**Lab2: Crime HotSpot Prototype Product Specification**

Crime HotSpot

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## 1. Introduction

Crime HotSpot's objective is to help the end user find areas that are within in the user's safety tolerance. With crime being prevalent in all societies it can become difficult to decide whether an area is safe. The volume of these crimes can be seen in the 7.7 million property crimes and the 1.2 million violent crimes committed in the United States of America in the year 2017 (FBI, 2017). Judging if somewhere is within safety tolerances is challenging given the possibility that two people may have different safety concerns, due to socioeconomical demographics. Suppose one person owns a car and another chooses to only take public transportation. The person that takes public transportation may be more concerned with becoming the victim of a robbery or assault, while the other person is more concerned with vandalism, larceny, or theft of the automobile. Presumably each person would do research to find an area that is within tolerance, but to do so is tedious and time consuming, and can often leads to negative or unreliable results. People concerned with safety frequently rely on common knowledge and opinions from locals in the area. One problem with this approach is that information that is regarded as common knowledge to one person may be foreign to another. There are other potential drawbacks to relying on the consensus of others when it comes to safety, for one there is not always a local nearby to query. Sometimes people are biased and areas that are relatively low risk are said to be dangerous due to racial biases, and social class structures. Another consideration is the source of the opinion; it is possible the person offering advice has vested interests in making some neighborhoods and business distracts appear safer than others to locate, or travel. The other case, that is perhaps just as bad, is people even without bias and only honest opinions and common knowledge, is peoples' safety standards differ. Each person offers advice to the other based one's own concerns; in the case of the two fictional people, the person without the car may not pay much attention to larceny from autos.

The other option, aside from using people to gather information, is to use the Internet as a tool to help decide what neighborhoods are safe and what areas to avoid. The problem with this resolution is that the tools currently available overwhelm users with information. The user's interface quickly becomes cluttered with a plethora of icons representing crimes, refer to the *Figure 1*. While these tools help the user see the crimes in the area, they do not ascertain the level of danger present. As an example, a shopping center will have many cases of shoplifting but the risk of becoming a victim of a crime against one's person or personal property are low.


*Figure 1*. Screen shot of crimes for the city of Norfolk, Virginia. Reprinted from Helping You Build a Safer Community in CrimeMapping.com., 2018 Retrieved from CrimeMapping.com

Areas that appear dangerous on these online applications are safer than assumed. In the case of election years where crime involving campaign yard signs spikes, areas appear more dangerous due to the property crime activities being reported equally to the other incidents, refer to *Figure 2*; “due to theft, trespassing and vandalism of said signs. That is due to an individual's political beliefs that have little to no actual effect on one's personal safety. And with so many crimes committed around the same area it can be difficult to differentiate between the types of crimes committed that hold value to individual crime-mapping user” (Crime HotSpot, 2018). Crime Hotspot solves this problem by focusing on quantitative data while allowing the user to prescribe qualitative meaning to the data displayed. Thereby allowing one to make the decision on the area’s safety. Crime HotSpot will use a heat map in balancing qualitive and quantitative information. The heat map will be discussed in more detail under the product description, refer to *Figure 4*.


*Figure 2*. Campaign yard signs from person whose yard was vandalized. Reprinted from Campaign Signs from Minnesota Brown, 2018. Retrieved from minnesotabrown.com/wp-content/uploads/2018/07/campaign-signs.png

