Virtual-fencing for a Disaster Information using Android

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***Abstract*—** Now-a-days it is essential to provide risk information timely to users in order to reduce damage. In the system, it is assumed that each user has a smartphone with position detection and internet connection. Virtual-fencing is a specific area defined by co-ordinate and radius. By using virtual-fencing, it is possible to defeat entries and exists of people at specific area. The system is based on client-server architecture where server collects risk information from various sources and notifies to the client. The location of the user is traced by using Global Positioning System (GPS) and if the user is in risk zone then the server delivers warnings and advices to them. Along with this user can check the risk information of particular area and safety measures.

***Keywords*—** **Virtual-fencing, location-based service, android application, notification, GPS.**

I. INTRODUCTION

Disaster Management, defined as the organization and management of resources and responsibilities for dealing with all compassionate aspects of emergencies, in particular readiness, response and retrieval in order to minimize the effect of disasters. Many peoples suffers from big damage due to natural disasters every year. The cause of this is lack of correct information to the people who need it[1].

Disaster management aims to expect the disaster occurrence, and also to decrease the number of sufferer. When the disaster occur, people get confused and panic [1]. In this situation, people tend to do unstructured actions towards self-rescue. This condition is worst for tourists who are not familiar with that areas. However, the government seems not present in that moment [1].

Virtual-fencing technology is gathering attention as one of the most important technologies toward the next generation of location-based services [2]. When a user enters a virtual-fence, which is a virtual perimeter defining a geographic area, the event is detected and predefined actions are triggered automatically [2]. Virtual-fencing as defined is a virtual perimeter for a real-world geographic area that allows users to receive notifications whenever they enter or exit a specified area. Virtual-fencing is used in location-based advertisements and child location services, road safety and gaming and even more critical purposes such as geo-targeted alerts and warnings [8].

If a system can directly deliver such risk information to all people who need it, the damage may possibly reduce. This research aims at developing a system that detects people's movement, delivers risk information and gives the appropriate path for safe place to people. For this purpose, we examine the precision of detection of people's movement using virtual-fencing, which dynamically defines geographic area of interest. By using virtual-fencing, it is possible to detect entries and exits of people at the particular area. Thus our system can deliver what is happening at a particular area directly to the users [1].

The virtual-fencing process requires two steps: the “geo-definition of the targeted area” and “geo-delivery of the message to recipients within the targeted area [7]. According to the geo-definition the area may be a polygon or a radius around a specified point [1]. One of the common ways to deliver end-to-end geotargeted notifications’ system is through cellular phones which have the capability of location tracking using the Global Positioning System (GPS) or wireless access (Wi-Fi). However, receiving continuous, accurate, locations using cellular phones results in a tremendous energy cost that reduces the value of locations-based applications [7].

II. THE GOAL

Implemented system delivers risk information timely to specific users who are in the area where a disaster has occurred or may occur with high probability [1].

It is assume that each user has a smart phone with position detection and Internet connection capabilities. Because the users usually handle their smart phones, they can also acquire information smoothly when a disaster occurs. Moreover, it is possible to detect the user's current location and receive information on the disaster from the Internet [1]. They also give a specific path to user for exiting from a dangerous zone.

III. LITERATURE REVIEW

This part describes the base of knowledge which is used towards the research. In this part, disaster management, virtual-fencing theories, disaster mitigation and system configuration is discussed.

A. Disaster Mitigation

Disaster mitigation is defined as a set of activities to reduce the risk of disasters by building the physical disaster resistant building, socialization to increase the residents' awareness, and the enhancement of capability against disaster. According to Ministerial of Indonesia Regulation No. 33 2006 about disaster mitigation, there are four important points in disaster mitigation such as:[6]

- The availability and the map of disaster-prone areas
- The socialization towards the enhancement of knowledge and awareness of disasters
- The knowledge about things to do and prevent, and also how to be safe
- The management and governance of disaster-prone area to reduce the disasters

This research aims to generate the technology to facilitate the four points above. First, it enables the availability and the map of disaster-prone areas. Secondly, it will help the government to spread the information towards the enhancement of knowledge and awareness of disasters. Third, the technology also enables the users to get the knowledge about things to do, standardized emergency actions, things to prevent, safe points, and how to reach the safe points when the disaster occurs. Finally, even though this technology cannot directly reduce the disasters but, as it accommodates the knowledge and information, it may help in reducing the risk of loss[6].

