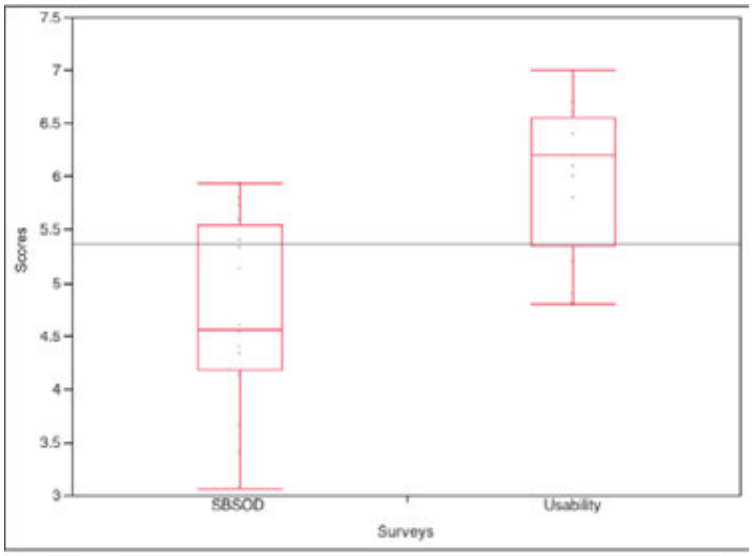
				Severe Storm
15	2-3 times a week	Less than once a month	Yes	Roadblock
16	Daily	Less than once a month	Yes	No

5.2 Survey findings

For the SBSOD, the positive framed questions were inverted so that a higher mean implied higher spatial ability. For the usability survey, the negatively framed questions were inverted so that a higher mean implied a higher usability. The SBSOD had a mean overall score of 4.717 out of 7 with a median of 5.125. The usability survey had a mean overall score of 6.00 out of 7 with a median of 6.40. Table 5.3 shows the simple statistics done to the survey results.

Table 5.3 - Simple statistics on the SBSOD and usability survey

SBSOD	Values	Usability	Values
n	16	n	16
Mean	4.717	Mean	5.95
Standard Deviation	0.886	Standard Deviation	0.693
Median	5.125	Median	6.25
Variance	0.785	Variance	0.48
Upper Bound	5.151	Upper Bound	6.34
Lower Bound	4.282	Lower Bound	5.66



Quantiles

Level	Minimum	10%	25%	Median	75%	90%	Maximum
SBSOD	3.067	3.3001	4.183	4.5665	5.55	5.8399	5.933
Usability	4.8	4.87	5.35	6.2	6.55	6.79	7

Figure 5.1 – Visualization of survey result statistics

5.3 During Study

5.3.1 Identifying tasks

In order to better analyze the participant during the study, each task event was categorized and given either a one (1) if the participant completed that event or a zero (0) if the participant did not complete it. The results of Tasks A-D were analyzed to assess the success of the application in a larger population. The Exact method was used to calculate the confidence intervals. Task E did not provide any direct insight into the research questions nor, upon further investigation, were the events represented by the markers serious enough to necessitate a reroute so it was not analyzed with the other tasks.

Task A

Fourteen out of the sixteen participants (88%) deviated from their planned path. Task A is interested in any type of deviation from the original map; this includes deviations before the participant notices any kind of crisis marker, virtual or physical. Using the binomial distribution comparison test recommended by Sauro & Lewis (2012) for a small sample with a benchmark of 70%, we calculate based on these data that there is a 92% chance CI [0.616, 0.984] that more than 70% of the population will deviate from their planned path.

Task B

Eleven out of the sixteen participants (69%) altered their planned path based on information received from the application. There is a 78.7% chance CI [0.413, 0.889] that 70% of the population will alter their path based on the information from Urban Forecast.

Task C

11 out of the 16 participants (69%) spotted a crisis marker during the study. There is a 78.7% chance CI [0.413, 0.889] that 70% of the population will spot a crisis marker.

Task D

10 out of the 11 participants (91%) who spotted a crisis marker successfully posted the event in Urban Forecast. The one participant who spotted the crisis marker but did not successfully post it was able to mark the location of the crisis marker and fill out the information regarding the event but did not click the post button. There is a 63% chance CI [0.354, 0.848] that 70% of the population will engage with the application during a crisis event.

Task E

Only three out of the eleven participants (27%) who spotted a crisis marker rerouted their path to avoid the location where the crisis marker was placed.

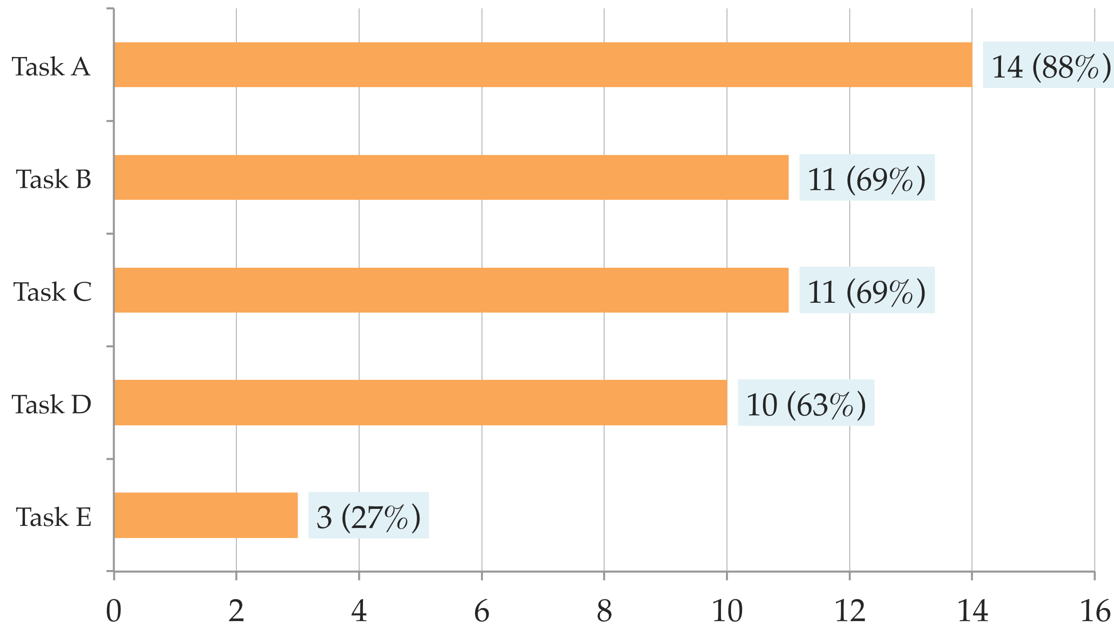


Figure 5.2 – Number/percentage of participants who completed a task

5.3.2 Pre/Post Map

Figure 5.3 shows the paths participants expected to take to arrive at the final destination. All participants' drawn paths converged into the most direct route.

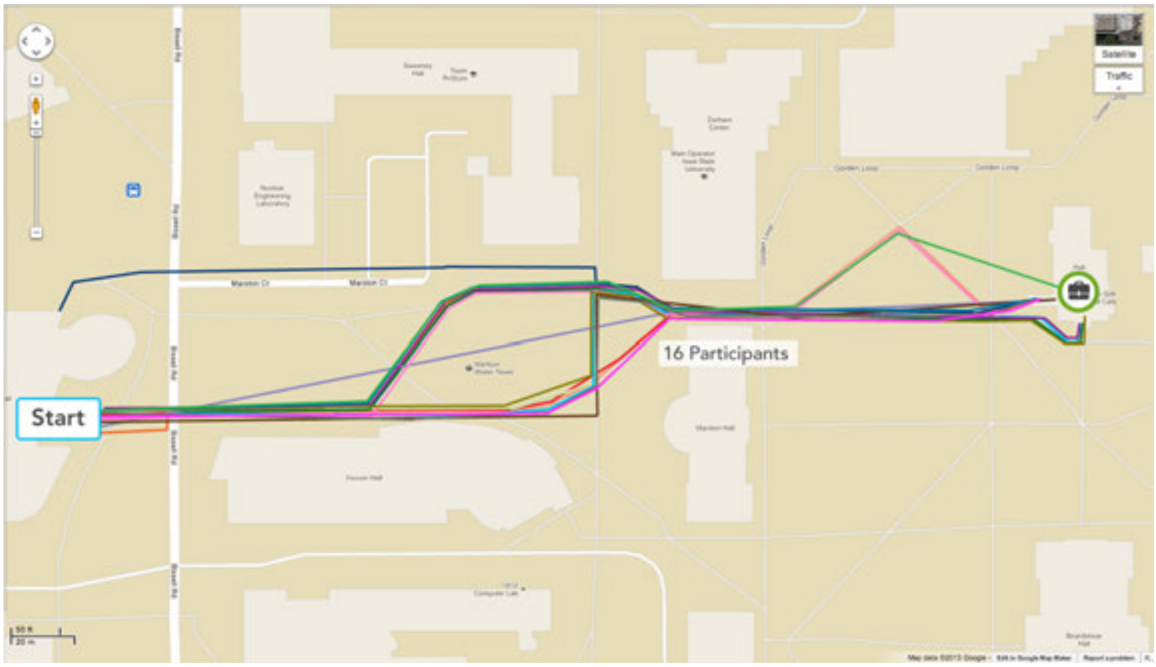


Figure 5.3 - Pre Study Path Map

The study was designed so that the participant had the ability to make a choice in the route he/she took to get to the final destination. Figure 5.4 shows the hypothesized common paths to be chosen alternative route with route A being the safest, route B being the second choice, and route C being the direct path but the most dangerous.

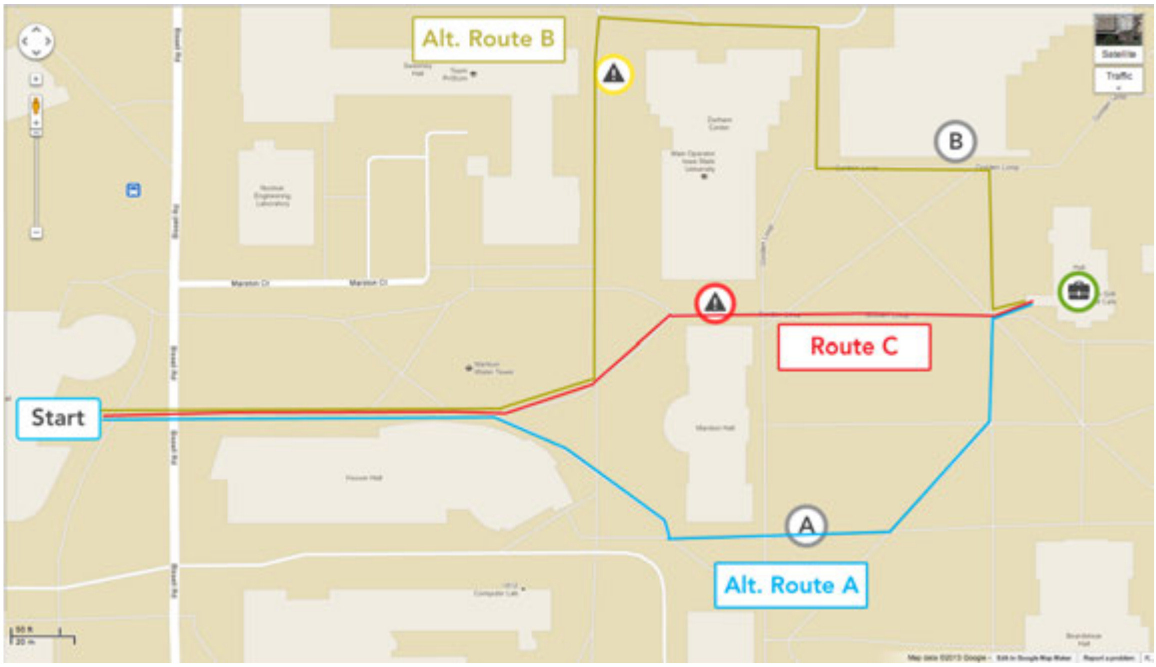


Figure 5.4 - Assumed Alternative Routes

Figure 5.5 shows the paths participants ended up taking during the study with information from Urban Forecast. Eight out of the sixteen participants chose a variation of alternative route A while three participants chose alternative route B. One participant went completely off campus. Four participants went through the direct route C.

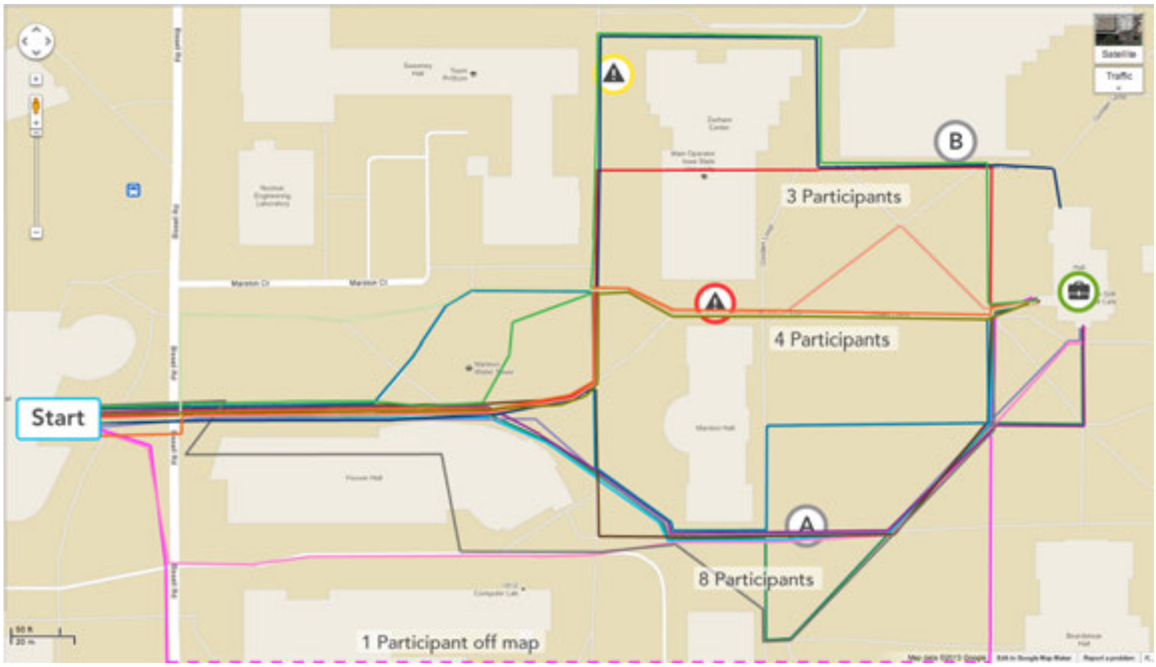


Figure 5.5 - Post Study Path Map

5.3.3 Participant Feedback

Before the study participants were encouraged to “think-aloud” while they interacted with the prototype. Eight out of the eleven participants who attempted to post the crisis event through Urban Forecast made a remark about having trouble dropping an annotation on the map (“long-tap” gesture). Three out of sixteen participants had a concern regarding the availability of coverage when traveling. One participant recommended a list that sorts the posted events by time to be able to choose a safe path. Some participants kept waiting for the application to show them the safest route instead of them finding it based on the events posted. Eight participants made at least one positive comment regarding the design of the application.

5.3.4 Moderating Variables

Table 5.4 shows correlations among possible moderating variables. Google Maps Usage and Twitter Usage were coded on a 1-7 scale. Experience with a Crisis was coded as a 0 if the user had not experienced any crisis, 1 if they indicated they had experienced only one crisis, two if they circled two of the crisis choices, and so on. The maximum number a user could receive is a 7. Using the Pearson test of significance, we see that higher scores on the SBSOD are positively correlated with higher scores on the usability test. Also, higher scores on the usability survey and the SBSOD were both positively correlated with Google Maps usage. Other correlations were not significant. A logistic regression was run on each of the Tasks A-E to see whether SBSOD, SUS, or participant age contributed significantly to the successful completion of any of the tasks, but significance was not found.

Table 5.4 - Correlation table for moderating variables

	SBSOD	Usability Survey	Google Maps use	Twitter use	Experience with crisis
SBSOD	-	0.496*	0.535**	0.383	-0.084
Usability Survey	-	-	0.434*	0.096	0.239
Google Maps use	-	-	-	0.173	0.118
Twitter use	-	-	-	-	0.107
Experience with crisis	-	-	-	-	-

** Correlation is significant at the 0.05 level (2-tailed)

* Correlation is significant at the 0.10 level (2-tailed)

5.4 Discussion

5.4.1 Avoiding Danger

RQ1: Do users alter their planned route based on information received from Urban Forecast?

RQ1 is interested in finding whether Urban Forecast has an impact on the user. The results show that 88% of participants deviated from their path and 69% of the participants successfully altered their path based on information from Urban Forecast and that when translated to a bigger population people will most likely alter their path based on the information. This suggests that users of Urban Forecast can successfully interpret the information from the app to make decisions on their path.

Four out of the five participants who failed at altering their path based on information from the application were of Asian ethnicity, which might suggest a cultural difference in the interpretation of the Western-style icons, though this sample size is small enough that this correlation might be coincidence.

5.4.2 Community Participation

RQ2: Do users engage with Urban Forecast when a physical crisis is observed?

Urban Forecast depends on user participation in order for content to exist so for that to happen users must be able to easily contribute information. 69% of participants noticed the physical markers during the study and 91% of those participants successfully posted the event using the application. Nielsen (2006) stated that most in online communities only 10% of the users contribute information with 1% accounting for most of the contributions. Therefore, the high posting rates of participants support the idea that Urban Forecast might be successful.

The only one participant out of the ones who noticed a crisis maker failed to post through the application. Most participants, however, did try a few times before successfully dropping an annotation on the map. The Apple Maps API uses a *long tap* gesture to drop an annotation on the map that requires the user to hold his or her finger down for a full second in order to complete the action. Users were expecting to complete the action by quickly tapping on the map, which led to some confusion.

Even after the confusion, users were able to mark the crisis event on the application and fill out the additional information form and post the event. The participant who was unsuccessful in posting the event did fill out the form, but closed the app before the post button was pressed.

