An Efficient Power Saving Technique Based Location Alarm For Smart Phones

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Abstract. In today’s world it is not possible for everything to work at the scheduled time. Therefore it is necessary that our daily applications remind us on a particular location instead of a particular time. When the reminder is set, it continuously checks the distance from the destination. If it matches with the maximum distance entered it reminds the user that he/she is about to reach their destination. When the user enters the proximity radius that was set in the application, the user is notified. The application is set to work with availability of GPS as well as mobile network data in the users’ device which runs on android platform. The application also limits the impact of battery life of its device by bringing down the rate of updates and background services when the device battery is low and hence optimizing the battery usage for further important tasks. The location can be either a place or the GPS location of other user. The notification can be enabled on both the users and both the user can be notified based on the proximity radius set by them.

1. Introduction
The battery optimized location based alarm system is an android application. The usage of android mobile devices has increased drastically in this present generation because it is an open source operating system [1][2]. The aim is to create an android based application, which gives a reminder on the location of a place or other user specified by user. In time based reminders, the system alerts a person based on the time set but the location based alarm system alerts the person based on the geographical area[3][4]. This is more useful when the time of an event is unknown to the person and hence it brings more relevance.

The application allows user to enter the destination address which are then converted into latitude and longitude points for the GPS and network location provider to alert the person when the user reaches the proximity of the area set. The user can also set the target location as the location of the other user[5]. Both the users can enable the notification and they both will get notified based on the proximities set by each of them. [6][7]. GPS is a satellite based system which gives geographical information to the android device and location based network provider gives the location information through cell towers [8][9]. While travelling to a place the user can set an alarm based on the location instead of constantly checking the distance left to be covered. In current trend, carpooling is booming. This application provides the user to set a notification based on the location of multiple other users and the user will be notified while nearing the other users which would be a great deal in carpooling or any transport services. The location based system allows software to obtain the current location of android device. This will consist of location obtained from the Global Positioning System (GPS) satellite.
constellation[10]. In our battery optimized application, we will get the current location of user using the longitude latitude. Also, it is battery optimized application which means that application monitors the battery status whether is discharged or charging via USB or AC adaptor and accordingly changes rate of updates and background services.

2. Methodology

2.1 Geocoding

It is a technology which is used when a user provides the postal address in the application and this address is later converted into a location on earth’s surface which is described in the form of latitude and longitude. The application requires internet connection for the proper functioning of this module. Android system provides class to implement this functionality which is called Geocoder class which contains the entire API’s necessary for the execution of the geocoding module. The API getFromLocationName is useful in presenting a list of all related addresses matched with the postal address provided by the user and if the address provided by the user is not relevant or does not exist the API throws an exception.

2.2 Reverse-Geocoding

It is a process of converting the latitude and longitudes generated by Geocoding technique back to the human readable format that is in form of postal address. This process can be useful when the address name of the pointing location is unknown and is helpful in identification of streets and areas and any other unknown location which a user needs to know.

2.3 Proximity Alerts

Android have LocationManager class which provides location services supported by the device to an application. The location based application uses API for setting proximity alert for a given address. The API needs latitude/longitude geographic coordinates, radius around the central point of alert region and an expiration time for the alert. It passes a notification to the mobile application whenever the device hits the proximity radius specified by the user earlier as well as manages the validity for the notification. A parameter called Pending Intent Parameter gets executed when the alert is established and the API which is used is:

```java
locationManager.addProximityAlert(latitude, longitude, radius, expiration, pendingIntent);
```

Figure 1. Proximity alert.

Distance Computing Formula

\[
\begin{align*}
\text{dlon} &= \text{lon2} - \text{lon1} \\
\text{dlat} &= \text{lat2} - \text{lat1} \\
a &= (\sin(\text{dlat}/2))^2 + \cos(\text{lat1}) \times \cos(\text{lat2}) \times (\sin(\text{dlon}/2))^2 \\
c &= 2 \times \arctan(\sqrt{a}, \sqrt{1-a}) \\
d &= R \times c \text{ (where R is the radius of the Earth)}
\end{align*}
\]
2.4 Address Inputs

The application lets user to enter the address at which he needs to be notified and also the option to provide a proximity range around that area. User can get the spatial address (longitude and latitude) by entering the address string with the help of geocoding.

2.5 Notifications

A user gets notification when an alert is triggered and this notification is managed by the Android notification Services. Android uses Notification manager class to notify the user by creating notification alerts and alerts are produced in the status bar of the device.

