Location Based Approach for Messaging Services

A.Elazab[1], B.Shababa[2] , H.Hefny[3]

[1,3]Institute of Statistical Studies and Research (ISSR), Cairo University, Egypt
[2]Misr Higher Institute for Engineering and Technology, Egypt
ashrafalazab71@yahoo.com

Abstract

Since the advent of 2G mobile phones are being used as a strong alternative to radio and television sets for giving public marketing messages, but not as expected strong in the field of the warnings of the risks and evictions, which Strongly require to deliver critical messages in right time and in the event's location. After the Asian tsunami and with the use of mobile GPS in positioning, a great interest paid to risk management field. However, there are still many economic, technical and legal barriers limiting the use of those contributions, especially in developing countries, that cannot afford to spend on these systems despite their dire need for them. This paper focuses on new approach to improve the process of delivering important messages and alerts automatically to mobile devices in a particular location related to an event when it occurs by integrating GPS technology with GIS tools, and GIS measuring distance algorithms. The proposed approach could help people receive alerts in a timely and in-location manner. It would be an alternative solution to existing messaging systems such as SMS, CBS and social media applications for use by Governments or a licensed civil society organization at the lowest possible cost. The success rate in the practical experience of the proposed approach was 97%.

Keywords: *Location based services, Mobile phone in risk reduction management, Real-time information, Wireless communication, Machine-to-Machine auto interaction.*

1. Introduction

Location-based Services (LBS) seems to be a crucial for life saving and for many other fields such as marketing, health caring, and anti-terrorism. LBS is the information, which obtained by mobile devices and uses information of the geographical location of the mobile device. [1] Recently, there are huge efforts have been made to deliver information to audience through their smart phones, especially in risk management, These efforts are being made in many areas such as in development of communication, GIS, and cloud technologies, which have wide-ranging of tools and applications in disaster preparation, reduction, mitigation, and management. Remote sensing in warning dissemination is also successfully have been used to minimize the impact of inform people about the risky areas near them with the vital information and instructions to follow. Cloud services, Social media, LBS mobile applications and traditional messaging system SMS and CBS are examples for methods used to deliver LBS. However, each of those technologies has its limitations that reduce the possibility of relying on risk time.

The methodology followed in this work through the using of the following:

1- GPS technology included in mobile phones is used to determine mobile location.
2- Sensors connected to remote server throw GSM.
3- GIS tools are used to determine where sensors are located and spatial information.
4- Spatial database is used to determine the nearest alternative routes (in the case of a problem).
5- Android applications that uses GIS Algorithms to measure the distance between two points on the Earth's surface (sensor location and mobile location), and calculate the radius of the circuit.
6- SQL databases to identify people who are located within the perimeter of the effective sensor to send the message to them.

Next sections of this paper organized as follows. Section 2 presents a brief explanation of LBS rolls in risk reduction management. Section 3 discusses previous works. Section 4 presents problem definition. Section 5 presents the proposed approach. Section 6 discusses other community benefits for implementing the proposed approach. Section 7 discusses the recommended actors or bodies that will be responsible for managing the proposed approach. Finally, Section 8 gives the conclusion and future work.

2. LBS rolls in risk reduction management

Location Based Messaging Services (LBMS) are essential in Risk Reduction Management (RRM), whether in natural disasters, or human made risks, and in many other areas that require informing numbers of people caught up in the scope of a particular area, to identify them in emergencies to help save their health and their life processes. Regardless the recipient's phone numbers or there segments (age, gender state, the address in the contract with service provider, and if they use a post-paid or pre-paid line).

According to counter point magazine, 47% of smart phone users spend approximately from 5 to more than 7 hours per day looking in their phones, 64% of them are searching for information using internet, [2] in other hand Microsoft reported in December 2011 that 52% of smartphone users used LBS, and 94% of them thought it was valuable. [3] Those indicators point to a growth in the chance of using smart phones in rescue operations and reduce risks management (RRM). RRM has many phases, in the pre-hazard phase, early warning infrastructure is the most essential process, and it is very important in all of the other next phases. where the using of developed technologies, like Auto sending alert messages to the people who are at the same area of hazards through mobile sets (mobile phones, tablets), could be deployed in responding effectively to emerging hazard, reducing the impact of risk in terms of reduced mortality, injuries and loss of life and property. [4]

3. Previous Works

Cloud services are used strongly in messaging systems, Google cloud (Firebase Cloud Messaging service FCM) is an example, which allows the application's owner to send updating messages to all of his application users [5], but this technique is not a LBS itself, because the cloud server sends the message to all application users. On other hand, Some SQL statements are also not supported in Google cloud [6, 7], so you will need another

server to determine the location of your customers that you want to send to them through Google Cloud server, this will increase the message cost and the transmission will be slow.

