Lab 2: Crime HotSpot Product Specification

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1 Introduction

It is generally accepted that people do not desire to be victims of crime. The popularity of car alarms, home security systems, and self-defense classes attests to this. Despite people taking these defensive measures, the FBI estimates that 9.9 million crimes occurred in 2017 (FBI: UCR, 2017). Rather than defending from crime, the average person may find it more useful to avoid areas where crime is likely to occur. People tend to do this instinctually, but what if their perception of safety is incorrect? Safety assessments based on hearsay and physical observations are easy to make, but they can be drastically influenced by recent, isolated events. Analyzing factual sources, such as police records, may offer a better perspective, but drawing conclusions from these sources can be too time-consuming or challenging for the average person. People need a reliable source of crime information that remains as readily interpretable as hearsay.

Several public websites exist which aim to fulfill this need. While the websites often supplement with graphs, charts, and one-off statistics, the most popular approach to conveying crime data is through crime maps. A crime map visually denotes the geographic occurrences of crimes. These maps have been used by police departments for decades to analyze crime trends and determine hot spot areas which may require additional police resources. Crime maps can be an incredibly useful medium for conveying data, but public web implementations do not feel intended for the public. As shown in Figure 1, the maps present each individual crime occurrence as an icon on the map.

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

Searches regularly return a similarly cluttered visual that requires extensive filtering and search adjustment to achieve meaningful results. This may be reasonable for a crime analyst, but can be daunting, confusing, and even misleading to the average person.

Current crime maps do not distinguish between isolated crime reports and multiple crime reports related to a single incident. They provide no inherent distinction between crimes that endanger a person and those which cause minor inconvenience. This can be especially deceptive when crime targets are clustered together, such as the political signs pictured in Figure 2. For every sign that is damaged, stolen, or moved, crime icons for a combination of vandalism, theft, and trespassing appear on the map.

Figure 2: Theft of political campaign signs is a minor offense but can be over-represented in an area during campaign season and make the area appear unsafe. Reprinted from "Campaign Signs." Minnesota Brown, minnesotabrown.com/wp-content/uploads/2018/07/campaign-signs.png.

Even though these crimes pose little threat to safety, the average user will only see the overwhelming number of crime occurrences in that area and mistakenly believe the area is dangerous. From these examples, it is apparent that current crime maps do not display data in a way that allows the user to make effective and informed decisions about their safety.

A better approach to crime mapping for the public keeps the audience in mind. People visit crime mapping web sites because they are concerned about safety, be it theirs or their property's. Crime occurrences are therefore only as important as their impact on that safety. An ideal crime map displays crimes relevant to the user's concerns and in a manner that reflects the threat of those crimes. Dangerous crimes should be weighted to impact the crime map more, while less threatening crimes should draw less attention. To minimize user confusion, the map display should appear uncluttered regardless of the number of crimes displayed. The core map data must remain verifiable despite these transformations. Statistics may be used to focus on specific crime trends but should not overwhelm the crime map. Most importantly, users must be provided a standard method by which they can reliably assess the safety of the area. These aspects will combine to form the ideal solution to public crime mapping: Crime HotSpot.

1.1 Purpose

Crime HotSpot will be a crime mapping tool with a design focused on conveying safety information to everyday people. Users will be able to visit the Crime HotSpot website, search for a location on the crime map, and understand the general level of safety at that location. As shown in Figure 3, using search filters and additional analytics tools may enhance the user's experience, but meaningful safety information will be conveyable through viewing the results of a simple search.

