

Carlos III University of Madrid  
Master in Electronics Systems Engineering



## Exercise 1

# Digital systems integration and web interfaces.

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## Introduction:

This project involves developing a smartphone application that controls the device position and if the user goes out a preconfigured perimeter security, the application sounds an alarm and sends a message to a server. This application is designed for old people who can't go too far from a point, for example, their houses. The application can be set up only by a parent with the password (see the user manual to find the default password), who introduces the center position on a map and how many meters from this center the user will be able to get away. [1]

For this exercise, the application won't send a message to a server (this feature will be introduced in the next exercise).

The mobile platform chosen is Android, an open source operating system for mobile devices developed and supported by Google Inc. Currently it's the most popular operating system for smartphones in Spain, with 87, 6% of market share, but the reason it was selected for this project is its SDK is free and the applications can be debugged directly on a Nexus phone through ADB. [2] [3]

This document shows how the application has been developed and a short user's manual with useful information to use the application for first time.

## Development:

The application was developed on Android Studio 1.4.1 for Windows using API level 14 (Android 4.0) and debugged on a Nexus 4. This API level was chosen because it has a good compatibility with the most part of devices, and provides all the needed features for this project.

It has 3 activities with layouts and user interface and a service that runs on transparently doing the position control task. These activities and service are:

### **Welcome:**

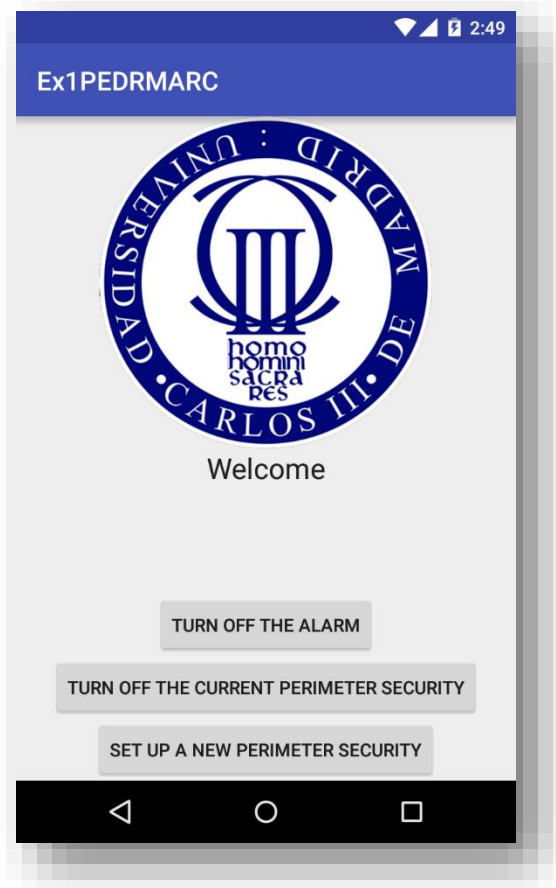


Figure 1 Welcome activity GUI

This activity is the main activity. It's launched when the application is started for first time (even the service is running). Here the user can:

- "Turn off the alarm" if it's sounding.
- "Turn off the current perimeter security" and stop the service if it's running.

- “Set up a new perimeter security” and pass to *SetupActivity* activity to configure a new center position and radius starting a new service.

The two buttons at bottom (“Turn off the current perimeter security” and “Set up a new perimeter security”) are protected with password. The default password is “1234” and it can be changed only using source code.

### **SetupActivity:**

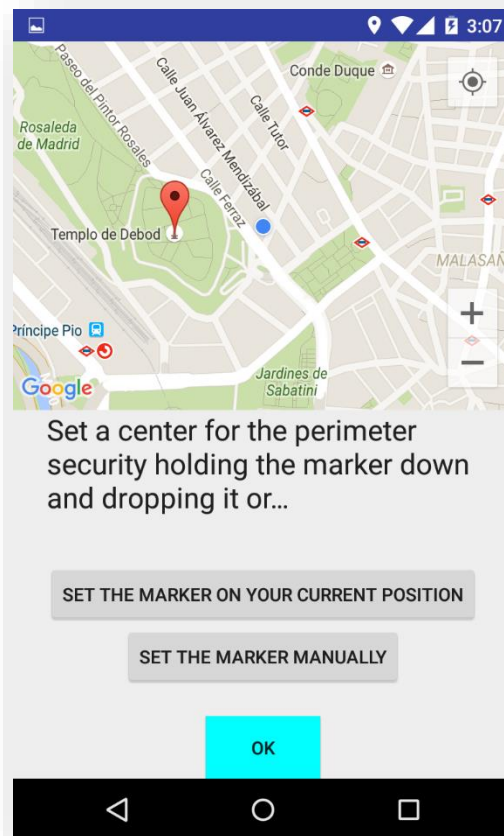


Figure 2 SetupActivity GUI

In this activity the user is able to set a new service up introducing a new position center and a radius in meter and start it. To do the setup easier, instead of Android Location APIs, the activity use Google APIs, because of the following reasons:

- Google APIs use GPS, Wi-Fi, GSM and the Google Location Service to get a better location with less consumption, even the device hasn't GPS signal.
- Google APIs allow to introduce Maps and markers, doing the setup easier.