Social media could be considered as LBS, by creating a location based group page (e.g. college students or residents of a particular city). Especially after the new (safe check) in Facebook, which helps the user if there is a risk in the last place he lived, tells his friends that he is safe [8]. In general, Social Media is plagued by a lack of credibility largely where fraudulent and information is disseminated without accuracy [9].

In addition, mobile applications can be used to provide information about certain places such as traffic congestion monitoring applications. However, they depend on what subscribers write about the reasons for congestion and not on real reasons through sensor system.

Modern passengers transport applications such as "Uber and Ola" can be used as LBS applications, to provide helps in risky stations, especially after the addition of the "SOS" button for users in India, so that the passenger can send a message of risk to the company if she/he is located somewhere and endanger. But those applications not used to warn the passengers if she/he is coming to a dangerous area- for example-, or to tell her/him that the place in which she/he is now dangerous, as well as privacy violations and customer accounts- as ibtimes report 2017- [10].

Traditional ways to send information to mobile such as Short messaging services (SMS), and Cell broadcast services (CBS) are strongly used in countries suffering from natural disasters or political unrest, however, as well as the high cost of these technologies, SMS requires prior knowledge of the message recipient's phone numbers. (Which usually cannot be available in crisis place), in risk situations large amount of SMSs pushed at the same time of voice calls which may lead to network overloading. On other side, CBS is LBS technology that used to deliver critical information to audiences, it could be sent to all devices, which are connected to one tower or all network towers in the country. However, few countries use it, because CBS sent by service provider only. In addition there is no obligation for service providers to provide citizens with warning messages, it is voluntary, or may be done through the contributions of civil society organizations in countries where risk is frequent. Since this technology is not used in commercial purposes. Unlike the SMS, CBS service providers cannot determine the number of people that delivered message, or their phone numbers, where it is sending as a broadcast [11, 12, 13, 14].

There are many cases that governments used LBS tools in RRM to identify their citizen with the current situation, for example:

- SMS for allay SARS fears –April 2003.
- SMS for Relief fears after a massive power failure in Italy -September 2003.
- CBS and SMS in Tsunami disaster in Sri-lanka - 2004.
- CBS and SMS in Early warning missile alert system in Israel-2017.
- SMS Lightning risk alert system in Singapore -2007.
- SMS for impend disasters in New Zealand- 2007. [15]

4. Problem Definition

Countries with either natural disasters or political turmoil find themselves forced to spend on risk management infrastructure such as the SMS or CBS, despite their high cost, but in developing countries that do not use any of these means. There is a desire to alert people, specially, after the outbreak of terrorist attacks, beside SMS, CBS and other ways have their defects, which reduces dependence on the time of danger.

So that, this paper involves a new approach that attempt to be an auto sending messages system , in the time of occurrence of event , with picture attached- as a machine to machine, to people who are in /or near the area of the event location to avoid the old technologies disadvantages.

5. Proposed Approach

Wherever the new system Location-Based System for Messaging Services (LBSMS) could be classified as a location based, handset based and as GPS based system.

System components and their implantation technologies are illustrated in Table 1.

Table 1. System Components

Component	Implementation Technology
Sensors	Physical Sensors
Mobile application	Android
Back-end Server	Cloud server
Admin/Client Web App	MS VB. NET
Database	MS SQL Server

The new approach uses sensors such as smoke detector or any other alerting physical sensors which connecting with the cloud server when the accident accurse.

The new system architecture for this application comprises two main components: the mobile application (Android in this case study) for sending mobile handset coordinates (Latitude, Longitude) to SQL database created on public server, and to receive the notification from the public server if the mobile coordinate's is located in the affected sensor region. The latter component is an admin/client Web Interface(ASP.NET) which has 4 features, presented through Graphical User Interfaces (GUIs) that cover almost all the functional requirements for both ends, the contents provider (system admin), and client module.

