CrimeSafe - Helping you stay safe

Syed Islam
University of East London
London, UK
syed.islam@uel.ac.uk

Arnold Dovnarovic
University of East London
London, UK
u1244889@uel.ac.uk

Usman Naeem
University of East London
London, UK
u.naeem@uel.ac.uk

Mhd Saeed Sharif
University of East London
London, UK
s.sharif@uel.ac.uk

Abstract

The chances of becoming the victim of a crime are on the increase and even more likely when travelling to unknown parts of a city. This is particularly true for cities like London, which are major tourist hubs and yet exhibit very high crime rates. In this paper, we propose CrimeSafe, a highly interactive and novel mobile application that shows police recorded and crowdsourced crimes in any London locality. The application displays crime data using colour coded maps at various aggregated granularity and also using location based services to proactively prompt users in taking appropriate cautionary measures. Initial evaluations demonstrate need and effectiveness of the application.

Author Keywords

Personal guidance, Intelligent actioning, Personalization, Proactive support, Mobile sensing, Crowdsourcing

ACM Classification Keywords

H.5.m [Information interfaces and presentation]: Miscellaneous

Introduction

Criminal activity around the globe and in London has been on the increase for the past few years compounded by economic turmoil and uncertainty. London has one of the highest populations amongst any europe city and correspondingly has one of the highest crime rates. In 2016, there were 868,635 crimes recorded by the police (Table 1). Just like any other large metropoli-
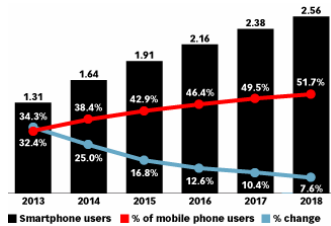
Figure 1: Growth of Smartphone users
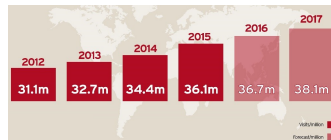
Figure 2: Growth Visitors to London

	2016
ASB	239,817
Burglary	68,258
Robbery	22,308
Vehicle	89,312
Violent	203,220
Theft	107,605
Drugs	34,108
Bike	18,501
Person (theft)	35,752
Weapons	4,486
Public order	45,268
Total	868,635

Table 1: Recorded crimes in London

tan city, when going out into unfamiliar parts of London, it is prudent to know about the area and take appropriate precautionary measures. Owing to the rich history and multi-cultural population London is expected to attract 38.1 million visitors in 2017 [1] (Figure 2).

The rise of smartphones have become an epidemic, with 2.83 billion estimated to be in use by 2018 (Figure 1). Smartphones have opened up a new area of information sharing with many applications being highly reliant on crowdsourcing. Examples include social media sites like Twitter for information sharing, navigation apps like Google Maps and Citymapper that actively collect traffic and transportation information, and, Waze which is a community-based navigation and is heavily reliant on user participation.

In this paper, we propose a novel mobile application called CrimeSafe, which helps users to become aware of their surrounding by giving them information about both reported and crowdsourced crimes. The initial evaluation of the application shows great potential, user and market study shows a potential demand for provided features in CrimeSafe.

Related Work
Crowdsourcing is a technique of gathering information by a crowd (a disorganised group of people) [6]. Traditionally data collection was exclusively performed by professionals and organisations. However, crowdsourcing avails unorganised users to collect information which, in certain circumstances can be the best sources of information [5]. These situations can be for financial rewards or simply where users see the need to use the data themselves. Some good examples where users actively and passively (Crowd Sensing [7]) participate by providing and sharing information are Google Maps and Waze.

There are several other applications that have been developed for viewing and using crime statistics for geographical regions, some use crowdsourcing from social media [8]. It is beyond the scope of this paper to provide a thorough coverage, we limit our scope to those applications that use UK Police force data [2]. These include a few web applications that provide crime statistics about geographical regions [4] and those that correlate statistics to house prices and population data [1]. There is a host of mobile phone applications that also allow visualisation of official crime data with some using maps for visualisation [3]. One that stands out is called CrimeFinder [2], which uses Augmented Reality.