5.4.3 Predictions

The three participants who gave Urban Forecast the lowest usability score were all below the average on the SBSOD, with one having the lowest spatial ability score of the sixteen participants. This was one of the predictions that were made; low usability score correlation with low SBSOD. The correlation Table 5.4 shows that indeed usability and SBSOD scores were correlated. That prediction was accurate.

The three participants with very low Google Map usage (level 2 out of 7) had an average usability score of 5.2 out of 7 (SD=0.55), which is lower than the usability scores of the four participants with very high Google Map usage (level 7 out of 7), which averaged 6.0 out of 7 (SD=0.50). This shows that the participants who have higher experience with tools such as Google Maps had a better overall experience than the participants with little experience. That prediction was accurate as well.

The five participants who failed both task A and B had an average SBSOD score of 4.63 out of 7 (SD = 1.18), which is lower than the SBSOD scores of the 11 participants who succeeded in both task A and B, which had an average score of 4.73 out of 7 (SD = 0.78). However, this difference was not significant ($p = 0.83$, $d = 0.13$). Similarly, the six participants who failed both task C and D had an average SBSOD score of 4.68 out of 7 (SD = 1.03), which is lower than the SBSOD scores of the nine participants who succeeded in both task C and D, which had an average score of 4.74 out of 7 (SD = 0.84). This difference is also not significant ($p= 0.90$, $d=0.06$). Although these differences are not significant, the differences suggest that the prediction that lower spatial ability will affect the usage of Urban Forecast may be accurate.

The five participants who failed to deviate from their route based on the information from Urban Forecast had an average usability survey score of 6.0 out of 7 (SD = 0.63), which is equal to the 11 participants who successfully altered their path based on information from the app, which also had an average usability survey score of 6.0 out of 7 (SD = 0.75). This suggests that the prediction that confusion about the application would be correlated with a low SUS score was inaccurate. It seems that participants are able to be confused by the app or not engaged by it for reasons independent of their sense of its usability. On one hand, this fact suggests that usability is not a critical problem for Urban Forecast. On the other, it suggests that there are other factors to consider that affect app usage.

Similarities between the pre and post maps of participants cannot be attributed to the application's ability to successfully convey dangerous areas, since two of the participants said after the study was over that they knew they were walking through a “dangerous area” but thought they had to stick to their drawn route. Therefore, we know that participants' exact behavior may not be a complete indicator of how they perceive the app.

CHAPTER 6 – CONCLUSION

6.1 Overview

Social technology has helped the public share crisis information with each other but there seems to be a lack of tools aimed specifically at helping people avoid crisis situations. The rise in drug violence in Mexico and revolts in places like the Middle East have forced citizens to live in constant fear of being caught in a crossfire. Social media tools like Twitter or Facebook have helped facilitate some of the spread of information but neither one was created with this type of situation in mind.

This study was interested in developing an application that could help people avoid dangerous locations. Tasks were created to evaluate the effectiveness of the application. Crisis were simulated using “crisis markers” in order to observe the participants interaction with the prototype. The overall goal was to provide answers to the following questions:

RQ1: Do users alter their planned route based on information received from Urban Forecast?

RQ2: Do users engage with Urban Forecast when a physical crisis is observed?

Sixteen Iowa State University students, ages 18 – 35, participated in the study. One participant per session was asked to walk from a starting point to a final destination using the Urban Forecast application to make decisions about what the safest route would be.

The results show that most participants were able gather information from Urban Forecast and alter their path based on that information. Participants suggested, however, that the application help find the safest path instead of having the user do most of the work. The results also show that participants were able to successfully engage and interact with the application in order to post crisis events that they came across during the study. These findings indicate that a crisis management crowdsourcing application like Urban Forecast can be useful and successful at helping people avoid dangerous situations.

6.2 Future Work

After analyzing the results of the Urban Forecast prototype, another iteration on the design was created to address issues in the first prototype and implement more functionality from the literature.

6.2.1 Design

Figure 6.1 shows the initial view of the redesigned Urban Forecast when the application is loaded. In the prototype used in the study only three virtual crisis markers were added to the map and they were strategically spread out to make the participant choose an alternate route. In a real world scenario this would not be the case since multiple users can report the same event at slightly different coordinates. This can cause the screen to fill with overlapping markers and interfere with interactions and performance. In the new design crisis markers that are within a certain distance from each other are clustered into one icon to improve loading performance and a number is shown to indicate how many markers have been clustered together. Only three buttons are displayed to the user. Like the prototype in the previous chapter, the bottom right button is to return to the user's current location and the bottom left button is to access the location preset menu.

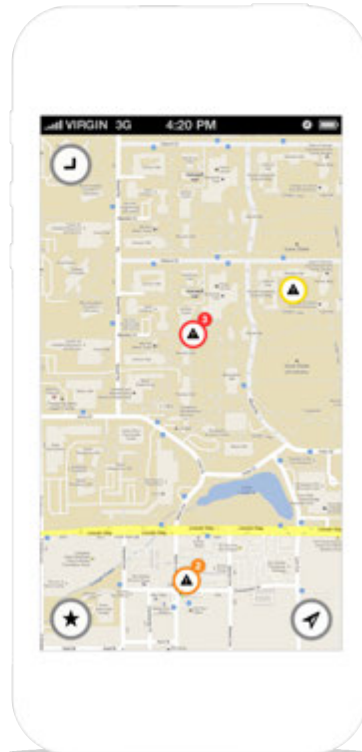


Figure 6.1 – Initial view of Urban Forecast

In the prototype users had trouble remembering to use the "long-tap" gesture to add a marker on the map. In the new design adding a marker to the map can be done by simply tapping on the location where the marker needs to be placed. Once the marker is dropped on the map a window will slide from the bottom with more information about posting the event (see Figure 6.2). Using swiping gestures the user can swipe right to continue to post the event, swipe left to cancel or swipe up to bring out more options (see Figure 6.3).

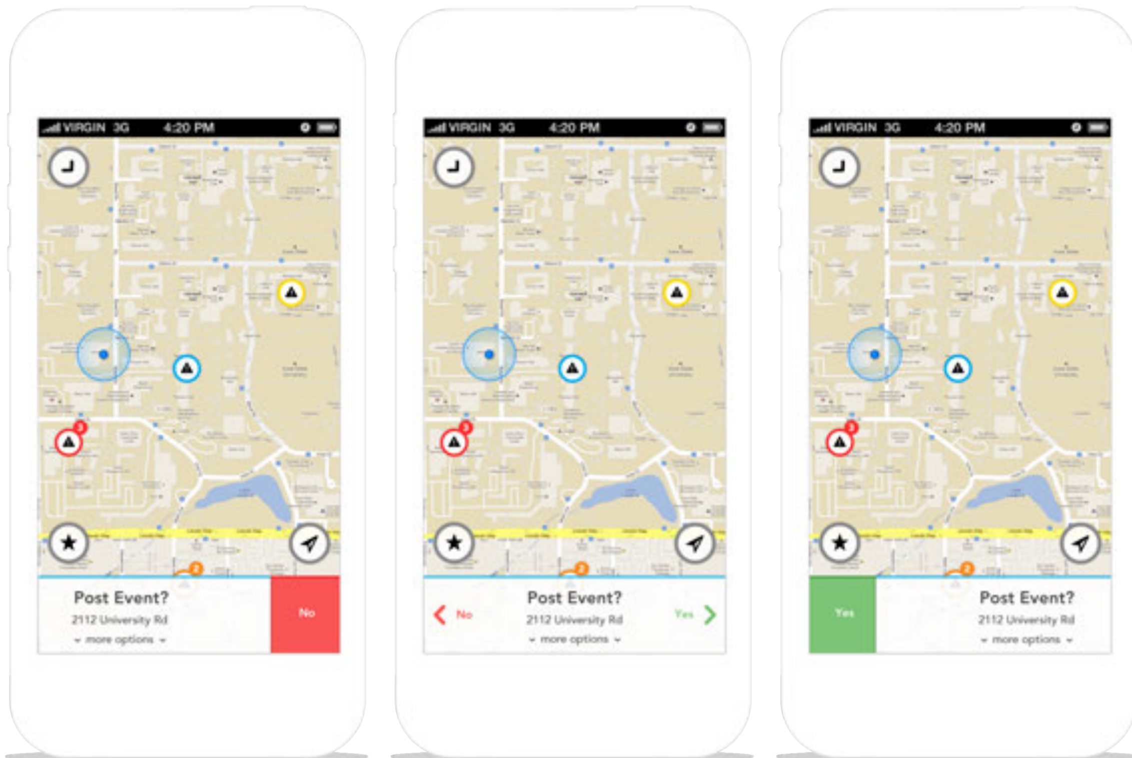


Figure 6.2 - Event posting window slides out from the bottom. Slide finger to the right to post or slide to the left to cancel.

Pressing the *Travel Here* button will route the user from their current location to the location of the marker using paths that avoid any other crisis markers. This feature was added after participants commented that the prototype showed them what spots to avoid but didn't have any information on the best route. Users can also add the location to their presets from this menu or simply *watch* the location and get notifications of any crisis events posted around the location.

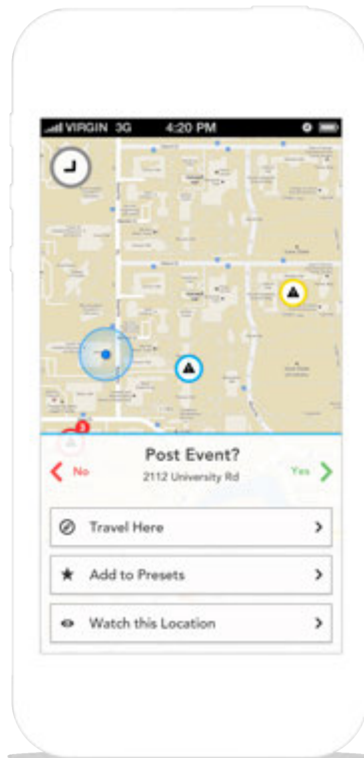


Figure 6.3 - Swiping up will reveal more options that can be applied to the dropped marker.

If the user decides to post the crisis, the location coordinates will be saved and the user will be asked for more detailed information regarding the event. In this iteration pictures can be added to further document the situations, and every post can be shared with current social media networks as well as through text and email to facilitate the spread of information.

Once the crisis is posted, clicking on the crisis marker or any other crisis marker will bring up more information about the event (Figure 6.4). The window can be swiped up to reveal more options such as pictures and the ability to share the post. In order to increase the accuracy of the application, any user is able to verify whether any event is accurate or inaccurate.

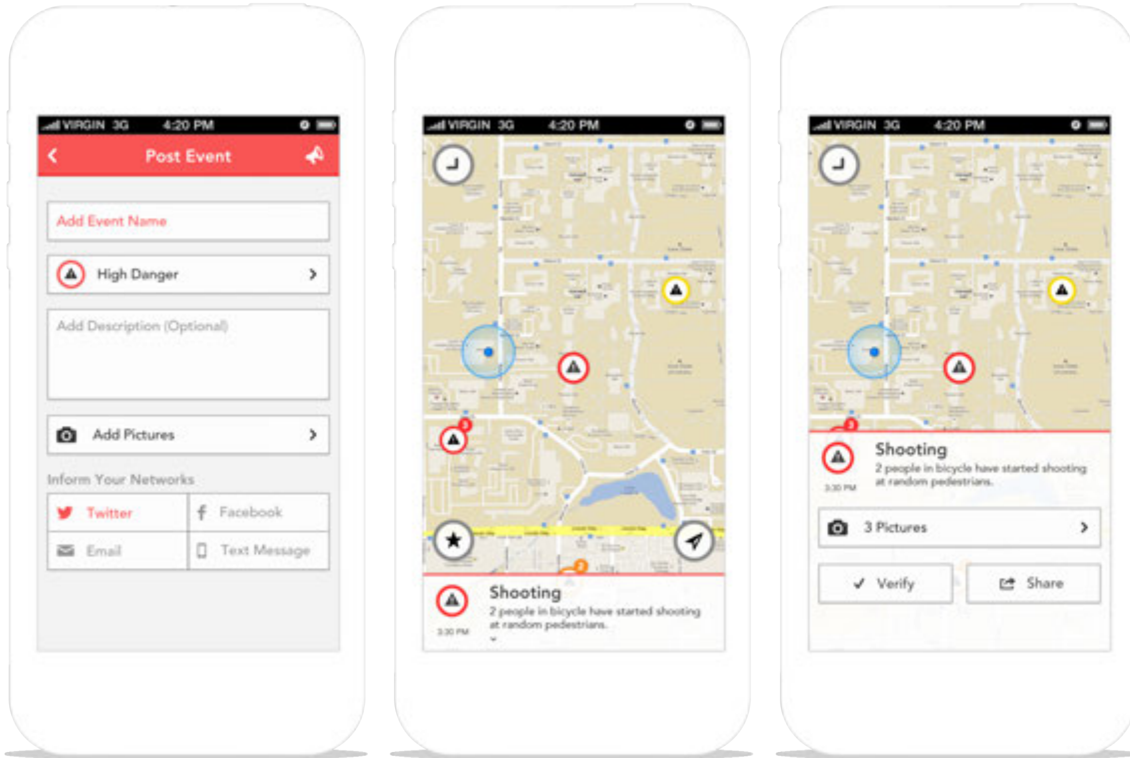


Figure 6.4 - (Left) Detailed form for crisis event posts. (Center) Quick view of information when a crisis marker is tapped. (Right) More information if the window is swiped up.

The preset location menu is still present (see Figure 6.5) for quick access to important locations. Figure 6.6 shows the process of adding a new preset.

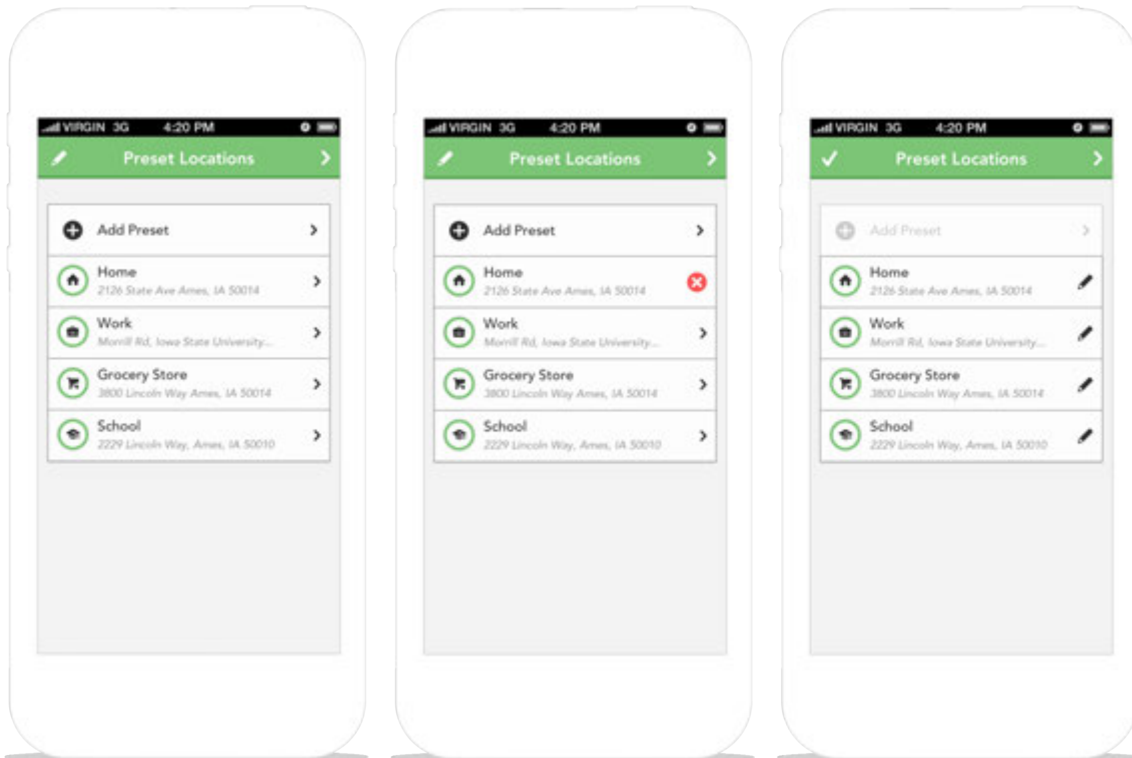


Figure 6.5 - Preset locations menu. Presets can be deleted (center) or edited (right)

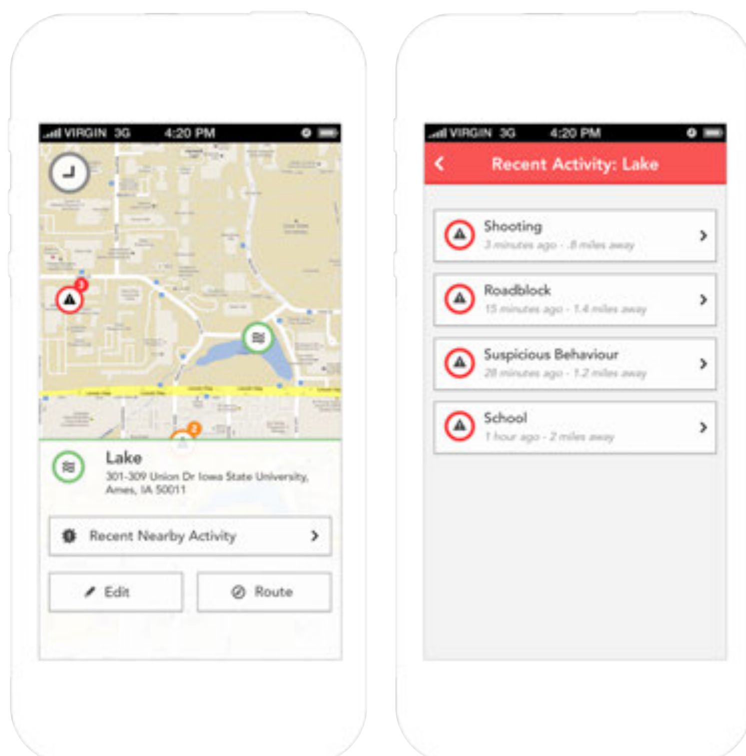


Figure 6.6 - Preset coordinate map (left), preset details form (center), and preset information window when preset is clicked (right)

If a user wants to view a list of recent crisis events posted around a specific location they can do so by clicking on the *Recent Nearby Activity* (Figure 6.7) button that will pull up a list of events with the most recent at the top.