B. Location Based Notification-Services

The concept of location-based notification is itself not new, and is often generically referred to as “virtual-fencing.” A search on the Web will turn up many companies offering this capability as a fleet-tracking service, typically employing GPS with vehiclemounted receivers. Cell-Loc provides location-based notification services known as Virtual--Fence and GeoLasso. Virtual-Fence is a virtual geographic boundary such as one surrounding a factory. Virtual-Fence events are generated whenever one of a specified list of devices are detected entering and/or exiting the area. GeoLasso is a one-time specification of an emergency notification area. Once an area has been defined, a list of cell phone users who are active in the area, or have recently been active, will be generated.

In , there was a mention of a system developed by TruePosition , which "will allow cellular telephone companies to locate their customers and warn them of possible dangers in the area." Cingular Wireless has signed on to test this service. In this system work exists in the larger context of location-aware computing, which itself is part of the field of context-aware computing. Space unfortunately does not permit discussion of in this work's relation to this body of work[5].

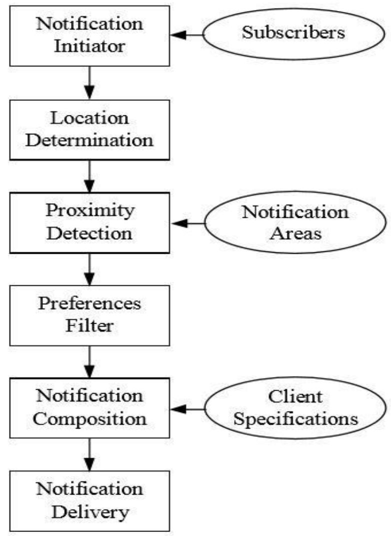

Figure 1. High-level model of location-based notification [5].

C.Virtual-Fencing Technique

Virtual-fencing is known as virtual fence on specified location. It is originally referred to a practice of limiting mobile users to a specific geographic location by tracking their whereabouts via GPS. It combines awareness of the user's current location with awareness of the user's proximity to location that may be of interest. Virtual-fencing can be used to test whether a presence inside the fence is true or not in order to trigger some sort of action. The fence around a physical location is known as virtual-fence. Figure 2 shows the visualization of virtual-fence technique simulated in Palembang, South Sumatra, Indonesia [1][6].

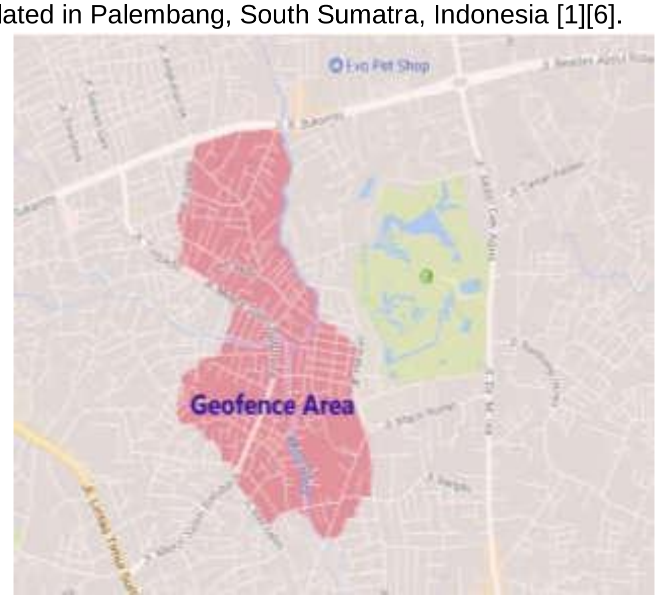

Fig 2 The virtualfence area in Palembang, South Sumatra, Indonesia [1].

IV. THE PROPOSED SYSTEM

A.What is virtual-fencing

Virtual-fencing is a location –based service in which an app or other software uses GPS, RFID, Wi-Fi or cellular data to trigger a pre-programmed action when a mobile device or RFID tag enters or exits a virtual boundary set up around a geographical location, known as a virtual-fence[8].

Depending on how a virtual-fence is configured it can prompt mobile push notifications, trigger text messages or alerts, send targeted advertisements on social media, allow tracking on vehicle fleets, disable certain technology or deliver location- based marketing data Some virtual-fences are set up to monitor activity in secure areas, allowing management to see alerts when anyone enters or leaves a specific area. Businesses can also use virtual-fencing to monitor employees in the field, automate time cards and keep track of company property[10].

