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COMPUTER ENGINEERING

MASTER THESIS

MOBILE GPS TRACKING FOR CHILDREN AND FAMILY SAFETY AND COMPARISON OF LOCATION ACCURACY ON DIFFERENT DEVICES

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Title of the Thesis: **Mobile GPS Tracking For Children and Family Safety and Comparison of Location Accuracy on Different Devices**

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ABSTRACT

MOBILE GPS TRACKING FOR CHILDREN AND FAMILY SAFETY AND COMPARISON OF LOCATION ACCURACY ON DIFFERENT DEVICES

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This study explains the GPS tracking on mobile phones for family safety. The aim of this study is to track children over the phones and to send SMS to notice parents when the child has a trouble or the child is out of the safe region determined by parents. The study also includes comparison of location accuracy on different devices and it focuses on the results of the application when different devices are placed at a (known) fixed location for a few hours. Most probably, all mobile devices will support GPS in the near future and this study will provide valuable information for family safety.

Keywords: GPS Tracking, Mobile GPS Tracking, Mobile GPS Tracking for family safety, Comparison of Location Accuracy, Comparison of Location Accuracy on different devices, Android GPS Tracking.

ÖZ

ÇOCUKLAR VE AİLE GÜVENLİĞİ İÇİN MOBİL GPS TAKİBİ VE FARKLI CİHAZLAR ÜZERİNDE KONUMSAL DOĞRULUĞUN KARŞILAŞTIRILMASI

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Bu çalışma, aile güvenliği için, cep telefonları üzerinde GPS takibini açıklar. Bu çalışmanın amacı, telefonlar üzerinden çocukları takip etmek ve bir sorun halinde veya çocuk ailesinin belirlediği konumun dışına çıktığında ebeveynlerini SMS göndererek uyarmaktır. Çalışma aynı zamanda farklı cihazlar üzerinde konumsal doğruluğun karşılaştırılmasını içerir ve farklı cihazların birkaç saat için bilinen belirli bir konuma yerleştirildiğindeki uygulamanın verdiği sonuçlar üzerinde durur. Büyük bir olasılıkla, yakın gelecekte bütün mobil cihazlar GPS i destekliyecek ve bu çalışma aile güvenliği için kayda değer bilgiler sağlayacaktır.

Anahtar Kelimeler: GPS Takip, Mobil GPS Takibi, Aile güvenliği için mobil GPS Takibi, Konumsal doğruluğun karşılaştırılması, Konumsal doğruluğun farklı cihazlarda karşılaştırılması

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My heartfelt thanks go to my mother, to my fiancée Sümeyye Turan. This work could not have been accomplished without their support.

August, 2013

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INTRODUCTION

1.1 Statement Of The Problem

GPS devices became increasingly smaller step by step. Finally it is a part of mobile devices and we can see it in most of mobile phones. Nowadays, we can see the GPS device on the phones used by children. With the increasing heavy-paced work, family wants to keep track of their children remotely. As you see in the below table [3], most of children activities are related to parents and emergency purposes have very huge percentage in the activities.

Table 1.1.The Cell Phone Activities Study published by GfK MRI [3]

Top Cell Phone Activities for Children Age 6-11	
Activity	***%***
Call my parents	88.1
Call friends	68.1
Emergency Purposes	55.7
Text Messaging	54.1
Play Games	49.0
Take Pictures	47.8
Listen to music	34.4
Picture messaging	24.2
Download ringtones	16.5
Source: MRI American Kids Study 2009	

At the same time, numbers of children who own mobile phones increase year by year as we see in MRI's Kids Study in USA (5000 participants) [5]. Figure 1.1 shows that most of the children in near future will use mobile phones and the importance of family safety applications on mobile phone will increase.

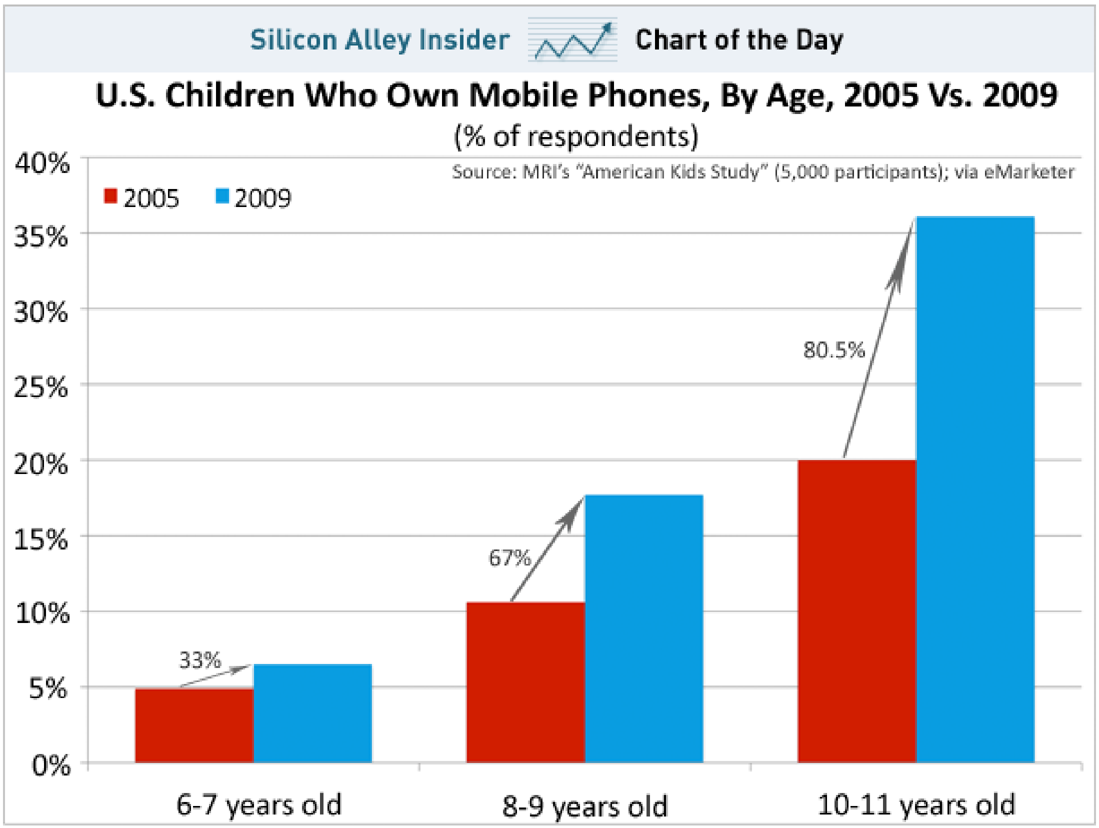

Figure 1.1 MRI Kids Study Report Graph [5]

Depending on TUIK Statistical Institute reports, approximately 37 percent of kids in 11-15 age groups have a phone in Turkey. [15]

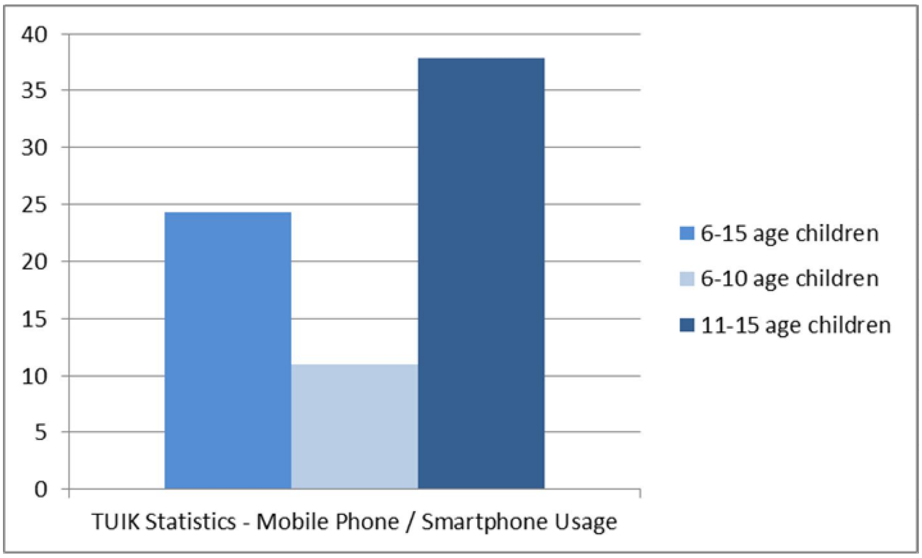

Figure 1.2 TUIK Institute Study Report Graph [15]

As in the graphs (Figure 1.1 and Figure 1.2), phone usage of the children is substantial degree. These percentages show that family safety application can be used practically in real life. There are some applications in the USA. In Literature Review Chapter explains details of the applications.

1.2 Literature Review

Family Tracking Applications allows you to track your children, wife, husband and friends. For example; your children tell you that they are staying late with their friends to study for their exams. Are your children really there, or did they go different place without letting you know? You can know where they are, at anytime; whenever they have their smart phones with them.

Your wife should be at work but she is not answering her phone and you are afraid she may have had an accident. By using family tracking application on your phone, you will know she is safe in her office.

With the increasing family safety needs, mobile family tracking became very popular topic in the world. Some applications have been developed about this topic such as life360, Sprint and GenieTrack applications. These applications have some common properties like showing the family members on a map and send alarm with e-mail. Life360 offers send SMS functionality with premium membership other ones just push application notifications. You can also get weekly and monthly report from the applications. [11]

Between school, work and other activities it is becoming very difficult to stay connected with our kids. Family Tracking Applications provides you stay in touch with your children.

