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Friend's Location Tracker

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Abstract: Personal Tracking Systems are the tracking devices specially built up for personal information. The person takes it with him and the information of where he is presently is provided. The same system has been implemented in this mobile tracking application but various extended features that the existing system does not have. This system is GPS enabled android mobile phone whose location is tracked. Our application provides the functionality of defining the geo-fence areas as safe, risky and highly risky.

Keywords: GPS, Friend's tracking app, geo-fence, A-GPS

I. INTRODUCTION

Various GPS-based tracking systems have been successfully deployed and utilized in various applications such as fleet and vehicle location identification, and in route guidance. Recently, systems that integrate GPS and GSM technologies with Google earth to provide real-time data have also been proposed. However, for indoors and closed environments GPS systems fall short and it becomes difficult to acquire the necessary satellites for accurate position computation. Some of the alternate techniques that are proposed for indoor location tracking include the integration of Bluetooth technology with 3G networks. The proposed solution suggests that Bluetooth terminals can exchange information with each other and then a Bluetooth access point provides the interface to a mobile network. In their solution they presumed that Bluetooth fixed infrastructures are expected to be installed in offices, homes and public areas which is not the case nowadays. The implementation of a mobile indoor application that delivers maps and linked database information to indoor wireless devices such as mobile phones and PDAs. Users would then interact with the web pages on their phones while viewing floor plans around their current location, searching for an office or a classroom.

In today's world, child's safety is a major concern. It becomes difficult for the parents to keep track of their children all the time they are away from home. Hence a need arises to provide a way to do so in order to ensure child's safety. This application is of interest to the parents and police department to restrict the roaming of a mobile user to a predefined geographical boundary. If mobile user breaches this boundary, then a alert message containing mobile's current location is sent to register mobile phone numbers and email ids.

II. OBJECTIVES

The application aims at providing a simple way-out for ensuring the child's safety all the while he is by his own. The main objectives of this application are as follows:

- The application would provide the ability to divide interested geo-graphical area into different sub zones (e.g. safe, risky, highly risky etc.) and based on breaching of these zones a different alert message would be sent to registered users.
- The application would also provide the ability to automatically send a message to registered users with mobile's current location after user configured time interval.
- On geographical boundary breach, the application would warn user in the form of a message with beep so that mobile user would also be well informed about risk associated with his/her movement.

III. LITERATURE REVIEW

A. Global Positioning System

Global Positioning System (GPS) is a Global Navigation Satellite System (GNSS) developed by the United States Department of Defence. It is the only fully functional GNSS in the world. It uses a constellation of between 24 and 32 Medium Earth Orbit satellites that transmit precise microwave signals, which enable GPS receivers to determine their current location, the time, and their velocity. Its official name is NAVSTARGPS. GPS is often used by civilians as a navigation system. A GPS receiver calculates its position by precisely timing the signals sent by the GPS satellites high above the Earth. Each satellite continually transmits messages containing the time the message was sent, precise orbital information, and the general system health and rough orbits of all GPS satellites.

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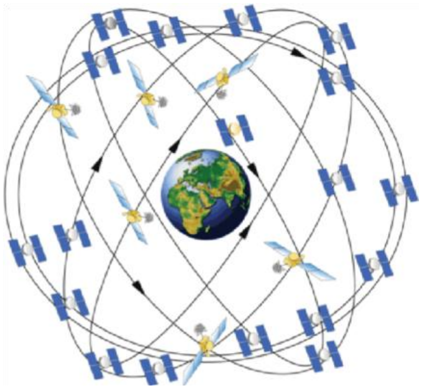
Figure 1: GPS satellite constellation

In general, a GPS receiver uses information from the GPS satellites orbiting the earth to calculate its current location. The GPS system contains 27 satellites that continually orbit the earth, transmitting information to would-be receivers. Each satellite follows a defined path, ensuring that at least four satellites are "visible" from any point on earth at any given time. Being able to have a "line of sight" to at least four satellites is necessary to determine location using GPS. Figure 1 shows a depiction of the GPS satellite constellation.

Each GPS satellite in the constellation continuously transmits its current position (ephemeris data) and almanac data. The almanac data includes data about each satellite in the constellation, including orbiting data as well as information about the overall state of the system as a whole. To say it another way, ephemeris data is information about a single satellite, and almanac data is information about every satellite. Every satellite transmits both. Though both the ephemeris data and almanac data provide location data for a given satellite, the ephemeris data provides accuracy for location calculation.