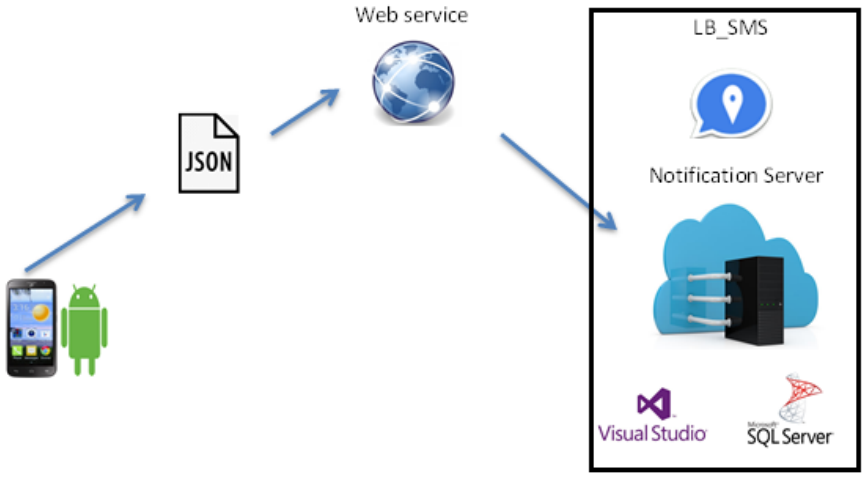


Figure 1. LB_SMS system Components

The process of using the LBSMS android application and the Web Interface (admin/client) is described briefly in the following scenario (considering using the system in field of RRM and evictions):

Fig. 2 illustrates the admin home page with the four feathers “Sensor button” to create new sensor data, “Notification” to create a new notification, “Track phone” to show specific mobile number last location stored in the server database, “Active Sensor” to show the current active sensor and its spatial attributes.

The published web application can be accessed through Mobile phone, PC, laptop, tablet or any device with internet access.

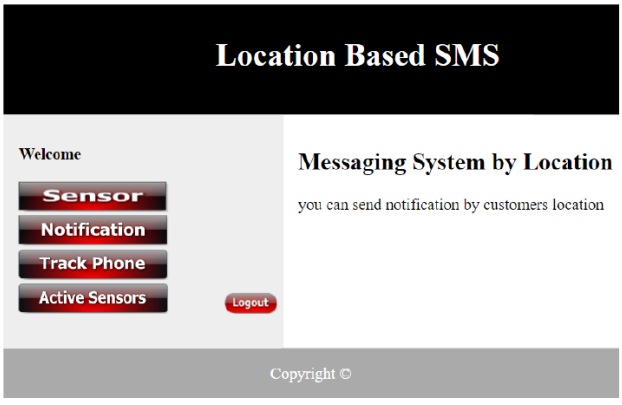


Figure 2. Admin web application

5.1 Creating a new Sensor

- System admin can install a physical sensor(s), which can connect with the remote server in case of active statue.

Figure 3. GSM Smoke detector sensor

- System admin can use Google-Maps (or any other solution) to know the current sensor coordinates.
- He/she can use the admin web application GUI to insert the new sensor data (latitude, longitude, sensor full address, alternative other best path) into remote server.