These kinds of applications are very helpful for family but they are not free and we can just use as a trial version with some shortcomings. For example, Non-smartphone users cannot be added in your list for Life360 application. Also if you don't live in USA or Canada so you cannot send alarm SMS message to your parents that have non-smartphone and you cannot set your parents as an alarm person to send panic message. [11]

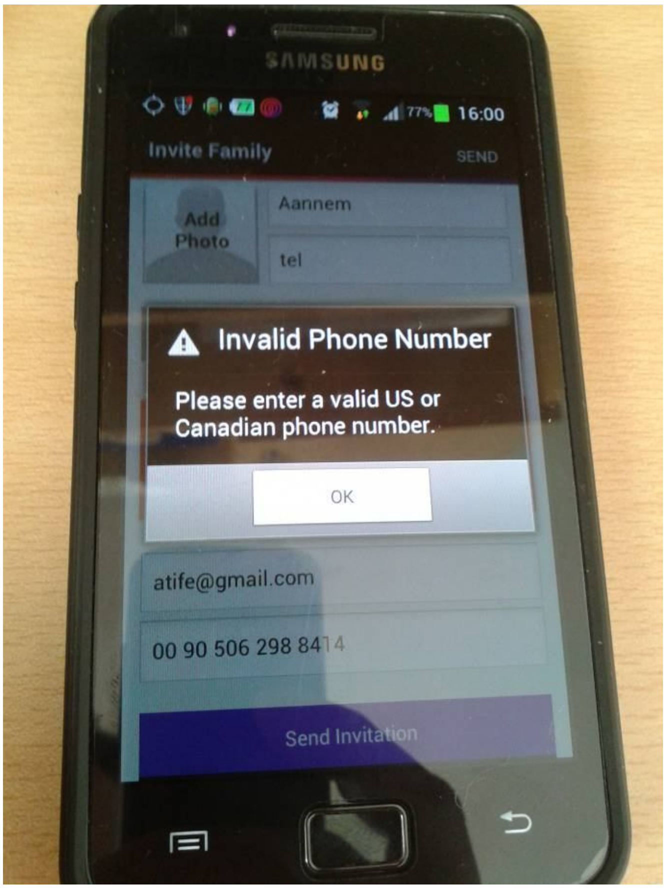

Figure 1.3 Life360 Android Application

Sprint Family Locator only accepts US numbers to register so it can not be tested practically. According to the web page, families can follow their children and can get notifications when the children push the alarm button but the parents cannot define custom places for notification in the application. [13]

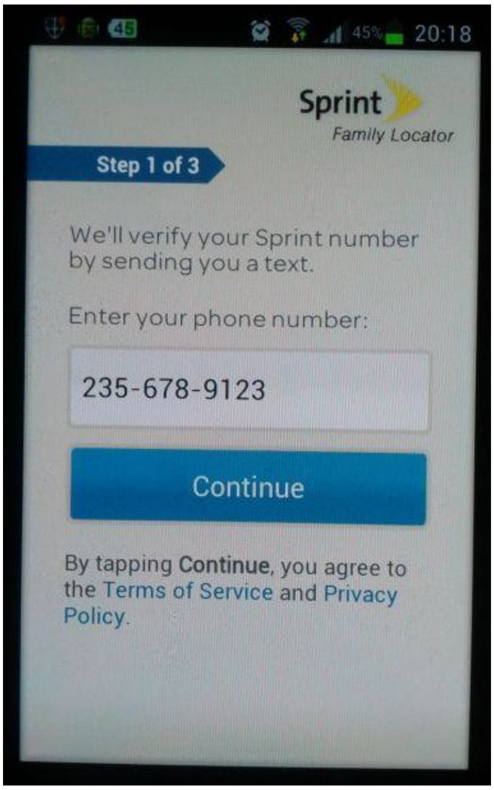

Figure 1.4 Sprint Family Locator [13]

Genietrack Family Tracker application also accepts only US numbers. According to the application webpage, application offers SMS and e-mail alerts depending on membership types but you cannot define a safe region for your child to notify you. [7]

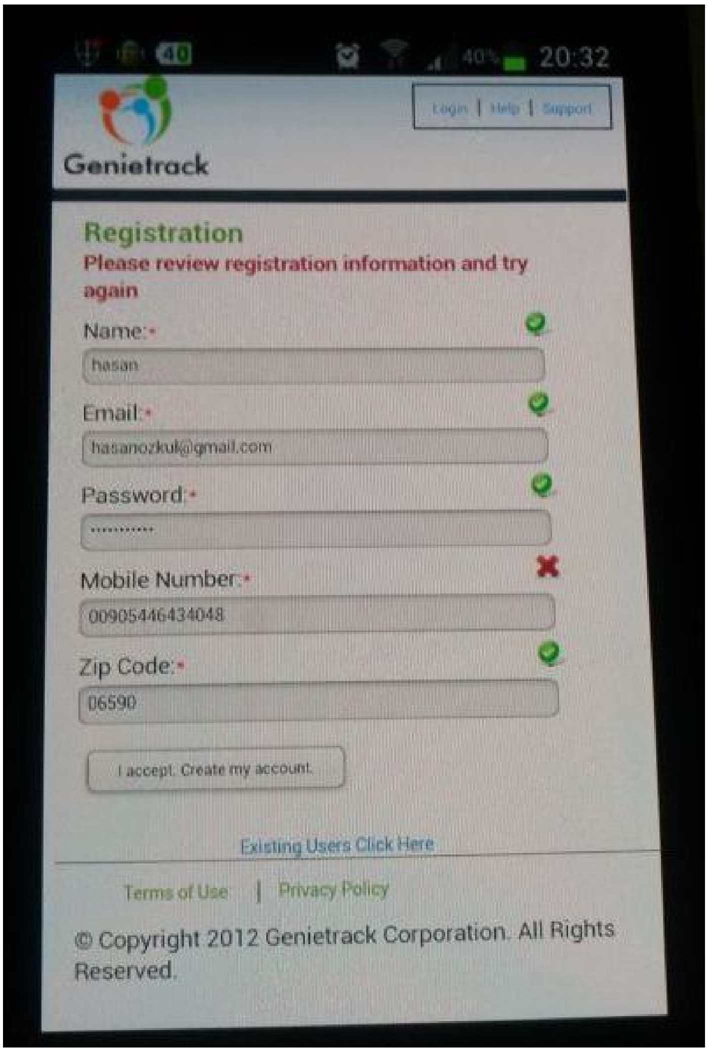

Figure 1.5 Genietrack Family Tracking Application [7]

Victor, a reporter-producer of Time press says "*Ever lie to your parents, even once, about where you were after school? It'll be tougher for today's teenagers, who may have to leave their smart phones behind if they don't want Mom and Dad following their every move. An increasing number of apps for mobile devices are utilizing GPS technology to help parents keep tabs on their kids. One research firm estimates that more than 70 million people across North America and Europe will be using such programs to track family members by 2016*." [16]

Sarah, a techcrunch.com writer indicates that *"Emergency alerting functions of the applications haven't yet been seen to thwart any serious crimes – like kidnappings, for instance, families can still take advantage of the functionality for more common incidents, like a kid who falls off his bike or etc* ." Sarah also report that *"Jessica Denay, a single mother in Los Angeles, uses Life360 to monitor her 12-year-old son Gabriel as he travels to school, basketball practice and her ex-husband's house. I can't even describe how comforting it is, she says. It's hard for moms to let go of our babies. This makes me feel better. I don't have to be hovering right there, but I know that he's safe. "*[12]

Suzanne, a MSNBC writer report that *"About 41 percent of 8- to 12-year-old children in the United States have cell phones, according to the Yankee Group technology researching and consulting firm. "* [14]

1.3 Background Of Gps Tracking

GPS stands for *Global Positioning System.* GPS is a satellite network, and sends the encoded information on a regular basis by measuring the distance between the satellites makes it possible to identify the exact location on Earth. This system of the U.S. Department of Defense consists of 24 satellites rotating continuously. These satellites emit very low power radio signals. Earth GPS receiver gets these signals. Thus, it is possible to determine the location.

Figure 1.6 First GPS Model [4]

GPS Satellites are 20,200 km away from the earth's surface. This is a wide field of view. A GPS receiver must see at least 4 satellites for 3D and at least 3 satellites for 2D. Satellites move 7,000 miles an hour. They throw on a tour around the world in 12 hours. They work with solar energy and are designed to be used in at least 10 years. There are also small igniter thrusters and spare batteries to correct the orbits of the GPS satellites for solar eclipse. [8]

The first goal of this system was for purely military purposes. GPS receivers are to find the way, the military and rocket stickers are designed to be used in the shootout. However, in the 1980s, the GPS system was opened to civilian use.

Nowadays, GPS has wide range of usage areas as indicated in the following table.

Table 1.2 GPS Application Areas [9]

GPS Application Areas
1 • Archaeology
2 • Seismology(geophysics)
3 • Glaciology(geophysics)
4 • Geology(mapping)
5 • Surveying deposits (mineralogy, geology)
6 • Physics(flow measurements, time standardization measurement)
7 • Scientific expeditions
8 • Engineering sciences (e.g.ship building, general construction industry)
9 • Cartography
10 • Geography
11 • Geo-information technology
12 • Forestry and agricultural sciences
13 • Landscape ecology
14 • Geodesy
15 • Aerospace sciences
16 • Geometric
17 • Land Surveying
18 • Photogrammetry
19 • Hydrography

The principal idea of GPS is the calculation of distance between satellite and GPS receiver. Satellites broadcast their current position on orbit with signal and GPS receiver will receive the signal and calculate the distance as in the following example: if we know the accurate distance from satellite at outer space, thus we can find out that we are located on a place at imaginary sphere where the radius is equal to the distance of satellite's radius. We can disclose that we are on the line in which those spheres intersect, if we know distance between two satellites. And if we get third or fourth calculation from two satellites or more, we can determine our position. GPS receiver process calculation of satellites distance and find out its position.

Trilateration method is used for calculation of the accurate position on global 2D positioning systems.

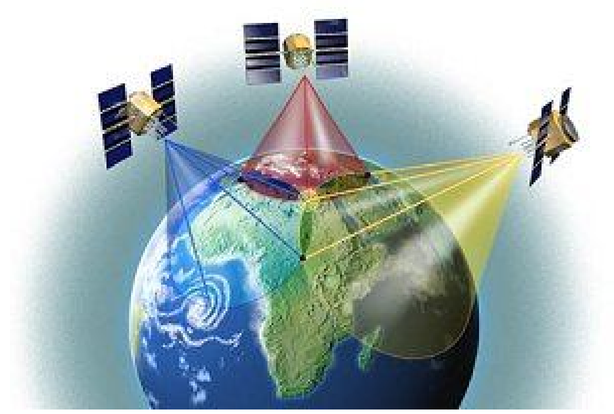

Figure 1.7 Basic Architecture of GPS Triangulation [18]

Trilateration is described as follows: the signals sent by a satellite to the earth's surface in the form of a single cone creates a large area. Second satellite signals narrow gradually this area and third satellite eventually intersects the area and gives you two dimensinal position on the earth. Position is calculated based on two dimensions with 3 satallites but if you want to do the calculation in 3 dimensions, you need 4 satallites to calculate 3d position. [6]