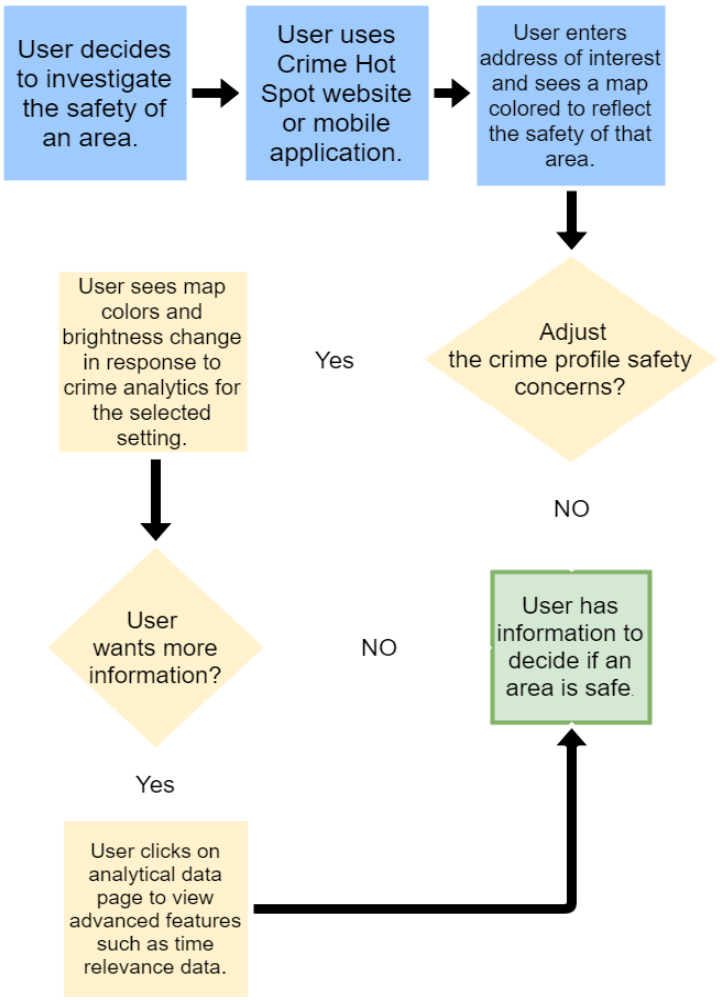

Figure 3: Process flow for Crime HotSpot. Reprinted from "Presentations" by Crime HotSpot, 2018, Retrieved from https://www.cs.odu.edu/~cpi/old/410/silverf18/presentation.

Crime HotSpot will convey safety information, not pure crime data. This will cater to an audience composed of people untrained in crime analysis. The Old Dominion University Police Department has shared their data with the Crime HotSpot team, so initial users will consist of those interested in safety around the ODU campus. These people, and future general public users, will use Crime HotSpot to check the safety of areas when making decisions. People may check areas they intend to visit for their personal safety, research locations before purchasing a property, or check their location's safety level when considering buying security systems. Businesses may use Crime HotSpot for similar purposes. Some specific businesses, such as small real estate agencies or companies marketing security measures, may use Crime HotSpot to target locations or persuade customer purchases.

1.2 Scope

Crime HotSpot will have two major distinguishing features: the visualization method of crime threat and the calculations determining the corresponding SafetyScore. A heatmap will visualize geographical crime references with intensities proportional to the threat those crimes represent. Map areas where crimes are clustered will appear “hotter” than their surroundings. Users will be able to adjust their search and the resulting heatmap by selecting from premade “crime concern” profiles, then finetuning the weights of specific crime types. Crimes weighted to indicate a higher threat to the user will produce more individual heat than crimes that are not within the user's concerns. The heat levels on the Crime HotSpot map will directly translate to a numerical SafetyScore denoting the crime threat of the area. The SafetyScore thus will serve as a safety rating for a specific location based on the frequency, severity, recency, and geographic proximity of nearby crimes.

The full Crime HotSpot product will be available to users both as a website and a mobile application. Both will communicate user location and search preferences to an application server. The server will query a database for relevant crime records, perform calculations to determine the weights for the data points, and return the data ready for visualization. A terminal service will be used to update and maintain the database.

The Crime HotSpot prototype will be structured similarly to the final product but will not include a mobile application or terminal service. The prototype will behave similarly to the full Crime HotSpot product but provide fewer options.

1.3 Glossary

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.

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

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

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

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.

RGB - red, green, blue colors.

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.

1.4 References

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1.5 Overview

The following sections describe the structure, features, and capabilities of the Crime HotSpot prototype.

2 General Description

Development of the prototype will focus on the Crime HotSpot website and necessary supporting components. The prototype will behave similarly to the full product, but the database will remain static and fewer options will be provided for search customization.

2.1 Prototype Architecture Description

The major components of Crime HotSpot will be implemented using the MEAN Stack framework complemented by Google Maps API. The connections between these components are shown in Figure 4. As mentioned in Section 1.2, prototype development will forgo the mobile application in favor of focusing on the Crime HotSpot website. The website will use Angular.js to provide a dynamic web page to communicate user location and search preferences to a Node application server. The server will query the collection of crime records stored as JSON documents in MongoDB Atlas, perform calculations to determine the weights for the data points, and return data ready to be drawn by Google Maps API. Since the prototype and dataset will not be changing, a terminal service will not be used for maintenance or updates.