However, these applications focus on presentation and visualisation of officially reported crimes. None of them employ the notion of crowd sourced crime reporting and augmenting that data with officially recorded crimes, as proposed by the work in this paper. We argue that as most crimes are reported by public and recent report show that police in the UK fail to record up to 20% of crimes reported [3], we must augment the official recorded data with crowd sourced data. This approach will also form the foundation of personal navigation systems where instead of avoiding traffic, one could avoid crime prone areas or take necessary precautionary measures. Moreover, this data can be used by the police and other authorities to improve deployment patterns and maximise resources.
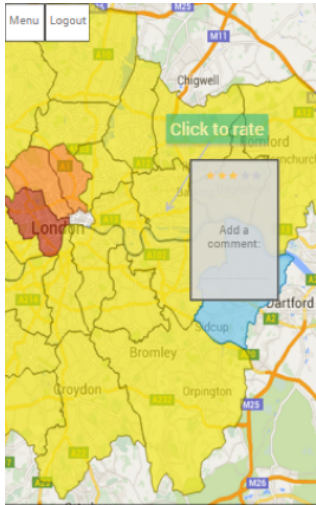
Implementation and Features
Implementation Highlights
For the initial prototyping and implementation, Android platform was chosen as it currently enjoys an approximately 80% [4] market share for mobile devices. Furthermore, as we will be heavily
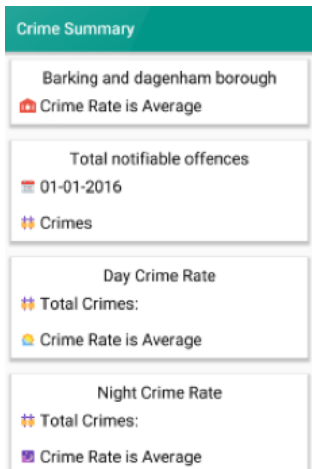
---

[1] https://www.visitbritain.org/forecast

[2] https://www.police.uk/apps/
[3] http://www.bbc.co.uk/news/uk-30081682
[4] www.idc.com

Figure 3: CrimeSafe visualisation interface

Figure 4: CrimeSafe data interface

relying on Google Maps API we found that developing for Android had the least barrier to entrance. This application will be extended to iOS and is envisioned as future work.

At the heart of the mobile application is the recorded crime data. This data for London is obtained from the Metropolitan Police as CSV files and via its public web services API[5]. Our server uses these data sources and exposes a private REST API that our CrimeSafe application uses. We improve performance and overcome API call limits using caching.

There are several mapping options available which could be used for the visualisation, examples are: Bing Maps, Foresquare and OpenStreet. After careful consideration of features, we chose Google Maps as its API demonstrated the compatibility, reliability, flexibility and richness that was best suited.

Several map colouring techinques were considered for displaying crime data on maps. Amongst these were i) Kernel density mapping - which produces a heatmap through data aggregation, ii) Grid mapping - where the maps is divided into fixed size squares allowing colouring, iii) Spatial Eclipse technique - where eclipses are drawn by grouping of activity based on proximity iv) Choropleth mapping technique - colourable units are drawn to mimic geographical and other boundaries. We chose the latter to be the most suitable and Figure 3 shows its implementation in CrimeSafe as a data layer to the Google Maps interface.

Feature Highlights
Basing the mapping interface on Google Maps allows us to inherit enormous interaction capabilities. The map interface supports various Google Map style functionalities such as Zooming, Pinch, Rotate, Compass Orientation, map overlay with satellite and terrain views. We have also included a day and night

---
[5]https://data.police.uk/

mode on the map which improves the usability of CrimeSafe.

CrimeSafe allows users to remain anonymous or create accounts so that they are able to customise the application to their own needs and setup profile information. For now, the profile information allows setting up favourite locations saving the user having to perform repeated tasks for frequently used information look up. CrimeSafe allows users to register with the service by either providing their personal and contact information or using existing accounts from popular services such as Google and Facebook.

CrimeSafe allows the user to primarily look at crime data from those recorded and published by the police, as well as, those crowdsourced from other users. This data can be visualised using two different interfaces, the first is the Map interface based on Google Maps API. The data is layered on top of Google maps allowing, data to be viewed in an easy to understand colour coded format for various geographical boundaries (Figures 3 and 5) and user defined geographical areas (Figure 6). Other than the map interfaces, users are also able to see raw crime statistics in its own listing interface (Figure 4).

Users also have the ability to tag geographical, localities and regions with comments and ratings (Figure 3). This crowdsourced data is compiled and stored on our server. CrimeSafe has the ability to display both formal and crowdsourced crime data together or individually. Additionally, the application is able to use GPS positioning and provide proactive prompts to user when in areas with high crime rates.