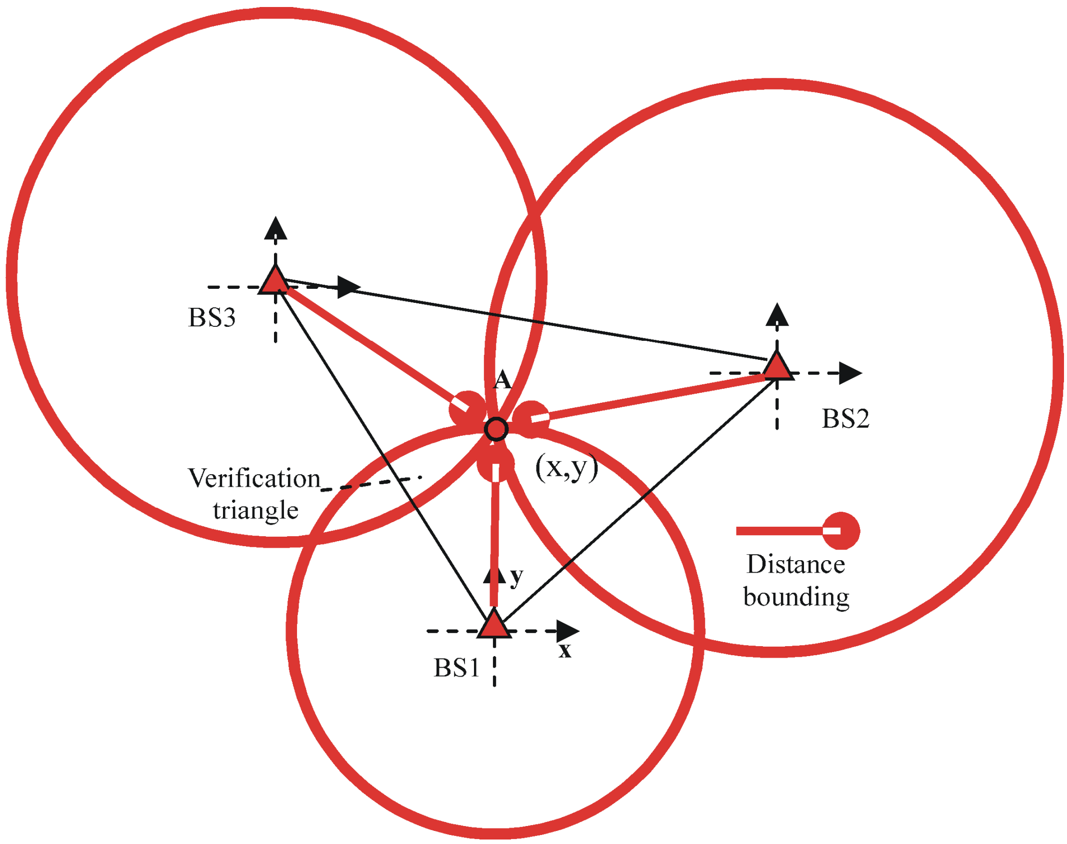

Figure 1.8 Trilateration Method [17]

Standard GPS receiver emits the GPS signal and provides accuracy down to a few meters but sometimes insufficient number of GPS satellites may be available in indoors to calculate the position. Assisted GPS may be implemented to improve sensitivity and reduce the amount of time needed to acquire the satellites. Cellular communication system can improve indoor availability as the indicated in the Table 1.3 [10].

Table 1.3 .Location Measurement Types [10]

Measurement Type	Description
GPS	Solution based solely on GPS. Highest accuracy. May not be available for certain environments (e.g., indoors).
GPS and A-FLT	Hybrid solution based on a combination of GPS and cellular communication system. Intermediate accuracy. Improved indoors availability.
A-FLT	Solution based solely on the cellular communication system. Reduced accuracy. Commonly available in urban area and may be available where GPS is not available (e.g., indoors).
Enhanced CELL-ID	Solution based solely on the cellular communication system. Low accuracy (generally depends on the cell sector size and accuracy of round trip delay or similar measurement; may include other cellular measurements such as signal strength).
CELL-ID	Solution based solely on the cellular communication system. Lowest accuracy (provides only the identity of the cell where the terminal is located; therefore, accuracy is dependent on the size of the cell).

1.4 Goal Of The Thesis

This study includes Family Tracking Application details and experiments on different devices. Families follow their children by using tracking application and the application generates alarm when a child has a trouble. The application send alarm SMS to parents when the child push alarm button in danger. SMS text includes a link that points position of child on Google Maps. Parent can see the child position by clicking the link in SMS text. The parent also set a safe region place in the application for the child. When the child is out of this place, the application generates and sends alert SMS to his parent. All location values in database table are encrypted by using the key value that is just known by the family. Key value is not stored in server side database table. When the parent wants to see his child position on the map, the application ask the key value and then it shows the child position on the map by decrypting with this secret key value. If the user wants to see his friend's position on the map, the user must learn secret key of his friend by asking.

The position accuracy is very important for these kinds of applications. Another goal of the thesis is to compare accuracy of GPS positions on different mobile phones. Using the proposed application, it is possible to compare the accuracy of the position in different mobile devices. Sometimes positions can be irrelevant on low GPS capability smart phone. So determining which kind of devices can be capable is very important for the safety. This study explains the application general workflow and technological background in Chapter II and experimental results on different devices in Chapter III.

CHAPTER 2

METHODOLOGY

2.1 General Workflow Of The Application

First of all, parent and child register and login to the application. Then parent add child to tracking list. Every Android client gets the location values from GPS Service and sends them to the database after encrypting. Location values are secret data for the users so every location value is encrypted by the user secret key and is sent to the database. Thus nobody can see the location values in database. When parents want to see the location of child, application asks the secret key and shows child position on the Google map by decrypting location value. Parent has the option to set safe region for her child. When the child is out of the safe region, the application notifies parent by SMS. Details of scenario will be explained in Chapter 2.3

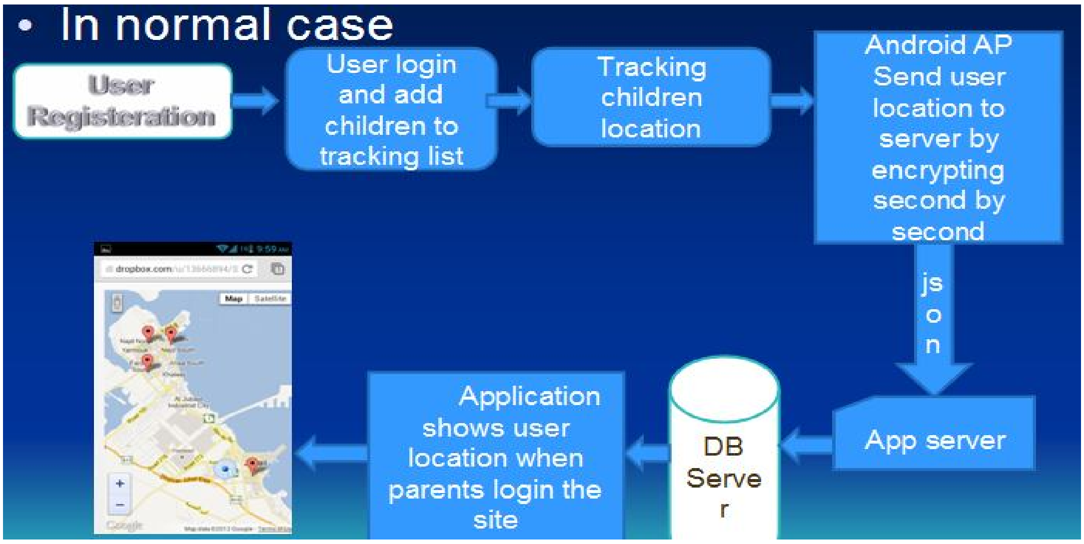

Figure 2.1 Normal Case Workflow

The user logins with his family key. After entering the key, new key value is generated depending on ASCII table. The application gets longitude and latitude values from GPS Service and then it multiplies the location values by the new generated key value. Finally the application stores the changed location values in database table.

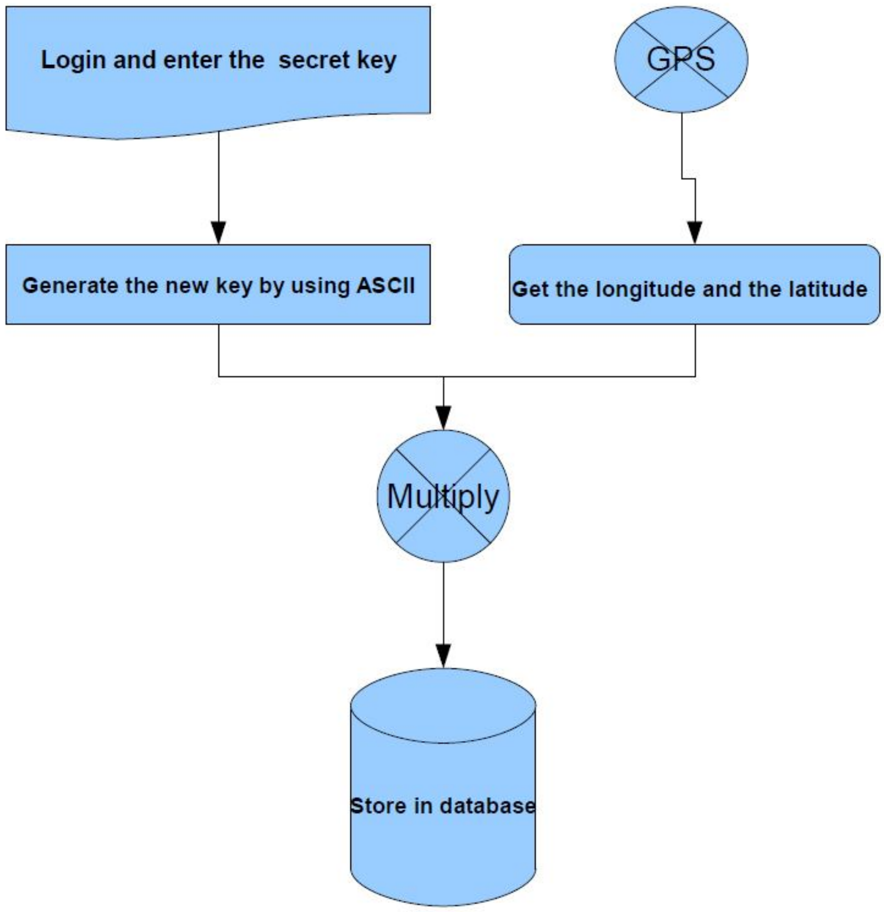

Figure 2.2 Encryption Flow

When parent wants to see the child position on the map, the parent enters the secret key and the application generates new key value depending on the secret key. The application read the longitude and latitude values from database table and it divide the location values by the new generated key value. Thus, the parent can see the position of child on the map.

