2015 The 5th International Workshop on Computer Science and Engineering
doi: 10.18178/wcse.2015.04.126

UniCrime: A Mobile Solution for on Campus Crime Reporting using Volunteered Geographic Information

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Keywords: Volunteered Geographic Information; On Campus Crime; Mobile Application.

Abstract. Rapid advancement of information and telecommunication technologies today enables the Internet users to produce, share and consume geographic information (GI) virtually and globally. This type of information, termed as volunteered geographic information (VGI), has been widely used as an alternative source of information for many areas; world mapping, health monitoring, disaster relief and crime prevention. In this paper, we discuss the potentials of acquiring VGI as an information source to a mobile application for reporting an on campus crime incident. We analyze the expected features required by our potential users which were gathered through a survey and propose an application prototype for our to-be developed mobile application based on the survey results.

Introduction

The introduction of Web 2.0 technologies, coupled with miniaturization of global positioning system (GPS) devices inadvertently introduces a new horizon for collecting geographic information (GI). The production of GI traditionally was known to be very authoritarian; professional experts produce, dissemination is radial, and amateurs consume, due to the beliefs that the acquisition of GI requires extensive training, thus to be beyond the abilities of amateurs [1]. However, with the help of technologies, the Internet users, referred by Goodchild as *citizens* or *sensor*, are now empowered to produce GI voluntarily, hence the introduction of VGI [2]. Realizing the promising benefits, many organizations are moving towards exploiting the volunteers to serve as GI providers for the organizations. Through the volunteers, organizations can expedite the process of acquiring and updating GI [3], hence reducing the operational cost as this new means of collecting information is considerably cheaper [4-7].

The use of VGI started within the area of world mapping, and is rapidly extending to other domains such as health monitoring and disaster relief [8]. Crime mapping also now has emerged as one of the domains which utilizes VGI as the source of information [9]. Many crime reporting systems which utilize public or volunteers as the information providers are coming into usage nowadays. As mobile devices are getting more affordable by many, the number of smartphone owners proportionately increases, in line with mobile application growth. A study by eMarketer.com projected that 1.76 billion people will own and use smartphones all over the world by the end of 2014. The number is expected to increase to 2.83 billion by 2018 [10]. Thus, many local authorities make use of this new phenomenon to engage volunteers through mobile application to participate in community watch programs, including crime monitoring. These include *Enforce Crime Map, CrimeWatch Mobile, Community Against Crime, Malaysia Crime, Community Alert, MyDistress, CrowdSafe, Stop Crime, Crime Stoppers, CityConnect, and myPD.* These mobile applications aim at alerting others who are within the same vicinity on recently happened crime incident, so that safety measures can be taken to prevent the reoccurrences of similar crime. Eventually, these applications aim at helping the local authority to reduce the crime rate in the local area, thus making the neighbourhood a safer and more pleasant environment to stay. Studies in Brazil and Latin shown that web and mobile applications help in minimizing the number of crime violence in local area [11].

Our research targets at investigating the potentials of using VGI for on campus crime reporting through a mobile application. As a preliminary study, we collected input on what potential users or volunteers expect to see in a crime reporting mobile application through a survey. We selected a private university in Malaysia which does not have an existing online platform to report a crime incident for this study. 30 random university residents were asked to fill in a paper based questionnaire and their answers serve as the basis for the mobile application, known as *UniCrime*, which will be used for our research.

The following sections explain in detail the methodology we used as well as the results that we obtained. Following the explanation, we discuss our proposed prototype that we produced for the mobile application based on the input from the survey. We then conclude our findings in this preliminary study by discussing the future works of our main research objective.

