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Research paper

Development of Location Based Service Utilization System to Prevent Repeat Sexual Crimes

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Abstract

Background/Objectives: Recently the number of victims of sexual offenses has increased from not only adults to but also to the elderly and children, greatly increasing the rate of repeat sexual offenses.

Methods/Statistical Analysis: The system of this thesis has been developed based on the electronic ankle monitor system of existing sexual offenders and utilizing the location based system (LBS) of the user to prevent repeat sexual offenses. The system was developed using the GPS API built in smartphones for the location based service and using a virtual electronic ankle monitor to receive the latitude and longitude coordinates of the GPS to calculate the distance and azimuth between the smartphone and the virtual electronic ankle monitor. It is a real-time service that sends an alarm to the user of the risk of sexual crime when the distance between the smartphone and the virtual electronic ankle monitors enters a prescribed distance.

Findings: The system developed in this paper compares the GPS values of the virtual electronic ankle monitor and the smartphone terminal. In order to confirm that the smartphone alarm went- off for risk of sexual crime when the distance between the two GPS values are within 1km, the virtual electronic ankle monitor was set to a latitude of 35.966927 and longitude of 126.954814 and the user's smartphone GPS was mobile and then experimented eight times. When the distance between the virtual electronic ankle monitor and the smartphone was measured within 1km for four times, the alarm for risk of sexual crime displayed "True". When the test was measured four times with the distance between the virtual electronic ankle monitor and the smartphone exceeding 1km, the alarm for risk of sexual crime displayed "False".

Improvement/Applications: The system proposed in this paper is expected to reduce the incidence of sexual crimes by using the values of the electronic ankle monitor GPS and the user's smartphone GPS.

Keywords: *GPS, smartphone, sex crimes, electronic ankle monitors, location based service*

1. Introduction

In recent years, with the rapid increase in sexual crimes in Korea, electronic ankle monitors have been introduced and widely applied to violent crime offenders. However they are assessed as inadequate and considered insufficient for preventing repeat sexual crimes due to illegal modifications and poor management of the electronic ankle monitors. Therefore the government produced and made accessible a mobile application that shows the domicile of sexual offenders. However this too stopped at presenting only the initial domicile and could not make marked advances in preventing sexual crimes or preventing repeat sexual crimes[1, 2].

With the existing sexual crime prevention application called "Sexual Offender Alarm e" in [Figure 1], the application user can search areas in a map or a designated range in which information on sexual offenders exist. Personal information on sexual offenders living in the searched area is provided to the user. However due to the limited information provided by the "Sexual Offender Alarm e", it has its limitations in actually preventing sexual crimes[3].

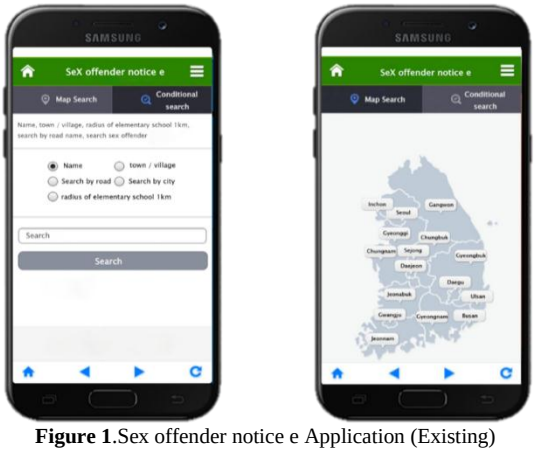


Figure 1.Sex offender notice e Application (Existing)

This paper, therefore aims to solve the above problem of not being able to prevent sexual crimes on a real-time basis by utilizing the GPS (Global Positioning System) of the electronic ankle monitoring system and the user's smartphone terminal.

This system has been developed as a mobile application to prevent sexual crimes. When the distance between the user's GPS value and the sexual offender's ankle monitoring system are within a

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prescribed range, the user's local location and a "push" is provided.

This paper is composed as follows. In chapter 2, the development of the system is discussed in context of the existing ankle monitoring system and the user's location based system (LBS). And the software development details of the system and its main technology are discussed. In chapter 3, the results of the research development based on the data provided in chapter 2 are presented. The conclusion and forward thoughts are provided in chapter 4.

2. Materials and Methods

With the increase in sexual crimes leading to limitations with existing sexual crime prevention applications, this paper presents the development of an application to overcome these by utilizing the GPS (global positioning system) of the existing electronic ankle monitors and location based service (LBS) to prevent sexual crimes.