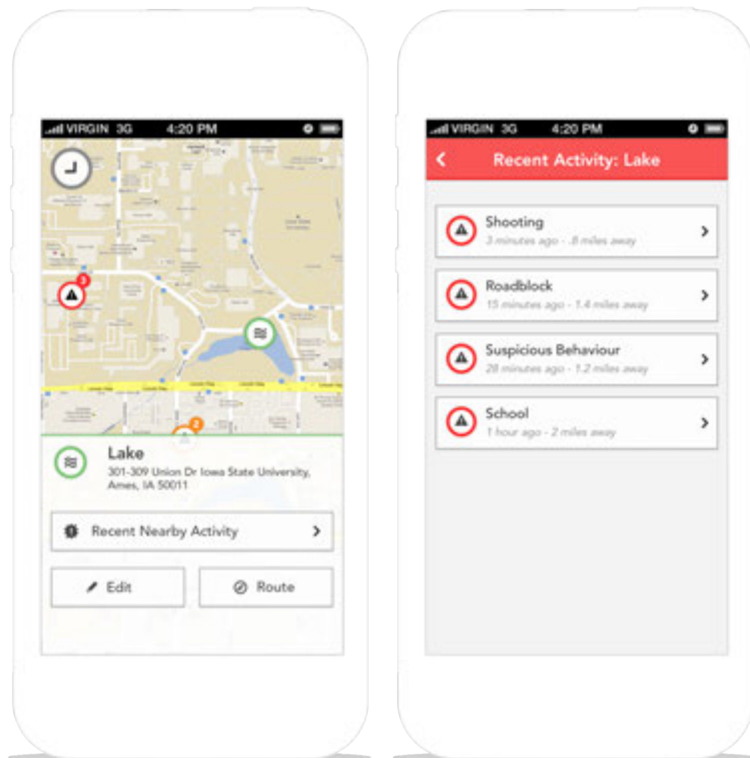


Figure 6.7 - Preset location additional options (left) and the recent activity window (right)

Reputation was one of the major characteristics of establishing trust in software (Corritore et al., 2003; Flanagin & Metzger, 2008; Metzger, 2007; Shneiderman, 2000). In this iteration the goal was to make the system transparent, which was noted by the crisis management literature as good practice (Robert & Lajtha, 2002), and bring the system reputation to the front by visualizing all the information recorded. Figure 6.8 has the System Reputation screen where the user can see the total number events posted, the amount of users, and how many of the posts were verified as true or false. The goal is to be able to develop an algorithm based on all the data and calculate a reputation score. The graph is to help the user compare the current data with previous data to see the changes. Each user can also see his or her own reputation. The user reputation can be used to assess the validity of their future posts.

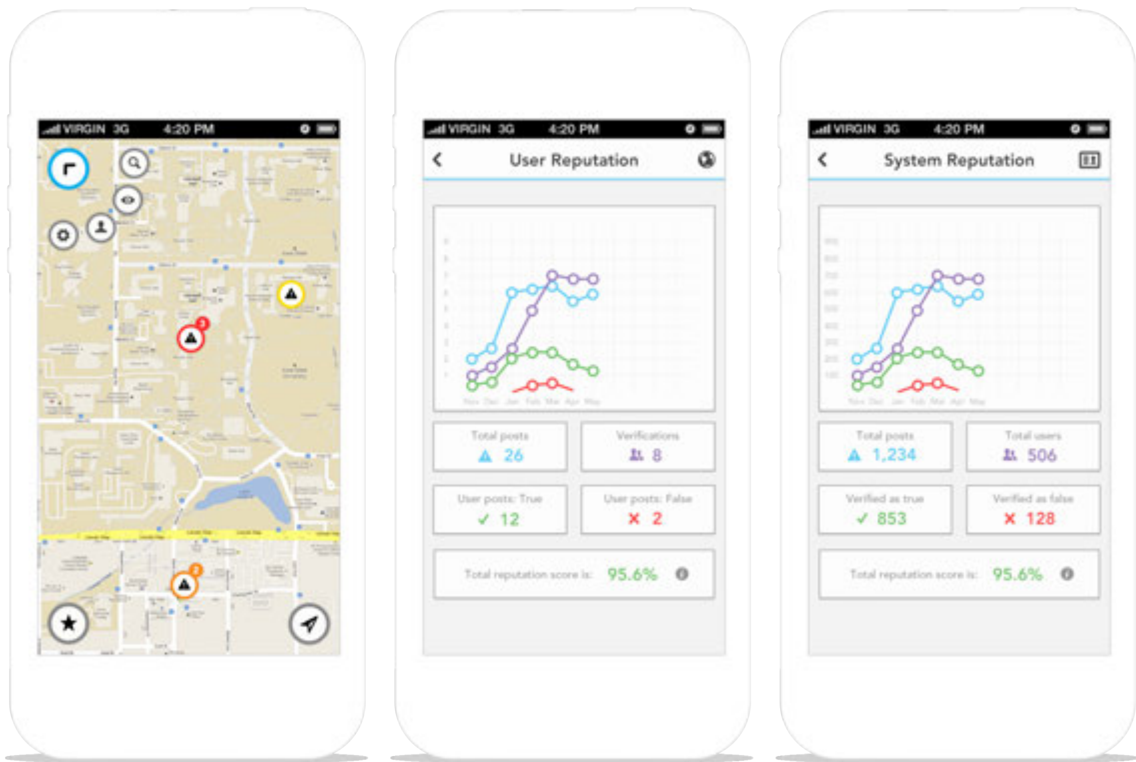


Figure 6.8 - Pull out menu (right) where the User Reputation (center) and System Reputation (left) section can be accessed

The buddy system screen (Figure 6.9) is used to keep track of family and friends. A person's name and information is followed by a green light if he or she is safe or a red light to indicate that the person is currently in a crisis. In order for the red light to appear, the Urban Forecast application must be set to the emergency state mode by performing a specific gesture that cannot be replicated by accident. In the Emergency State, everyone in the user's buddy system list is notified and important functionality is brought to the main screen.

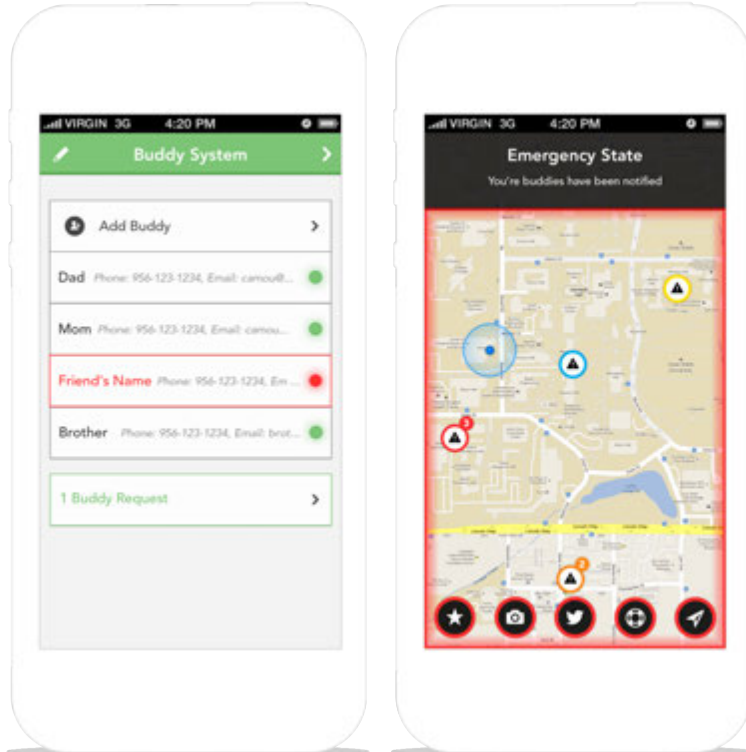


Figure 6.9 - Buddy system window (left) and Emergency state mode view (right)

6.2.2 Functionality

Offline Caching

A common suggestion that was mentioned during the study by participants was about cell network coverage. One of the concerns was about coverage and what would happen if the user were in a place where they had none. Another concern was about limited data plans and how much that would take when they were not in a place that offered Wi-Fi. Uploads and downloads can easily reach the limit of the user's data limit for the month if they are not in a place where they can access a Wi-Fi connection. A solution would be to implement offline caching that would store all activity done during the offline state and sync once a Wi-Fi connection is found (Hirsch & Madria, 2010; Ioannidis, Massoulie, & Chaintreau, 2010).

Event Listening

One of the features of Ushahidi is the ability to “listen” for specific events or for activity around a certain location. This is something that could be possible to bring to Urban Forecast. Preset locations can be monitored and a vibration or an alert can be used to notify users.

6.3 Study Limitations

The main limitation was the number of participants that took part in the study (sixteen participants). More participants from different ethnicities and age groups could have made the representation of the variety of user’s more accurate. More participants would have made the regressions more effective. Another iteration of the study using an updated version of the prototype would have been beneficial in evaluating the improvements on the new design and more information on what design patterns and functionality work best by comparing the first study with the second. An iteration with more complex paths and more crises, run over a longer time of consecutive days, might also yield more information about regular usage of the application and its desirability.

6.4 Lessons Learned

The original idea for this project was motivated by the violent events happening specifically in the country of Mexico but after conducting research on the applicability of something like Urban Forecast I was overwhelmed by the events happening around the world. I also learned how to consider the user's situation in the design in order to facilitate participation; in this case the situation being a crisis. The user should not have to click through page views to post or find out information when under a potential stressful situation and gestures should be taken advantage of to make navigating more efficient. I was also exposed to the challenge of creating an application that depends on user input and participation for its content. The product is useless if no one is participating and contributing. Creating a product that is enjoyable to use on an emotional level should be an objective for all user experience designers in order to promote participation. I also had the opportunity to learn how to combine Objective-C, PHP, and MySQL to create a dynamic iPhone application.

6.4.1 Design Recommendations

One main recommendation to designers and developers seeking to make an application in the crisis field is to start with a native application. Paul Kinlan from Google stated that native applications are leading the way for mobile devices explaining that native apps can take advantage of features like voice and card interactions where mobile web experiences can not (Kinlan, 2013).

Focus on the quality of the visual design when designing the application. It is easier for the user to develop trust in the application when it has a polished and consistent visual aesthetic.

6.4.2 Future Questions

Future work would need to be done to answer a few more questions such as: What kind of situations would be considered a crisis to the user? Answering this question can help inform the design to facilitate the reporting process of specific situations and to create icons that match the event.

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APPENDIX A - SBSOD

SANTA BARBARA SENSE-OF-DIRECTION SCALE

Sex: F M Today's Date:_______________

Age:_______ V. 2

This questionnaire consists of several statements about your spatial and navigational abilities, preferences, and experiences. After each statement, you should circle a number to indicate your level of agreement with the statement. Circle "1" if you strongly agree that the statement applies to you, "7" if you strongly disagree, or some number in between if your agreement is intermediate. Circle "4" if you neither agree nor disagree.

1. I am very good at giving directions.

    strongly agree 1 2 3 4 5 6 7 strongly disagree

2. I have a poor memory for where I left things.

    strongly agree 1 2 3 4 5 6 7 strongly disagree

3. I am very good at judging distances.

    strongly agree 1 2 3 4 5 6 7 strongly disagree

4. My "sense of direction" is very good.

    strongly agree 1 2 3 4 5 6 7 strongly disagree

5. I tend to think of my environment in terms of cardinal directions (N, S, E, W).

    strongly agree 1 2 3 4 5 6 7 strongly disagree

6. I very easily get lost in a new city.

    strongly agree 1 2 3 4 5 6 7 strongly disagree

7. I enjoy reading maps.

strongly agree 1 2 3 4 5 6 7 strongly disagree

8. I have trouble understanding directions.

strongly agree 1 2 3 4 5 6 7 strongly disagree

9. I am very good at reading maps.

strongly agree 1 2 3 4 5 6 7 strongly disagree

10. I don't remember routes very well while riding as a passenger in a car.

strongly agree 1 2 3 4 5 6 7 strongly disagree

11. I don't enjoy giving directions.

strongly agree 1 2 3 4 5 6 7 strongly disagree

12. It's not important to me to know where I am.

strongly agree 1 2 3 4 5 6 7 strongly disagree

13. I usually let someone else do the navigational planning for long trips.

strongly agree 1 2 3 4 5 6 7 strongly disagree

14. I can usually remember a new route after I have traveled it only once.

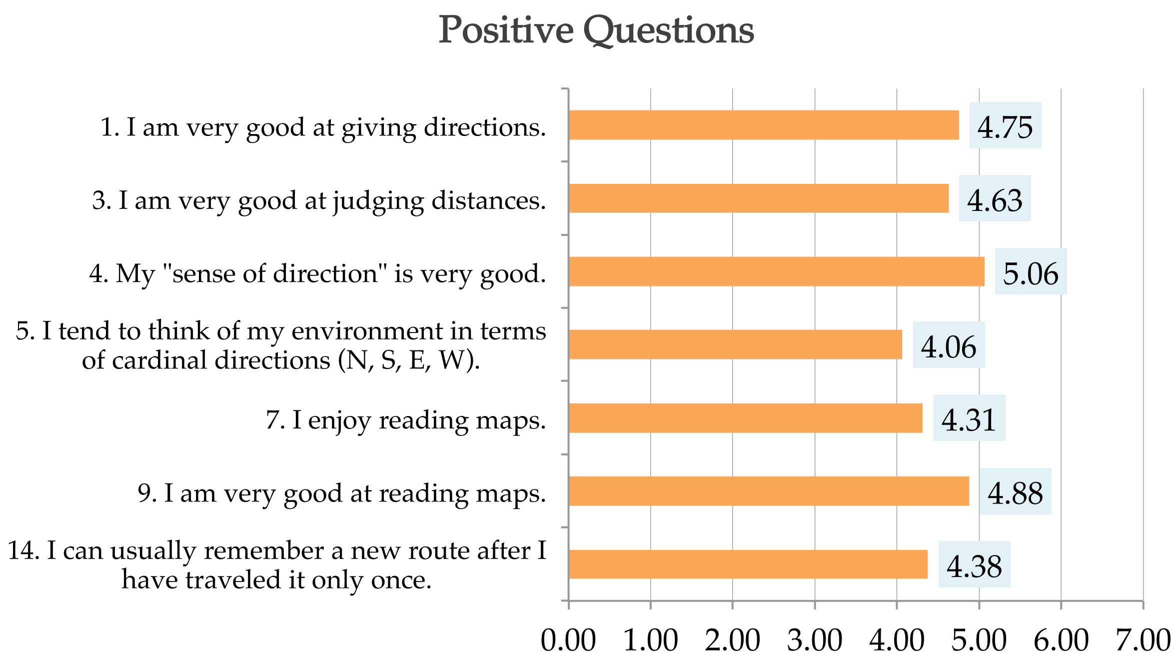
strongly agree 1 2 3 4 5 6 7 strongly disagree

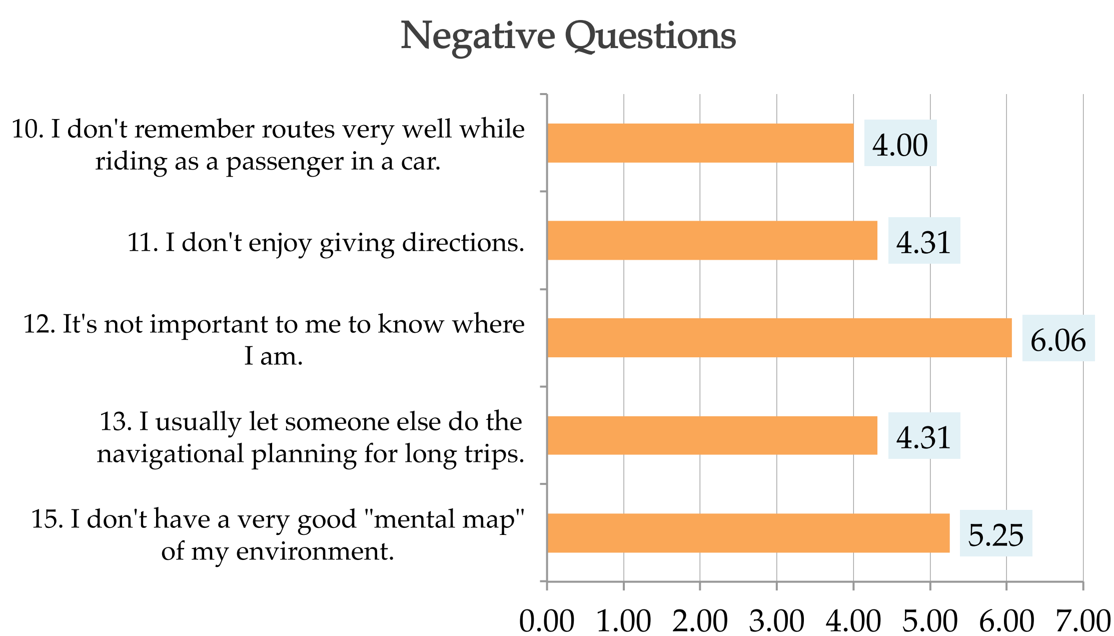
15. I don't have a very good "mental map" of my environment.

strongly agree 1 2 3 4 5 6 7 strongly disagree

APPENDIX B - SBSOD RESULTS

Positive questions were inverted so that a higher number represented a better score.