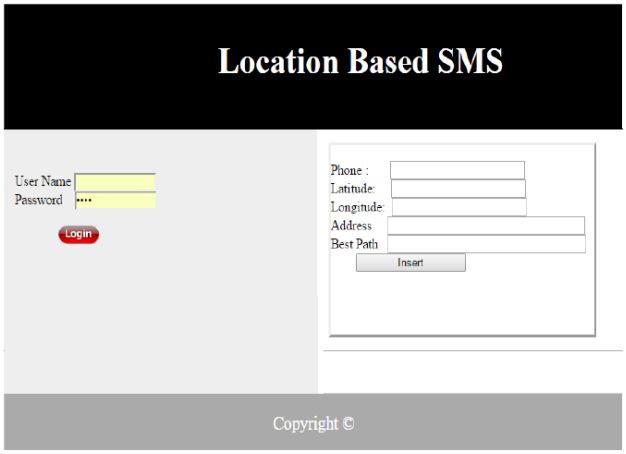


Figure 4. adding new sensor data to remote server

5.1 Creating a new Notification

- System admin can use the Notification page in the admin web interface GUI to insert a specific notification or alert to a specific sensor (he/she can choose sensor and write the notification text related to this sensor to be sent in its active statue).
- He/she can also add a picture (snapshot) public URL to be sent with the notification text (it could be an advertising picture in the field of Marketing or may be a statue or museum image (in the field of tourism) or may be any security-related photo (in the field of counter-terrorism) . . . etc.

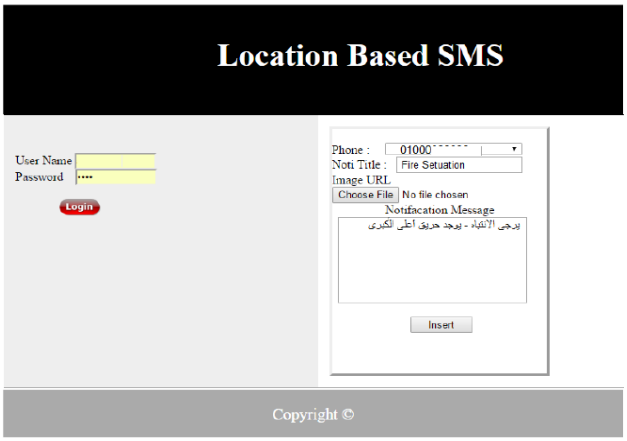


Figure 5. adding new notification to specific sensor

5.2 LB_SMS Android application

LB_SMS application enables the mobile handset to send its coordinates to SQL database which on public Server, the data will be updated by the application every period of time or in changing of mobile location (for example we can determine the time as every two or five minutes, and the distance in every 100 Meter from the current location).

Figure 6. LBSMS application sending geo-spatial data to remote server

5.3 Notification delivery

When any accident will accrues (fire or any other sensed accident), the installed sensor will be in active statue, and establishes connection to remote server, which will deploy SQL queries to determine people who locate inside a circle around this active sensor , using GIS distance function between two pointes on the earth surface. Then SQL query will fire a pre-created notification, the android application LB_SMS will receive the notification and the image (if it is attached) as shown in the follow Fig 7.

Figure 7. LBSMS application received a notification text with an image

Part of the code used in implementing this function is given as follows:

-Android code for updating mobile location and mobile data to remote server

```
Package com.example.ash.LBSMS;
import android.graphics.Bitmap;
import org.ksoap2.SoapEnvelope;
import java.net.URL;
import java.util.StringTokenizer;
public class MainActivityextendsActionBarActivity {

private static final long MINIMUM_DISTANCE_CHANGE_FOR_UPDATES = 100; // in meters
private static final long MINIMUM_TIME_BETWEEN_UPDATES = 50000; // in millisecond
```

Figure 8. The code that determine when the LB_SMS will update and send its geo-spatial data to remote server

```
public void sendlocation() {
try {
SoapObject Request = new SoapObject(NAMESPACE, METHOD_NAME);

Request.addProperty("Log",getCel);
Request.addProperty("Lat", getCel2);
Request.addProperty("MC", phNumber);
Request.addProperty("Line1", liNumber);

SoapSerializationEnvelopesoapEnvelope = new
SoapSerializationEnvelope(SoapEnvelope.VER11);
soapEnvelope.dotNet = true;
soapEnvelope.setOutputSoapObject(Request);
HttpTransportSE transport = new HttpTransportSE(url);
transport.call(SOAP_ACTION, soapEnvelope);
} catch (Exception ex) {}}
```