Background Study

This study was originally derived from the lack of an online medium to report on campus report crime incidents. As majority of people now are always connected to the Internet, information sharing is seen borderless. People share crime incidents with their close friends and family members through various channels ranging from social media like *Facebook* and *Twitter*, to group messaging applications such as *Whatsapp, WeChat* and *Line*. However, the information appears on these channels are unstructured, making it difficult for the local authority to track crime hotspot and perform further analysis. Therefore, it is vital that a suitable application, specifically mobile application, to be developed to be of assistance for all parties namely the victim, the local authority or security officers and the university residents. The victim can easily lodge a report regardless of his/her location, the local authority can take immediate action once they receive the report, and at the same time the other residents can be alarmed on the newly occurred crime incident so that preventive action can be taken appropriately. The questions that we asked in the survey were grouped into 3 different categories; the first category asks participants about their perceived safety perception with the existence of such mobile application, the second category asks about their willingness to provide GI with regards to crime incident through a mobile application while the last category asks participants about the features they would prefer to have in such application.

Methodology We randomly distributed a paper based questionnaire to 30 students at a private university where the mobile application will be used at. The survey was distributed to any students during Semester I 2014/2015 session, regardless of their fields of study to avoid biasness towards the use of Internet technology. This is also done to ensure that the sample represents the population of our future mobile application users. There were 10 questions asked in the survey, and 9 out of 10 questions are close-ended. No demographic question was asked as we do not see any requirement to perform such analysis in our study. The results from each question are tabulated in the form of descriptive statistics.

Data Analysis Based on the survey results, 63.3% of the respondents are unaware of any medium that allows them to report any suspicious activity on campus (Table 1). The university practices the traditional method of lodging crime report, which is through a paper based form but apparently majority of them are not informed on this. Of those who are aware of the existing medium, majority of them agree that the existing medium is not effective in reducing the on campus crime rate.

90% of the respondents are willing to use a mobile application as a medium to report suspicious activity or crime incident that happened on campus it the application is available (Table 2). Most respondents (93.3%) also agree that having such application will help increase their awareness on the safety level of their surroundings. However, most respondents (43.3%) prefer to use public web site as the official channel to report crime incident as opposed to individual website such as blogs and mobile application (Table 3). This implies that they perceive public web site as a more official and reliable channel to use for crime reporting activities. For features that they prefer to have in a mobile application, majority says they would like to receive alert through their mobile phones (73.3%). This is not surprising as short messaging system has been widely used to send instant

notice to recipients. Additionally, for the 3 types of information that they would like to see, many of them prefer to see the time and date, the location as well as photos related to the crime incident (Table 4). Results from the survey are summarized in the following tables.

Table 1: Awareness on existing medium to report crime incidents.

Response	Frequency	Percent
Yes	11	37.3
No	19	63.3
Total	30	100

Table 2: Willingness to use mobile application to report crime incidents.

Response	Frequency	Percent
Yes	27	90
No	3	10
Total	30	100

Table 3: Preferred medium to report crime incidents.

Response	Frequency	Percent
Public websites	13	43.3
Private websites	7	23.3
Mobile application	10	33.3
Total	30	100

Table 4: Preferred details of crime incident.

Response	Frequency	Percent
Time & date	24	26.7
Location map	20	22.2
Type of crime	17	18.9
Pictures of the crime scene	20	22.2
Reporter details	3	3.3
Severity level	6	6.7
Total	90	100

The results from this survey were used as the basis in designing a mobile application for crime reporting. As we intend to study the potentials of using VGI for reporting crime information, it is crucial that we also consider good attributes of successful existing VGI applications when designing this application. Hence, we complement the results that we obtained from the survey with the analysis that we have previously performed on common features that exist in commonly cited VGI applications in literatures [8].

Application Prototype

We designed the prototype for our application based on the input we collected. As suggested by Nakatsu, having a login functionality is vital when designing an interface for crowdsourcing or VGI application [12]. Additionally, by having this functionality, the quality of VGI can be better controlled as the volunteers can be tracked through their logins. Besides, to encourage active participation by the volunteers, it is suggested that they are rewarded [13], thus, we decided to include login functionality in our design as shown in Fig. 1. As we crime related information is considered sensitive, it is important that we protect the reporter's personal information; this is why only nick name will be used to display the reporter's name. Other details are not required as we want as many volunteers as possible to use this application.