To calculate its location, a GPS receiver must be able to determine its distance from multiple satellites. It does this using the ephemeris data. Included in the data that is transmitted from the satellite, along with the position data, is the time at which the transmission started. Each GPS satellite contains highly accurate timekeeping mechanism that allows the satellite to keep its time in sync with the rest of the satellites. To produce an accurate location calculation, the GPS satellites and GPS receivers must have their clocks highly synchronized. Even the slightest difference in time can cause large errors when computing location.

Using the transmission start time, the GPS receiver can calculate the time it took for the transmission to be received (the receiver knows when the transmission ended). This calculation is made with the assumption that the radio waves that transmit the data travel at the speed of light in a vacuum (which is not always the case). Using the start time, end time, and a constant for the speed of light, a GPS receiver can calculate the distance of the satellite from the receiver.
Using the distance from multiple satellites, the GPS receiver can triangulate its current location. Essentially, the point at which all the spheres intersect is the location of the receiver. A minimum of three satellites is needed to determine a two-dimensional location (latitude and longitude).
Communications from additional satellites allow a GPS receiver to determine additional positional information such as altitude. A GPS receiver will not limit itself to only four satellites. In general as the number of satellites from which the receiver can receive data increases, so does the accuracy of the location (there is an upper limit, however).
GPS is useful for determining current location, but it does have some drawbacks (especially for mobile platforms), one of which is the time it can take to calculate the current position. Before the location can be calculated, multiple satellites must be found. Many satellites are orbiting the earth, but only a handful can be "seen" at any given time because most will be below the horizon and blocked by the earth (remember, a line of sight is needed). The almanac used by the GPS system can provide assistance in determining which satellites should be used for a given location at a given time. However, if the GPS does not have a relatively current almanac, it will need to have the almanac data transmitted by a GPS satellite. This can be a slow process.

GPS consists of three segments - the satellite constellation, ground control network, and user equipment.
Space segment - The satellite constellations that provide the ranging signals and navigation data messages to the user equipment.
Control segment - ground control network which tracks and maintains the satellite constellation by monitoring satellite health and signal integrity and maintaining satellite orbital configuration.
User segment - user equipment.

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B. Google Map API

To develop application Java ME platform will be used. Java ME is a development tool which enables to develop programs for different mobile phones. As a background map Google Maps will be used. Google Maps API for Java ME is available on the internet.

The coordinates of users will be taken from GPS and interpreted. After getting latitude and longitude values, location of users are represented on map by symbols. User will be able to zoom in and out of map. In addition he will be able to look around using directions which might be set differently for different mobile phones such as using fingers for smart phones and number for other phones.

Through the known geographic position, this application enables the user to track a mobile device and send alerts if it is out of the radius around an interest point, previously defined by the application administrator. The advantages of this technology is by using existing equipments and free services like Google maps and GPS, we can construct a very reliable location tracking system. The basis of this program is GPS.

IV. METHODOLOGY

We intend to develop an application which tracks the mobiles location and if the location is outside the security zone that is the zones are divided into three priority regions. The priority regions are safe, risky and highly risky. So if the mobile's location co-ordinates are found breaching the priority zones, an alert message is sent to the number which is registered for receiving the alert message.

The overview of the application is described in figure 3 given below.

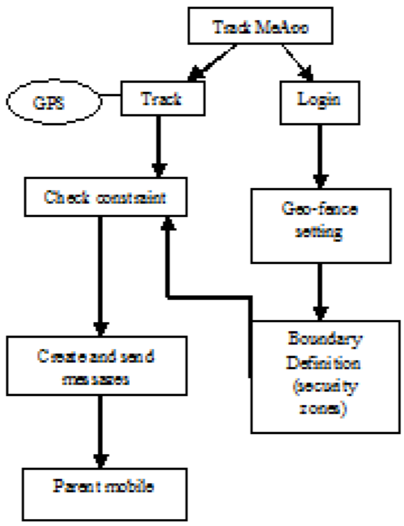

Figure 2: Block diagram of TrackMeApp

Step1. Install application.
Step2. Login
Step3. Enter phone number
Step4. Specify radius for each of the three zones
Step5. Select the centre location on the map
Step6. Set the zones
Step7. The application checks for updates from the GPS at regular intervals
Step8. If the current location is outside the fence1 then send alert message1 go to step7
Step9. If the current location is outside the fence 2 then send alert message2 go to step7
Step10. If the current location is outside the fence3 then send alert message3 go to step7

