AENSI Journals

Australian Journal of Basic and Applied Sciences

Journal home page: www.ajbasweb.com

GPS and SMS-based Child Tracking System using Smart Phone

M.F.A. Abdullah, H.K. Bashier, S. Sayeed, I. Yusof, A.M.T. Al Mazloum, E. Omer

[1]*Faculty of Information Science and Technology, Multimedia University, Jalan Ayer Keroh Lama, 75450 Melaka, Malaysia*

ARTICLE INFO

Article history:
Received 10 October 2013
Received in revised form 21 November 2013
Accepted 22 November 2013
Available online 20 December 2013

Keywords:
Child Tracking System, Global Positioning System (GPS), SMS-based Mobile Application, Smart phones, Android-based

ABSTRACT

Background: Recently, many cases of missing children between ages 14 and 17 years are reported. Parents always worry about the possibility of kidnapping of their children. Moreover, most mobile phones are equipped with location services capabilities allowing us to get the device's geographic position in real time. **Objective:** This paper proposes an Android based solution to aid parents to track their children in real time. The proposed solution takes the advantage of the location services provided by mobile phone since most of kids carry mobile phones. The mobile application use the GPS and SMS services found in Android mobile phones. **Results:** The system allows the parent to get their child's location on a real time map. The system consists of two sides, child side and parent side. A parent's device main duty is to send a request location SMS to the child's device to get the location of the child. On the other hand, the child's device main responsibility is to reply the GPS position to the parent's device upon request. **Conclusion:** The work was developed to aid locating missing or lost children. The solution proposed in this paper takes advantage of the rich features offered in Androids smart phones.

To Cite This Article: M.F.A. Abdullah, H.K. Bashier, S. Sayeed, I. Yusof, A.M.T. Al Mazloum, E. Omer., GPS and SMS-based Child Tracking System using Smart Phone. ***Aust. J. Basic & Appl. Sci.,*** *x(x): 133-138, 2013*

INTRODUCTION

In today's world, over 80% of the world population, including children around the age of eight or seven, owns smart phones (Anson, 2012). One of the reasons is the remarkable features and capabilities that new smart phones offer especially Android based smart phones. With that many features, the need for resourceful applications rises. In our opinion, GPS offers outstanding capabilities in locating position and this can be used to develop resourceful application that helps in locating missing or lost children.

Studies conducted by Cyber Travel Tips (Cavell Group, 2007) showed that in Malaysia, missing children are basically classified into two categories. The first category is disappearance, which includes running away from home. The other category is abduction or kidnapping. Statistics reveal that since 2004, a total of 5,996 children under the age of 18 went missing from their homes. Fortunately, around 4092 children returned home or found by the police. However, the other 1,904 children are still missing. Those children are boys and girls with ages between 14 years and 17 years. Moreover, when parents want to go family trip, they always concern about their children's safety. This worrying may affects negatively on the parent to enjoy their family trip. Even worst, parents can lose sight of their children and fear the possibly of kidnaping or worst for them.

Consequently, this project is designed to be used by parents and aimed to help locating missing or lost children. It takes advantage of the fact that many of today's children bring smartphones which is convenient for this kind of situation. In this work, GPS is combined with one of the basic service of a smart phone which is GSM, more specifically SMS, in one system. An application at the parent side will allow parents to send a location request to a child side then retrieve the location from the request reply and shows it on a map. On the other hand, the application at the child's side gathers the necessary information of the smart phone that will be used to locate the smart phone. Information such as GPS coordinates and time are gathered and sent to the parent smart phone that's pre-registered on the application. The communication between the parent and the child applications is done using Short Message Service (SMS). SMS offers the system unique features. It will allow the system to work without the need of internet connection thus allows the application to be implemented on smart phones that don't support GPRS, 2G or 3G internet connectivity. The system sends the location of child's smart phone to parent's smart phone when the parent wishes to check on the child.

This paper is organized as follows. Section I is an introduction of the work. Section II reviews the related work focusing on location-based services and GSM. Section III describes in details the system development

Corresponding Author: Mohd Fikri Azli bin Abdullah, Faculty of Information Science and Technology, Multimedia University, Jalan Ayer Keroh Lama, 75450 Melaka, Malaysia.
E-mail: mfikriazli.abdullah@mmu.edu.my

including its requirements, architecture and how the system works. Section IV is the conclusion and future work.