To use these APIs, the application must be registered with a Google Account in Google Developers and its Android Manifest file must have the private key that allows to use these Google services.

The red marker will be the center of the perimeter. The user can set the center up holding the red marker down and dropping it in the desired position. The button “Set the marker on your current position”, as its name says, set this marker on the current device position if it’s available. The third method to set the marker is introducing manually the latitude and longitude values. The application checks if these values are correct and puts the marker on the new place.

When the user clicks on OK, the application asks the meters for the perimeter radius, and shows an advice with information about how the service works. Then, the service is started, and all the activities are closed.

### ***AlarmActivity***

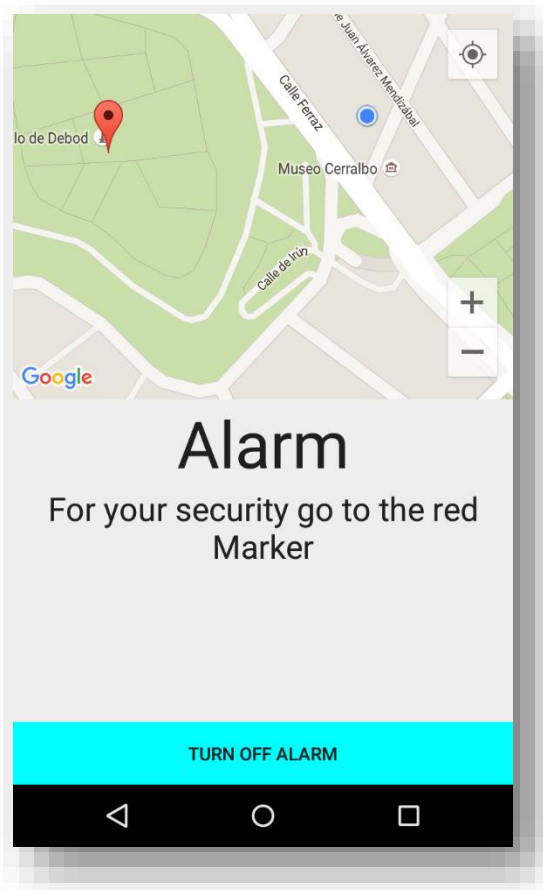


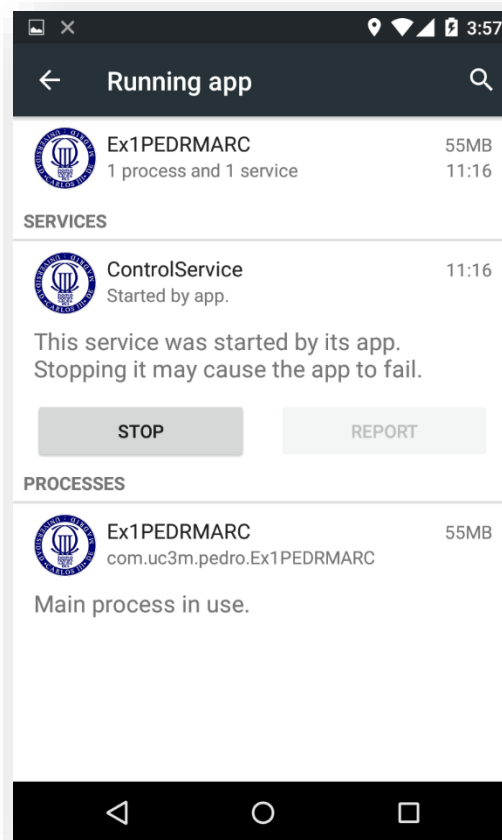
Figure 3 AlarmActivity GUI

Before starting the service, it begins to control the device position, and if it goes out the configured perimeter, the service sounds an alarm and starts this activity.

This simple activity shows a map to help the user arrive to the perimeter center. The button “Turn off the alarm” orders the service to stop the alarm. The alarm is stopped when the activity is closed too.

The activity is able to be started when the device is locked and screen is off.