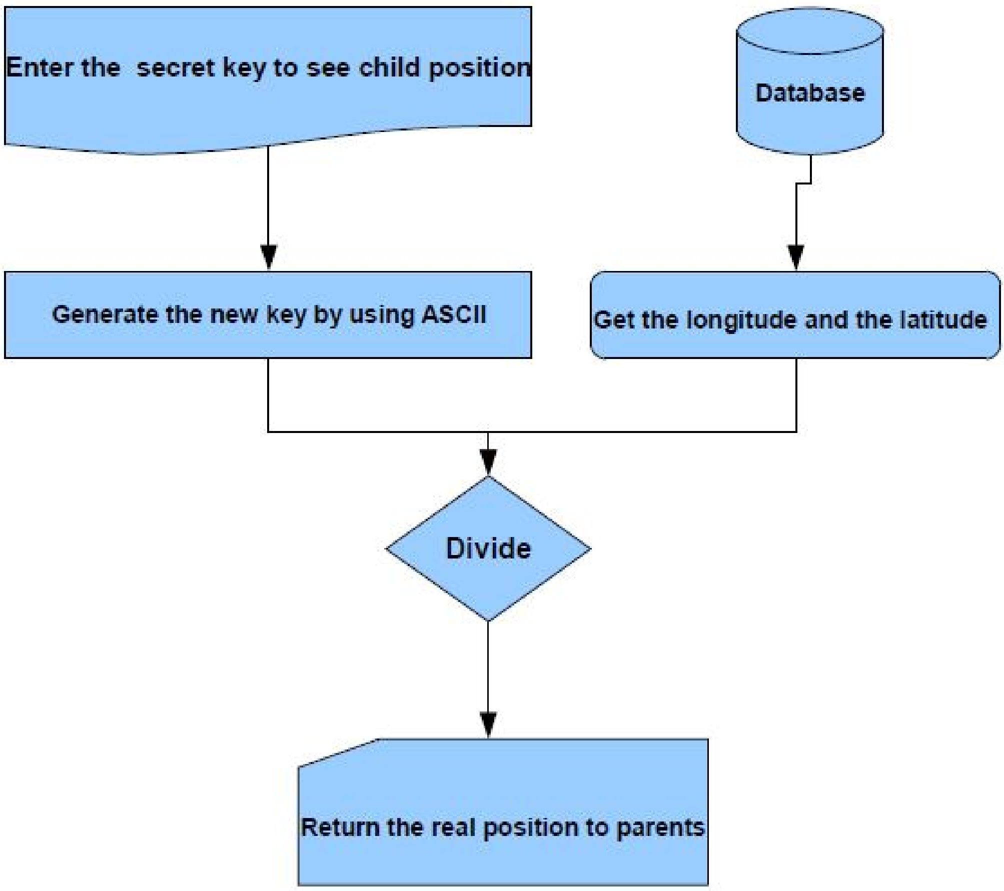

Figure 2.3 Decryption Flow

The key value is entered by login screen and the longitude and latitude values encrypted by using this key. Whenever parent wants to see the child position, he/she must enter the key that is just by known in family. After entering the key, the location is shown on the phone screen.

Figure 2.4 The key screen to see the child position

Encryption algorithm works as follows: The key value is Hsn. All of the characters are converted to decimal numbers by using ASCII table. H: 72, s: 115, n: 110, 72 + 115 + 110 = 297 every latitude and longitude value is multiplied by new generated key value (297) and the multiplied value is stored in database table.

When the parent enter the child secret key by pressing Location button, the child's longitude and latitude values in database are divided by the generated key value of encryption algorithm. Thus, the secret key value is not stored in database and it is known by family members. The key value is just known by asking to the person who is tracked. The key value is not stored in server side.

In alarm condition, child push alarm button android client sends notification to the parents via SMS. Parents can see location on Google map when they click the link in SMS.

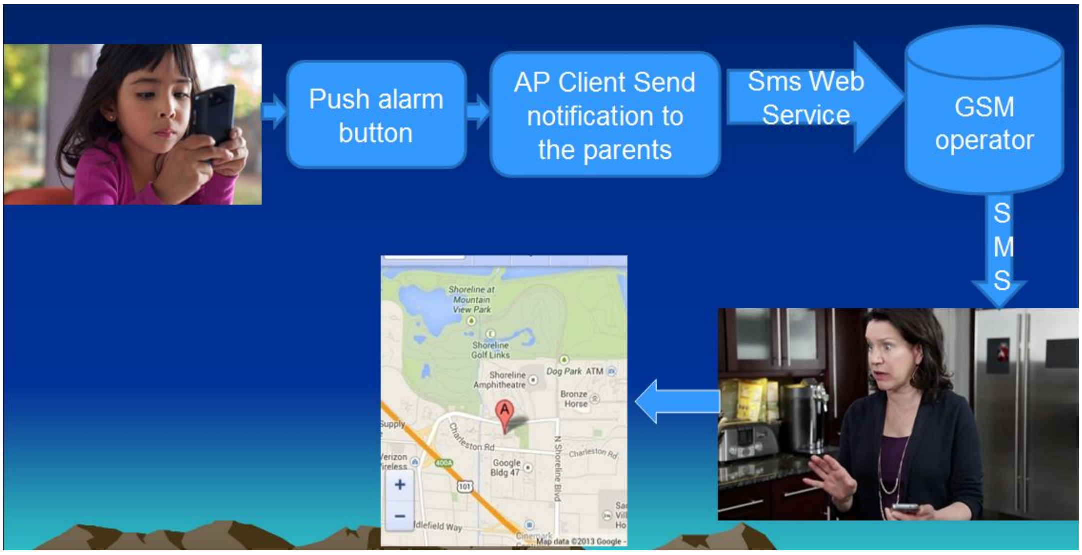

Figure 2.5 Alarm Condition

SMS text includes these kinds of information: Emergency Hasan ÖZKUL My number 0544643**** my location https://maps.google.com/maps?f=q&q=39.9280414,32.8781939

The latitude and longitude values in SMS are the position when the child has an trouble .Mobile application get the location from GPS Service and send the location values with SMS Service. Parent clicks the link and sees the position of child.

2.2 The Technologies Used In The Application

When android application connects to the MYSQL database, Android client sends data to PHP script by using JSON model. PHP script connects to the database and executesSQL command. Android application behaves like HttpClient and sends Http Request to PHP server with JSON pairs of data. PHP deserialize JSON data and create SQL command with incoming data and finally execute the query. All of the database accesses are asynchronous. For example, when I change my location, one thread send GPS location to the database. Therefore GPS thread and database access threads are inherited from AsyncTask class they work in background without preventing user interaction.

```
public class DatabaseOperationInsert extends AsyncTask<NameValuePair , Void, JSONArray>
```

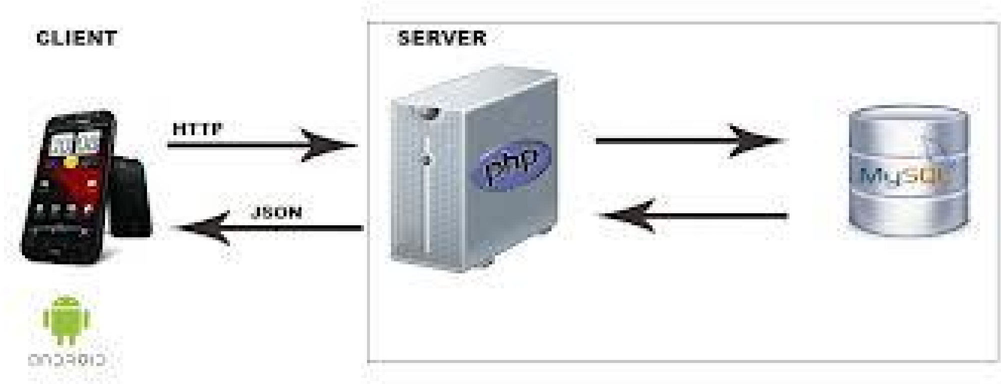

Figure 2.6 How to Android App access database

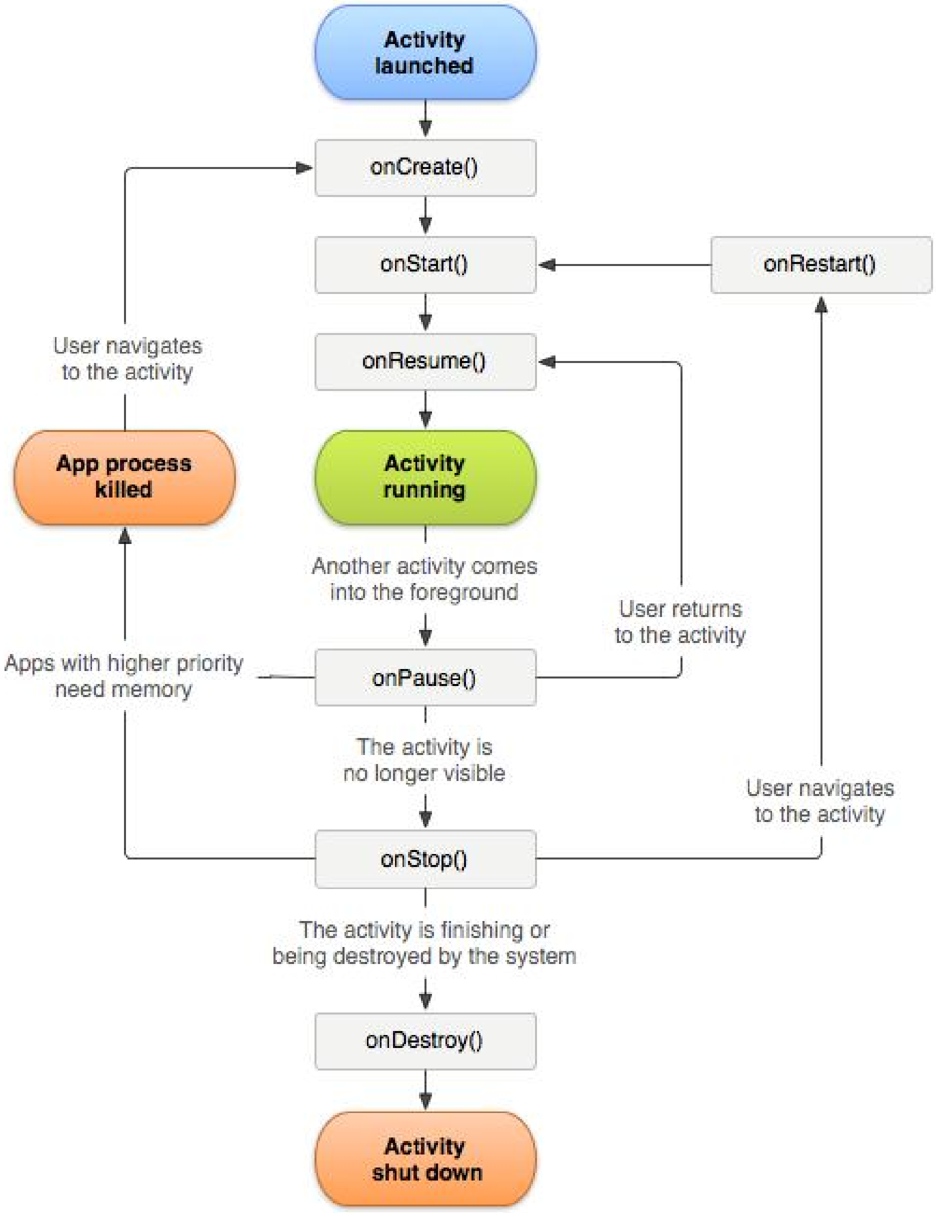

Figure 2.7 Activity Lifecycle Diagram [1]