Related Works:

In Al-Suwaidi and Zemerl (2009), the problem was solved by proposing an application "Locating Friends and Family Using Mobile Phones with Global Positioning System (GPS)". The architecture of the system is based on client-server approach. The client phone registers and login into the server. Then, the client periodically sends his coordinate location updates to the server which stores it in a database. Thus, any client wishes to learn the location of another client will have to register and login to the server to request the location. This application was developed to helps locate family member and friends. The mobile application was implemented using J2ME. As for the server, it uses MySQL Database along with PHP to guarantees that the server would not be overloaded. This proposed solution makes each client has same control and command privileges as the other which is not convenient for use in child tracking application where only the parent should have the control and command privileges. A limitation of this solution is that in order for the system to work there must be internet connectivity in both client and server sides.

In the paper by Almomani *et al*. (2011), a "Ubiquitous GPS Vehicle Tracking and Management System" is proposed. This system architecture designed in a way so that it offers maximum accessibility for the user anytime and anywhere by providing two types of end user applications, a web application and a mobile application. The architecture of the system is based on client-server. In the server side, it contains a GPRS, a web and an SMS server along with database to store user details and data. As for the client, it is a box that contains a GPS tracker and a GSM modem. When users request location from the web or mobile application after registering and logging into the web server, an SMS request will be sent to the GSM modem in client device. Then the client device responds using GPRS which will be received by the GPRS server and forwarded back to the SMS server. Finally the SMS server forwards the response to the web server. This project was designed for fleet operators in monitoring driving behavior of employees or parents monitoring their teen drivers.

Chandra *et al*. (2011) used a simple web server approach along with SMS to solve the problem. It was implemented for JAVA enabled mobile devices equipped with GPS receptor. A client can either send his location to other clients directly by SMS or share it by sending it to the web server's database via internet. Clients can view the locations on the Google maps. The aim of this application is to enables the user to share his location with their friends or even who uses the same solution.

Anderson *et al*. (2009) proposed solution for" transportation information system" using only GPS and SMS. On the client side, a device (a box) containing a GSM modem and a GPS unit. On the back end side, a database server stores the details and locations connected to a basic GSM phone for SMS capability. When a user wants to request a location of a client, it sends an SMS request to the server's GSM phone, the server then replay with the latest location acquired from the client to the user issued the request. A unique feature of the solution is that it does not require internet connectivity on both sides for it to work.

As it can be established from the literature review conducted, there are many exiting solutions for locating missing or lost children. Some of the above discussed solutions require internet connectivity on both sides of client and server which is not convenient for some cases where there is no internet connectivity at any of the child or parent sides. Additionally, the relationship between the child and parents devices should be controlled by parent side. A child should not be able to delete or modify his details without parent's permission. Hence accordingly, we have assembled suggestions of approaches to solve child locating problem which led to propose a solution designed for any smart phone that supports Location Based Services including GPS. Unlike most of the systems discussed, the main feature of the proposed application is to get the child location without the child's interaction in the process and with simple and cost effective's methods. This is done through the use of GPS and SMS only.

Application Development:

A. Requirements:

This work is designed for parents and children. Both must have a smart phone that supports GPS and SMS as a minimum. SMS is a basic service on any smart phones but GPS can be found on new smart phones. The application is mostly to be used by parents to track down the child's location. In a later phase for implementation purposes, the system will be developed using Android SDK tools and Eclipse supporting Android. The main reason why the Android OS was chosen for the implementation of this work is to target more users. Statistics shows that the market share for the Android OS in 2012 is 68.8% (Mobithinking, 2013). This makes it the highest over others smartphones operating systems currently in the market.

B. General Architecture:

We propose a solution to solve the problem based mainly on GPS and GSM technologies. It takes

advantage of the two main rich features that is offered in advanced smart mobile platforms nowadays. Those features are location services, mainly GPS, and basic telephony services, mainly SMS. The solution proposed will be implemented to support Android platforms in a later work. The system proposed is based on a simple idea that is the use of SMS for communicating between the parties involved, parent and child. It is designed in a simple way so that it will involve few elements and less user interaction. This way it will result in a system that is simple and easy to implement and use, making it more user-friendly.