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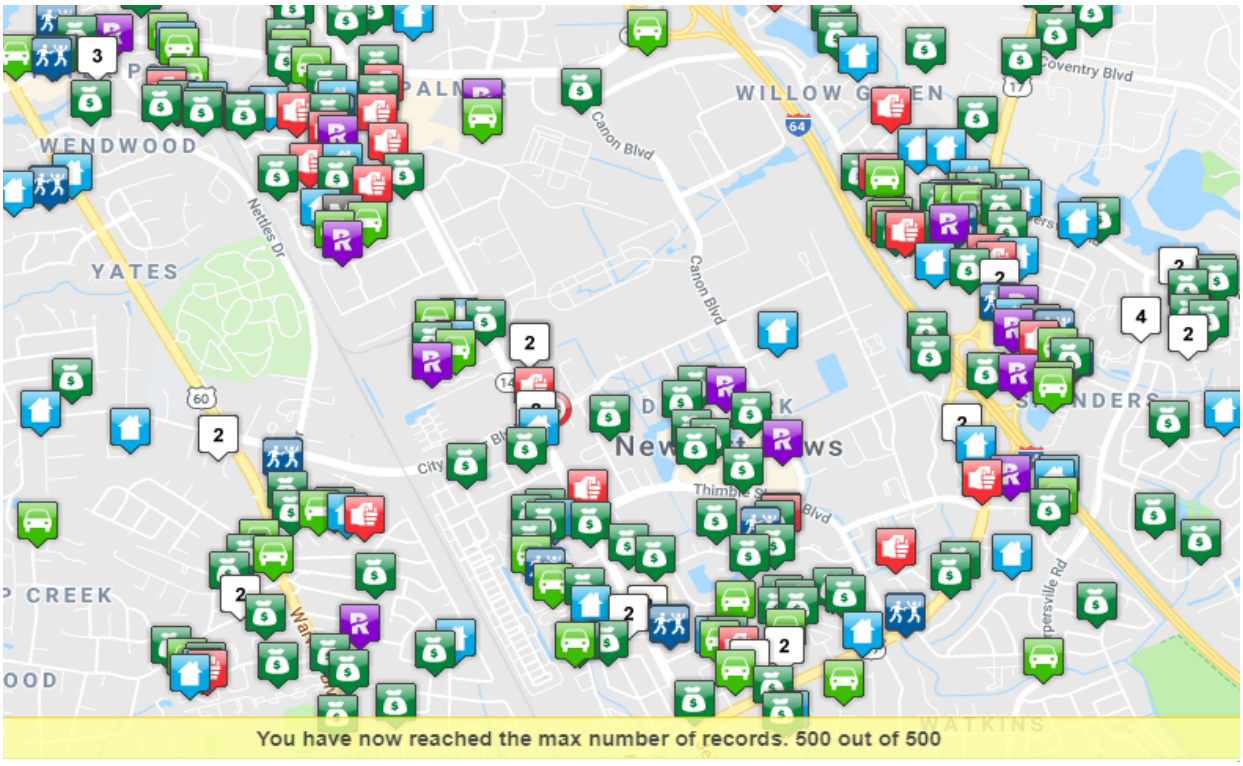


*Figure 3.* Once again, another example of how prevalent the icon graph is in displaying crimes and how difficult it is to interpret anything from the information. Reprinted from Lexus Nexus in Lexis Nexis Community Crime Map, 2018. Retrieved from https://communitycrimemap.com/.

## 1.1. Purpose

Crime HotSpot's solution to the cluttered displays of icon graphs, shown in Figure 1 and Figure 3, is to display crime on a heatmap. The application will allow the end user to modify the crime categories that are of interest and display the modification on a heatmap. A heatmap is a technique of applying a radial color, with nontransparent or brighter colors meaning a higher statistical significance and lighter and more transparent colors generally meaning lower density or statistical significance. Examine *Figure 4* for an example of a heatmap. Crime HotSpot uses the number of crimes and the user's provided significance of the crimes to decide the SafetyScore and the color displayed on the map. A comparison of *Figure 3* and *Figure 4* demonstrates how a crime heatmap can abstract the individual details of the myriad number of crimes of area while at the most basic level improves readability of crime density. Heatmaps provide opportunities to represent crime data in new ways, such as prescribing severities of the crimes committed and showing the level of danger in area and allow the user to see density of individual crime types.

To maximize the effectiveness of the heatmap Crime HotSpot will relate every color to a numerical score, which is the SafetyScore. The SafetyScore is unique to the user's personal preferences, the number of crimes, frequency, surrounding population density, and the level of danger associated to each crime incident. All these factors impact the SafetyScore and thereby the depiction of color on the map, thereby going one step further than the other applications available in displaying meaningful information to user about the level of danger. Previously when a user would use a crime mapping tool the user would follow *Figure 5*'s process flow bellow, which is the process flow Crime HotSpot aims to simplify.

Examine the proposed solution process flow, *Figure 6.* There is a notable difference in the number of steps between *Figure 5* and the solution flow, *Figure 6*. Another key difference is that the user can find the information needed at any point in the process in *Figure 6* while in *Figure 5*, the user only has one solution.