2.1. Electronic Ankle Monitor

The electronic ankle monitor is a middleware system that monitors the real-time location of the person wearing the electronic ankle monitor using GPS (global positioning system) satellites and electronic devices. Electronic ankle monitor is a device used to prevent repeat sexual crimes, murder and other violent crimes by making the criminal wear it. The electronic ankle monitoring system consists of a wearing device, portable terminal (tracking device) and home supervision device and through these devices the location of the sexual offender can be monitored real-time. [2]

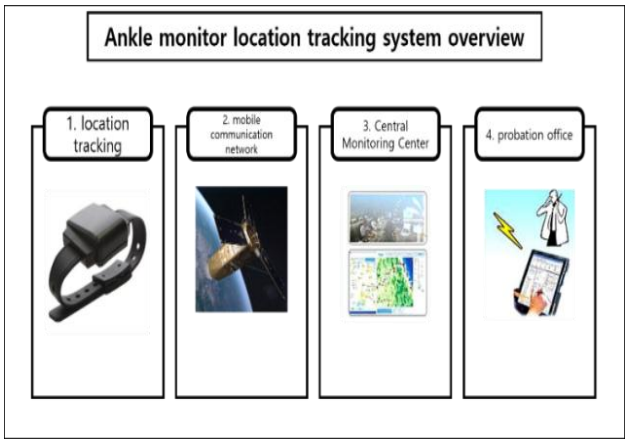


Figure 2:. Ankle monitor location tracking system overview

[Figure 2] presents an introduction of the electronic ankle monitoring system. The electronic ankle monitor is attached to the sexual offender's ankle and if the distance between the electronic ankle monitor and portable terminal is more than 1 meter apart or the electronic ankle monitor is illegally modified or forcibly severed, an alarm will go off. When the alarm goes off, there is a system to transmit the warning to the control center via mobile communication network, and a text message is transmitted to the probation office and officer [4].

2.2. Location Based Service (LBS)

Recently with the widespread use of smartphone terminals, the use of location based services (LBS) using global positioning system (GPS) is increasing. Location based service (LBS) is a service where the location based service server provides information based on the smartphone terminal user's real-time local location, providing various services such as nearby points of interest (POI), location tracking, navigation and map service[5].

2.3. Development of a System to Prevent Sexual Crimes Utilizing Location Based Service

The system to prevent sexual crimes utilizing location based service presented in this paper has been developed as an application for use on mobile terminals. As per [Figure 3], the user's real-time GPS value and the GPS value of the electronic ankle monitor wearer are calculated and transmitted to the server. It has been designed to provide an alarm to the user to inform the risk of sexual crime if the distance between the electronic ankle monitor and the user's smartphone GPS are within 1km[6, 7].

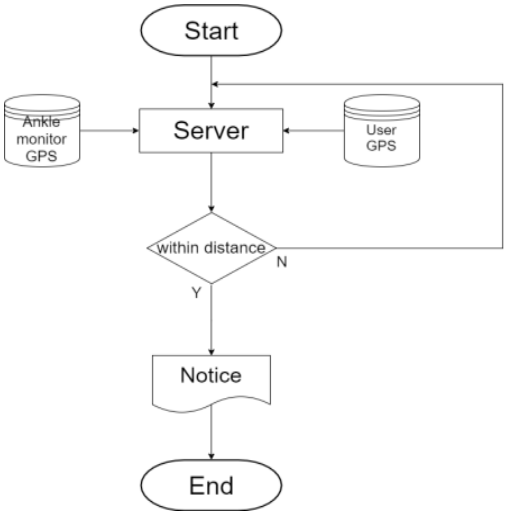


Figure 3: System Flowchart

2.3.1. Virtual Electronic Ankle Monitor

The system development proposed in this paper is an application that informs the user of the risk of sexual crime occurring when the distance between the smartphone terminal GPS and the sexual crime offender's electronic ankle monitor GPS are within a prescribed distance. In this paper, a virtual electronic ankle monitor was developed for use as the sexual offender's electronic ankle monitor. As per [Table 1], the virtual ankle monitor GPS coordinates were set to latitude of 35.966927 and longitude of 126.954814 and tested[7].

Table 1: Fixed location code source

```
//default location, Wonkwang University
LatLng DEFAULT_LOCATION = new LatLng(35.966927, 126.954814);
String markerTitle = "Unable to get location info";
String markerSnippet = "Check your location permissions and GPS activity details";
```

2.3.2. Measuring the Distance between the Virtual Electronic Ankle Monitor and Smartphone

The system development proposed in this paper utilizing location based system transmits the real-time GPS coordinates of the smartphone terminal to the server in order to provide the user with the risk of sexual crime occurring [5]. The distance between the virtual electronic monitor with GPS coordinates of latitude 35.966927 and longitude 126.954814 and the smartphone GPS was measured following [Step 1] [8].

$$D = \sqrt{(X_1 - X_2)^2 + (Y_1 - Y_2)^2}$$

Step 1: In the development of this paper, the Google Map API used to retrieve the user's smartphone GPS values uses the latitude, longitude/UTM coordinates (world geodetic system) of the WGS84 ellipsoid. Following the below formula the distance between the two coordinates are calculated. From the below formula, D is the distance, X_1 is the latitude of the virtual electronic ankle monitor, X_2 is the latitude of the user's

smartphone terminal, Y_1 is the longitude of the virtual electronic ankle monitor, and Y_2 is the longitude of the user's smartphone terminal[9].

3. Results and Discussion

The system development proposed in this paper compares the GPS values of the virtual electronic ankle monitor and the user's mobile terminal to lower the risk of sexual crime occurrence in real-time for the user. And when the distance between the virtual electronic ankle monitor and the user's smartphone terminal GPS coordinates are within 1km, an alarm to prevent sexual crime is sent to the user's smartphone terminal as [Figure 4] [10, 11].