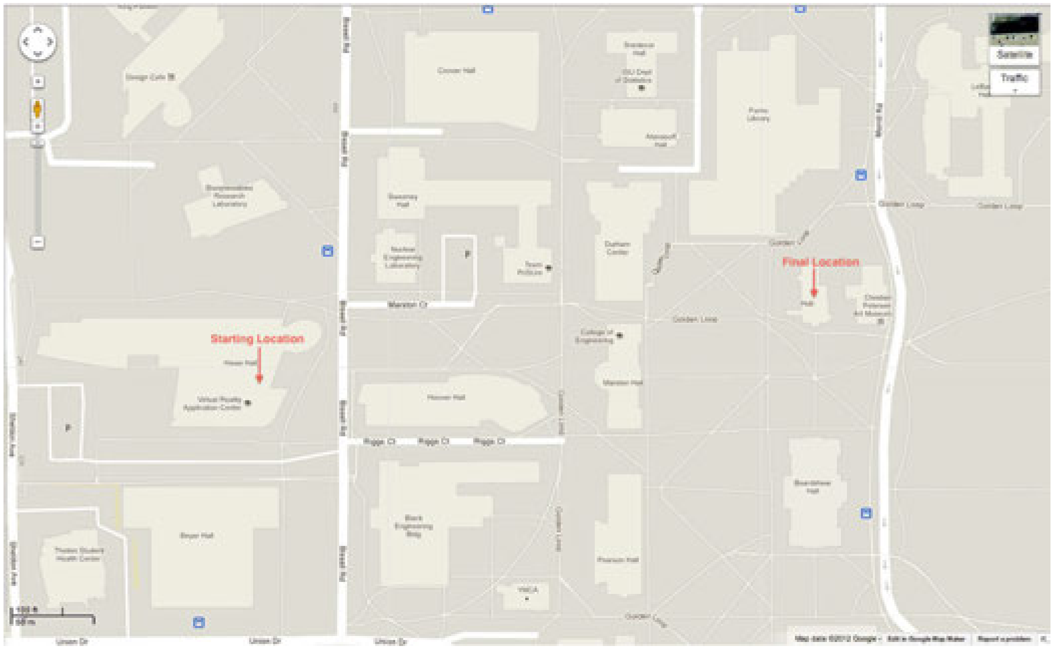


APPENDIX C - MAPS

Pre Study

Participant ID: ________________

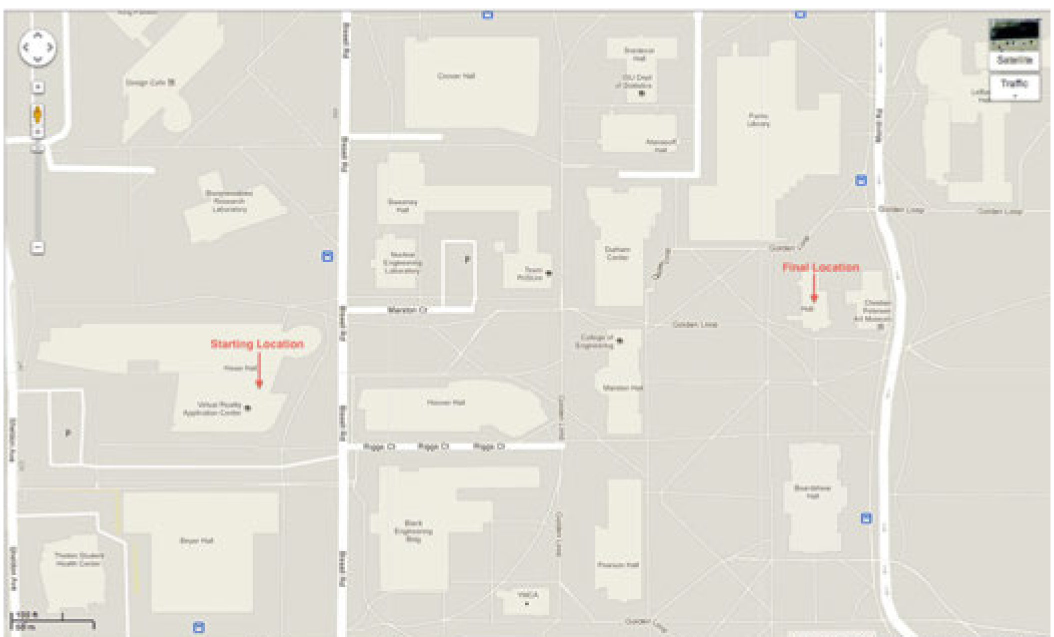
Directions: Draw the path you expect to take from your starting location to your final location.



Post Study

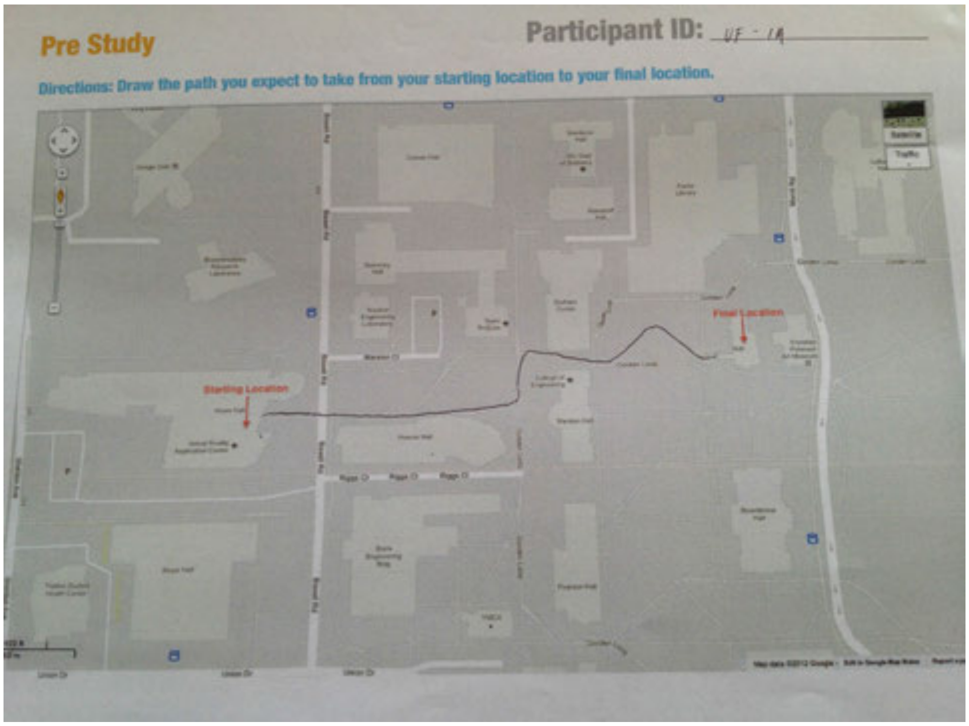
Participant ID: ________________

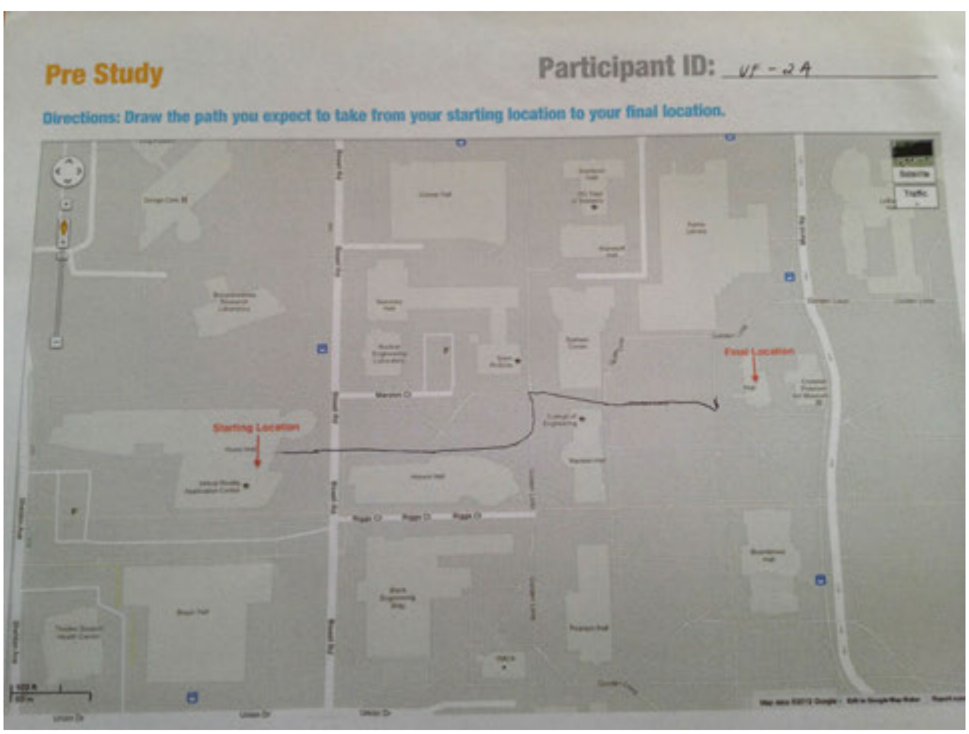
Directions: Draw the path you actually took from your starting location to your final location.

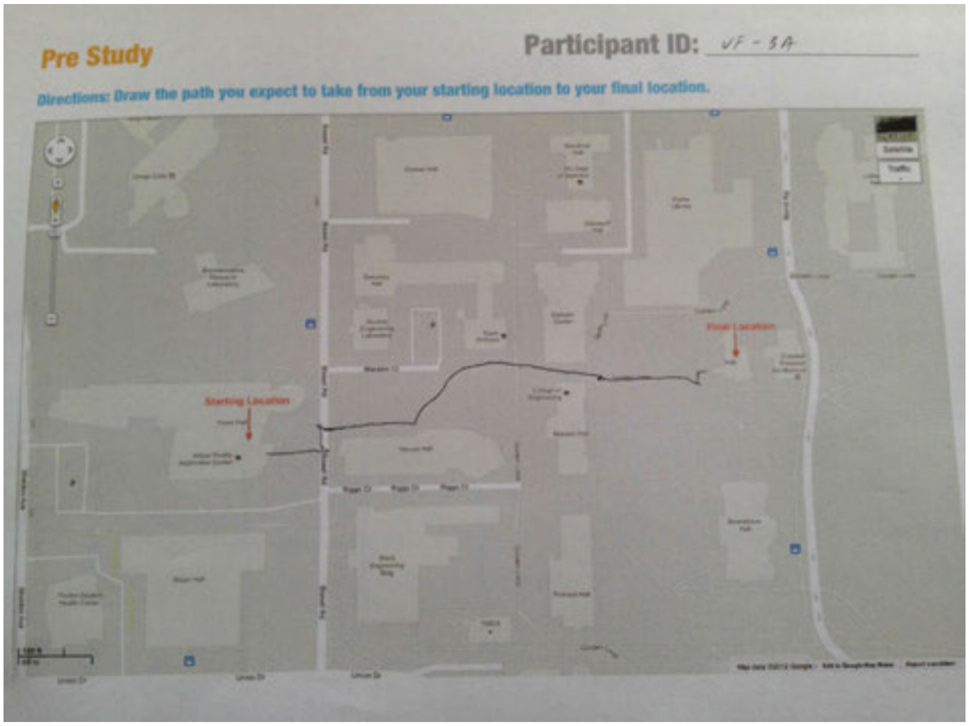


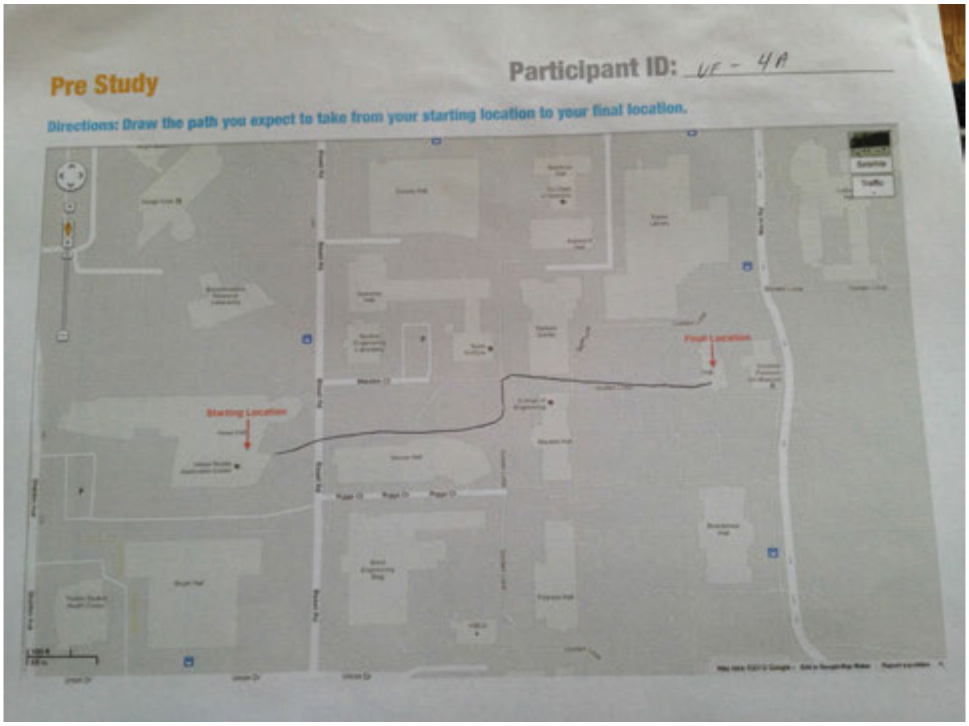
Pre-Study Mapping

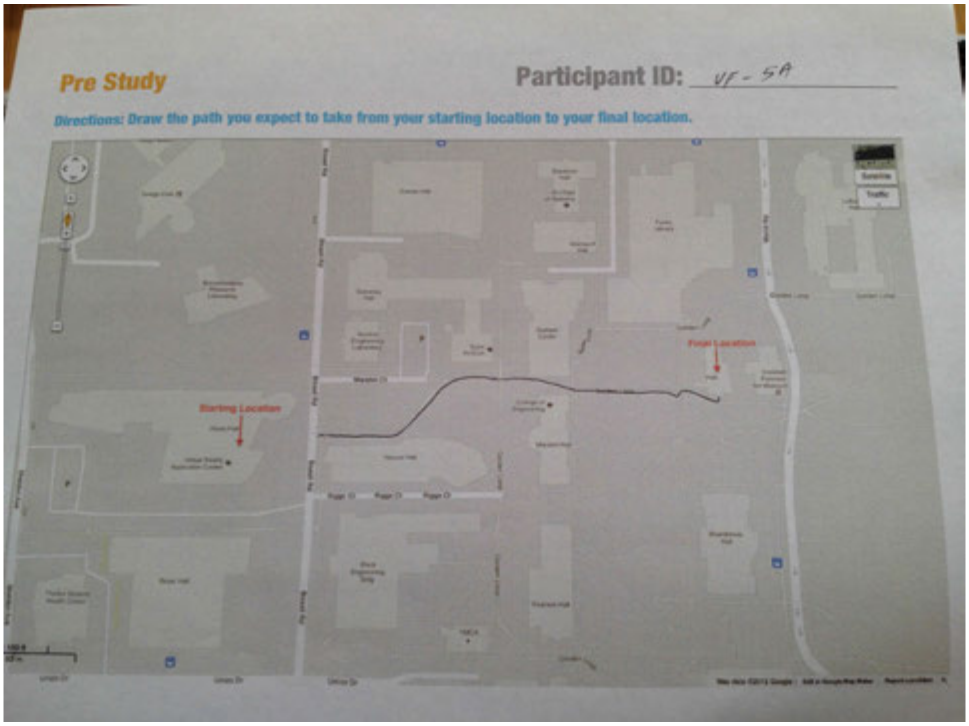
Participants were asked to draw the path they assumed to take before interacting with the prototype or leaving the briefing area.