Activity classes are used in android applications. Activity is a screen and user can perform different actions in it. There are some states for activity classes; Active state, Paused State, Stopped State, Destroyed State. When screen is visible and running in front of user, it is in active state. When activity is partially visible or another activity is focused but not covering the entire screen, it is in paused state. When the activity is not visible and the activity resources can be freed by the system if it is necessary, the state is in stopped state. When the activity resources no longer exist in memory, the activity is in destroyed or killed by the system, it is destroyed state. [1]

Intent class is also very important in the application because the system know which activity will be active by using Intent classes. When user switches between screen, Intent class notifies the system as we saw in the below code.

```
Intent i = new Intent(getApplicationContext(), MyDigitalLocation.class);
startActivity(i);
```

If the application has a user interface layout xml must be defined. Layout xml is visual structure of screen. All controls are defined in xml files and read by Activity classes when the activity created by the system as we see in the below code.

```
    String ns = Context.NOTIFICATION_SERVICE;
    NotificationManager mNotificationManager;

     public void onCreate(Bundle savedInstanceState) {
            super.onCreate(savedInstanceState);
            setContentView(R.layout.main_screen);

            alarm = (Button) findViewById(R.id.alarmbutton);
```

Figure 2.8 Layout xml and activity relationship

Google Map API is used in order to show the user last position on the mobile application. Android API key must be created to access the Google maps in the application and the key must be inserted to AndroidManifest.xml in the application workspace.

Figure 2.9 Usage of Google Map's Api Key

The API handles access to Google Maps Server in the android application. Project package name must be defined in Google API Console as the Figure 2.9 in order to accept android client request in the Google Maps Servers. The API supports unlimited number of users and unlimited number of android client's map requests.

Every activity related with different screens in the application. Diagram also shows screen transitions.

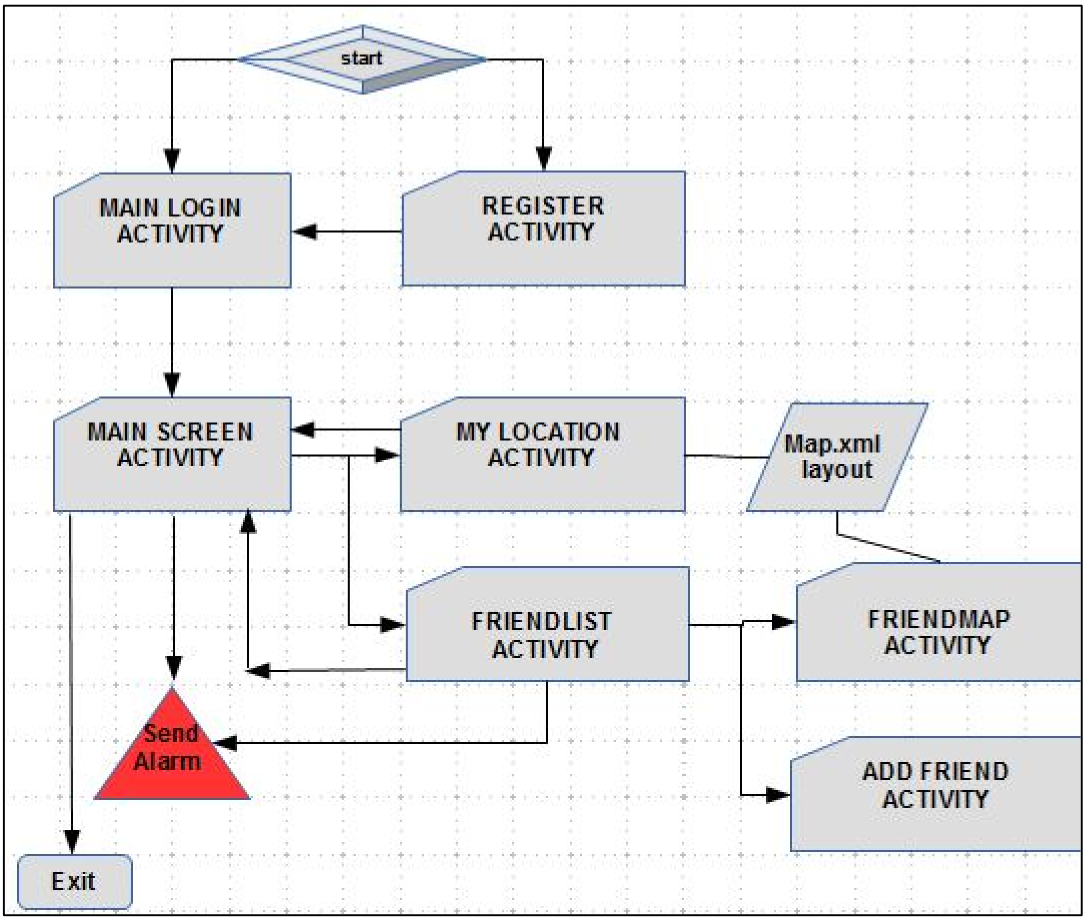

Figure 2.10 UGpsTracker Application's Activity Diagram

2.3 Step By Step Application Scenario

First of all, Parent and child register by typing name, surname, phone number, mail and password. Every person must enter his phone number and his mail to be findable user when other users want to add this person in their tracking list. After the registration, users login the application with password and secret family key. Family key is for encryption of location values. It is just known by the family and close friends. It is not stored in database table.

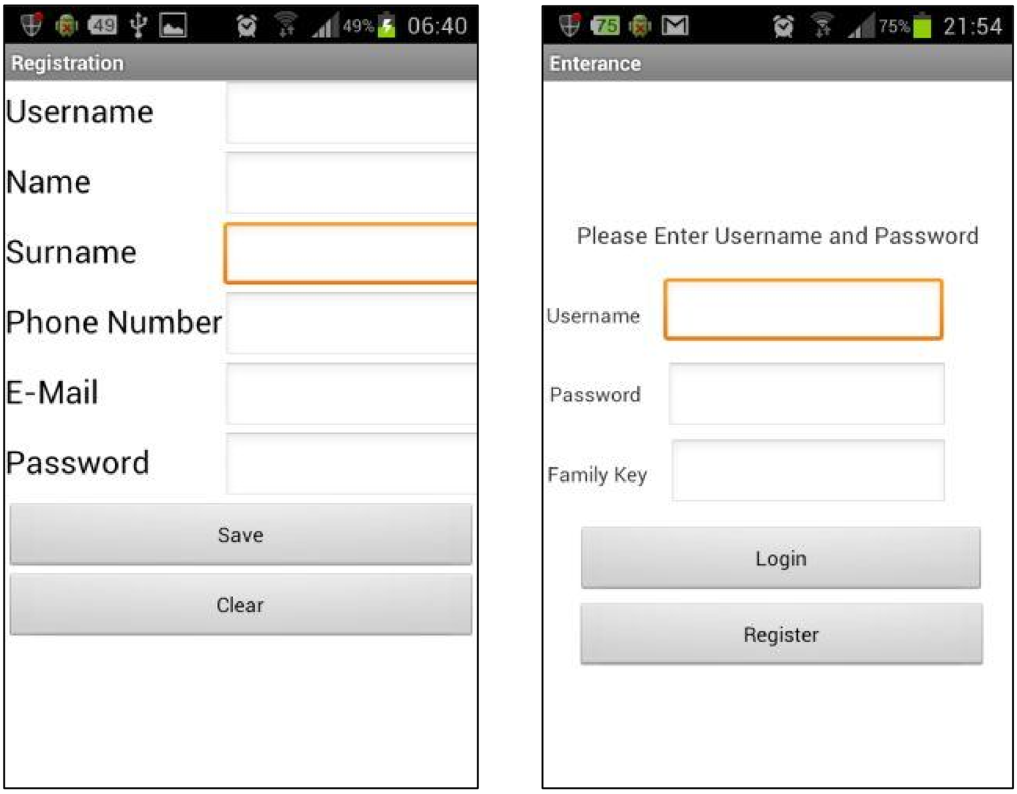

Figure 2.11 Registration and login screens

In Step 2, User access main screen and application gets location values from GPS Service and sends location data to the database when location changes. Locationmanager controls location in every 1 second in background by default. If location changes more than 1 meter automatically it is inserted to the database. The 1 second refresh interval and 1 meter sensitivity can be changed in setting screen. Location values are encrypted by the family secret key value and stored in the database. The user also can see his location on the map when he clicks the “My Location” button in the application.