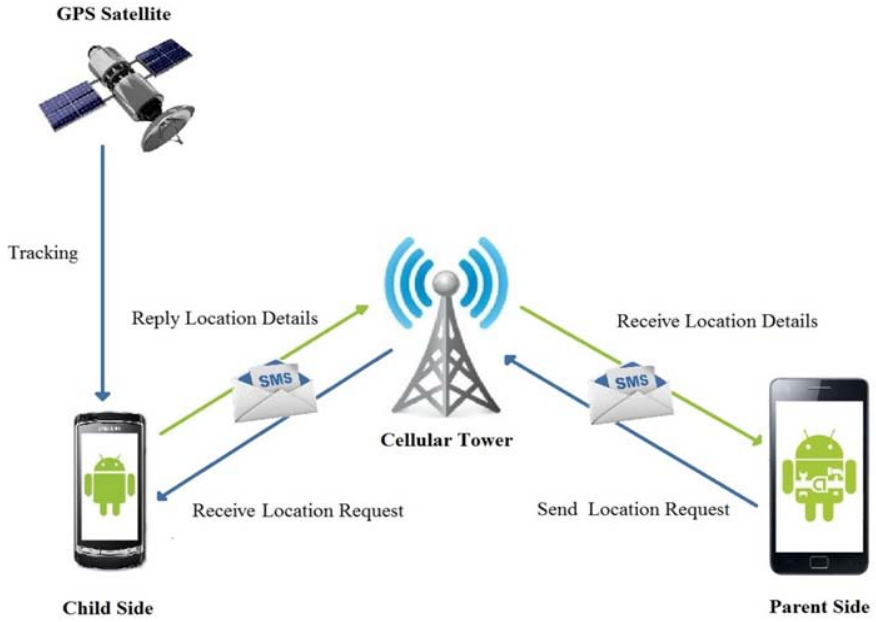


Fig. 1: Architecture of the Proposed System

The architecture of the system proposed, illustrated in Fig. 1, consists of two sides. First is the parent side which acts as a server for the system though it is not actually a server. It is basically an Android phone owned by the parent of the child to be located. The parent's side uses SMS for communicating with the child and maps to view the location of the child on a map. Thus, it requires telephony and internet services to be enabled in the parent's phone for the system to function. The second is the child side which acts as a client for the system. The child side is also another Android smart phone but owned by the child to be located. The child side uses SMS for communicating with the parent side and location services, GPS or Network, to get the location of the child in form of coordinates. On the child side, telephony and location services must be enabled and up running on the child side for the system to work. Where else the parent side might only need internet connectivity for showing the map.

C. Proposed Application:

a) Parent side:

In parent side application, it starts by checking the availability of the child's phone number stored in the device. If the number is not found, the application prompts the user for input. The application later stored the number in the device. Next, the application requests the child's location by sending an SMS to the child's phone. The child's phone will reply with the current location coordinate of the child. Lastly, the application will process the coordinate and show it in the Google map of the parent's phone. Fig. 2(a) shows the flowchart of the parent side application.