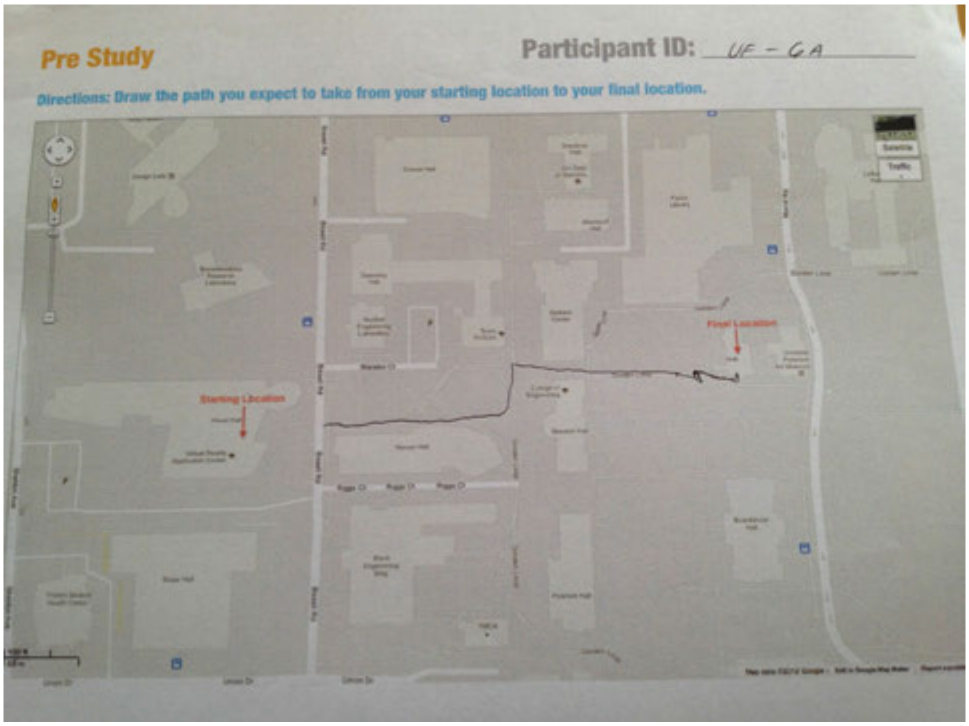


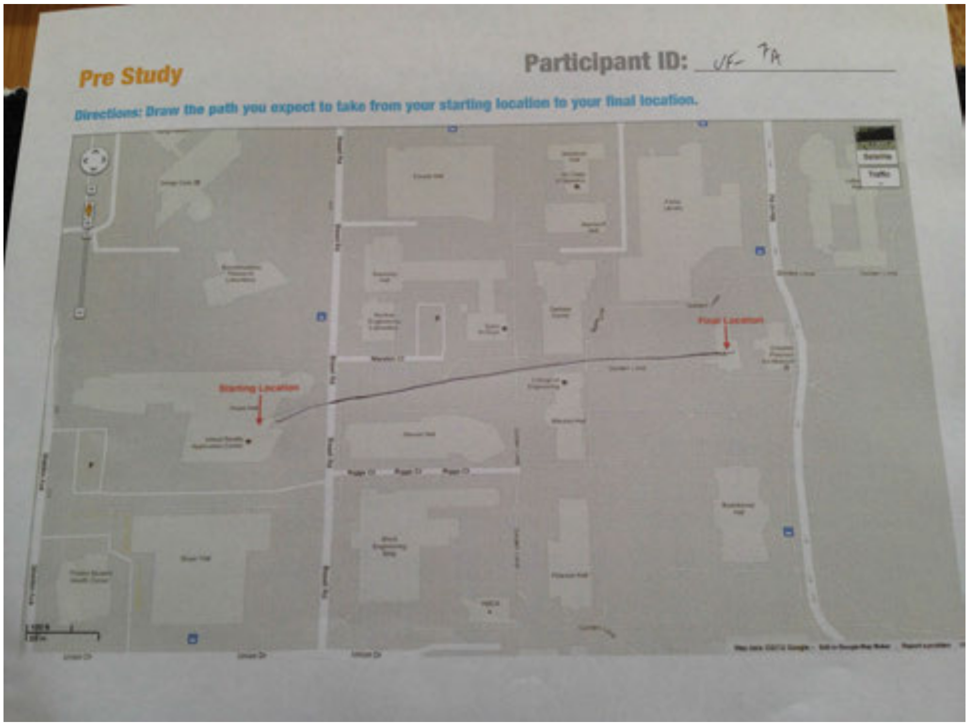


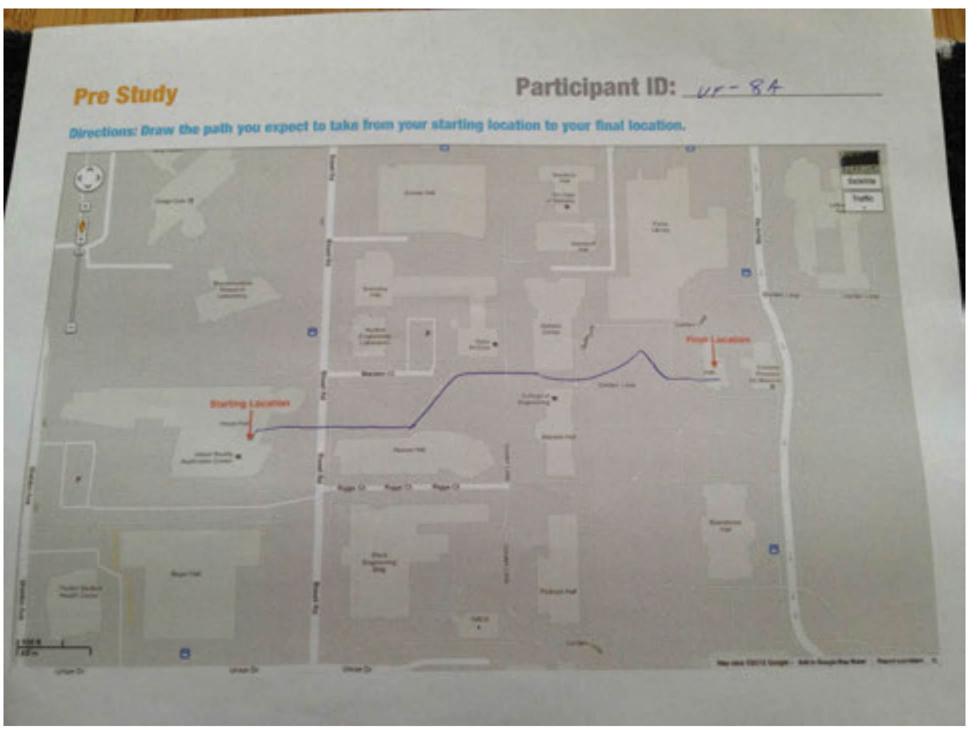

Pre Study
Participant ID: UF-3A
Directions: Draw the path you expect to take from your starting location to your final location.
Starting Location
Final Location

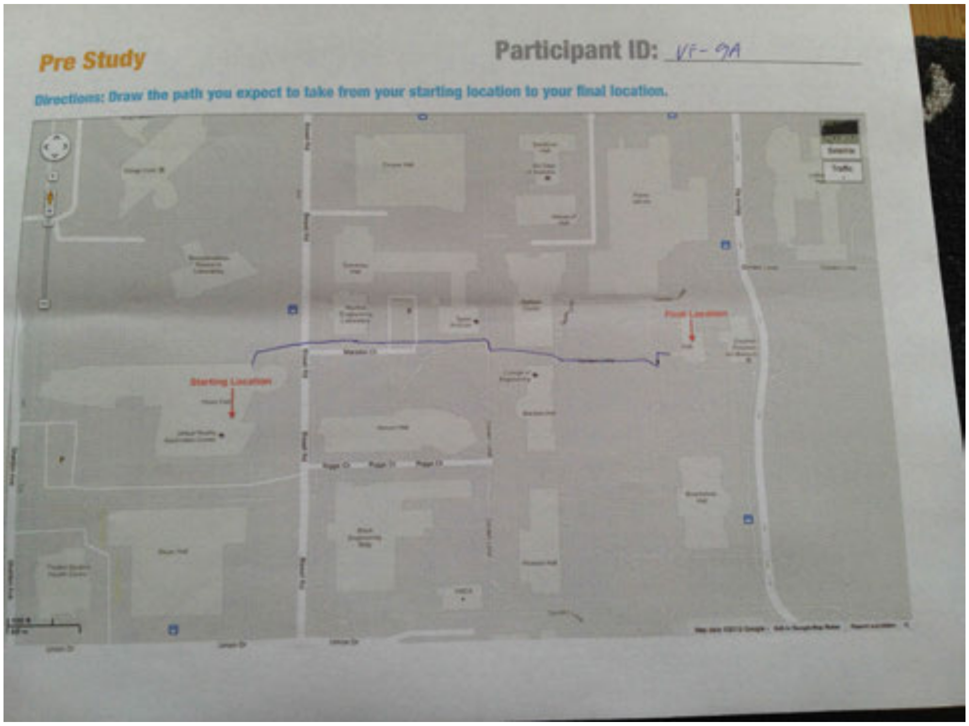

Pre Study
Participant ID: UF-4A
Directions: Draw the path you expect to take from your starting location to your final location.
Starting Location
Final Location

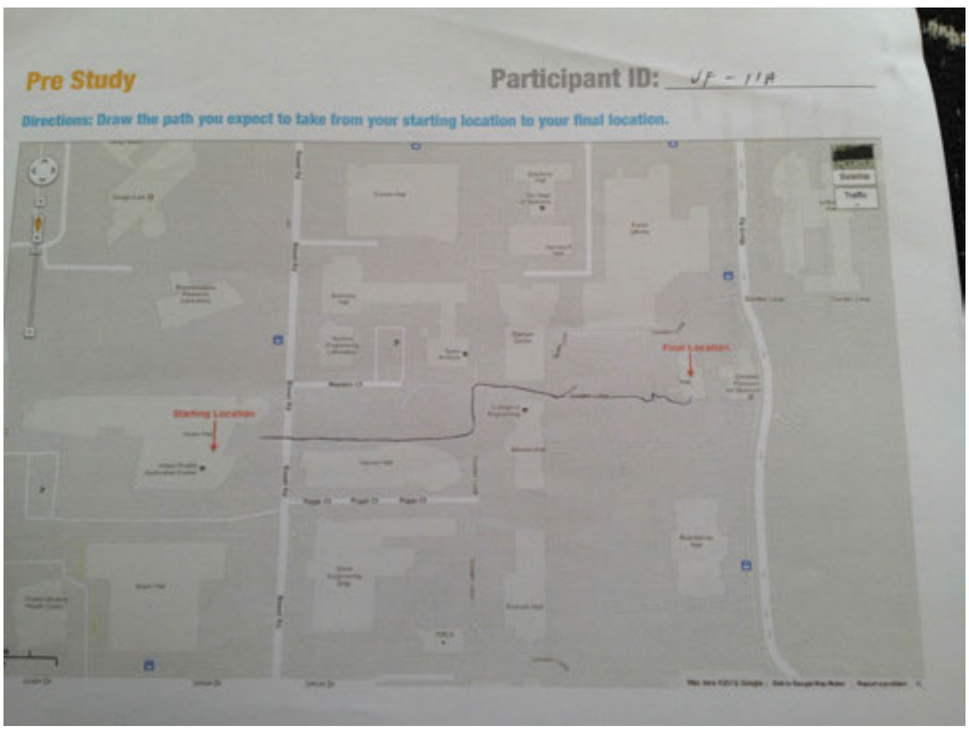

Pre Study
Participant ID: UF-5A
Directions: Draw the path you expect to take from your starting location to your final location.
Starting Location
Final Location

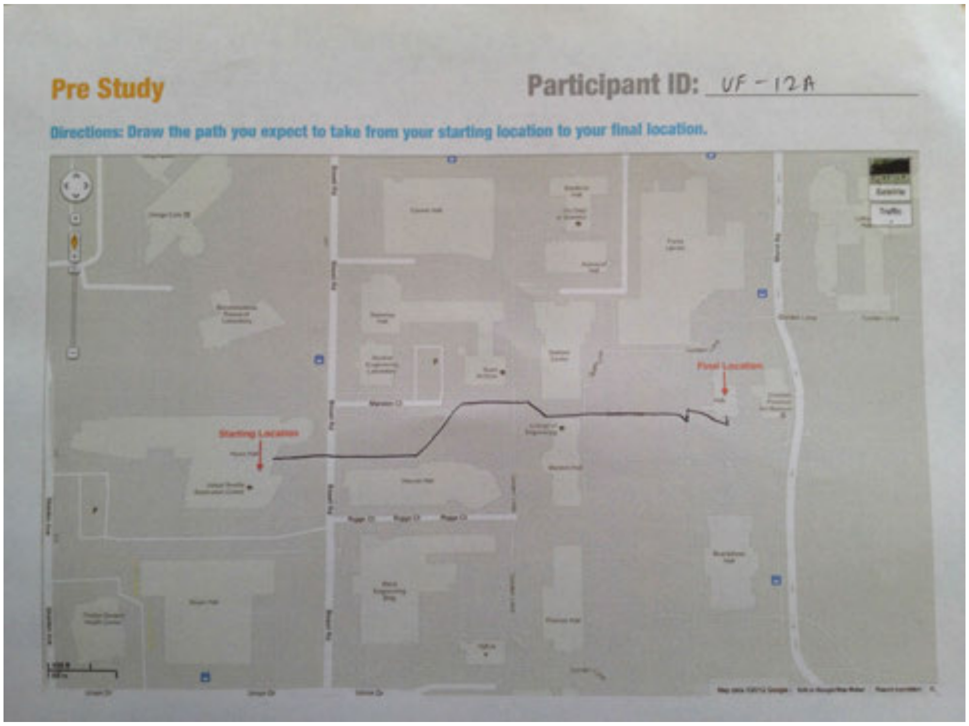

Pre Study
Participant ID: UF-6A
Directions: Draw the path you expect to take from your starting location to your final location.
Starting Location
Final Location

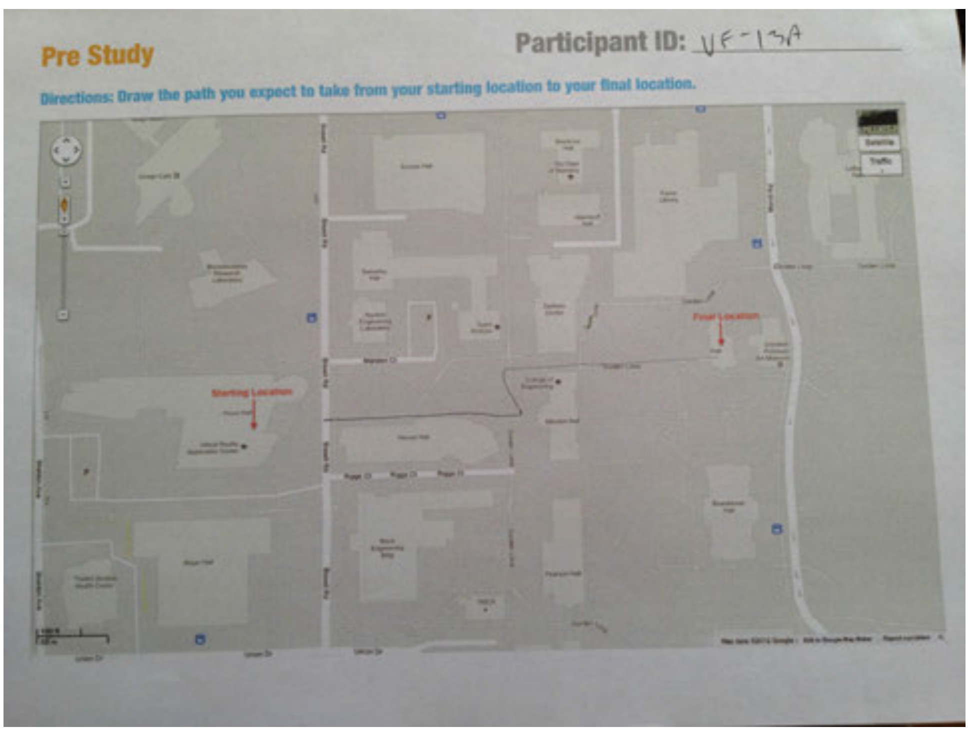

Pre Study
Participant ID:
Directions: Draw the path you expect to take from your starting location to your final location.
Starting Location
Final Location

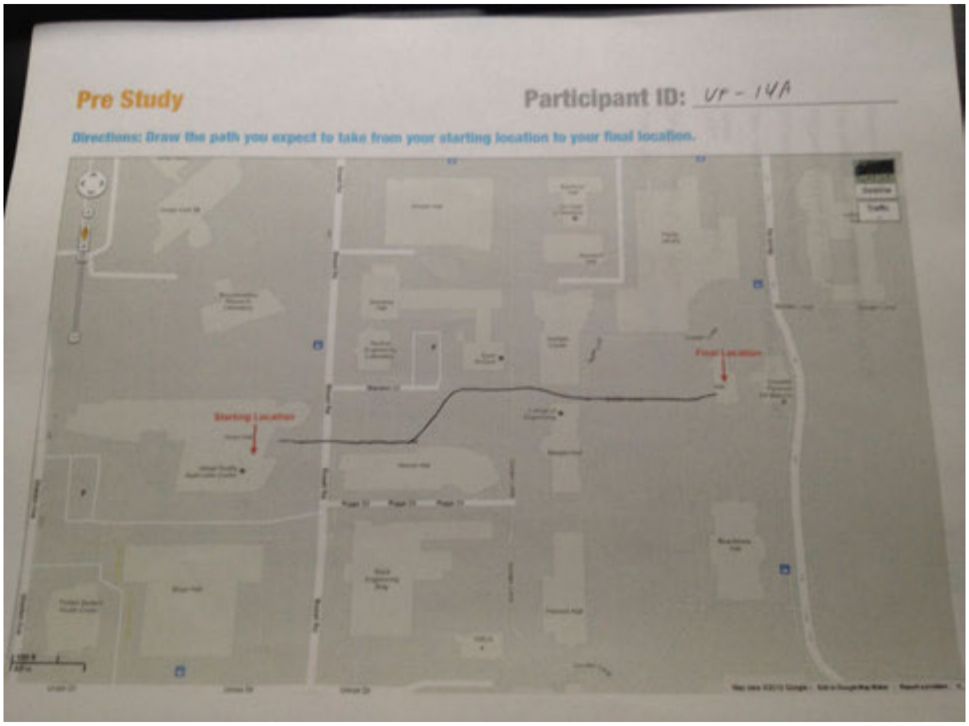

Pre Study
Participant ID:
Directions: Draw the path you expect to take from your starting location to your final location.
Starting Location
Final Location

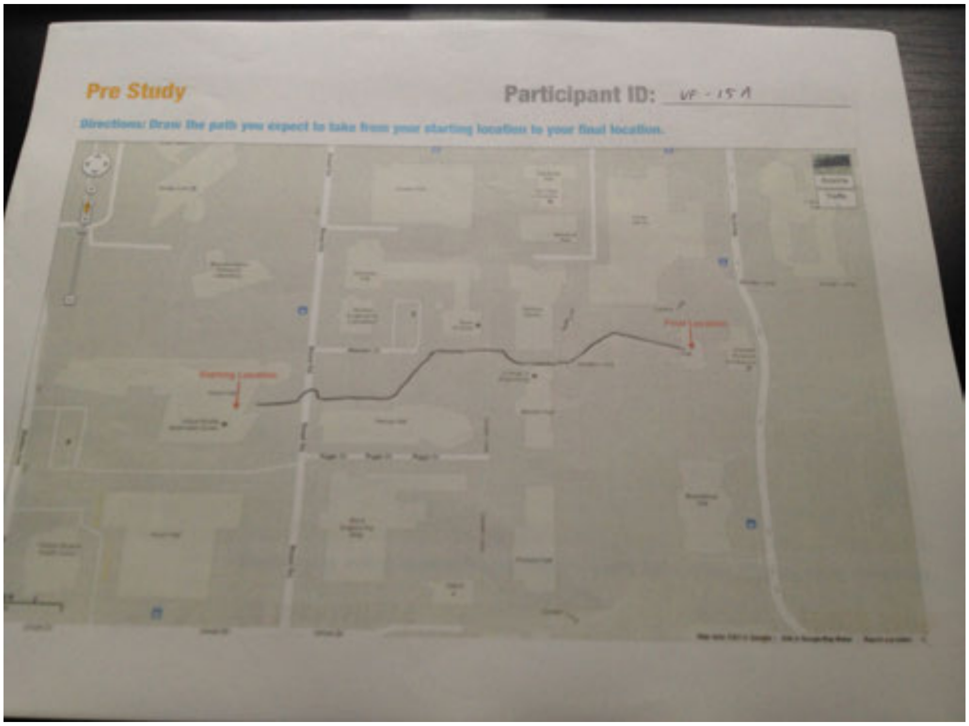

Pre Study
Participant ID:
Directions: Draw the path you expect to take from your starting location to your final location.
Starting Location
Final Location