Figure 4:. Development screen

The following [Table 3] shows the resulting data of alarms set-off when the distance between the user's smartphone GPS and the virtual electronic ankle monitor GPS values were within 1km. The distance between the virtual electronic ankle monitor and the user's smartphone was measured a total of 8 times. The distance between the virtual electronic ankle monitor and the user's smartphone was set to within 1km for four times, and the alarm (for risk of sexual crime) value returned "True" representing 100% accuracy. When the test was measured four times with the distance exceeding 1km, the alarm (for risk of sexual crime) value returned "False" representing 100% accuracy.

From the above, we could confirm that a pop-up alarm for risk of sexual crime was accurately provided to the user when the distance between the user's smartphone terminal GPS value and the virtual electronic ankle monitor GPS were within 1km.

4. Conclusion

The prevention of sexual crimes utilizing location based system proposed in this paper was developed to resolve the shortfalls of the existing "Sexual Crime Alarm e" application. The system proposed in this paper provides a real-time alarm to the user's smartphone to prevent sexual crimes when the user's smartphone terminal location is within 1km of a sexual offender's location. As per above, the system proposed in this paper will lower the risk of sexual crime occurrence in real-time. Additionally, if a repeat sexual crime were to occur, the user's smartphone location value and the culprit's electronic ankle monitor location value will be stored in the server real-time, shortening the time to arrest the culprit.

Table 3: Notification status results

User smart phone GPS (Latitude, longitude)	A virtual ankle monitor GPS (Latitude, longitude)	Distance (D)	Notification status (True/False)
35.962926, 126.954048	35.966927, 126.954814	**436m (D < 1km)**	**T**
35.953276, 126.941177	35.966927, 126.954814	**2000m (D > 1km)**	**F**
35.930177, 126.971754	35.966927, 126.954814	**4400m (D > 1km)**	**F**
35.964217, 126.958063	35.966927, 126.954814	**349m (D < 1km)**	**T**
35.960946, 126.954004	35.966927, 126.954814	**660.37m (D < 1km)**	**T**
35.961682, 126.967609	35.966927, 126.954814	**1030m (D > 1km)**	**F**
35.964752, 126.947913	35.966927, 126.954814	**664.04m (D < 1km)**	**T**
35.957336, 126.955879	35.966927, 126.954814	**1070m (D > 1km)**	**F**

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References

[1] Hong-bae Son, Hyo-joong Kim &Eui-tay Jung. (2010). A Study on a Smartphone Application for the Warning and Prevention of Crime using Extensible Mark-up Language. Journal of Integrated Design Research, 9(2), 63-74.

[2] Kwang-Myeong Kim, Dae-Han We & Seung-Jin Moon. (2013). Sex offenders to prevent recidivism proposed smart electronic ankle bracelet system. Proceedings of Symposium of the Korean Institute of communications and Information Sciences, 583-584.

[3] Eun-mi Kim, Jae-ah Kim, Yoon-ha Park & Jae-Young Yun. (2016). A Case Study on the Applications for Preventing Crimes against Women. KSDS Conference Proceeding, 50-51.

[4] Gil-Yong Lee & Soo-Hyun Park. (2012). The Smart Electronic Tagging System for Sexual Offenses Prevention Context-Aware Services in Extreme Situations such as Location Unrecognized. Journal of the Institute of Electronics and Information Engineers, 49(11), 118-131.

[5] Eun-Jee Song. (2012). A Case of the Mobile Application System Development using Location Based Service. Journal of Digital Contents Society, 13(1), 53-60.

[6] Min-Ji Chun, Myung-Sin Kim & Young-In Kim. (2014). Am Improved Sexual Offence Prevention Assistance System utilizing the Location Information in the Laster Related News and the User`s Location. Proceedings of KIIT Summer Conference, 464-468.

[7] Jin-Young Jung, Chang-Jun Lee, Chang-JueYeom, Kyung-Sook Han & Ki-Sok Kong. (2013). Design and Implementation of Sexual Assault Total Solution based on GPS Information. Proceedings of Symposium of the Korean Institute of communications and Information Sciences, 561-562.

[8] Yang, M., Cheng, C., & Chen, B. (2018). Mining Individual Similarity by Assessing Interactions with Personally Significant Places from GPS Trajectories. ISPRS International Journal Of Geo-Information, 7(3), 126. doi :10.3390/ijgi7030126

[9] Chang-Hee Park, Jin-Suk Kang & Jang-hyung Kim. (2006). A Study of Location Based Services Using Location Data Index Techniques. Journal of Korea Multimedia Society, 9(5), 595-605.

[10] Masutani, O., Iwasaki, H., Tei, K., Fukazawa, Y., & Honiden, S. (2007). Real-time POI detection and rating using floating car data. In 14th World Congress on Intelligent Transport Systems, ITS 2007, 2552-2559

[11] Ashbrook, D., & Starner, T. (2003). Using GPS to learn significant locations and predict movement across multiple users. Personal And Ubiquitous Computing, 7(5), 275-286. doi :10.1007/s00779-003-0240-0