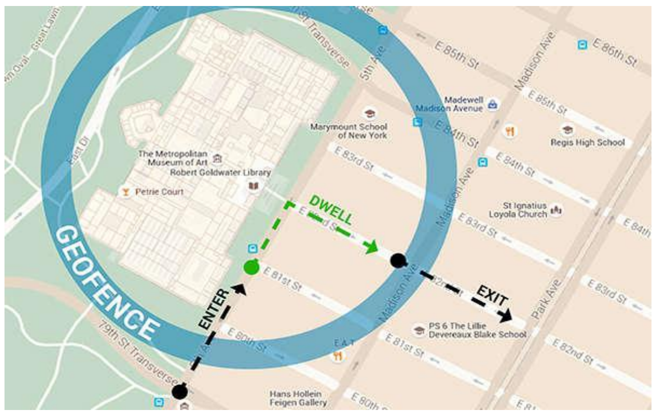

Fig 3 Virtual-fencing action example[1].

B. How virtual-fencing works

To make use of virtual-fencing, an administrator or developer must first establish a virtual boundary around a specified location in GPS or RFID enabled software. This can be as simple as a circle drawn 100 feet around a location on Google Maps, as specified using APIs when developing a mobile app. This virtual-fence will then trigger a response when an authorized device enters or exits that area, as specified by the administrator or developer[9].

A virtual-fence is most commonly defined within the code of a mobile application, especially since users need to opt-in to location services for the virtual-fence to work. If you go to a concert venue, they might have an app you can download that will deliver information about the event. Or, a retailer might draw a virtual-fence around its outlets to trigger mobile alerts for customers who have downloaded the retailer’s mobile app. In these cases, a virtual-fence that is managed by the retailer is programmed into the app, and users can opt to decline location access for the app[9].

A virtual-fence can also be set up by end-users using virtual-fencing capabilities in their mobile apps. These apps, such as iOS Reminders, allow you to choose an address or location where you want to trigger a specific alert or push notification. This is called an “if this, then that” command, where an app is programmed to trigger an action based off another action. For example, “If I’m five feet from my front door, turn on my lights.” Or you might ask a reminder app to send you an alert once you reach a specific location[9].

C. How to use virtual-fence

The system using virtual-fencing is possible to deliver the disaster information to the user who has just entered the fence. In this research, we implement virtual-fencing with the Core Location framework of Android. This framework provides a detection of the entries and exits of the user with the observation of a specific geographic region. The geographic region is an area defined by a circle with a specified radius around a known point on the earth. Every time the user crosses the boundary of the region, the system generates an event for our application. This enables the notification of the disaster information. That is, by using the observations of geographical area, it is possible to detect user behavior in the same manner as the definition of virtual-fencing[1].

Moreover, the system does not report the event until the user goes into the region further from the boundary plus a system-defined cushion distance. This cushion value prevents the system to generate numerous events while the user is traveling close to the boundary. The cushion distance is determined by the hardware and the location technologies that are currently available.

D. Types of Geo-notification

(1) Static geo-notification: This is based on the geographical position of a mobile user with respect to a fixed area. For Example, notification is send to particular mobile user when he entered into geo-fence, for example student enter int1o school campus.

(2) Dynamic geo-notification: This is based on the geographical position of a mobile user with respect to a changing data stream. For example, the “open parking space” notification that is sent to mobile users who happen to be driving nearby.

(3) Peer-to- Peer geo-notification: This is based on the geographical position of a mobile user with respect to other users. For example, go through notification of nearby friends on a social mobile app like Facebook, or Foursquare[4].

In this system, delivers risk information timely to specific users who are in the area where a disaster has occurred or may occur with high probability. It is assume that each user has a smart phone with position detection and Internet connection capabilities. Because the users usually handle their smart phones, they can also acquire information smoothly when a disaster occurs. Moreover, it is possible to detect the user’s current location and receive information of the disaster from the Internet[9].

V. SYSTEM CONFIGURATION

The system is composed of clients, a server and information sources. Fig. 2 shows the system structure.

Each client is an application program running on Android. It connects to the Internet and obtains the information from the

Server. Moreover, it defines a virtual-fence based on information from the server, and notifies disaster information to the user. The client is implemented by using PHP and tested by Android simulator [1].

The server is a web application running on Android. The data of android mobile sent to PHP server and fetch data from PHP server to android devices in the form of JSON. The server acquires disaster information from information sources. It analyzes the information and stores the result in a database. The database is used to define a fence by the client[3].

An information source is the RSS file of Weather Warnings and Advisories that Yahoo! JAPAN provides. The RSS file, provided in the RSS 2.0 format, contains “Special alert,” “Weather Warnings,” or “Advisories” across Japan. The RSS file is updated regularly according to the information announced by the Japan Meteorological Agency[1][3].