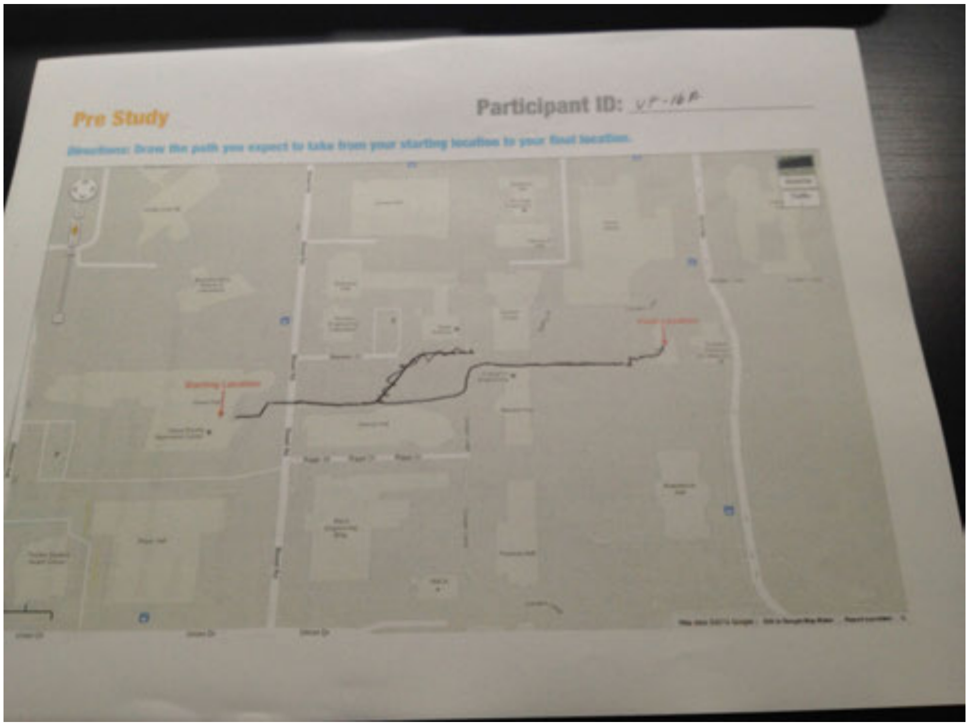

Pre Study
Participant ID:
Directions: Draw the path you expect to take from your starting location to your final location.
Starting Location
Final Location

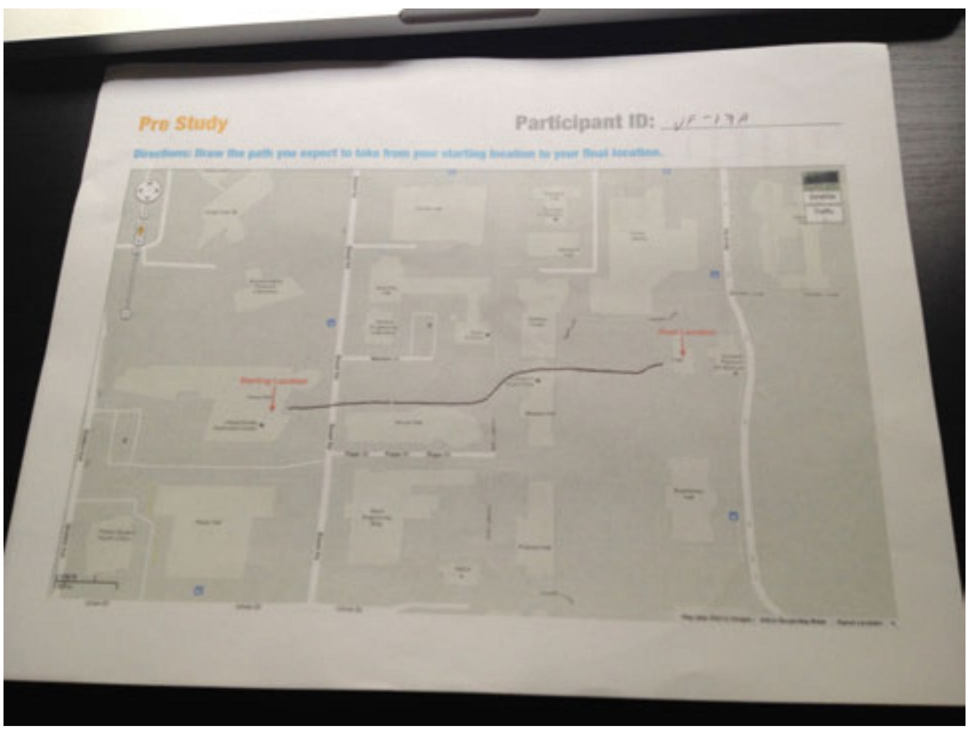

Pre Study
Participant ID: UF-12A
Directions: Draw the path you expect to take from your starting location to your final location.
Final Location
Starting Location


Pre Study
Participant ID: UF-13A
Directions: Draw the path you expect to take from your starting location to your final location.
Final Location
Starting Location


Pre Study
Participant ID: VP - 14A
Directions: Draw the path you expect to take from your starting location to your final location.
Starting Location
Final Location

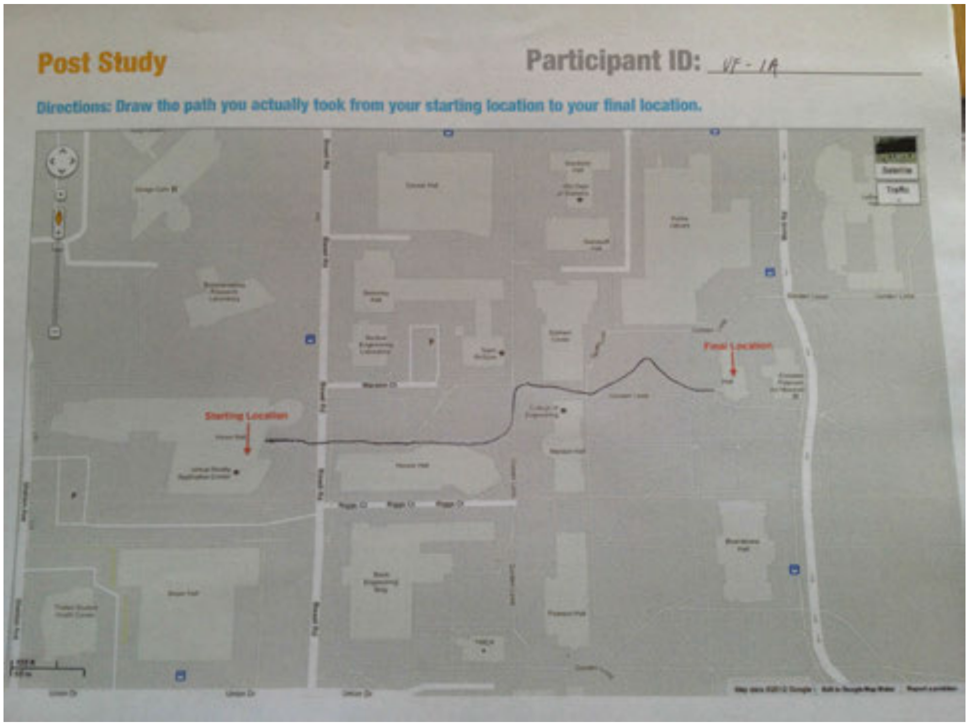

Pre Study
Participant ID: VP - 15A
Directions: Draw the path you expect to take from your starting location to your final location.

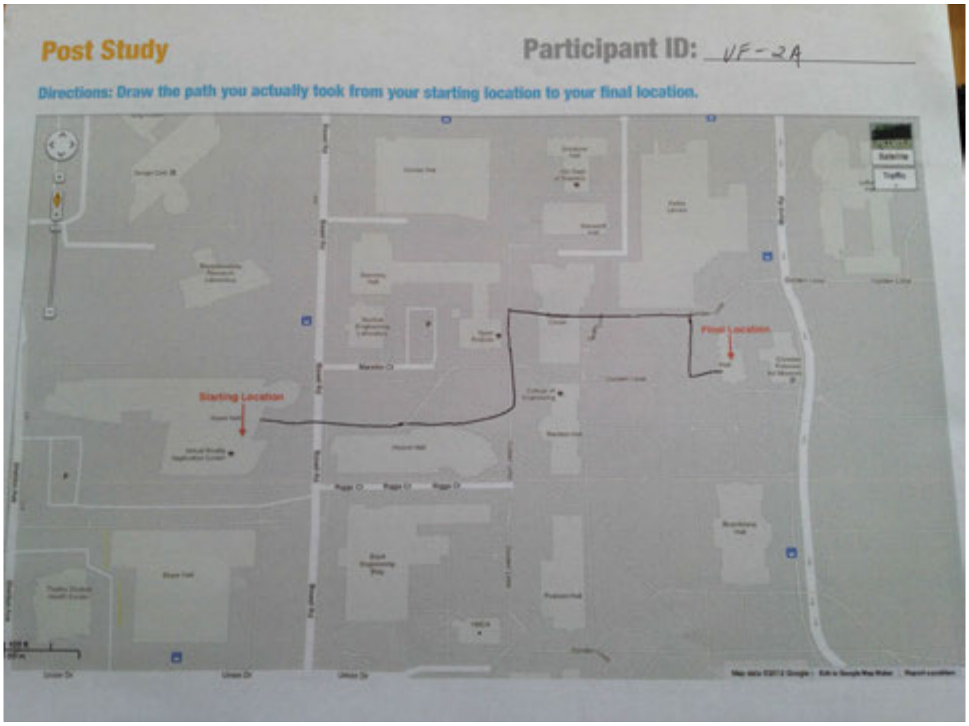

Pre Study
Participant ID:
Directions: Draw the path you expect to take from your starting location to your final location.

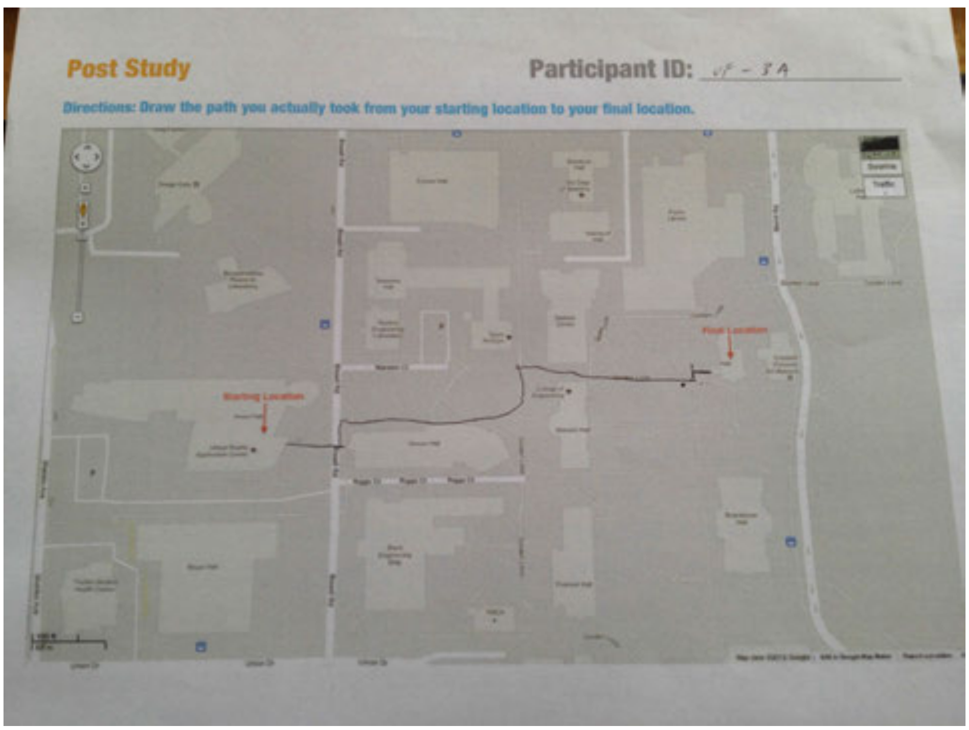

Pre Study
Participant ID:
Directions: Draw the path you expect to take from your starting location to your final location.

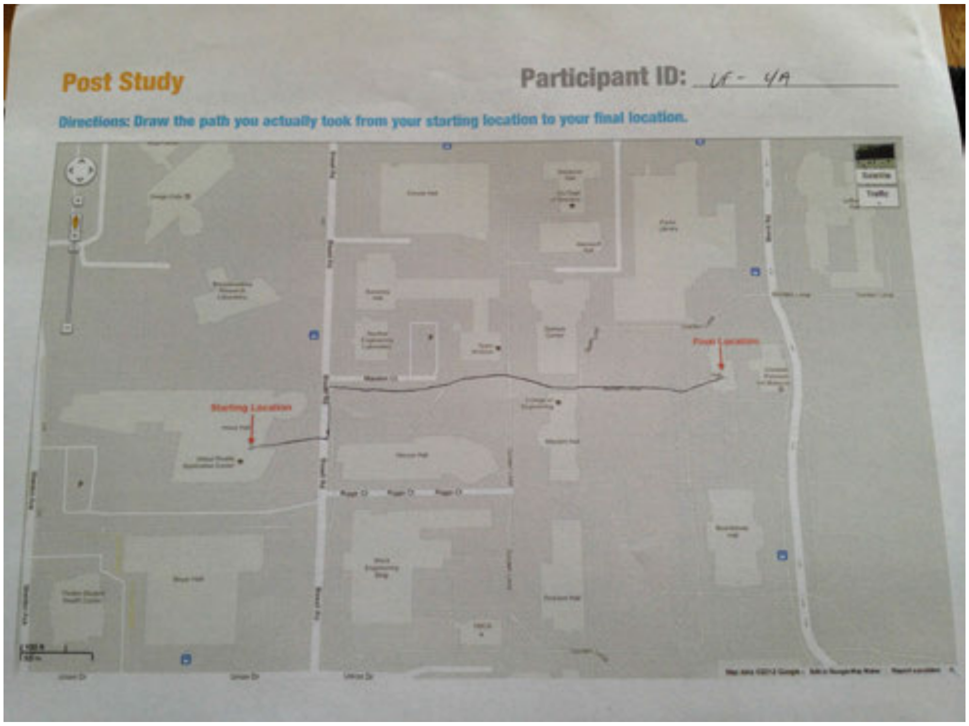
Post-Study Mapping

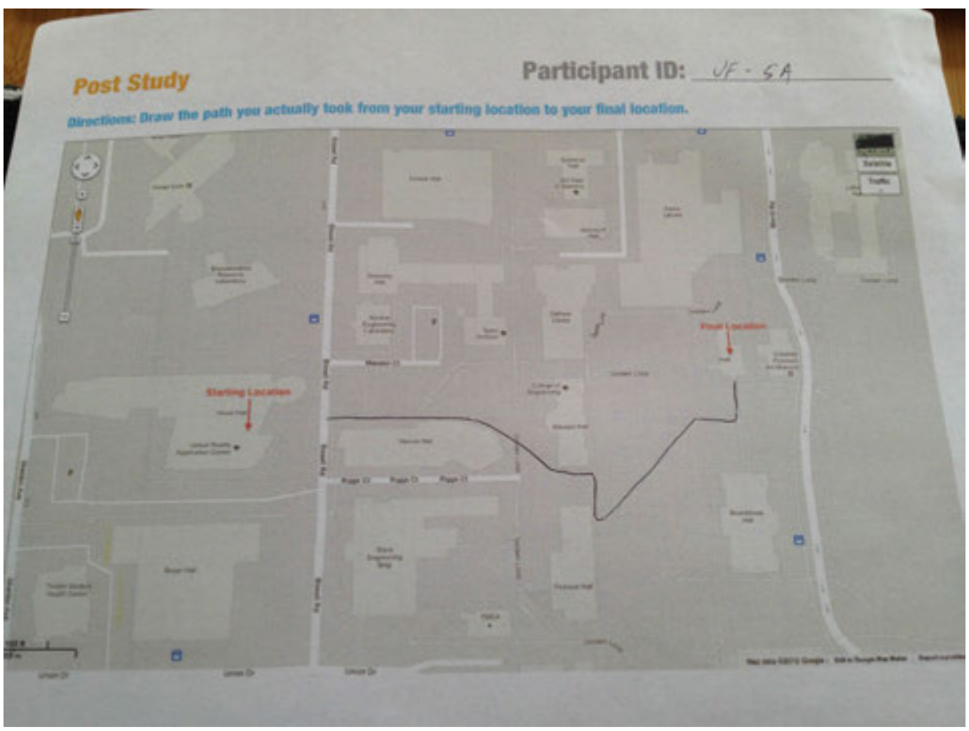
Participants were asked to draw the path they actually took after reaching the final destination.