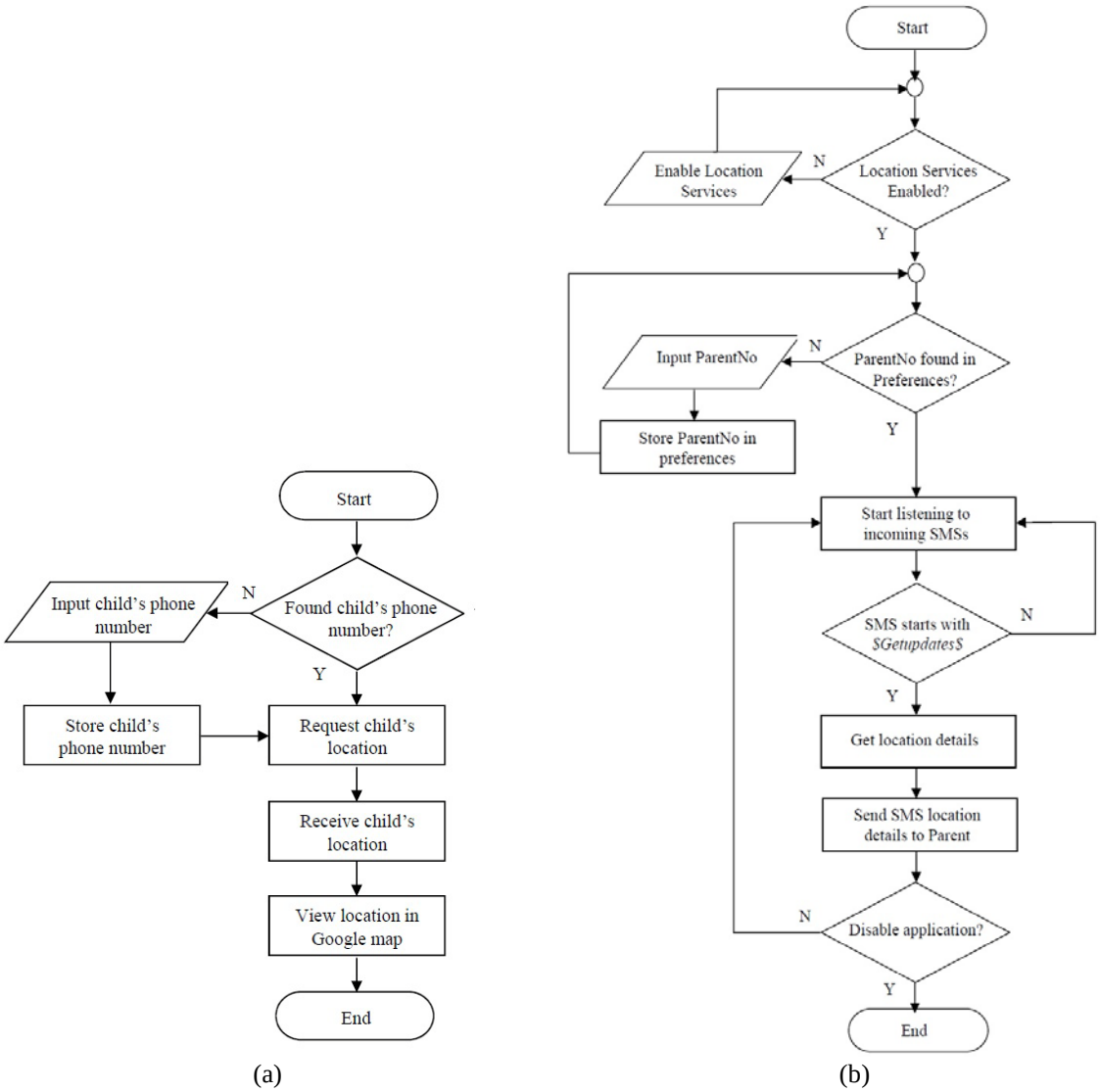


Fig. 2: Flowchart of the system for (a) parent side and (b) child side

b) Child side:

Fig. 2(b) shows the flowchart for the application at the child side. The first function performed by the child side application when it starts running is checking the status of the location services on the Android mobile phone. If the services are disabled, then prompt the user to enable the location services and proceed back to the location services checking. Otherwise, if the services are enabled then proceed normally.

After the location services check, another function is run to check if the parent phone number has been set. If the number has not been set then prompt the user to set the number of the parent and store in the preferences memory. Note that this function should be only done by parent hence it is protected by a password that should be only known to the parent.

When all the checking functions are passed, the application starts its main function which listening to all incoming SMS messages. The application keeps on listing and only reacts when an SMS message received starting with the string "*$Getupdate$*". A message that starts with that specific strings means it is a location request coming from parent side of the system. Consequently, the application will get location details, from the location services and then sends the details as an SMS message to the parent number stored in the application preferences.

Finally, the application goes back to listening state again unless it was manually ended by the user since it runs on the background.

D. Application Prototype:

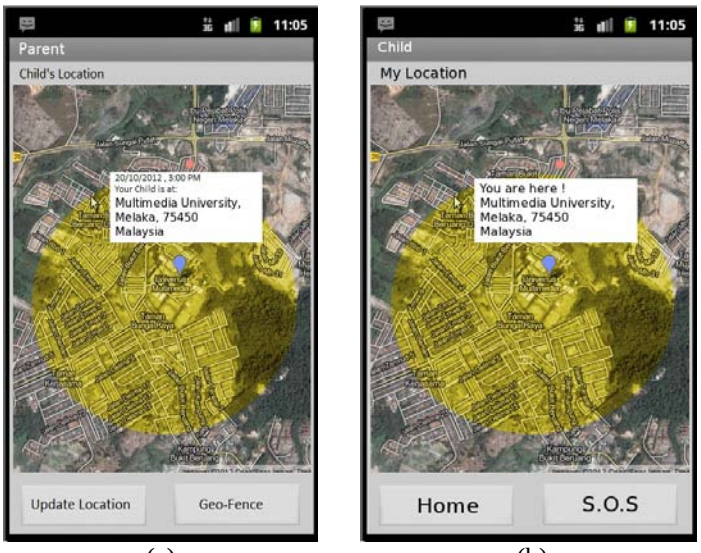
On the parent side, the application by minimum runs the user interface, mostly for map tracking, as well as a service (Listener) that runs in the background of the smart phone. On the child side, the application is mostly a

service or Listener that runs in the background of the smart phone. A user, parent, will use the interface to send a location request SMS to child. The Listener at the parent side employs one main function and that is to listen for the child's reply for the location request. However, the Listener at child side employs two main functions. One of these functions is periodically listens and gets location coordinates updates from GPS satellite or Network provider whichever more accurate. The other main function is listening and waiting for a location request from the parent side.