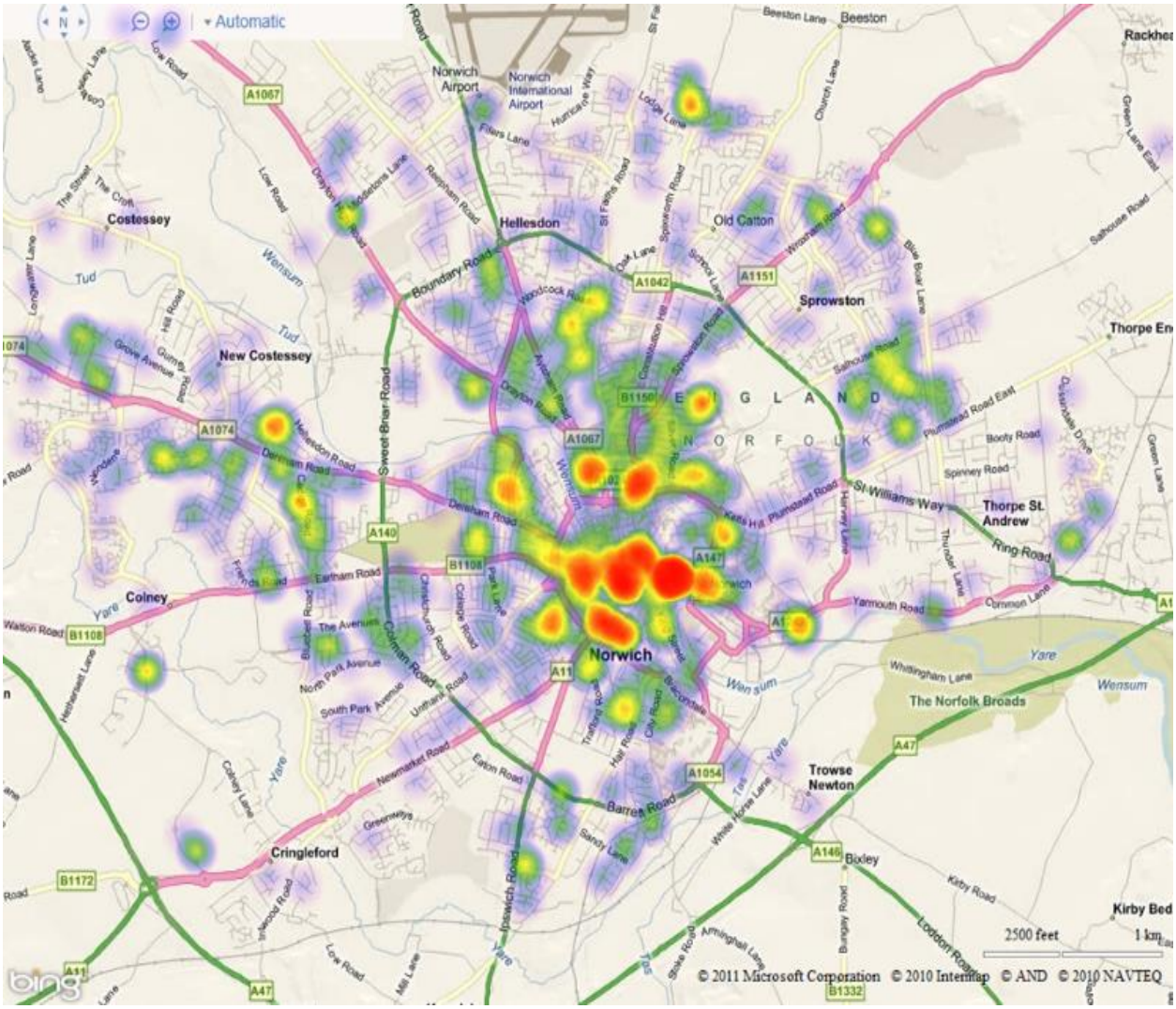


*Figure 4.* Example of a heatmap, with the red areas depicting a hotspot which where there is higher density of crimes. Reprinted from "Heat Map" by Microsoft, 2011, Retrieved from alastaira.files.wordpress.com/2011/02/image24.png.