2.6 Intent and pending intent

An android intent is an object carrying a message from one component of the system to the other component, they can communicate messages among any of the three components of the application - Activities, Services and Broadcast Receivers. Intent is a passive data structure which holds the abstract information of the operations need to perform.

```java
private double distance(double lat1, double lon1, double lat2, double lon2) {
    double theta = lon1 - lon2;
    double dist = Math.sin(deg2rad(lat1)) * Math.sin(deg2rad(lat2)) + Math.cos(deg2rad(lat1)) * Math.cos(deg2rad(lat2)) * Math.cos(deg2rad(theta));
    dist = Math.acos(dist);
    dist = rad2deg(dist);
    dist = dist * 60 * 1.1515;
}

private double deg2rad(double deg) {
    return (deg * Math.PI / 180.0);
}

private double rad2deg(double rad) {
    return (rad * 180.0 / Math.PI);
}
```

Figure 2. Code Snippet for calculating the distance between two locations using their longitude and latitude value.

Figure 3. Intent
Pending Intent is a indicative that you give to a foreign application like Notification Manager, Alarm Manager, or other 3rd party applications, which allows the foreign application to avail your application’s permissions to execute an existing piece of code. By giving the pending intent to the third party application we can make use of that application in such a way that it is ours only, so pending intent is just the reference to the data which contains the original intent.

2.7 Event Broadcast
After providing the destination address, location manager continuously checks for the coordinates of the specified region along with the proximity region’s coordinates and whenever the co-ordinates of device hits the proximity specified by the user, location manager carry out the pending intent with additional Information whether user is entering the locality or leaving it. The application state its interest in the broadcast intent by recording a broadcast receiver in its manifest file using intent filters. The application can run in the background When the Broadcast Receivers are registered in the manifest

2.8 LBS (Location Based Services)
Location based services are the type of services which uses real time geo data of the cellular device or mobile phones which are GPS enabled, to provide them with the real time information. LBS can be question based and provide the user with the data regarding the queries or they can be push based providing the various marketing information and delivering offers and deals to the users who are in a particular geographical area. LBS requires five basic components: software application of the service provider, a mobile network to transmit data and requests for service, a content provider to provide the end user with geo-specific information, a positioning component and the end user’s mobile device.

2.9 Battery Manager
The Battery Manager relays all battery and charging information of the device in a sticky Intent with the charging status. Since it is a sticky Intent it is not necessary to register a Broadcast Receiver. The charging status can be extracted, if the device is being charged via USB or AC charger or is in discharged state as:

```java
int chargePlug = batteryStatus.getIntExtra(BatteryManager.EXTRA_PLUGGED, -1);
boolean usbCharge = chargePlug == BatteryManager.BATTERY_PLUGGED_USB;
boolean acCharge = chargePlug == BatteryManager.BATTERY_PLUGGED_AC;
```

Figure 4. Battery Manager.

3. Architecture Design
The system architecture can be mainly divided into following activities:
User provides the source and destination address in the application. Along with this he also defines the proximity at which he wants to be notified. After receiving the address from user, the application converts the string into latitude and longitude values provided by GIS, co-ordinates on the earth’s surface.
The destination point is saved in the database which is instantaneously checked by the Geocoder class.
with the current location.

![Architecture of Proposed Model](image)

**Figure 5. Architecture of Proposed Model**

Application will do the periodic measurement of the current location with the destination address and when user enter in the proximity range of the destination address a notification alert will be send by the notification manager to the application. Also, in order to cut down the battery usage by the application, the app monitors the battery level of the device. The application increases the rate of background updates in regarding where the device is connected to an AC charger, decrease the rate if the charge is over USB, and decrease it further if the battery is discharging. The charging status can switch as easily as an android device can be plugged in, so it's important to track the charging state for changes and alter your refresh rate accordingly. The Battery Manager relays an action whenever the device is connected or disconnected from power. It is important to receive these events even while the application is not working, particularly as these events would impact on how frequent the application starts in order to initiate a background update.

### 4. Results

In our location based alert application, we will get the current location of user’s android device and when the user reaches the proximity area set of the destination address a alert will be send to the user. The user can also set the target location as the location of the other user. Also, it is battery optimized application which means that application monitors the battery status whether is discharged or charging via USB or AC adaptor and accordingly changes rate of updates and background services. In this section some screen shots of the implemented application are presented as follows:
Figure 6. Screenshot shows setting source and destination location for setting up location alarm.

Figure 7. Screenshot shows setting proximity radius for destination location.

Figure 8. Screenshot shows notification invoked on reaching destination location.

Figure 9. Screenshot shows to clear location alarm.
5. Conclusion

The application is for alarming a user while entering the proximity of an area or other configured users. It reduces the dependency on the time based alarm system, providing it more accuracy and precision by using the location to alarm the person. For this purpose the application uses the GPS and network location provider for the current location and destination. User can engage himself in some other important work as the life will be much simpler with the help of such applications that automates tasks.

6. Future Work

Including voice message in the future will enhance the usability of the application. The application can be improved to be used in all the public transports and public can be notified based on the location of the vehicle.

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