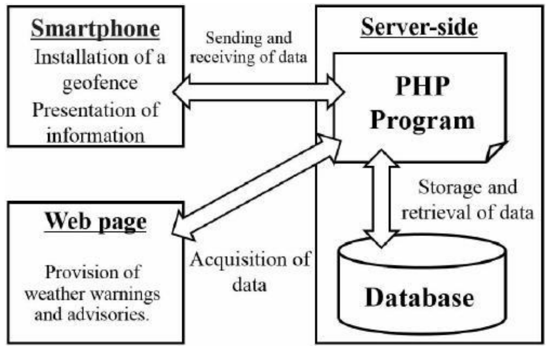

Fig 4 System structure[1]

VI. PROCESSING FLOW

As an example, suppose that the possibility of flood increased due to a heavy rain continued for long time. As the result, a flood warning has been issued to the area. Then, the server's PHP program acquires the warning by means of RSS files from the Internet. Then, it stores the disaster information in the database. On the other hand, a client periodically accesses the server to check new information. The server program retrieves the database based on the client's request and returns the result including location data to define a fence in a JSON format. In this research, it is assume that the specification of the fence is decided on the server-side. The client sets the fence by using the CLCircularRegion class. Then, the client starts monitoring of the entry and exit of the user to the fence by calling the startMonitoringForRegion method of the CLLocation Manager object. When the user enters the fence, the locationManager:didEnterRegion method is invoked. Then, the client warns the user that you have entered the dangerous area. When the user exits the fence, the location Manager: did Exit Region method is invoked. Then, the client notifies the user that you have exited the dangerous area. Fig. 5 shows a flowchart.

fig 5 Workflow of the system

When the warning is cancelled, the client finds no warning on the server. Then, it calls the stopRangingBeaconsInRegion method of the CLLocationManager object to stop monitoring of the entry and exit of the user to the fence. Fig. 6 shows the screen when operating in the foreground.

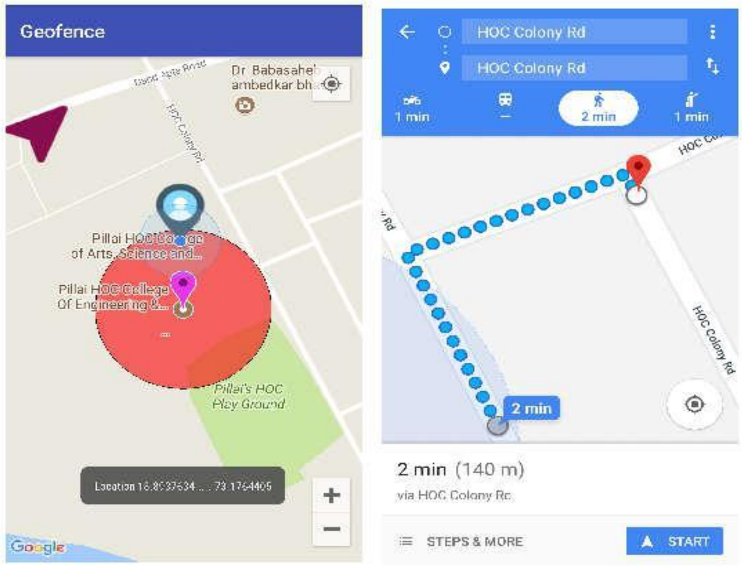

Fig 6 Sceenshot at foreground

VII. FUTURE SCOPE

Mobile app for iphone and windows OS can be develop. A fence of polygon shape can be created.

VIII. CONCLUSION

Information regarding disaster on the basis of person's movement is given by the implemented system. Implemented system based on virtual fencing concepts and results of the system are evaluated in an urban area. The system notifies disaster information to the user when user enters the fence provided that user must have android app and internet connection.

Implemented system is beneficial for user because it gives necessary information regarding disaster to the user. Also emergency contact number are given by the user and notification are send to those contact numbers in case of an emergency.

ACKNOWLEDGMENT

It is a privilege for us to have been associated with Prof. Babita Bhagat, our guide during this project work. We have been greatly benefited by their valuable suggestions and ideas. It is with great pleasure that we express our deep sense of gratitude to them for their valuable guidance, constant encouragement and patience throughout this work.

We express our gratitude to Dr. Chelpa Lingam (Principal), Dr. Ashok Kanthe (Head of Department) and all the faculties of Department of Computer Engineering for their constant encouragement, co-operation, and support. We are also thankful to lab assistants for providing the lab facilities. We take this opportunity to thank all our classmates for their company during the course work and for useful discussion. We had with them. We would be failing in our duties if we do not make a mention of our family members including our parents for providing moral support, without which this work would not have been completed.

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