A. Admin Console

In the Admin Console the information is stored into the database. The information is related to the parent and consists of their contact details and the geo-fence settings. The geo-fence is set by drawing circles of desired radius on the Google map. The centre of the circle is then fed into the database and stored. The map displays the location labels so that it is easier for the parent to identify the location before setting up the geo-fence. Admin console also provides the facility to change the password and phone number. The basic requirement of this application is a GPS enabled mobile phone.

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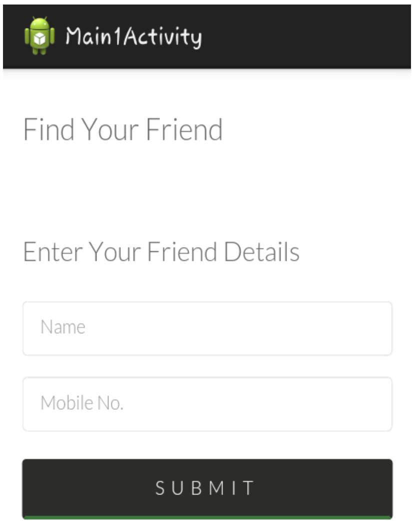

Figure 3: App Screen

The Figure 3 shows the App Screen which consists of the Google Map. The map opens up at the current location of the user. The parent then has to enter the radius and click on the "Set Circle" button and point at any location on the screen which needs to be set as the centre of the three zones. Settings provide the facility to change username, password and phone number.

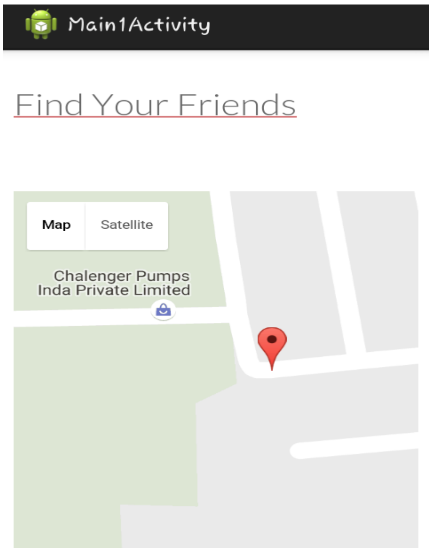

Figure 4: GPS location

Figure 4 shows the configuring of different security zones done by the parent. The parent provides the radii of all the zones and then clicks the button to set the zones and proceed with the next phase of application i.e. alert generation on breaching the safe boundary.
The safe zone is shown by the green colour region. Followed by it, is the second zone i.e. risky zone whose boundary is shown by blue colour and the highly risky zone is depicted by red colour boundary.
For example, here in the figure above, the user has provided the radii of different zones in meters. For the safe zone, the radius is provided as 1000 meters. And 2000 meters and 3000 meters for the risky and highly risky zones respectively. The zones are drawn around a fixed point which is shown by the pin point as shown in figure above. The parent sets this fixed point by clicking on the button "set Cor" and then the fixed point is set a followed by which the different security zones are drawn around it. And finally the zones are set.

B. Location Tracing
Although standard GPS can provide accurate location data, the limitations it imposes make it difficult for mobile devices to use it. To help circumvent some the limitations of standard GPS, modern mobile devices make use of assisted GPS (A-GPS) and possibly simultaneous GPS (S-GPS).

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A-GPS uses the mobile network to transmit the GPS almanac along with other pieces of information to a mobile device. This use of the mobile network allows for faster transmission of the almanac, which may lead to faster determination of the device's current location. This will also improve the time it takes to acquire a GPS location.
Devices that use standard GPS may use the same hardware to communicate with GPS satellites and make mobile phone calls. This means that only one of these actions can take place at a time. S-GPS addresses this issue by adding additional hardware that allows the GPS radio and the cellular network radio to be operational simultaneously. The ability to have two radios active can speedup GPS data transmission because it allows the data to be received while the cellular network radio is active.
In case the GPS does not work, we can also use the network provider to extract location. In Android, network-based location can use different methods for determining the location of a device. As of this writing, the network location provider can provide location information using cell towers, or based on wireless network information.