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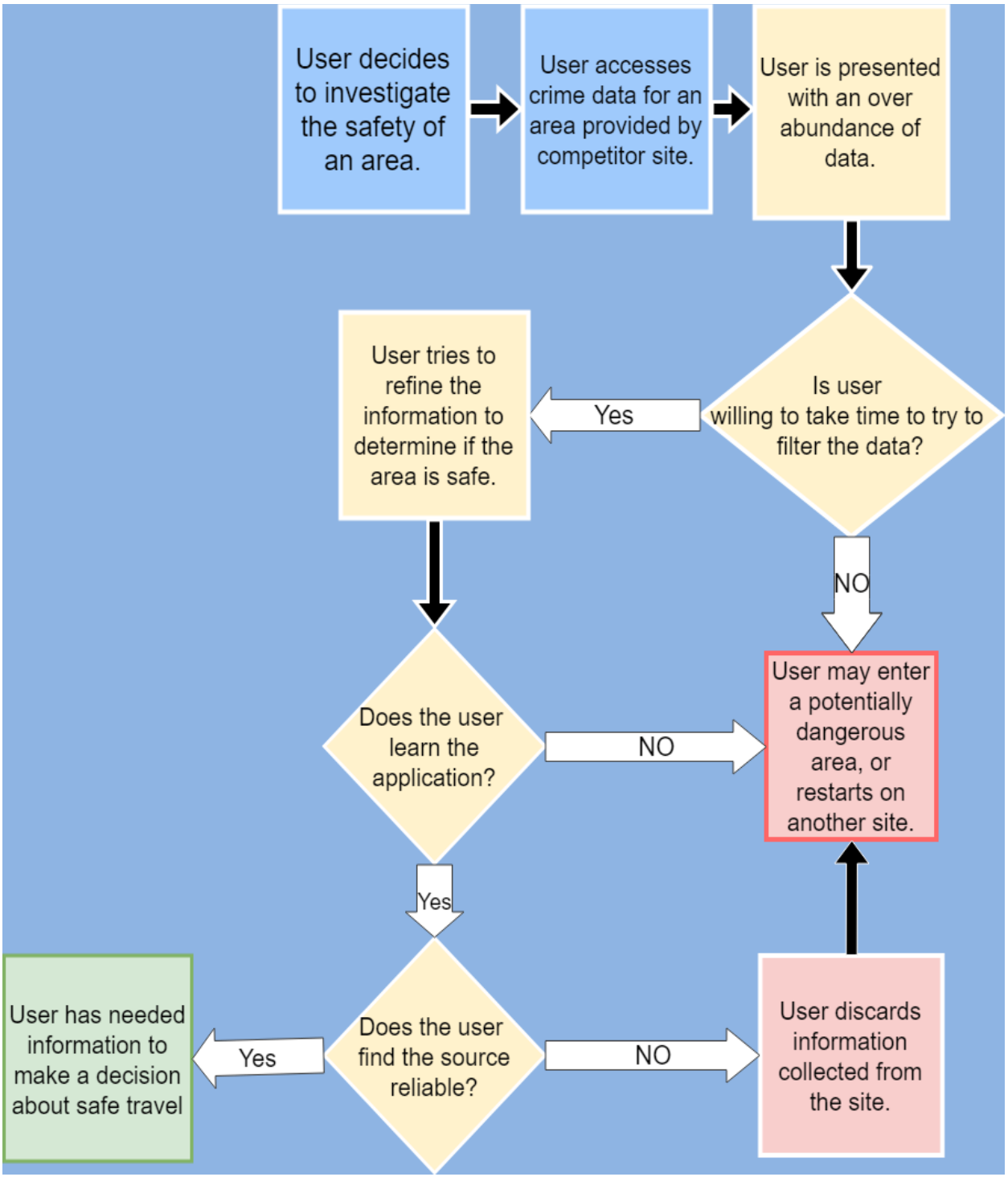


*Figure 5.* Current problem process flow, there is clearly only one way to decide if an area is safe and requires all previous steps to be correct. If at any point the user gives up or does not get the correct information, then the person may choose an unsafe location. Reprinted from 'Presentations' in Crime Hotspot, 2018, Retrieved from https://www.cs.odu.edu/~cpi/old/410/silverf18/presentation.html