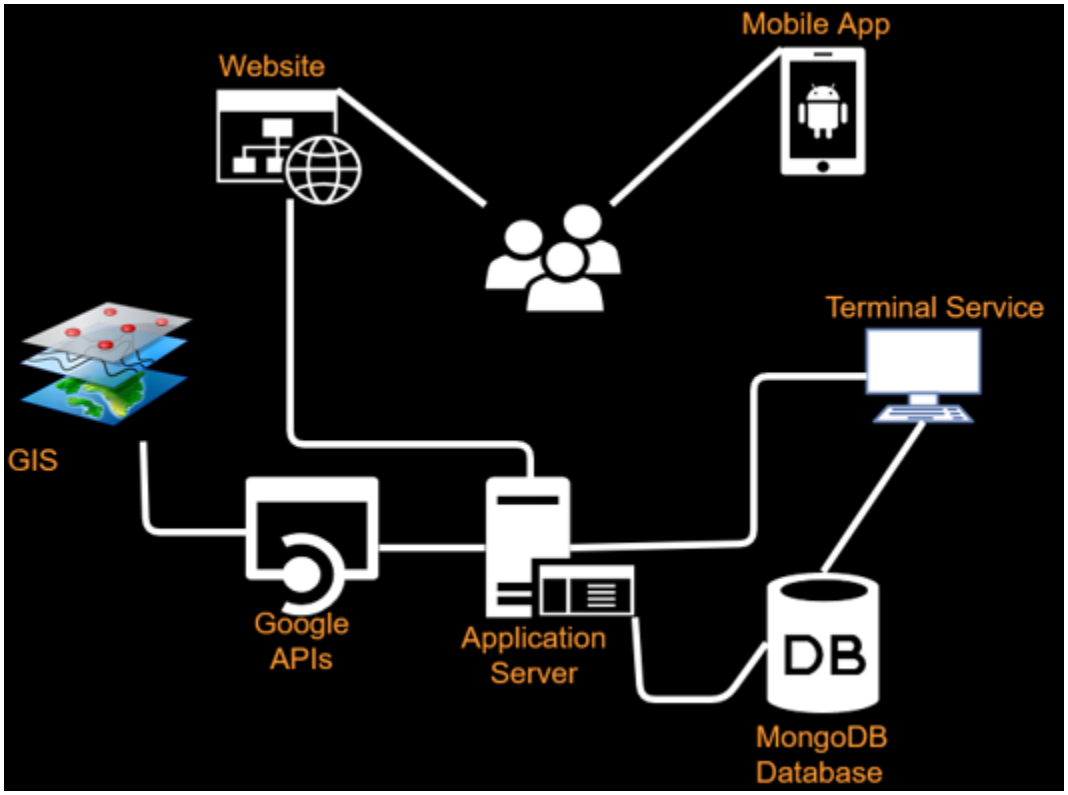

Figure 4: Major functional components of Crime HotSpot. Reprinted from "Presentations" by Crime HotSpot, 2018, Retrieved from https://www.cs.odu.edu/~cpi/old/410/silverf18/presentation.

2.2 Prototype Functional Description

The Crime HotSpot prototype will allow users to view and filter crime data for Old Dominion University. The database will be preloaded with crime data from 2017. Rather than distinguish between all crime types, crimes will be placed into one of four categories and given an inherent severity value. User search preferences may scale the severity value of specific crime categories or restrict the date range of the search. Updating the search preferences will in turn update the heatmap. The heatmap may be clicked on for additional information at any specific location. An analytics view may be clicked into for in-depth information regarding the active search.

2.3 External Interfaces

Crime HotSpot requires several interfaces. These have been grouped by type into hardware, software, user, and communications interfaces.

2.3.1 Hardware Interfaces

Users must have a device with an internet connection to interact with the Crime HotSpot website. The application server must also have a stable connection to receive requests and interact with the cloud database.

2.3.2 Software Interfaces

Crime HotSpot will use Google Maps JavaScript API for the base of the crime map. The heatmap layer will be created using the self-contained Maps JavaScript API visualization library. Crime data will be stored as JSONs in a MongoDB Atlas cloud database.

2.3.3 User Interfaces

Users interacting with the website require a screen for viewing, keyboard for typing search locations, and a pointing device for all other interactions.