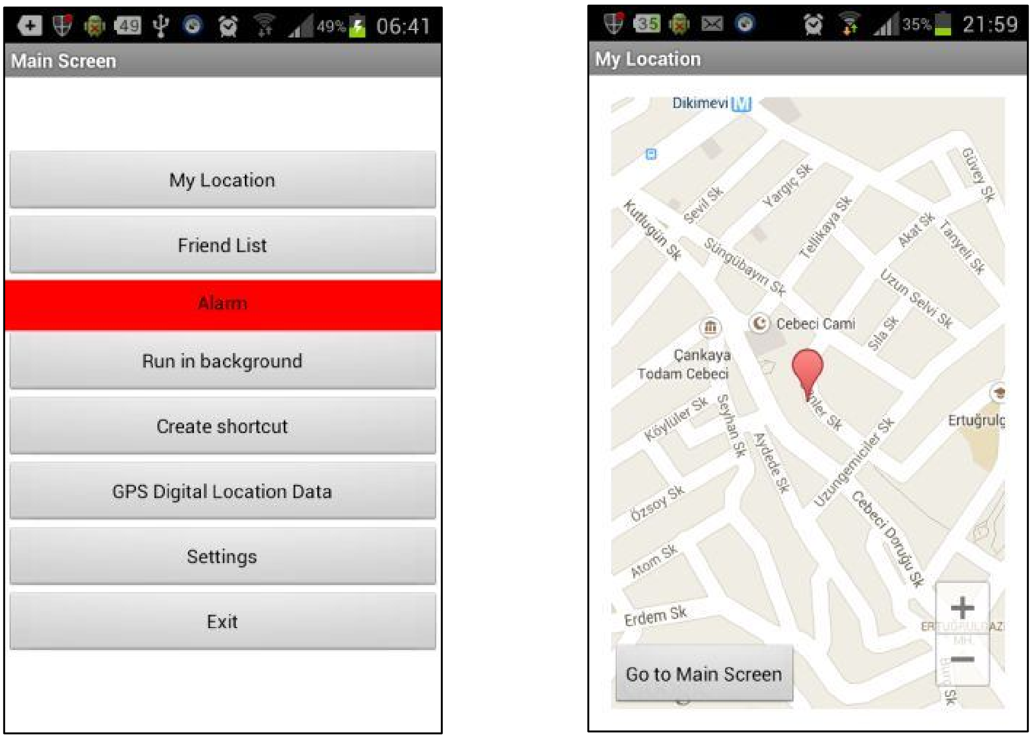

Figure 2.12 Main screen and my location screen

In Step 3, parent can see tracking list when he clicks the “Friend List” button. Parent sees children’s location on the map by entering the child secret key. The key value is just known by the family. Children can also set their alarm person whom they can send an alert when they have a trouble. Child only needs to click “Set Alarm Person” button in his list. When child pushes alarm button, alarm SMS message will be sent to his parents and his close friends in the list.

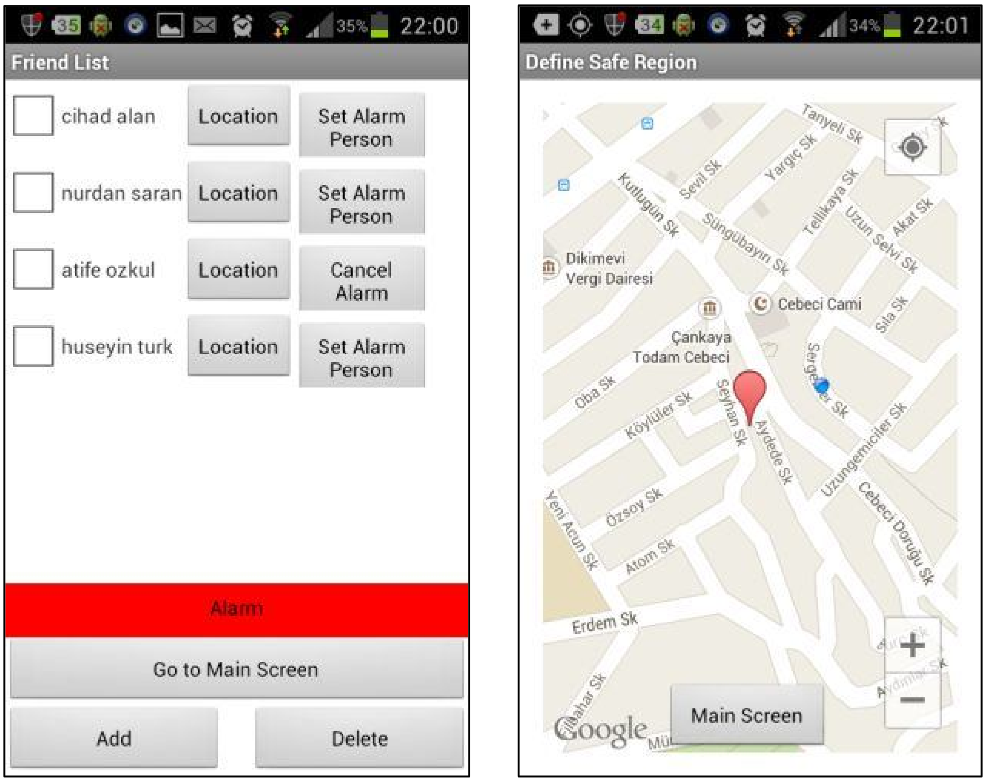

Figure 2.13 Tracking list and child location on map.

In Step 4, User can add his friends and parents in the tracking list. When the user add one person in his tracking list, the person status will be pending .If the person confirm him, the user can see his tracking list and can send alarm.

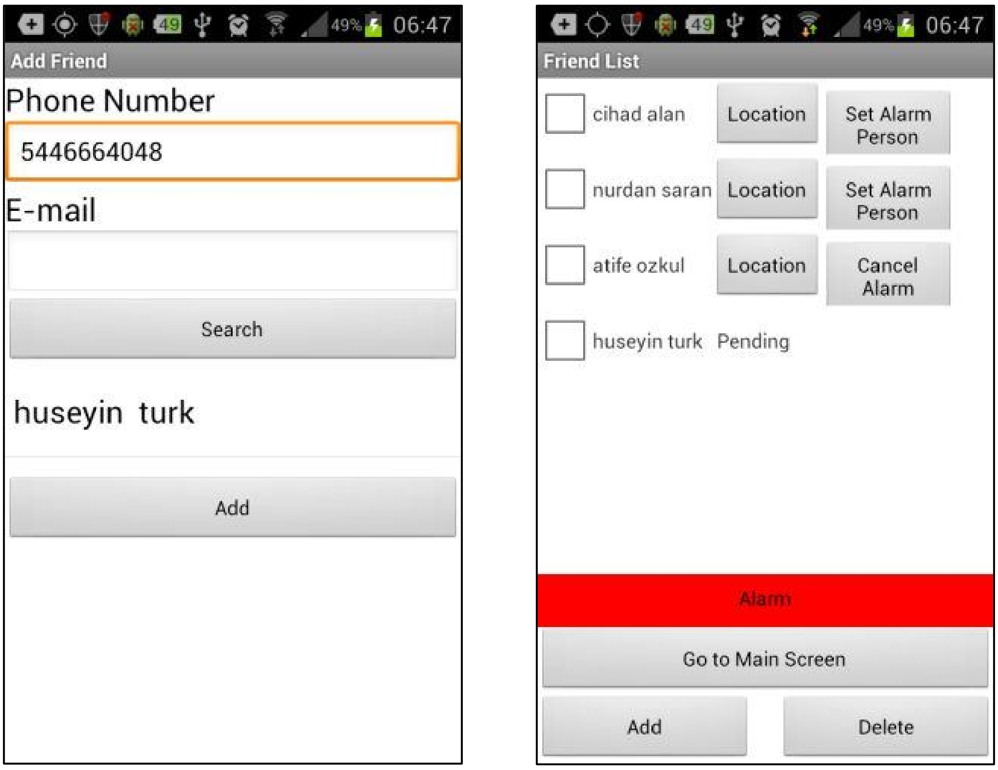

Figure 2.14 Adding in tracking list and pending status in the list.

In Step 5, Alarm SMS message is sent to the alarm people in the tracking list when child push red alarm button. Child can set the alarm people list just clicking the "Set Alarm Person" button. Alarm SMS message includes child's position and number as in the figure. When parent click the link he will see the child position on web Google map.

Figure 2.15 Alarm SMS Message

In Step 6, parents can set a safe region for their child on the mobile map. When the child is out of region, the mobile application sends SMS message in order to notify parents. For example; child goes to school near the home and if the child is out of this circular region, this case might be dangerous and the application must notify the parent using SMS Service. This property differentiates the application from the other applications.

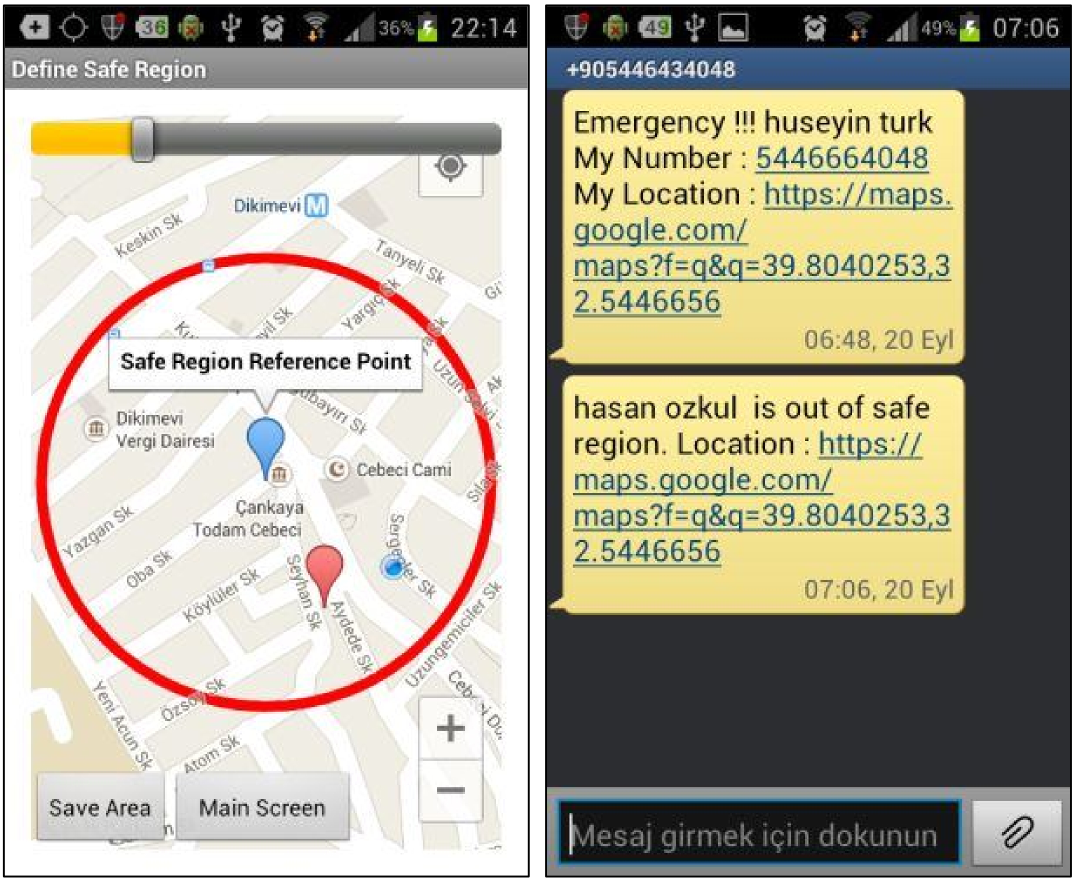

Figure 2.16 Safe Region that is determined by parent and the alert SMS

CHAPTER 3
EXPERIMENTAL RESULTS

Investigating the accuracy of mobile GPS devices are very important for family members tracking because the location sensitivity can be critical for family members. In this study, the accuracy of mobile GPS devices were compared over a few hours when placed at a (known) fixed location in the experiments. The accuracy of mobile GPS devices changed during the day as different satellites can be picked up by the GPS devices.