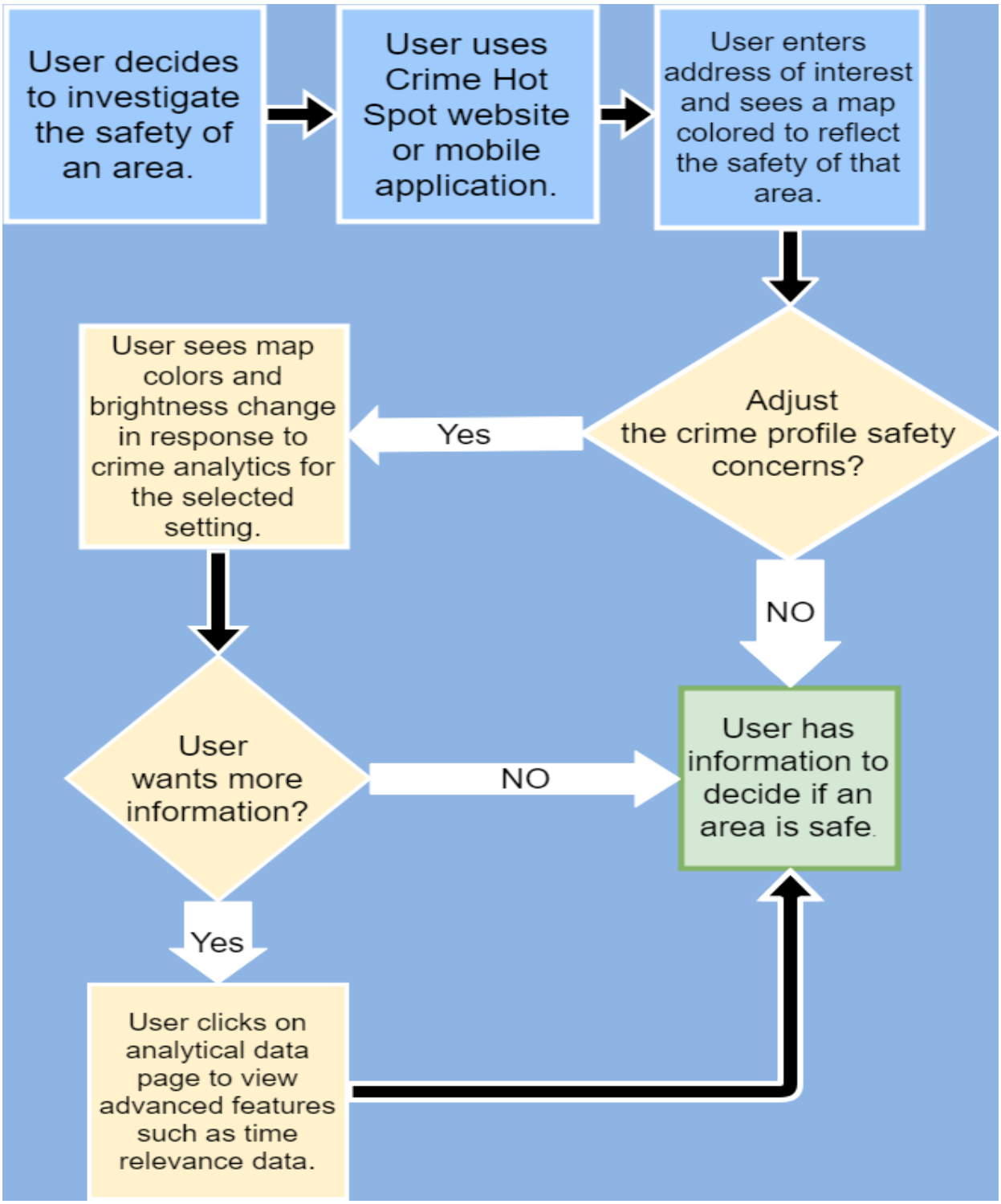


*Figure 6.* Simplifying the process while maintaining the useful information. Reprinted from 'Presentations' in Crime HotSpot, 2018, Retrieved from https://www.cs.odu.edu/~cpi/old/410/silverf18/presentation

### 1.2 Scope

The Crime HotSpot prototype architecture will be a modified version of the production application: taking away features that would be geared toward maintenance such as the terminal service. The prototype application will be focused on delivering a fully functional heat map with many of the same features of the full production application, such as crime filter, crime aging, etc., and a proof of concept analytics page.

### 1.3 Definitions, Acronyms, and Abbreviations

**Application Programming Interface (API):** a set of functions and procedures allowing the creation of applications that access the features or data of an operating system, application, or other service.

**Crime Map:** A map that has crime statistical data overlaid on it to provided information on the criminal activity of an area.

**Heatmap:** a representation of data in the form of a map or diagram in which data values are represented as colors.

**JavaScript MEAN Stack:** MEAN is a free and open-source JavaScript software stack for building dynamic web sites and web applications. The MEAN stack is MongoDB, Express.js, AngularJS (or Angular), and Node.js.

**JavaScript Object Notation (JSON):** a lightweight data-interchange format. It is easy for humans to read and write. It is easy for machines to parse and generate. It is based on a subset of the JavaScript Programming Language.

**SafetyScore:** A number, proprietary to Crime HotSpot, that represents the relative safety of an area.

**Soft Target:** A person or property which presents as having poor defenses against crime.

**Comma-Separated Values (CSV) File:** a delimited text file that uses a comma to separate values.

**Geographic Information System (GIS):** a framework for gathering, managing and analyzing data in respect to spatial location.

**RGB:** Red, Green, Blue colors.

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### 1.5 Overiew

The remainder of product specification details the architecture of the prototype, including the major functional components, which covers the APIs and services used to program the application, and the implementation methodologies used, such as the MEAN stack. This document will cover features that Crime HotSpot deemed crucial for demonstrating a proof of concept. Section 3 covers the prototype specification requirements, which will be provided in its own document.

## 2. General Description

The prototype focuses on key features of the full production application, delivering a heatmap with real data, showing how a heatmap abstracts crime, demonstrating how a user can interact with the heatmap through Crime HotSpot's application, and conveying useful information to the user through a simplified version of the analytics page. These features closely mirror the tenets of making decisions for one's safety simpler, which is the goal Crime HotSpot sets out to achieve.