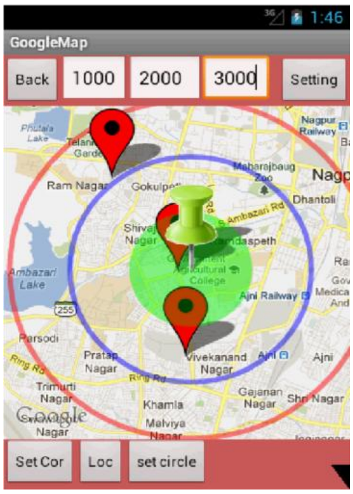

Figure5: GPS locations

In Figure 5, the different positions of the child are shown on the map. The GPS tracks the location of the child and provides the corresponding latitude and longitude based on which the alert message is generated by comparing the distance of child from the pinpoint and the boundary of the zones.

C. Location Processing
This is the core part of implementation of this application. The application has to generate alert message and send them to the registered mobile number. This has to be done at some time interval. The message is sent to inform the parent about the location of the child i.e. whether the child is safe or he has breached the safe zone. All of this is done in location processing.
For this application to run in background, we are using services in android. In the background the application will utilize the current location of the child from the location tracing module which is obtained from the GPS and the fixed centre of the geo-fence from the database. So, the distance of the child from the fixed point say, school or tuition centre will be calculated and that distance will be compared with the radius of the zones. For calculating this distance we use the Great circle Algorithm.

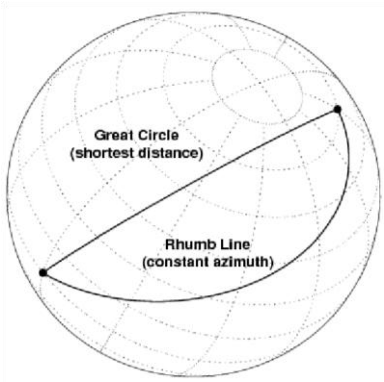

Figure 6: A great circle and one possible rhumb line connecting two distant locations.

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The great-circle or orthodromic distance is the shortest distance between any two points on the surface of a sphere measured along a path on the surface of the sphere. Because spherical geometry is different from ordinary Euclidean geometry, the equations for distance take on a different form. The distance between two points in Euclidean space is the length of a straight line from one point to the other. On the sphere, however, there are no straight lines. In non-Euclidean geometry, straight lines are replaced with geodesics. Geodesics on the sphere are the great circles (circles on the sphere whose centers are coincident with the center of the sphere).

A line on a sphere that cuts all meridians at the same angle; the path taken by a ship or plane that maintains a constant compass direction is called as rhumb line. The figure 6 shows the rhumb line and great distance line.

This method calculates the great circle distance, and is based on spherical trigonometry, and assumes that: 1 minute of arc is 1 nautical mile 1 nautical mile is 1.852 km.

D = 1.852 * 60 * ARCOS (SIN(L1) * SIN(L2) + COS(L1) * COS(L2) * COS(DG)) Where,
L1- latitude at the first point (degrees)
L2- latitude at the second point (degrees)
G1- longitude at the first point (degrees)
G2-longitude at the second point (degrees)
DG- longitude of the second point minus longitude of the first point (degrees) = G2-G1
D- Computed distance (km)
If the child is in the safe zone, the distance calculated should be always less than the radius of the safe zone. If the child breaches safe zone, the compared distance will increase and then the alert generation process will start. The message will be sent in some time intervals for instance, every 10 minutes or every 15 minutes. Likewise, for the risky and highly risky zones, the alert messages will be generated and the parent will be able to know the location of the child on breaching the fences.

V. CONCLUSION

A long way in a remarkably short time has been achieved in the history of android application development. A Mobile Device has numerous applications but there are much powerful applications available in mobile devices that are sparingly used. Location tracking is one of the killer applications available on the mobile devices. There are many applications for child tracking now a days. In this paper, we have proposed an application which allows specifying different safety zones. The application is cost effective and does not require any additional device. The application runs on a single mobile and the alert messages can be sent to any mobile.

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