First of all, the application is loaded on two different mobile phones (Samsung GT-I8160 and Samsung GT-I9100G) and put them together in front of the window. The devices were connected to the internet via Airties-6372 wireless ADSL modem.

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Figure 3.1 Airties-6372 wireless ADSL modem

Secondly, GPS property is turned on mobile devices then it is started on the phones and the application was started to send longitude, latitude and accuracy values to the remote database server via internet.

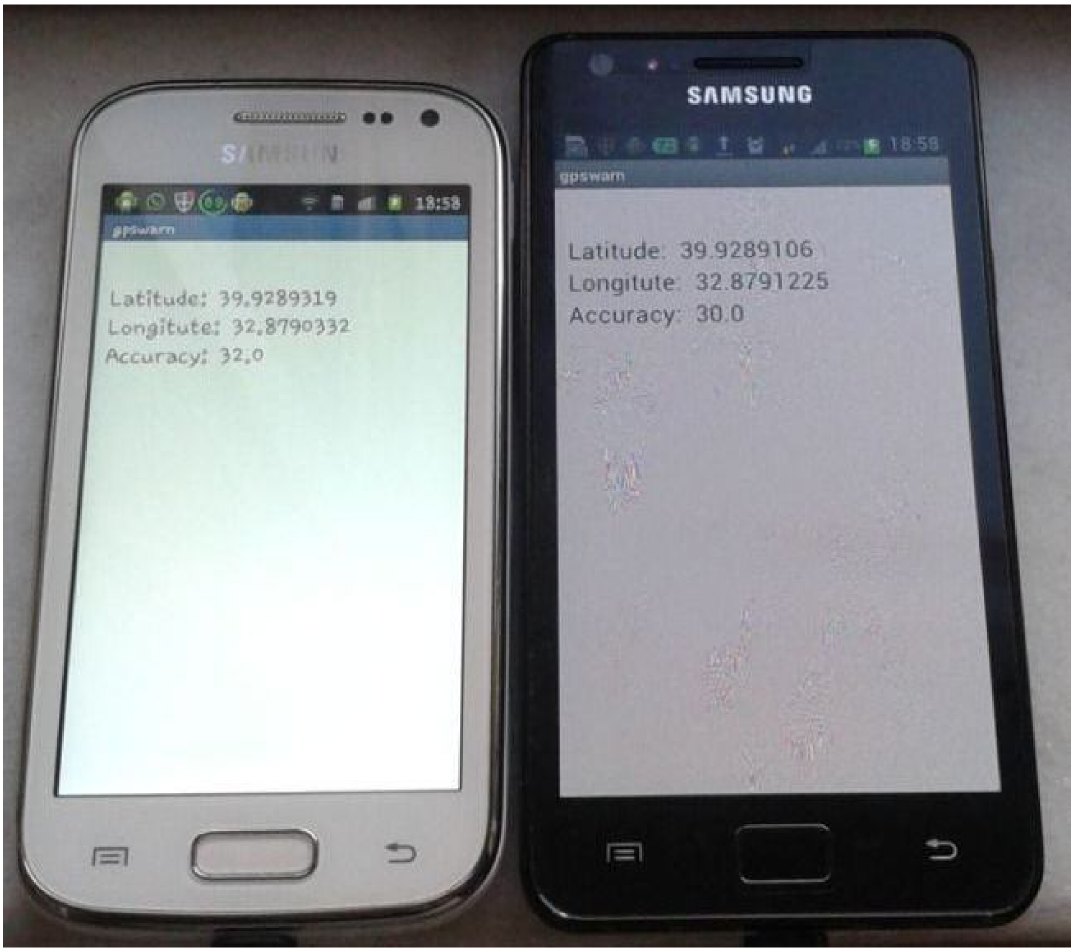
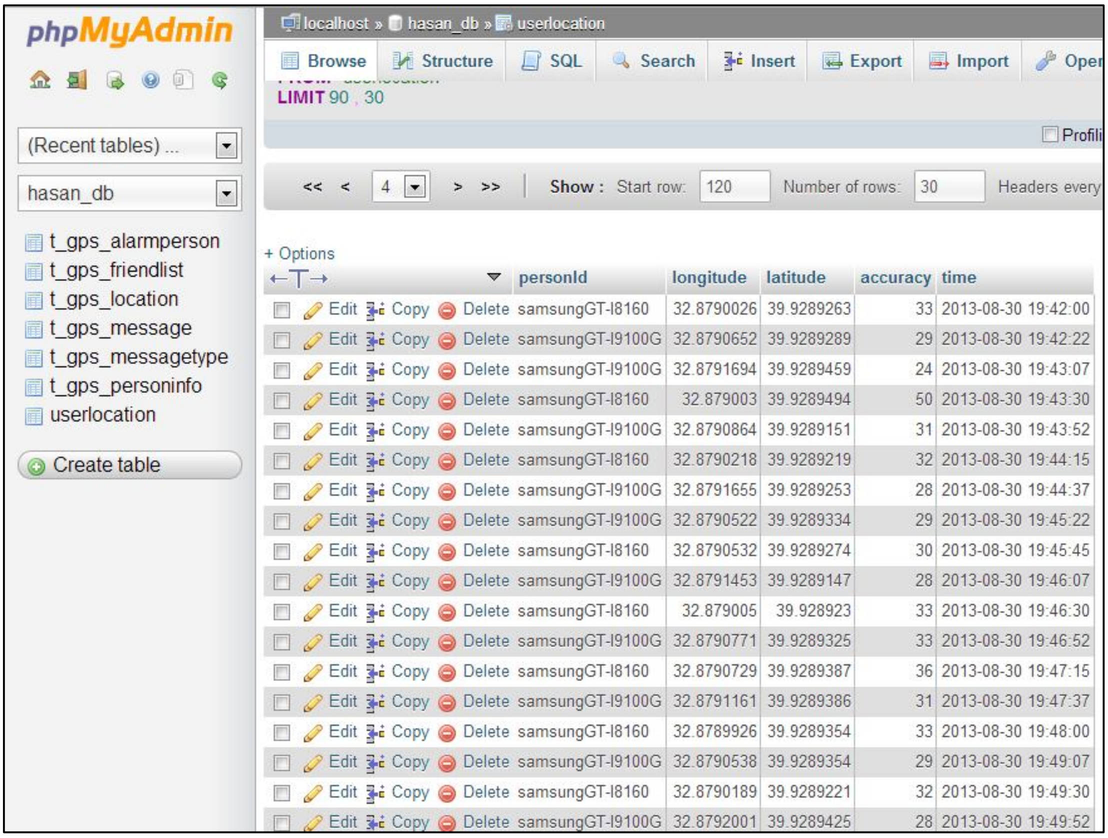


Figure 3.2 Samsung GT-I8160 and Samsung GT-I9100G

The mobile devices regularly send location data to MYSQL database server with device name. We can see the records (device name, longitude, latitude, accuracy, time) in the database table as in the figure. Samsung GT-I8160 stands for Galaxy Ace II and Samsung GT-I9100G is Galaxy S2 model in the table record.



	personId	longitude	latitude	accuracy	time
Edit Copy Delete	samsungGT-I8160	32.8790026	39.9289263	33	2013-08-30 19:42:00
Edit Copy Delete	samsungGT-I9100G	32.8790652	39.9289289	29	2013-08-30 19:42:22
Edit Copy Delete	samsungGT-I9100G	32.8791694	39.9289459	24	2013-08-30 19:43:07
Edit Copy Delete	samsungGT-I8160	32.879003	39.9289494	50	2013-08-30 19:43:30
Edit Copy Delete	samsungGT-I9100G	32.8790864	39.9289151	31	2013-08-30 19:43:52
Edit Copy Delete	samsungGT-I8160	32.8790218	39.9289219	32	2013-08-30 19:44:15
Edit Copy Delete	samsungGT-I9100G	32.8791655	39.9289253	28	2013-08-30 19:44:37
Edit Copy Delete	samsungGT-I9100G	32.8790522	39.9289334	29	2013-08-30 19:45:22
Edit Copy Delete	samsungGT-I8160	32.8790532	39.9289274	30	2013-08-30 19:45:45
Edit Copy Delete	samsungGT-I9100G	32.8791453	39.9289147	28	2013-08-30 19:46:07
Edit Copy Delete	samsungGT-I8160	32.879005	39.928923	33	2013-08-30 19:46:30
Edit Copy Delete	samsungGT-I9100G	32.8790771	39.9289325	33	2013-08-30 19:46:52
Edit Copy Delete	samsungGT-I8160	32.8790729	39.9289387	36	2013-08-30 19:47:15
Edit Copy Delete	samsungGT-I9100G	32.8791161	39.9289386	31	2013-08-30 19:47:37
Edit Copy Delete	samsungGT-I8160	32.8789926	39.9289354	33	2013-08-30 19:48:00
Edit Copy Delete	samsungGT-I9100G	32.8790538	39.9289354	29	2013-08-30 19:49:07
Edit Copy Delete	samsungGT-I8160	32.8790189	39.9289221	32	2013-08-30 19:49:30
Edit Copy Delete	samsungGT-I9100G	32.8792001	39.9289425	28	2013-08-30 19:49:52

Figure 3.3 Recorded data on the database table for experimental results

getAccuracy() function is used in the application to measure the sensitivity of location on a mobile device. The accuracy value means that if we assume a circle that has a reference point (x= longitude, y=latitude) with radius equal to accuracy value, the location is inside the circle with %68 probability according to the Android API Reference.[2]

The %68 probability just shows the horizontal accuracy. It represents standard deviation but location errors are not standard, the errors do not follow simple distribution in practice. [2]