### ***ControlService***

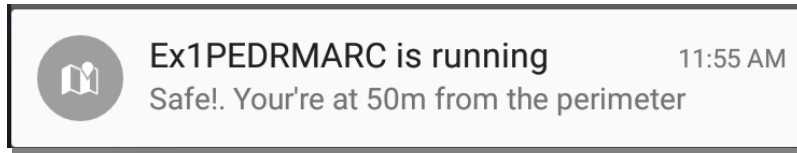


*Figure 4 ControlService running*

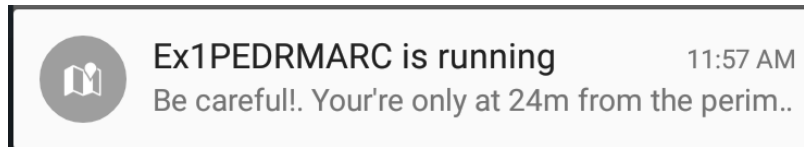
This service is designed to run in foreground with a permanent notification. The reason for setting to run in foreground is the need to keep the process running. If the service was on background, Android could close it when low on memory.

There is a thread with a loop which controls the device position and the distance from the center each 10 seconds. Depending of the center distance, the service shows different notifications showing this distance in meters

These are some notifications used to inform about the distance:

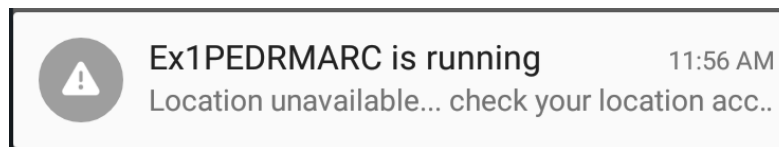


*Figure 5. Service's notification when device is close the center*



*Figure 6 Service's notification when device is far from the center*

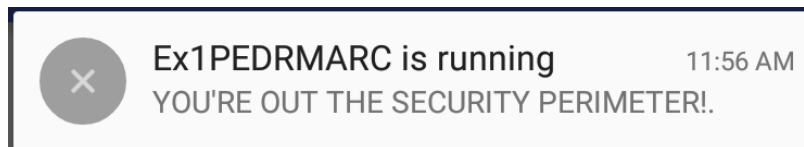
If the location access is unavailable, the service isn't able to work properly. Then, the notification showed is:



*Figure 7 Service's notification when location access is unavailable*

When the device goes outside the perimeter, the service does the following tasks:

- Make an alarm: The thread turns the device volume up to maximum, sounds the default alarm ringtone and vibrates constantly, until the user turns it off.
- Start AlarmActivity. This activity is able to be started even the device is locked or screen is off.
- Show figure 8 notification.



*Figure 8 Service's notification when device is outside the perimeter security*

All activities, service, and layouts were developed using as guides the following webs: [2] [4] [5] & [6].





## User guide

In this user's manual you can find all the keys to learning the basics of this application, such as first steps to install the application on your smartphone and how set it up.

This app is a virtual perimeter security for old people with an easy setup. The app constantly checks the person position and advises him if he goes out the configured perimeter security. When it happens, the app shows an easy map to help the person come back.

### **Requirements:**

After installing the application, you must meet the following smartphone requirements:

- GPS
- Internet connection
- Android 4.0 Ice Cream Sandwich or higher.

### **Installation:**

1. Enter in *Settings* => *Security* and enable the option *Unknown sources*.
2. Send the APK file to your smartphone (via USB, Bluetooth, etc.) and open it.
3. Click on *Install* and wait. When the app is installed, click on *done*.

### **How to use:**

After using the app, check and enable the *location access* on *high accuracy* mode:

1. Enter in *Settings* => *Location*.
2. Enable the location
3. Set mode on *High accuracy*

If you want to configure a new perimeter security:

1. Open the app.
2. Click on "Set up a new perimeter security".
3. Introduce the password "1234".
4. Follow the instructions on the screen.
5. Before locating the center marker, click on OK.
6. Introduce the radius perimeter in meters.
7. Accept and now the application is working in background.
8. Give the device to the old person to control his position.



You can check the status in the notifications. When the app detects the device out the perimeter security, an alarm will sound and an easy map will help the old person to come back. In this alarm screen the user can turn off the alarm sound.

If you want to turn off the perimeter security:

1. Open the app
2. Click on “Turn off the current perimeter security”
3. Introduce the password “1234”.

If you casually close the alarm screen but it doesn’t stop, you can turn it off manually:

1. Open the app
2. Click on “Turn off the alarm”.



## References:

- [1] Exercise 1 Electronic system development by programming mobile devices
- [2] Android Developers web site:  
<http://developer.android.com/> (last view: 8/11/2015)
- [3] Kantar World Panel web site:  
<http://www.kantarworldpanel.com/es> (last view: 8/11/2015)
- [4] Stack Overflow forum web site:  
<http://stackoverflow.com/> (last view: 8/11/2015)
- [5] Anonym. Get Distance in KM From 2 LatLng Coordinates. Posted in DroidJava web site:  
<http://droidjava.com/get-distance-in-km-from-2-latlng-coordinates/> (last view: 8/11/2015)
- [6] Mohit Gupt. Android Foreground Service Example. Posted in Truiton.com web site:  
<http://www.truiton.com/2014/10/android-foreground-service-example/>  
(Last view: 8/11/2015)