### 2.1 Prototype Architecture Description

The major functional components for the prototype are geared towards rapid prototyping, which is pivotal to demonstrating the advantages of a heatmap in crime mapping and proofing a user interface, refer to *Figure 7* for the major functional components of the prototype. The Prototype will use Google Maps API as in the full production. The development framework used in the prototype is the MEAN stack. The MEAN Stack is a conglomeration of MangoDB for the database, Express.js for creating APIs to handle requests in the application, Angular.js to make the application interactive, and lastly, Node.js to serve the application on the Internet. MongoDB and Node.js are backend technologies, the backend deals with interactions that are not transparent to the end user such as server requests, database queries. The front-end is as suspected the opposite and deals with the development of visible features and the logic of interactions with the user, such technologies such as Angular.js and Express.js. The application server will still serve the application and query the database for crimes but will not do real-time processing on a user's location. When the user's location changes in the full production version, the application will alert the user of the SafetyScore of the area relative to the current time based on analytics on the area.

The prototype databases data will be focused only on Old Dominion University data and will implemented through MongoDB Atlas, MongoDB's managed database service. Crime HotSpot decided to use MongoDB Atlas as it allows the team to focus more on development then on maintaining systems needed for deployment.

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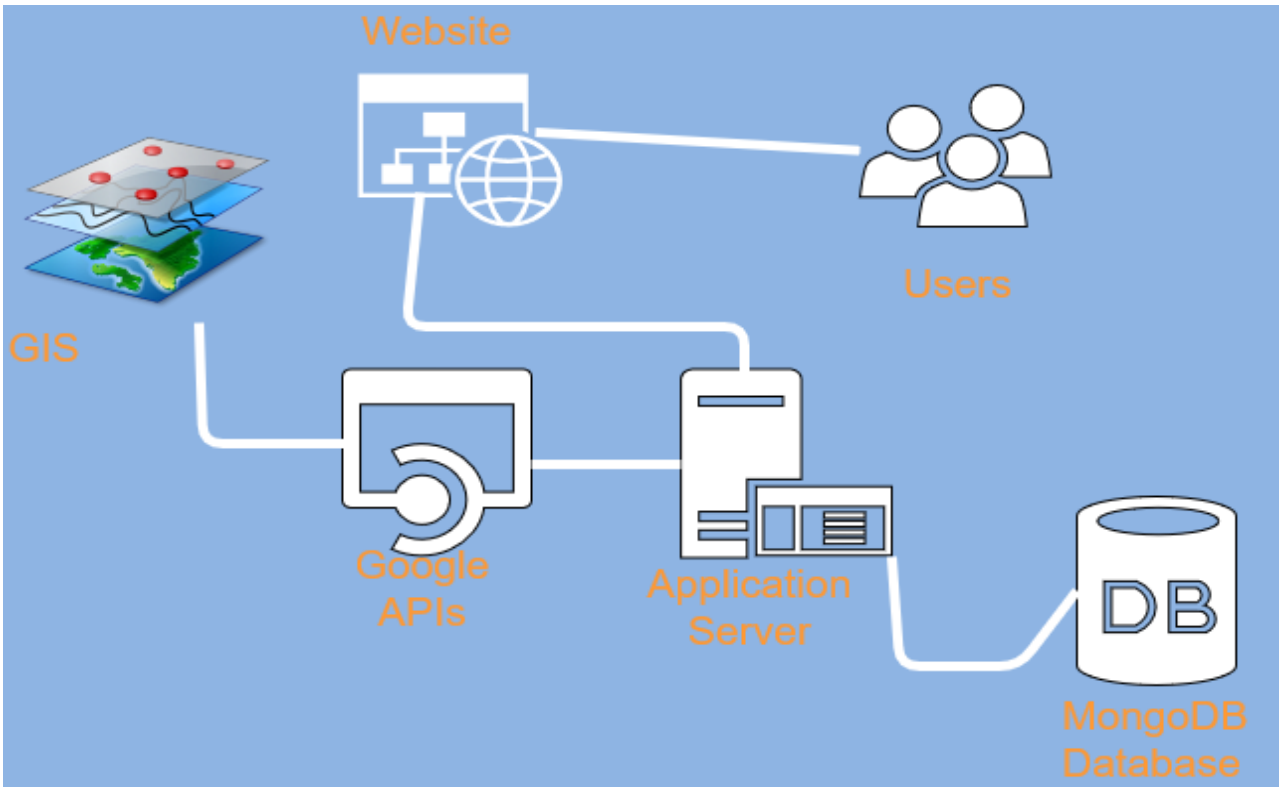


*Figure 7.* Prototype Major Functional Components. Reprinted from 'Presentations' in Crime HotSpot, 2018, Retrieved from https://www.cs.odu.edu/~cpi/old/410/silverf18/presentation