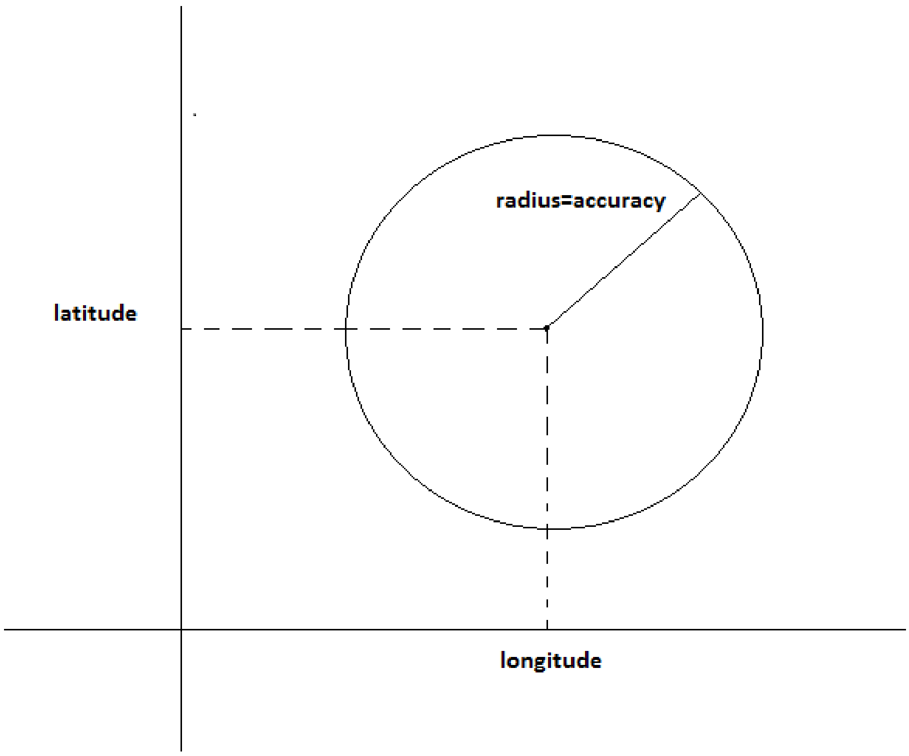


Figure 3.4 Definition of accuracy value in the experiment

Accuracy values were recorded to the database for two devices 2 hours (19:31-21:34).This figure shows comparison of two devices accuracy values by the time.

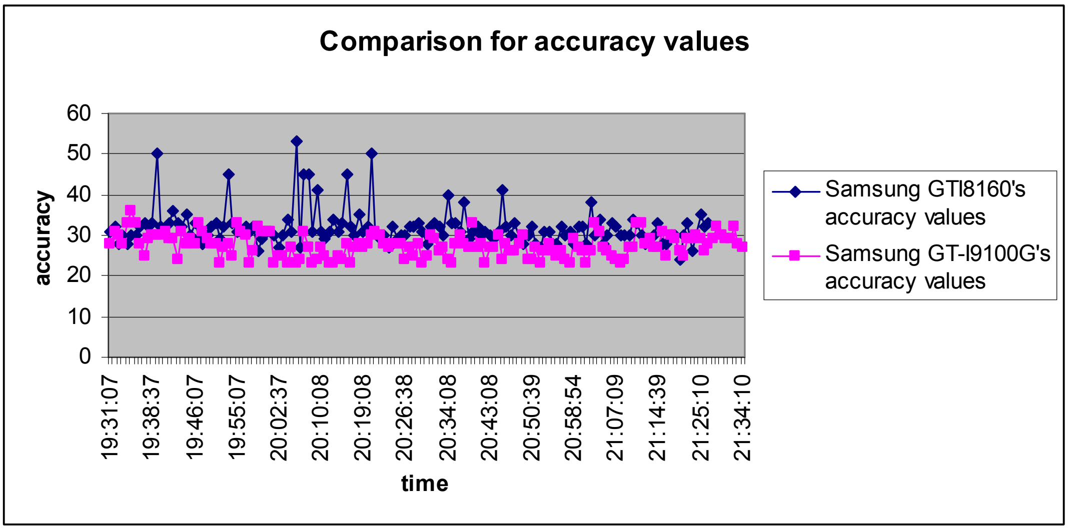


Figure 3.5 Comparison graph for the devices accuracy values

Figure 3.1.5 shows us the Samsung GT-I9100G device's accuracy is better than Samsung GT-I8160 device because when we draw a circle centered at this location's latitude and longitude, and with a radius equal to the accuracy for the devices, GT-I9100G's circle will be smaller than the other device depending on the Figure 3.1.5. It will show us GT-I9100G's location values are more accurate than GT-I8160.

Distribution of pink dots belongs to GT-9100 in Figure 3.1.6 which has more powerful GPS capability. Pink dots are closer than the blue dots to the center as you see in Figure 3.1.6. Which indicates that the location values of GT-9100G is better than GT-I8160.This figure confirm the result of Figure 3.1.5.

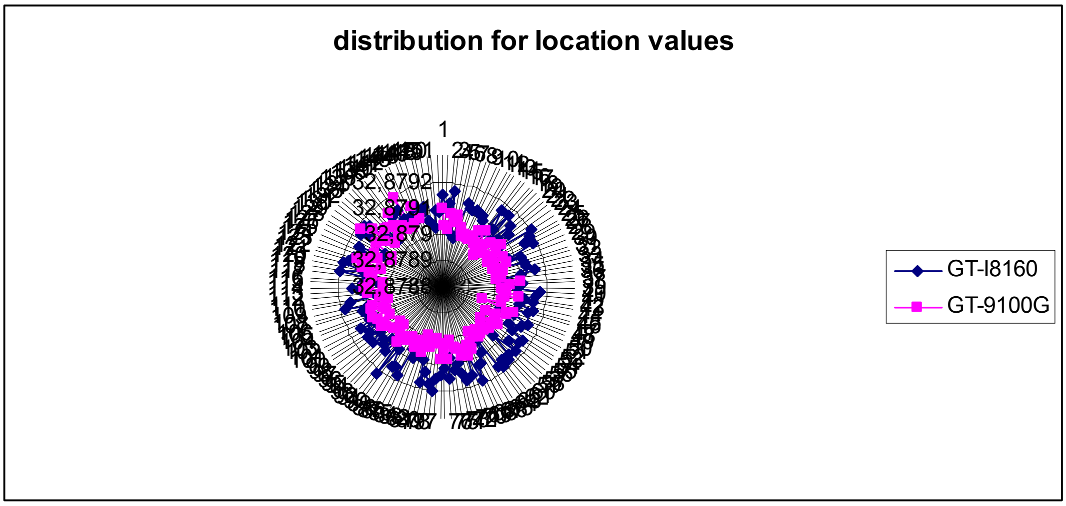


Figure 3.6 Distribution of latitude and longitude values for two devices

Depending on accuracy graph (Figure 3.1.5) and location graph (Figure 3.1.6), the more sophisticated device GT-9100G‘s location values are more accurate than the GTI8160.

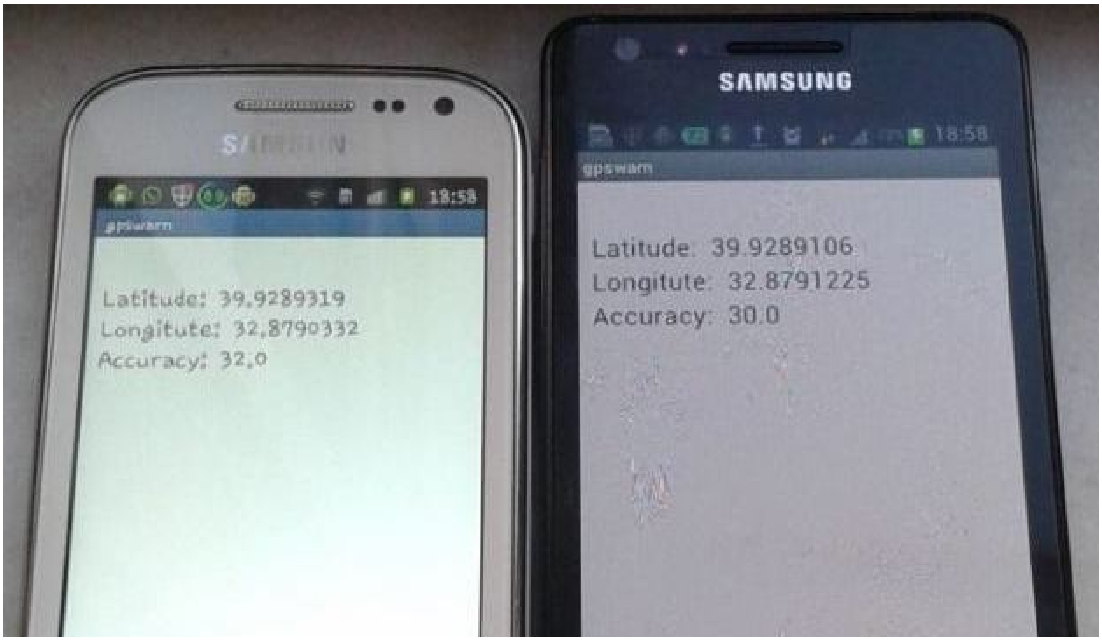


Figure 3.7 The picture for comparison of latitude and longitude values

Comparison of latitude values by converting meter is in the below calculation.

32.9289319-39.9289106 =0.0000213 latitude difference. The latitude has 111000 meter normally. 0.0000213*111000=2.3643 meter difference just think about the latitude data. GTI8160 gives 2.36 meter different result. GT-9100G has more powerful GPS and gives more accurate results.

In this experiment, the weather was sometimes cloudy. Average longitude and latitude values were compared for cloudy and clear weather conditions for Samsung GT-I9100. The weather was quite clear from 19:00 to 19:30 in 29 August and the average latitude value was 39.9289270 .The weather was cloudy from 9:00 to 9:30 and the average latitude value was 39.9289455. Difference is 39.9289455-39.9289270=0.0000185 * 111000 meter=2.05 meter practically. The weather condition effects GPS's performance depending on weather conditions according to this experiment.

CONCLUSIONS

Depending on statistics of children mobile phone usage [25, 15], it is foreseen that the value of Family GPS Tracking Applications will increase with the raising family security needs in the world. Nowadays, almost all of the smart phones have GPS module so Family GPS Tracking applications are applicable for every family that has smart phone but more sophisticated devices should be used for tracking applications on mobile devices because accuracy of location values change depending on the GPS hardware. The weather condition also affects the GPS's performance according to the experiments. GPS's performance is very crucial because the application sends alert to the family depending on the location value. Sometimes parents can define custom areas for their children and application compares every GPS location value with defined location value. If the child is out of safe region, the application immediately notifies the parent by SMS. This property differentiates this application from the other ones. One of the main advantages of this study is encryption for every location value with family key. Every pair of location value is encrypted with personal family key. Thus, nobody can see the user location value on the database table. These are the advantages that make the application more efficient from the others.

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APPENDIX A

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2010-2012	Huawei Telecom	Research Engineer
2009-2010	Smartsoft IT	Software Developer

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