Figure 9. The code for sending mobile geo-spatial data to remote server

- **C# code for determine the radius of the circle around active sensor by 500 Meters**

```
latA = double.Parse(slat);
longA = double.Parse(slong);
intbt;
cmd = newSqlCommand("select * from AndroidTrack where DateRegister='" + DateTime.Now.ToString("yyyy-MM-dd") + "'", openCon1);
                    openCon1.Open();
                    reader = cmd.ExecuteReader();

while (reader.Read())
                      {
longB = double.Parse(reader["AndroidLog"].ToString());
latB = double.Parse(reader["AndroidLat"].ToString());
                mc = reader["MC"].ToString();
varlocA = newGeoCoordinate(latA, longA);
varlocB = newGeoCoordinate(latB, longB);
double distance = locA.GetDistanceTo(locB); // metres
bt = Convert.ToInt32(distance);
if (bt<= 500) {cmd = newSqlCommand("if not exists(select * from ActiveUser where MC = " + mc + ") " +"INSERT INTO ActiveUser
(MC,Sensor_ID,Act_date,Act_flag) VALUES (" + mc + ",'" + simcard + "','" + DateTime.Now.ToString("yyyy-MM-dd") + "',0)" +
"else if not exists(select * from ActiveUser where MC = " + mc + " and Sensor_ID='" + simcard + "') " +                    "update ActiveUser
set Act_date='" + DateTime.Now.ToString("yyyy-MM-dd") + "',Sensor_ID='" + simcard + "',Act_flag=0 where MC=" + mc + " " + "else if
not exists(select * from ActiveUser where MC = " + mc + " and Sensor_ID='" + simcard + "' and Act_date='" +
DateTime.Now.ToString("yyyy-MM-dd") + "') " +
"update ActiveUser set Act_date='" + DateTime.Now.ToString("yyyy-MM-dd") + "',Sensor_ID='" + simcard + "' ,Act_flag=0 where MC="
+ mc + "', openCon);
openCon.Open();
cmd.ExecuteNonQuery();
openCon.Close();
  }
else{
}
```

Figure 10. the C# code for determine the radios of the circle around active sensor by 500 Meters

- GIS algorithm used by the system to calculate the distance between the two locations (A,B) as follows :
  - (locA) is the location coordinates for the first location (sensor location) [which the approach can use it as the center point of the circle

locA = (latA, longA)

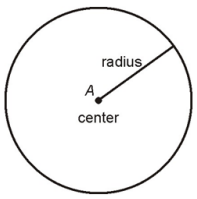
  - (locB) is the location coordinates for the mobile holder location

locB = (latB, longB)

- (distance) is the calculated distance between the two points (locations)

distance = locA.GetDistanceTo(locB)

(Android system use this function to calculate the distance)



LB_SMS System can be used in the other fields, such as in marking, tourisms, education campus, firms, and health, security and counter-terrorism fields. In those cases, the notification (and the attached image) will be sent to the mobile holders without using physical sensors. System admin can create a virtual sensor to the targeted location and store its geo-spatial attributes in the remote server as a virtual sensor, once the mobile holder inters the pre-limited geofence [16] the notification will deliver to the android application LB_SMS on his mobile.

5.4 Track phone feature

System Admin can also track any last stored location for mobile, by its SIM number or its Mac address, with Google map button to show this location on the map. This feature could be useful to find lost phones, and very important for parents to track their kid's location and this feature is very important in security and crime control cases.

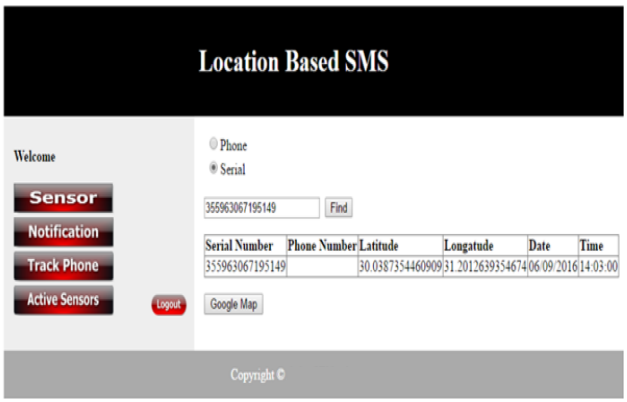


Figure 11. Track Specific mobile phone and its data on the remote server

5.5 Client module to show Active Sensor (s)

Finally, client application could be installed in fire station, police station or ambulances station. Client users can also show the current active sensors right now and its data (e.g. address and the other best path to reach it), but client users cannot see the other three features (adding new sensor, adding new notification or tracking user phone location), which can be used by a government agency or a licensed security organization only. Fig. 12 shows the active sensor(s).