A Listener is a service runs in the background and keeps listening to all SMS incoming but only will only reply to location requests or update coming from the other side of the system. So, when a parent sends a location request via SMS to the child side, the Listener at the child side will automatically reply to a location request SMS with the latest location update received from the location service. Afterwards, the parent's Listener will receive the location details from the child via SMS and processes it for viewing on a convenient map on the UI.

For The Listener to work, it listens for a specific string of characters that is predetermined between the parent and child sides. If an SMS message received starting with that predetermined string then the application will handle event. In this work, the string "*$getUpdate$*" will be used by the SMS sent by parent side for location request. Where else, the string "*$update$Coord*" will be used by SMS sent by the child side for updating the location. Note that the "*Coordinate*" in the string refers to the location coordinates decimals in the actual system.

The design of this proposed solution offers many advantages over many exiting solutions. First, the application operates automatically upon parent location request without the need for user interaction at the child side. This is considered as a big advantage for the system because usually a child cannot handle a complex mobile application and too many user interactions. Another advantage is that the system uses SMS for data transfer thus eliminating the need for internet connectivity. The system will only require location services and telephony connectivity. This is suitable for situations where the users might not have internet access. The third advantage this solution offers is that it can perfectly function indoors as well. It is done by using both GPS and Network provider for location determination. The application will always get coordinates from both, compare them and use the most accurate. In cases where there is no GPS satellite signal received, for example indoors, the application will use the only other source available which is the Network provider. It should be noted that Network provider location detection is based on the Cellular ID. Lastly, the system uses a master-slave relation between parent and child sides where the parent controls all the functions of the system and the child has very little control over the system.



(a) (b)

Fig. 3: Map-based interfaces for (a) parent side and (b) child side

Fig. 3(a) shows the parent's side application. The yellow area is the geo-fencing area where the child is allowed to roam within. If the child passes the limit of the area, the parent will be notified. Fig. 3(b) shows the interface of the child's side application. It shows the current location of the child.

Conclusion And Future Works:

In conclusion, this project was developed to aid locating missing or lost children. The solution proposed in this paper takes advantage of the rich features offered in Androids smart phones. The architecture of system built on two main component, GPS satellite and GSM telephony services. Developing this project would not have been possible without studying related and existing works. Some of these works relies on internet

connectivity or a server that has to be up running. The proposed system relies only on two main services, telephony and location, thus eliminating the need for internet connection or a dedicated server. Finally, like any software product or design, there is still room for enhancement. Features can be added to enhance the system such as Geo-fencing, emergency alerts and many others. The proposed system will be implemented, continued, reviewed and improved in a later work.

REFERENCES

Al-Suwaidi, Ghaith Bader, Zemerly, Mohamed Jamal, 2009. "Locating friends and family using mobile phones with global positioning system (GPS)," IEEE/ACS International Conference on Computer Systems and Applications.

Almomani, I.M., N.Y. Alkhalil, E.M. Ahmad, R.M. Jodeh, 2011. "Ubiquitous GPS vehicle tracking and management system," 2011 IEEE Jordan Conference on Applied Electrical Engineering and Computing Technologies (AEECT), pp: 1-6.

Anderson, Ruth E., *et al*., 2009. "Building a transportation information system using only GPS and basic SMS infrastructure," 2009 IEEE International Conference on Information and Communication Technologies and Development (ICTD).

Android Developers, available at: http://developer.android.com/sdk/index.html

Anson Alexander, "Smartphone Usage Statistics 2012," 2012, available at: http://ansonalex.com/infographics/smartphone-usage-statistics-2012-infographic/

Cavell Group, "Kidnapping – The Epidemic," 2007, available at: http://www.thecavellgroup.com/downloads/Kidnapping-The Global Epidemic. pdf

Chandra, A., S. Jain, M.A. Qadeer, 2011. "GPS Locator: An Application for Location Tracking and Sharing Using GPS for Java Enabled Handhelds," 2011 International Conference on Computational Intelligence and Communication Networks (CICN), pp: 406-410.

Eclipse Foundation, available at: http://www.eclipse.org

Mobithinking, "Global mobile statistics 2012 Part A: Mobile subscribers, handset market share, mobile operators," 2013, available at: http://mobithinking.com/mobile-marketing-tools/latest-mobile-stats/a#smartphone-shipments