## 2.2 Prototype Functional Description

Crime HotSpot's development verve is concentrated on styling and organization of the application, as well as wiring the functional units i.e., the controllers in the model view control paradigm. The website is to maintain a clean and functional heatmap with a slimmed down version of the full product. The focus will be on placing crime incidents on the heatmap and allowing for minor changes through the user filters. Filter will be applied against the map, such as deselecting crime categories. In the prototype there are only four types of crimes, crimes against the public, these include offense similar to drunk in public; crimes that generally have low impact to one's safety, and usually have one victim, that is usually the person whom committed the crime. Crimes against property, which involves cases of people's property being damaged, stolen etc. Crimes against the person, which include non-life-threatening crimes that are crimes directly against one's person, crimes such assault, domestic violence, harassment. Lastly there is severe crimes against the person, crimes homogenous to assault with a deadly weapon, abduction, and crimes with higher rates of fatalities. In the full production application, there would be these four categories with a wide range of subtypes available and the user would be able to modify how a single unique type of crime can impact the heatmap, given time constraints the prototype will only implement the most essential functions, which is demonstrating how these crime categories interact with the heatmap. The other half of the prototype is the analytics page which will have limited capabilities, but should allow the user to specify, date, time information and return reports consisting of charts and graphs. These charts

should help the user gain information such as what times had the most crimes or generate a pie chart of the composition of crime, such as the number of crimes in each category that make up the sum of crime for an area.

The prototype application overall sets out to demonstrate what it is Crime HotSpot does differently from its competition, refer to *Table 1* to see those differences and *Table 2* is what Crime HotSpot will be able to achieve in the prototype. Notice many of the key differences are being implemented in the prototype.

| Characteristics / Programs | Crime Hot Spot | LexisNexis Community Crime Map | SpotCrime | CrimeMapping | AreaVibes | Trulia |
|---|---|---|---|---|---|---|
| Generalized crime data | ✓ | ✓ | | | ✓ | ✓ |
| Crime types differentiated | ✓ | ✓ | ✓ | ✓ | | |
| Filter options: date, crime type | ✓ | ✓ | | ✓ | | |
| Weighted to user relevance (SafetyScore™) | ✓ | | | | | |
| Supplemental analytics | ✓ | ✓ | ✓ | ✓ | ✓ | |
| Companion app | ✓ | | | | | |
| Distributes data evenly across area of concern | ✓ | | | | | |
| Cluttered icon graph presentation | | ✓ | ✓ | ✓ | ✓ | ✓ |

*Table 1*. Table 1. Competition matrix highlighting some key features of Crime HotSpot. Reprinted from 'Presentations' in Crime HotSpot, 2018, Retrieved from https://www.cs.odu.edu/~cpi/old/410/silverf18/presentation

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| Feature | Prototype | Full Production |
|---|---|---|
| **Generalized crime data** | Yes | Yes |
| **Crime types differentiated** | Yes* | Yes |
| **Map Filter options: date, crime type** | No | Yes |
| **Distributes data evenly across area of concern** | Yes | Yes |
| **Weighted to user relevance (SafetyScore™)** | No | Yes |
| **Supplemental analytics page** | Yes* | Yes |
| **Companion app** | No | Yes |
| **Fully functional heatmap** | Yes | Yes |
| **Multiple data locations** | No | Yes |
| **SafetyScore for map click** | Yes | Yes |
| **Crime aging** | Yes | Yes |
| **Crime distance factor** | Yes | Yes |

*Table 2.* Prototype versus Full production.

### 2.3. External Interfaces

Crime HotSpot requires several interfaces working together to deliver a working prototype There are the hardware interfaces, the software interfaces and the user interface which the user interacts with directly. Some of these interfaces work indirectly together, such as the interface from the user to the Google Maps API, which is called for the user through Crime HotSpot and is manipulated using the web app.

#### 2.3.1 Hardware Interface

The user will need network speeds to support being able to download crime data to their machines to be able to support the use of the application. Must be capable of running a graphical web browser.

#### 2.3.2 Software Interface

For Crime HotSpot to be functional the user must be running a moderately up to date browser that supports Angular.js, JavaScript, and have CSS3 styling enabled. For browsers that do not support JavaScript the website will redirect them to a page notifying the user that application requires JavaScript.

### 2.3.3 User Interfaces

The user interacts with Crime HotSpot application with a mouse and keyboard for the prototype, and via touch input on a smart phone for the mobile application. The mouse will be used to click on the map and navigate to various pages in the web app. The keyboard will allow the user to provide data to the web application to get information pertinent to what the user want to know about, such as date and time ranges of crimes. For smart phones the user will use the virtual keyboard provided by the operating system, refer to *Figure 8* for an overview of the interface features.

Upon visiting Crime HotSpot, the user should be greeted with a heatmap of Old Dominion University for the prototype. For the full production application, the application would prompt the user to provide a location of interest. On the side of the page will be options for the user to make selections to what crimes they want to impact the heatmap. On the full scope application, the user would be able to modify the individual crimes from under the broader category of crimes my using sliders and input boxes, in prototype as discussed earlier the application will only allow the user to select from crime categories.