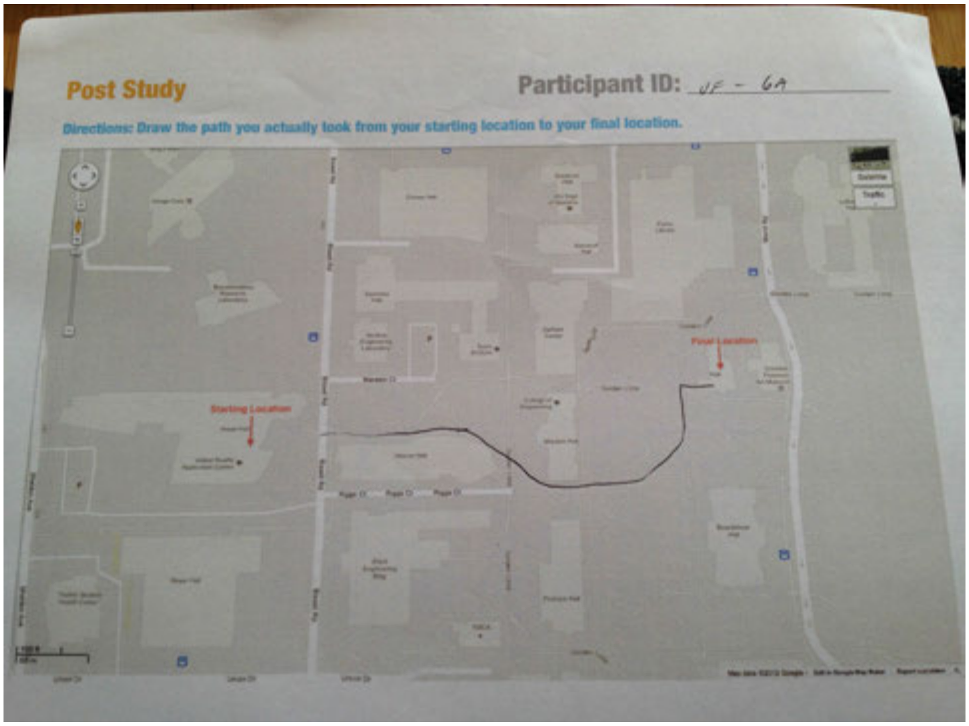


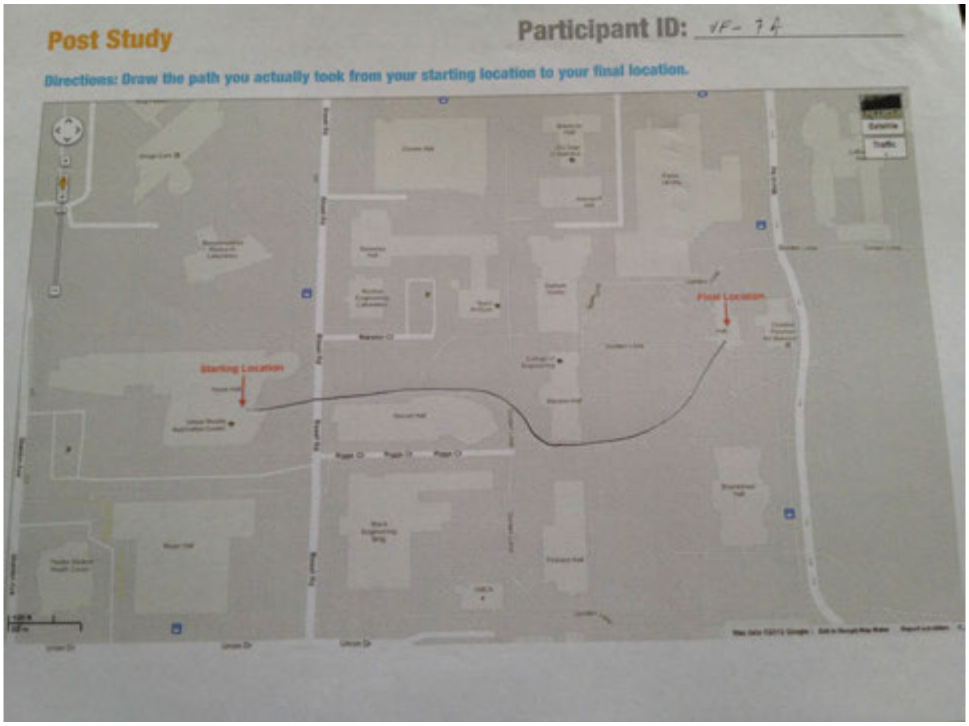

Post Study
Participant ID: VF-2A
Directions: Draw the path you actually took from your starting location to your final location.
Starting Location
Final Location

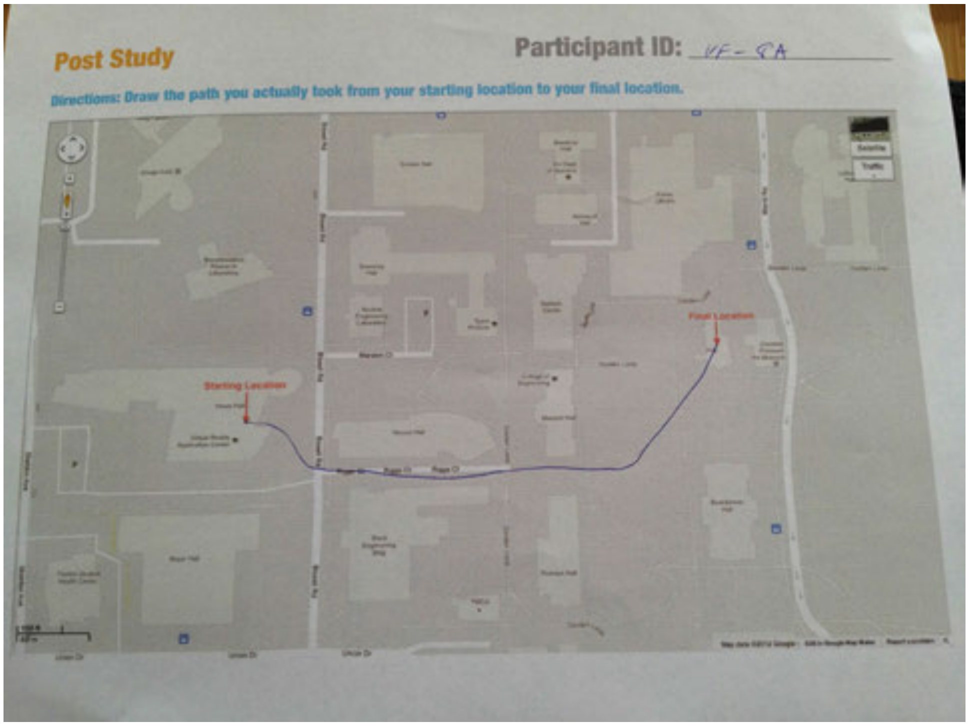

Post Study
Participant ID: VF-3A
Directions: Draw the path you actually took from your starting location to your final location.
Starting Location
Final Location

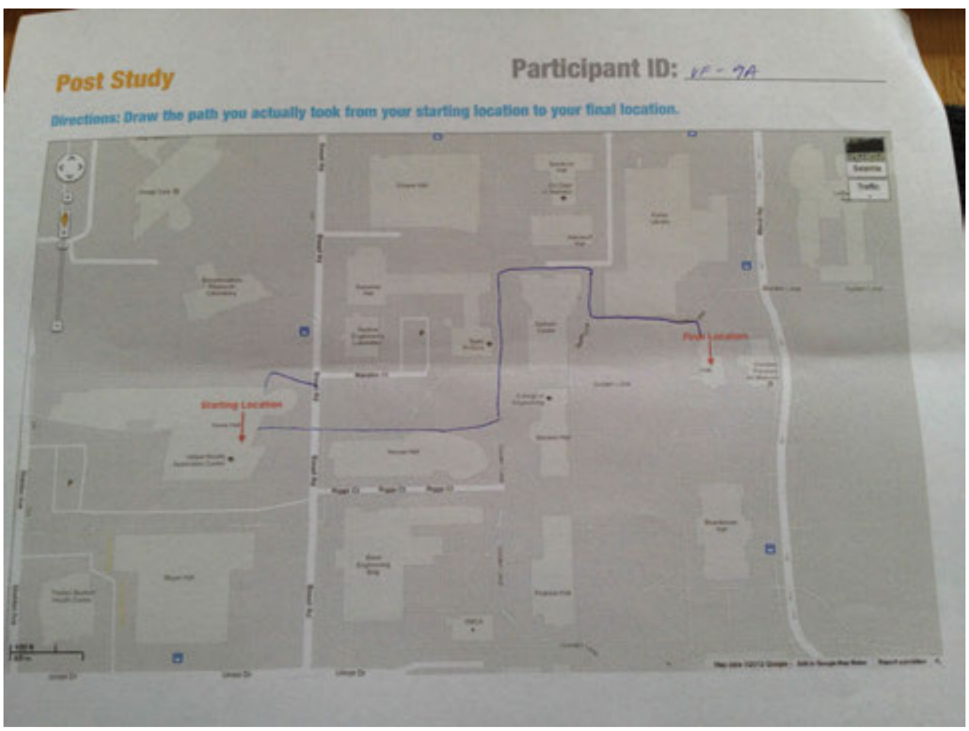

Post Study
Participant ID: UF-4A
Directions: Draw the path you actually took from your starting location to your final location.
Starting Location
Final Location

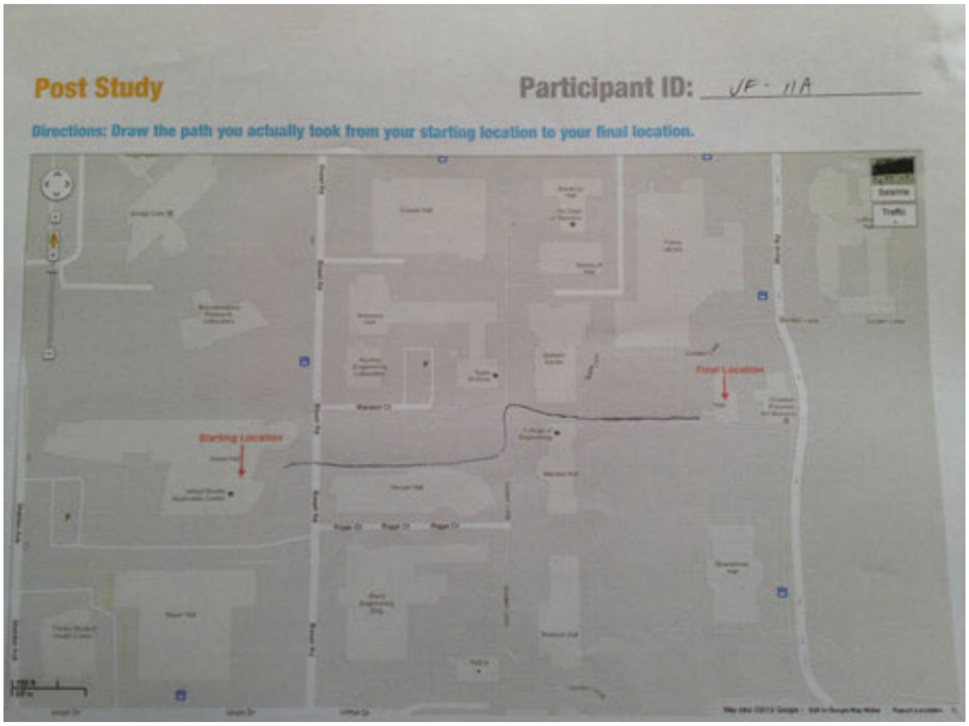

Post Study
Participant ID: UF-5A
Directions: Draw the path you actually took from your starting location to your final location.
Starting Location
Final Location

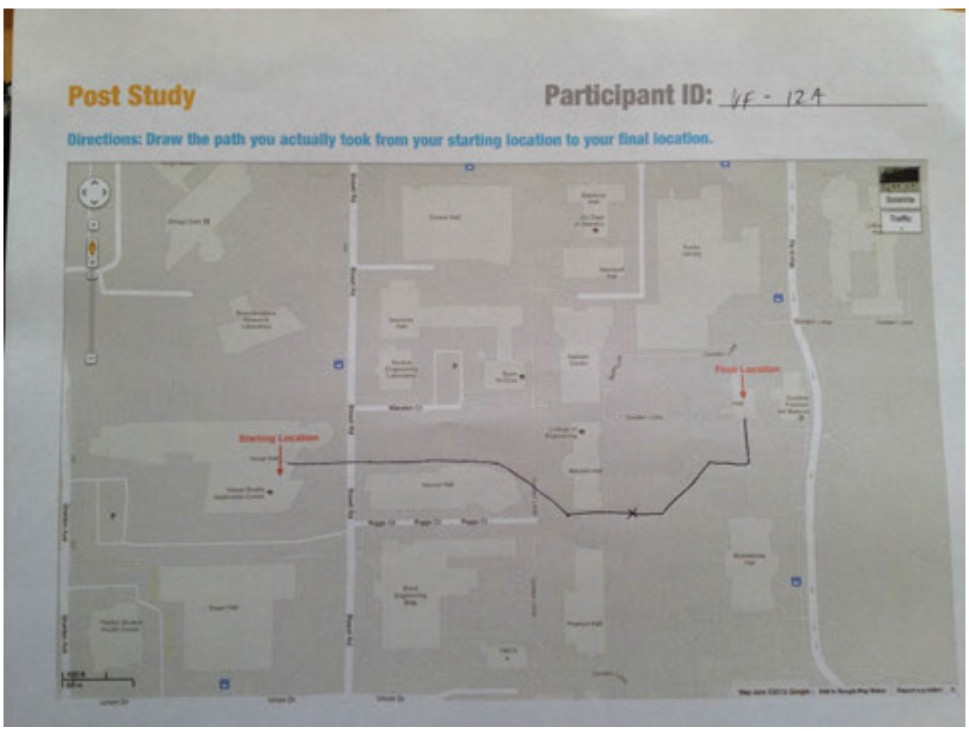

Post Study
Participant ID: UF - 6A
Directions: Draw the path you actually took from your starting location to your final location.
Starting Location
Final Location

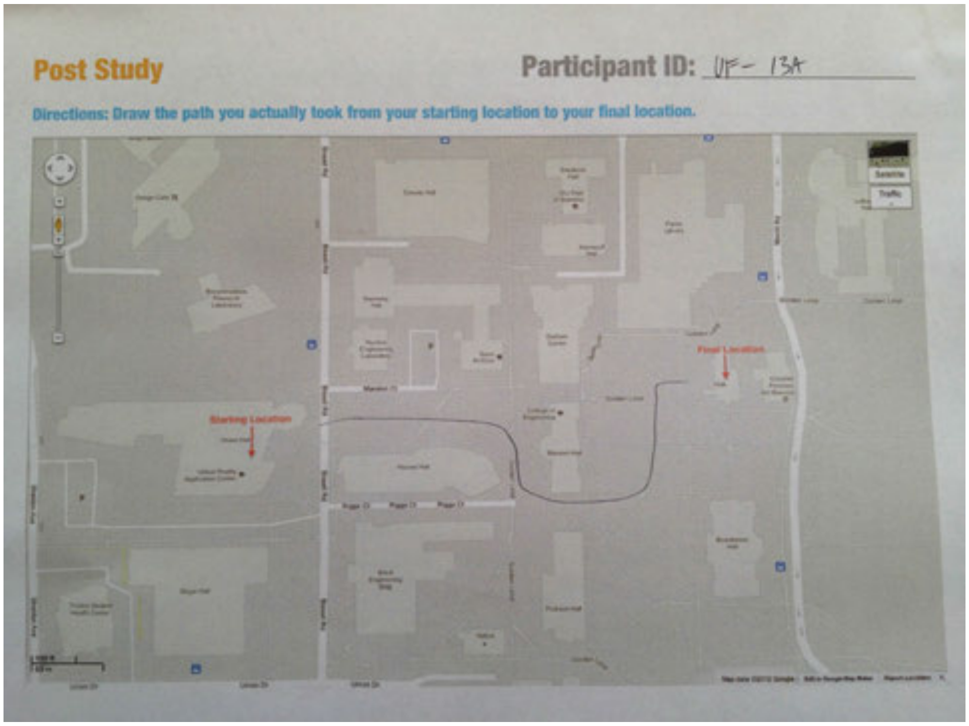

Post Study
Participant ID: UF - 7A
Directions: Draw the path you actually took from your starting location to your final location.
Starting Location
Final Location

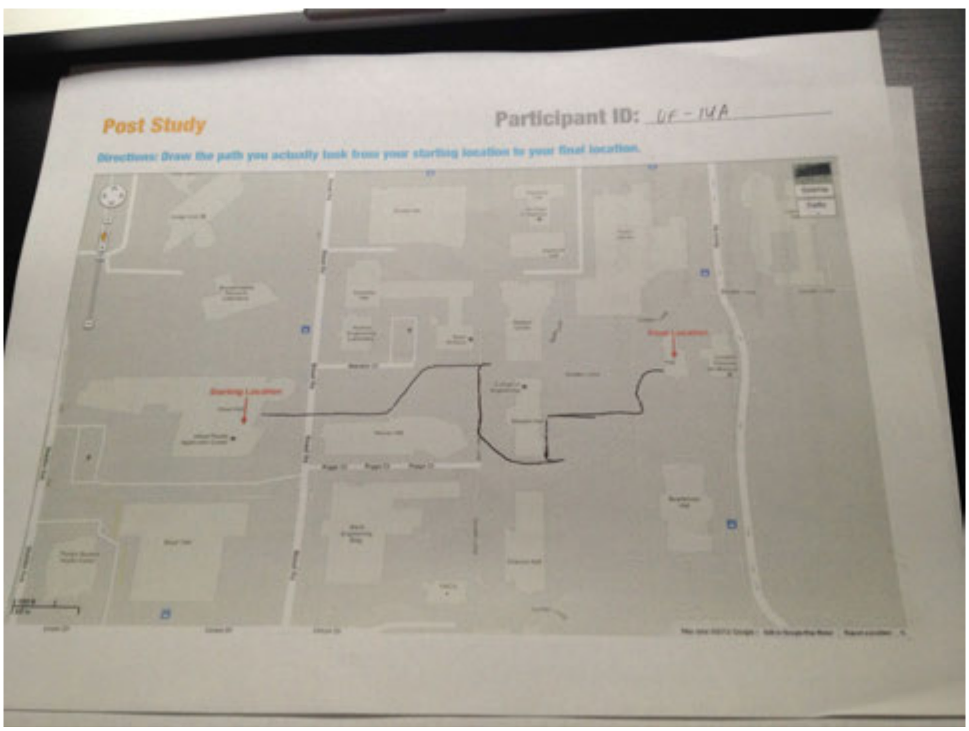

Post Study
Participant ID: VF-8A
Directions: Draw the path you actually took from your starting location to your final location.
Starting Location
Final Location