Figure 1 Register and login page.

Once logged in, users will be presented with the home view which shows the university map (refer to Fig. 2). Recently happened crime incidents are marked with appropriate color coding. Color coding is used to indicate the status of the incident whether it is new (less than a week old), recent (1 week to 2 weeks old) or old (between 2-4 weeks old). By having this feature, users can easily notice the place they should avoid visually. As we expected the information will accumulate over the time, old post on crime incident will be hidden automatically from the home view to reduce cluttered information. However, users can still view the old crime incident through the search functionality. We also use different icon for representing different crime categories. Once a new incident has been added, user will be prompted with an option to insert a photo related to the crime incident. The photo will be tied to the incident location. We allow users to insert more than 1 photo per incident.

The geometry used to mark the location of the crime incident is point-form, as we found out that point geometry is used tremendously in popular VGI applications such as *OpenStreetMap* and *Waze* [8]. This is also advocated by Nielsen in which he mentioned that in order to encourage participation, users should find the application "easy to contribute, without technical, logistic, legal or intellectual barriers" [13]. Due to the impact the crime information carries, it is important that any information entered to the mobile application is valid. However, as appears in any VGI applications, information that comes from volunteers is always questionable in terms of its validity. To tackle this issue, we introduce validate function, where other users can validate the supplied information through the mobile application. If the information appears to be invalid, as supported by many other users, the system administrator will change the state of the crime status to be invalid, thus removing it from the database.

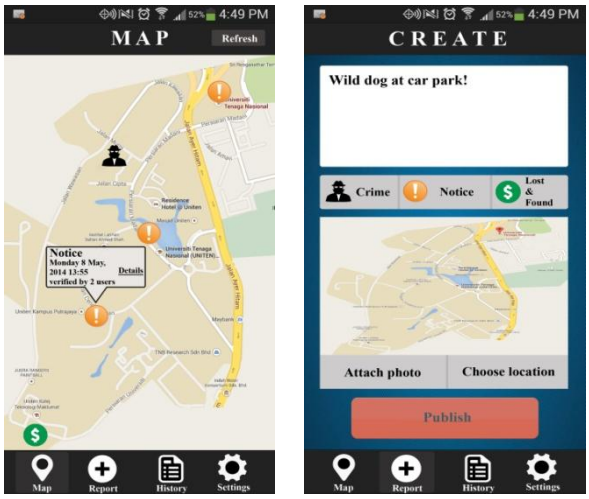

Figure 2 Home view and insert new incident.

As depicted in Fig. 2, the information that we require from user with regards to the crime incident is very minimum. We design as such so that user will not find it troublesome and time consuming to enter information, in line with the findings we obtained from our preliminary study which volunteers normally prefer simple and less complex application to use [12].

Future Works

GI entered through this mobile application will be used by us to further analyze the potentials of VGI in crime reporting for university use. VGI has been proven to be successful especially in the fields of in world mapping and navigation, thus triggering us to see whether the same can be applied in the field of crime prevention in university setting. Although the quality of VGI is still disputable, it is still seen as a promising source of geographic information, especially for non-profit organizations or bodies due to its low cost implementation. The result of this study will also be used to investigate the motivation that drives the volunteers to supply GI, in the context of crime prevention.

Conclusions

With the endless rapid revolution of mobile technologies, it is very promising to see that each mobile user will be an active volunteer for GI in the future. Despite its current disputable quality, one can still consider it as a very useful complementary method for data gathering rather than a total substitute. There are still many aspects that relate to VGI need to be explored especially in terms of its reliability and the applicability. More studies perhaps need to be conducted in the context of VGI, especially those involving communities participation, such as crime prevention.

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