Evaluation
Firstly, we evaluate CrimeSafe's core design against Maletic et al.'s framework [9], which considers the *why*, *who*, *what*, *where*, and *how* for information visualisation applications.

- *Task - Why will this help?* - The app will help users identify crime prone areas and take precautionary measures.
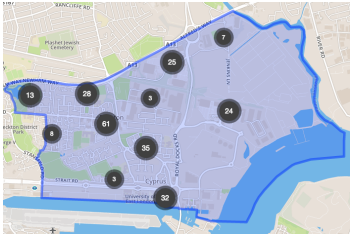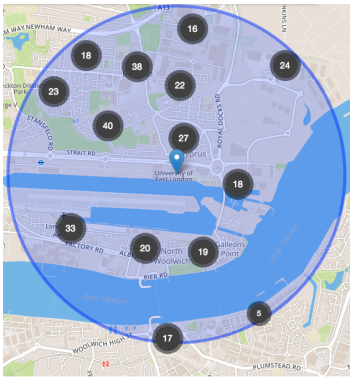
Figure 5: Postcode Crime Statistics

Figure 6: Radius Crime Statistics

- *Audience - Who will this help? -* People who are visiting and travelling within the areas where the data is being provided will use the app.
- *Target - What data source will be represented? -* Crime information collected from formal source such as the police and crowdsourced real-time information will be shown.
- *Medium - Where will the data be represented? -* The data will be presented using a highly-interactive mobile application.
- *Representation - How will the data be represented? -* The data will be presented by adding layers to Google Maps, allowing advanced interaction features. The granularity of the data will also adjust to views (depending on the level of zoom the user is applying) going from city-wide data down to street-level data. Filtering of data is also possible, for example, by crime types.

A limited user study was conducted to obtain initial feedback. The questionnaire asked users about the design, layout, usability, functionality, bugs, usefulness and improvement suggestions. All of the users were happy with the design and layout of the system and emphatically confirmed the usefulness of the application. They also suggested some functional improvements which have been incorporated into the future work discussion presented next.

Summary and Future Work

In this paper we present an initial prototype for a novel mobile application that allows users to view both formal and crowdsourced crime data using maps at various levels from granularity from city-wide to street-level. Initial evaluation of the prototype reveals that the idea is robust and effective making it useful for both tourists and locals. A review of the current applications reveal that there are no mobile applications that provide the holistic model offered by CrimeSafe.

Future work will add functionalities to CrimeSafe and launching performing extensive evaluation. Some of the functionalities are: personal navigation to avoid crime-prone areas, sharing locations with friends and family, information sharing with law enforcement regarding crime activity, mobile sensing coupled with Artificial Intelligence to automatically sense emergency situations, send out messages and allow GPS locating during emergencies, adding gamification to encourage crowdsourced information.

REFERENCES

1. 2017. CheckMyStreet. (2017). www.checkmystreet.co.uk.
2. 2017. Crime Finder. (2017). itunes.apple.com/gb/app/crime-finder-england-wales/id421810771.
3. 2017. Crime Map England & Wales. (2017). itunes.apple.com/gb/app/crime-map-uk/id422541257.
4. 2017. Go Geo Crime Data. (2017). http://demos.gogeo.io/police-uk/.
5. I. Ariffin, B. Solemon, and W. Bakar. 2014. An evaluative study on mobile crowdsourcing applications for crime watch. In *International Conference on Information Technology and Multimedia*. IEEE, 335–340.
6. C. Brabham. 2008. Crowdsourcing as a model for problem solving: An introduction and cases. *Convergence* 14, 1 (2008), 75–90.
7. B. Guo, Z. Wang, Z. Yu, Y. Wang, N. Yen, R. Huang, and X. Zhou. 2015. Mobile crowd sensing and computing: The review of an emerging human-powered sensing paradigm. *Comput. Surveys* 48, 1 (2015), 7.
8. M. Hamilton, F. Salim, E. Cheng, and S. Choy. 2011. Transafe: a crowdsourced mobile platform for crime and safety perception management. *ACM SIGCAS Computers and Society* 41, 2 (2011), 32–37.
9. J. Maletic, A. Marcus, and M. Collard. 2002. A Task Oriented View of Software Visualization. In *VISSOFT '02: Proceedings of the 1st International Workshop on Visualizing Software for Understanding and Analysis*.