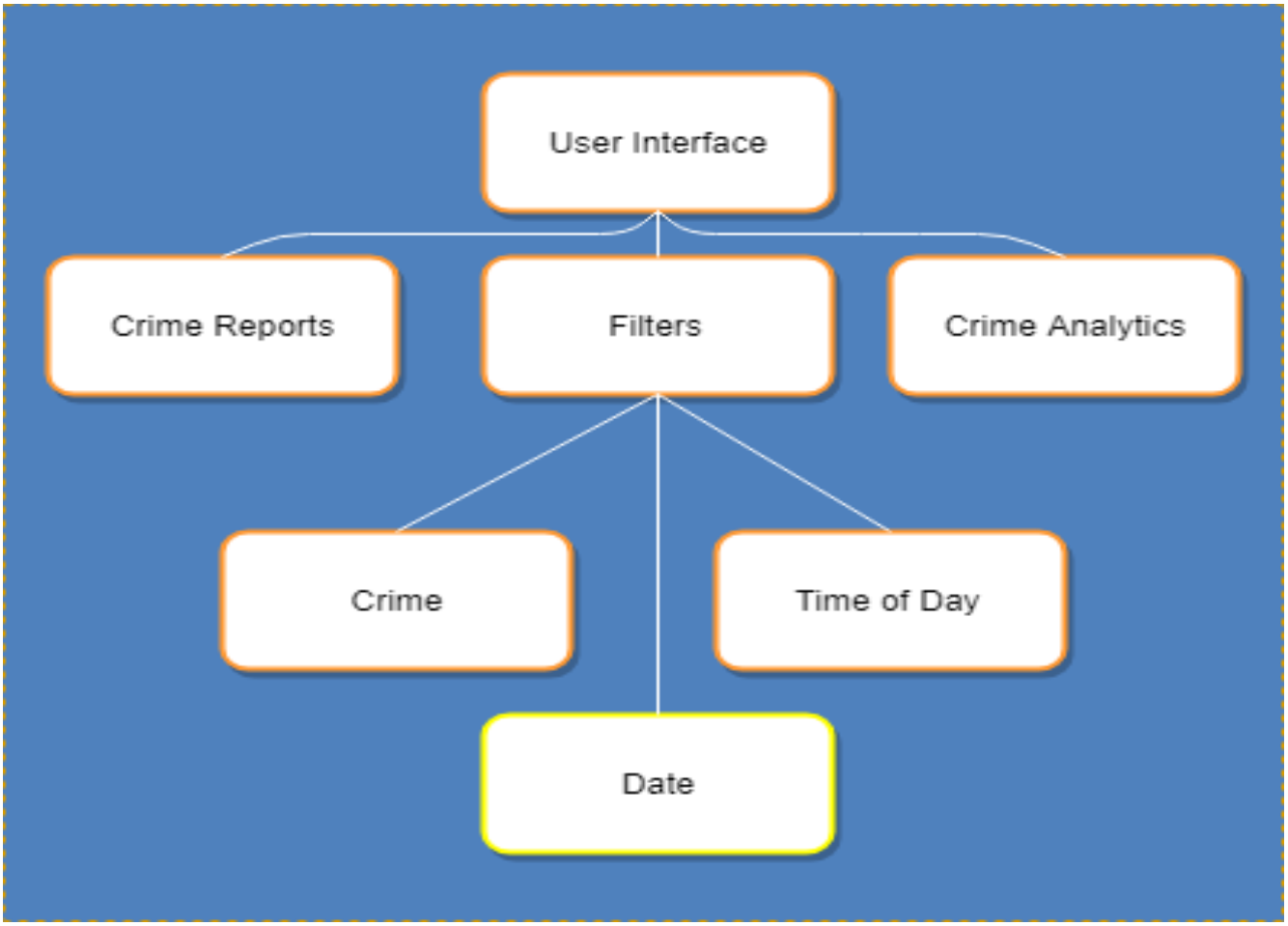


*Figure 8* User interface features diagram. Reprinted from 'Presentations' in Crime HotSpot, 2018, Retrieved from https://www.cs.odu.edu/~cpi/old/410/silverf18/presentation.

### 2.3.4 Assumptions and Dependencies

Crime HotSpot's prototype will use the JavaScript Google Maps API in managing and producing geological information, i.e., the GIS provider.

The prototype application will use MongoDB's Atlas service with data provided by the Old Dominion University campus police department.

All services and fees paid and or owned by the team members of Crime HotSpot will not be turned over to Old Dominion University, this includes API keys. Services and software will be shut off at the end of the prototype to ensure the financial and personal privacy of the team and its members. This does not include the source code which the university will be able to maintain in its archive.