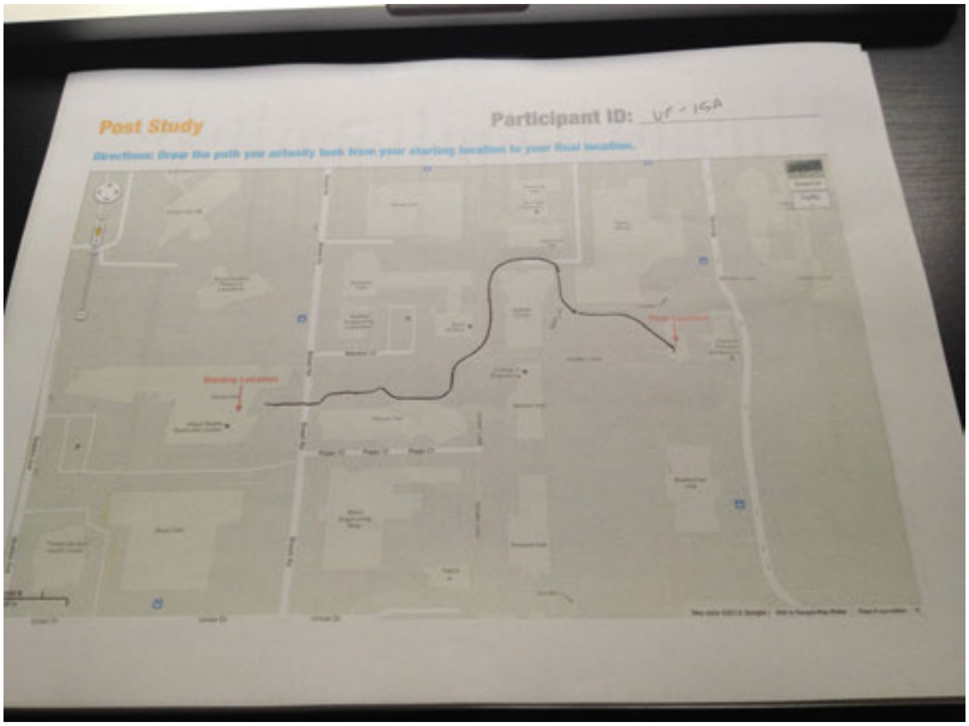

Post Study
Participant ID: VF-9A
Directions: Draw the path you actually took from your starting location to your final location.
Starting Location
Final Location


Post Study
Participant ID: JF - 11A
Directions: Draw the path you actually took from your starting location to your final location.
Starting Location
Final Location

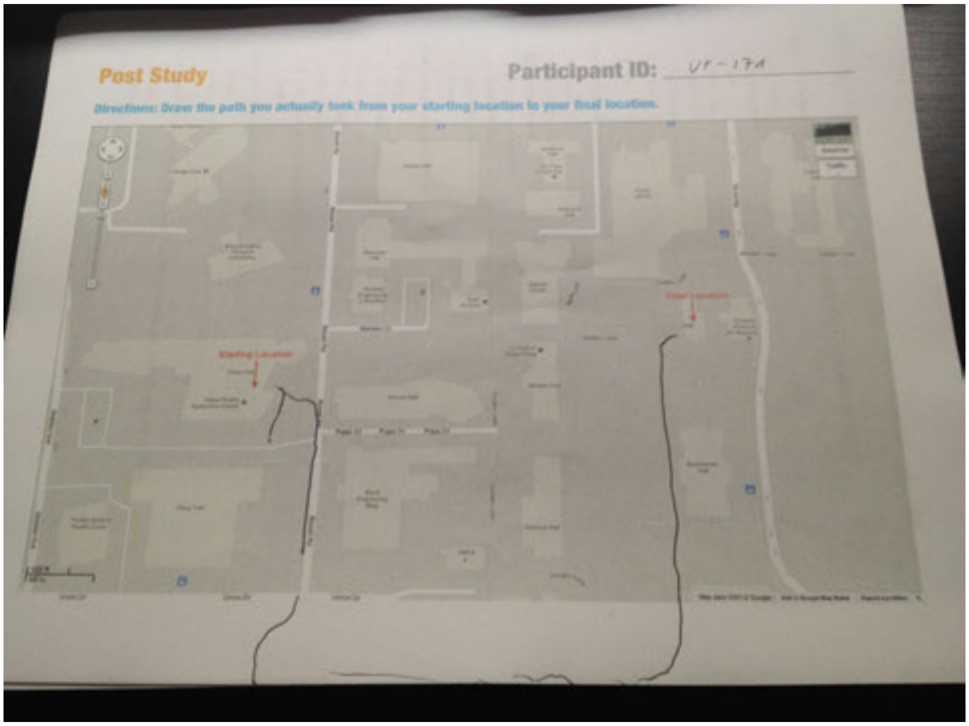

Post Study
Participant ID: VF - 12A
Directions: Draw the path you actually took from your starting location to your final location.
Starting Location
Final Location


Post Study
Participant ID: UF-13A
Directions: Draw the path you actually took from your starting location to your final location.
Starting Location
Final Location


Post Study
Participant ID: UF-14A
Starting Location
Final Location


Post Study
Participant ID: UP-15A


Post Study
Participant ID: UP-16A



APPENDIX D - POST – SURVEY

Urban Forecast Post Survey

Participant ID: ___________________

Have you ever had any experience with crisis situations? (Check all that apply)

○ Shooting
○ Kidnapping
○ Riot
○ Wild Fire
○ Flooding
○ Hurricane or Severe Storm
○ Other: ___________________
○ No

How often do you use Google Maps?

○ Daily
○ 2 - 3 times a week
○ Once a week
○ 2 - 3 times a month
○ Once a month
○ Less than once a month
○ Never

How often do you use Twitter?

○ Daily
○ 2 - 3 times a week
○ Once a week
○ 2 - 3 times a month
○ Once a month
○ Less than once a month
○ Never

Have you ever used a smartphone?

○ Yes
○ No

Did the information from the iPhone App help you avoid any dangerous paths?

○ Yes
○ No

For the following section assume you live in a dangerous location.

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
I think that I would like to use this system frequently	◯	◯	◯	◯	◯	◯	◯
I found the system unnecessarily complex	◯	◯	◯	◯	◯	◯	◯
I thought the system was easy to use	◯	◯	◯	◯	◯	◯	◯
I think that I would need the support of a technical person to be able to use this system	◯	◯	◯	◯	◯	◯	◯
I found the various functions in this system were well integrated	◯	◯	◯	◯	◯	◯	◯
I thought there was too much inconsistency in this system	◯	◯	◯	◯	◯	◯	◯
I would imagine that most people would learn to use this system very quickly	◯	◯	◯	◯	◯	◯	◯
I found the system very cumbersome to use	◯	◯	◯	◯	◯	◯	◯
I felt very confident using the system	◯	◯	◯	◯	◯	◯	◯
I needed to learn a lot of things before I could get going with this system	◯	◯	◯	◯	◯	◯	◯

How old are you?

- ○ 18 - 20
- ○ 21 - 24
- ○ 25 - 30
- ○ 31 - 35
- ○ 36 - 45
- ○ 46 +

What is your gender?

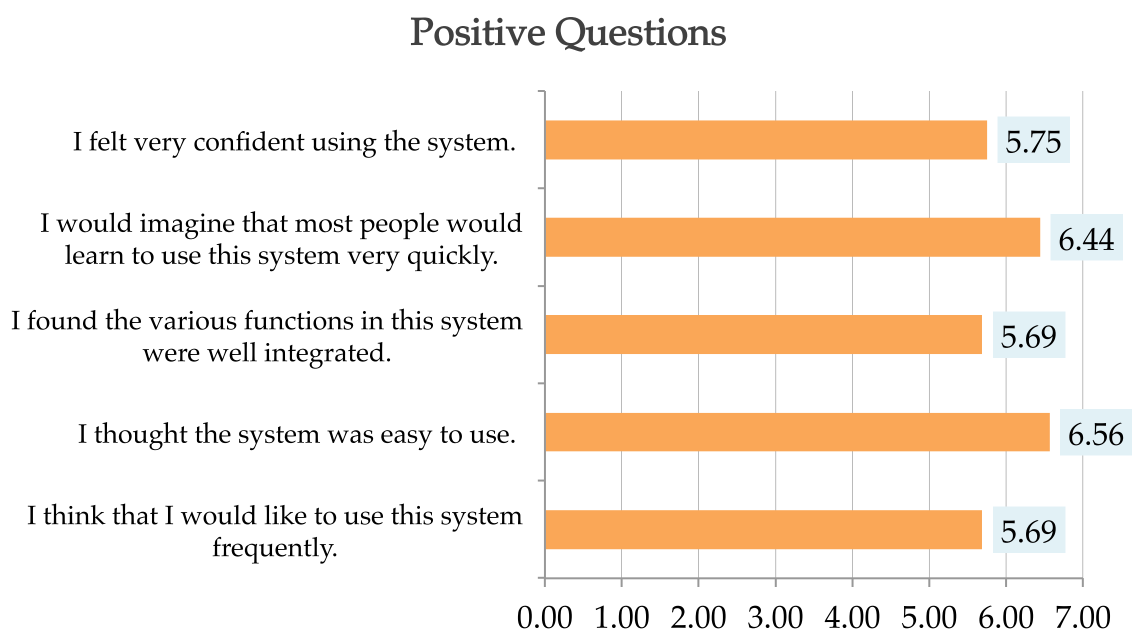
- ○ Female
- ○ Male

What is your race?

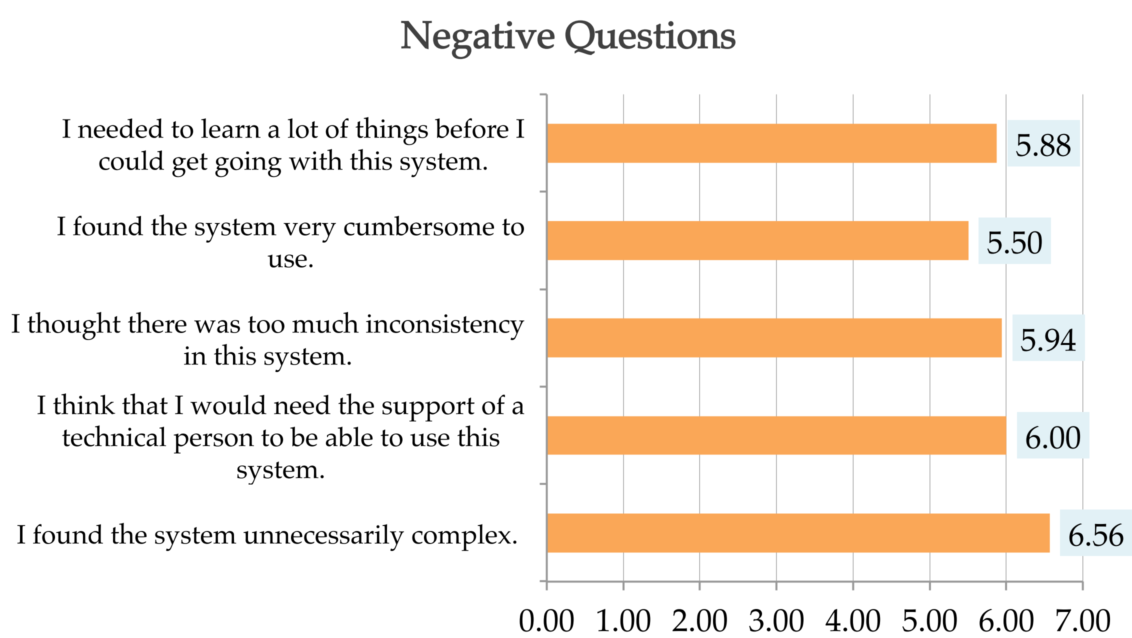
- ○ White
- ○ Black
- ○ Hispanic
- ○ Native American
- ○ Asian
- ○ Unknown
- ○ Other: ____________________

Thank you for participating in the Urban Forecast study!

APPENDIX E - POST – SURVEY RESULTS



Negative questions were inverted so that a higher number represented a better score.



APPENDIX F - INFORMED CONSENT

Consent Form for: Urban Forecast

This form describes a research project. It has information to help you decide whether or not you wish to participate. Research studies include only people who choose to take part—your participation is completely voluntary. Please discuss any questions you have about the study or about this form with the project staff before deciding to participate.

Who is conducting this study?
This study is being conducted by José Camou and Dr. Stephen Gilbert.

What is the purpose of this study?
The purpose of this study is to evaluate a software tool that could be used to help people in a crisis situation avoid danger such as a shooting, wild fire, flood, etc. The study will focus on the interaction between you and the software. For this study, you will not be put in a major crisis situation that would cause any undue stress or harm. Lesser crisis-like situations will be simulated for this study such as time pressure. In order to participate, you must be at least 18 years old.

What will I be asked to do?
If you agree to participate, you will be given a scenario where your objective is to get from your current location to a final location. You will be asked to draw your planned path on a map. You will then be given an iPhone with the preloaded software that will show you any "dangerous" areas around the path from your current location to your final location. You will then be asked to physically walk to the final location taking into consideration any information from the software. On the way to your final destination, you might see Crisis Markers (White poster with a bright orange border). Notify the facilitator you have spotted the marker and you will be given a description of the event. Post the description and location of the marker to share information about the crisis with others, and then continue to the final destination. Your GPS data will be monitored and one of our researchers may observe you during your walk. Once you get to the final destination, you will be asked to draw the actual path you took on a map and asked to complete a survey about your experience with the application. The task portion of the session, when you are waking and mapping, etc, should take approximately 30 minutes. The entire experiment takes less than 50 minutes.

What are the possible risks and benefits of my participation?

Risks—There is a possibility of becoming emotionally upset due to imagining yourself running into the scenarios described on the crisis markers, though we estimate the scenarios to be equivalent to reading a thriller novel that would result in a PG-13 movie.

Benefits— A better understanding of how software interfaces should be designed should benefit society by providing information relevant to the development of new computer interfaces that are easier to use. The information gained in this study should benefit society by providing an evaluated tool to help in crisis situations such as shootings, wild fires, floods, etc.

How will the information I provide be used?
The data collected in this research may be used for educational or scientific purpose and may be presented at scientific meetings or published in professional journals. Your name will not be identified in any use or publication of the data.

What measures will be taken to ensure the confidentiality of the data or to protect my privacy?
Records identifying participants will be kept confidential to the extent allowed by applicable laws and regulations. Records will not be made publicly available. However, federal government regulatory agencies, auditing departments of Iowa State University, and the ISU Institutional Review Board (a committee that reviews and approves research studies with human subjects) may inspect and/or copy your records for quality assurance and analysis. These records may contain private information.

To ensure confidentiality to the extent allowed by law, the following measures will be taken: Participant confidentiality will be ensured by not recording names of participants on any data gathering information. All data collected will be stored in a locked lab on a password-protected computer (digital data) or in a locked filing cabinet for non-digital data. Informed consent documents will be kept in a locked filing cabinet in an access-controlled lab. If the results are published, your identity will remain confidential.

Will I incur any costs from participating or will I be compensated?
You will not have any costs from participating in this study. You will be compensated for participating in this study. If you are participating as part of the Psychology Research Participation Pool, 1 unit of research credit will be registered on the SONA system, and you will receive a written receipt of your participation and a copy of the informed consent form. SONA alternatives to participate are described in your course syllabus. If you were recruited by other means, you will be compensated $10.00 for your time. Compensation will still be given even if you decide to stop the study. You will need to complete a form to receive payment. Please know that payments may be subject to tax withholding requirements, which vary depending upon whether you are a legal resident of the U.S. or another country.

Information regarding documentation required for participant compensation may be obtained from the Controller's Department, 294-2555 or http://www.controller.iastate.edu.

What are my rights as a human research participant?

Participating in this study is completely voluntary. You may choose not to take part in the study or to stop participating at any time, for any reason, without penalty or negative consequences. You can skip any questions that you do not wish to answer.

Whom can I call if I have questions or problems?

You are encouraged to ask questions at any time during this study.

- For further information about the study contact José Camou, 956-821-1160, jcamou@iastate.edu or Dr. Stephen Gilbert, gilbert@iastate.edu.
- If you have any questions about the rights of research subjects or research-related injury, please contact the IRB Administrator, (515) 294-4566, IRB@iastate.edu, or Director, (515) 294-3115, Office for Responsible Research, 1138 Pearson Hall, Iowa State University, Ames, Iowa 50011.

Consent and Authorization Provisions

Your signature indicates that you voluntarily agree to participate in this study, that the study has been explained to you, that you have been given the time to read the document and that your questions have been satisfactorily answered. You will receive a copy of the written informed consent prior to your participation in the study.

Participant's Name (printed) ____

(Participant's Signature) (Date)

Investigator Statement

I certify that the participant has been given adequate time to read and learn about the study and all of their questions have been answered. It is my opinion that the participant understands the purpose, risks, benefits and the procedures that will be followed in this study and has voluntarily agreed to participate.

(Signature of Person Obtaining Informed Consent) & (Date)

APPENDIX G - BRIEFING SCRIPT

Introduction

For this study, I ask that you pretend that there are random spots of violence around ISU. This is a simulation based on the current state of affairs in Mexico, where you may encounter criminal activity in the street at a roadblock or be caught in a shooting on your way to work. You will want to do your best to figure out if the paths around campus are safe, or if there are spots to avoid. Just as in Mexico, you cannot rely on the public news sources because they have been known to be bribed by the people creating the violence. Specifically, getting to and from different places poses a great challenge because you do not know where these random acts of violence will occur, and the news sources are unreliable to help you get to your desired destination. A good alternative source of information is social networking tools that are less susceptible to corruption. Today you are going to use a new tool you just heard about called Urban Forecast. Urban Forecast is a web-based application on the iPhone you have in you hands. It is designed to show you where other users have spotted crisis situations, which means you can post situations you come across as well.

Scenario

Your objective today is to walk from your current location to your final destination, which will be shown to you on a map in a few minutes, without running into any dangerous areas. You will be able to use the Urban Forecast to find alternative paths for a safer route. Once you arrive at the final destination you will be asked to fill out a short post survey and your part in the study will be done.

Crisis Marker Orientation

Along your path today, you will come across what I call Crisis Markers [hold up crisis marker example]. Each marker will represent a different type of crisis. If you come across or see a marker that has not been reported, let me know that you have identified a crisis and I will tell the details of the "event". You can then report it using the Urban Forecast tool.

Map Orientation

Use this map [give pre study map to participants] to draw a path you will most likely take from your starting location to the final location.

Technology Orientation

You will now have 1 minute to open the application and explore the tool.