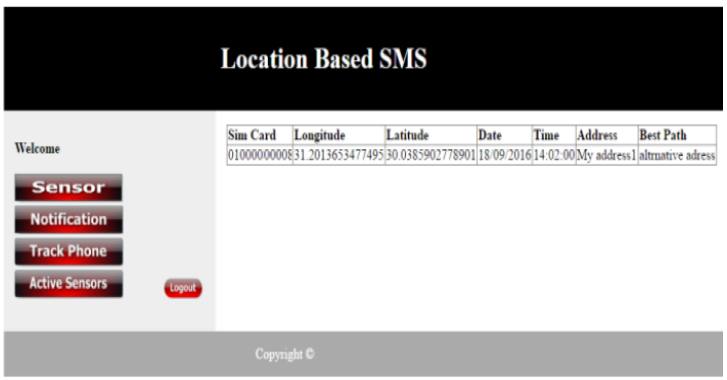


Figure 12. Active Sensor page

5.6 Results of the trial

Total observations: 351
Successful times: 341 (97%) from total observations
Failed times: 10 (3%) from total observations

Table 2. Results of the trial

No. of trails	Application cubature user location by GPS	User Location updated on the remote server	Results	Notes
324	Success	Success	Success	Text message delivered with attached Picture
12	Success	Success	Success	Text message delivered with delaying in attached Picture delivery
5	Success	Success	Success	Text message delivered without attached Picture (URL Error)
3	Success	Failed	Failed	internet off/or not responding
7	Failed	Failed	Failed	GPS off / or not responding

5.7 Evaluation of the new approach

Table 3. Comparison between proposed approach and traditional approaches such SMS and CBS systems

Characteristic	(SMS)	(CBS)	Proposed Approach
Handset compatibility	√	√	√
Unicast and Multicast communication	√	X	√
Broadcast service	X	√	√
Mobile number independency	X	√	√
Location dependency	X	√	√
Geo-information	X	√	√
Service barring	X	√	√
Context messages	X (Static messages)	√	√
Long Message length	X (140-160 characters)	√	√
Massage Storage	√	X	√
Two ways communication	√	X	X
No Congestion and delay occurred	X	√	√
No Delivery failure	X	X	√ (Except if no internet or GPS coverage area)
Delivery confirmation	√	X	√
Repetition rate	X	√	√ (one time for each mobile mac address per day)
Massage Language Multiplication	X	√	√
No Spamming	X	√	√
Good security	X	√	√

6. Community Benefits for the Implementation of this Approach

In case of not using physical sensors:

In the field of health and preserve the lives of the population, it may be useful to use mobile alerts by those in the neighbourhood that there is a certain vaccinate for them or for their children at a nearby health centres, Public service messages concerning the location and availability of health care services (flu shots, Polio vaccination . . . etc.).

In the field of pilgrimage and tourism, the LB_SMS Notification system can be used to guide pilgrims or tourists to their places and to push instructions and tips for them, as well as to send tourist information about the shrines and the areas around them, Tourists can receive the vital tourism messages.

In the field of Marketing, SMS has succeeded in increasing sales by more than 300% when used during the completion of the buyer to purchase in a store or internet site, by sending information about the product or service that he/she wants to buy. The on-spot SMS will help customer to take his/her decision, if it provided used intelligently and without the customer's inconvenience and delivered to him/her in the right time and right location. [17]

In the field of terrorist threats and Crime prevention: proposed system allows you to receive lifesaving alerts and recommended recovery actions, proactively engage the community in Crime Prevention through real-time notifications/alerts (prior to or during an outbreak, criminal activity alerts).

In the field of Children tracking, by their parents through the location of their mobile device, it will be useful in children missing or in women's and girl's violation cases.

7. Implementation recommendations

For security, confidentiality and legal issues next are the recommended actors or bodies who will have the responsibility and authority for administrating and managing the system, and the recommended targeted organization or places for implementing LB_SMS.

7.1 Recommended actors or bodies

As for security and for authenticity

- State and Local Government Agencies
- Emergency Operation Centres
- Military
- Wireless Carriers (communication providers)
- Marketing Companies
- Educational Campuses
- Corporate campuses

7.2 Targeted places

- Airports
- Schools, universities
- Public transport centres
- Hotels
- Police and defines complexes
- Government buildings

- Factories
- Conference and exhibition centres
- Shopping Malls
- Main Streets & bridges
- Car park facilities
- Sports centres
- Restaurants
- Homes
- Offices

8. Conclusion

This paper describes a new approach that involves designing and developing a mobile solution for auto sending location based messages by using physical sensors which are connect to remote server, this server collects the user's location updates from the android software , and gets the message from the server if the mobile holder located in active sensor region. The targeted area will be determined by The GIS algorithm for calculating the distance between two points (the active sensor and the mobile locations). Modern and traditional technologies for content delivery are investigated, and some of its weak points have been clarified, the most important is the high cost and no obligation for service providers to provide citizens with it in risks. Proposed approach is developed to be used in Risk Reduction Management filed or other fields including advertisements, in addition, it can be written in any language, in addition, it can be also with attached Image.

Future works include experiments with other mobile operating systems, other sensors, and positioning technologies, Studying different GIS algorithms, and more other methods of connecting to remote servers.

References

[1]. Amit Kushwaha and Vineet Kushwaha, "Location Based Services using Android Mobile Operating System," *International Journal of Advances in Engineering & Technology*, no. 2231-1963, Mar 2011.

[2]. Tina Lu. (2017, OCTOBER) counterpointresearch. [Online]. https://www.counterpointresearch.com/almost-half-of-smartphone-users-spend-more-than-5-hours-a-day-on-their-mobile-device/

[3]. Microsoft. (2011, Jan) microsoft.com. [Online]. https://news.microsoft.com/location_and_privacy_where_are_we_headed__web/

[4]. Dr. Satyabrata Sahu , *Guidebook On Technologies For Disaster Preparedness And Mitigation*. New Delhi, INDIA: Asian and Pacific Centre for Transfer of Technology (APCTT), 2010.

[5]. Google. (2017, November) firebase.google.com. [Online]. https://firebase.google.com/docs/cloud-messaging/

[6]. Google. (2017, November) cloud.google.com. [Online]. https://cloud.google.com/sql/docs/mysql/diagnose-issues

[7]. Rahul Jain. (2015, Feb) quora.com. [Online]. https://www.quora.com/How-Google-cloud-sql-is-different-from-mysql

[8]. Facebook. (2017, Aug) Facbook.com. [Online]. https://www.facebook.com/about/crisisresponse/

[9]. Martina Drahošová and Peter Balco, "The analysis of advantages and disadvantages of use of social media in European Union," *Elsevier*, 2017.

[10]. William Watkinson. (2017, November) Uber concealed cyber attack that exposed data of 57 million users and 600,000 drivers. [Online]. http://www.ibtimes.co.uk/uber-concealed-cyber-attack-that-exposed-data-57-million-users-600000-drivers-1648330

[11]. A. Aloudat , Katina Michael , and Jun Yan , *Location-Based Services in Emergency Management- from Government to Citizens_ Global Case Studies*. Melbourne: Australian Homeland Security Research Centr, 2007.

[12]. Francois Debrix and Mark J. Lacy, *The Geopolitics of American Insecurity-Terror,power and foreign policy*. London And New York: Routledge Taylor & Francis Group, 2009.

[13]. one2many, *Cell Broadcast Emergency Alerts*.: one2many, 2012.

[14]. Maneesh Prasad and Sonal Bahuguna, *Location Based Services- An overview of prospects and applications*. New Delhi, INDIA: FICCI, Federation House, Tansen Marg, 2013, p. 4.

[15]. Anas Aloudat and Katina Michael , *The application of location based services in national emergency warning systems: SMS, cell broadcast services and beyond*. Melbourne: Australian Homeland Security Research Centr, 2011.

[16]. Wiktionary Web Site , "Geofence," no. Definition from Wiktionary @ "https://en.wiktionary.org/wiki/geofence", 2016.

[17]. Rip Gerber, "6 secrets of successful geofence campaigns," *Mobile Marketer*, no. Mobile Marketer "http://www.mobilemarketer.com/cms/opinion/columns/14036.html", 2016.