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# Monitoring and control of users in open environments on the Android platform

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**DEGREE IN COMMUNICATIONS SYSTEMS ENGINEERING**

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# 1 Introduction

This summary is based on a Final Project which develops a client-server application that aims to monitor and control individuals in open environments through the Android mobile platform.

The operation of the mobile application is based on the GPS of the mobile device, controlling the position of a user at a configurable time and warning the server if he ever leaves of the area previously defined. In addition to the core functionality, we have included others, such as the ability to send a message to the server and the ability to add "doors". This unique function, which will warn the server when the user approaches a particular place, will give the order to open a certain door. This can be applied to the opening of a garage door as we approach a car, for example.

The new mobile phones, known as smartphones, have allowed us to perform tasks on our devices in a manner similar to that of a laptop. Tablets, which share the same operating system, have also grown in popularity, allowing the developer to work for a large number of devices available today.

It is important to clarify that existing applications are usually less powerful on a mobile device than on a computer, as they must adapt to the limitations on the terminals either by the processor, the battery, or the screen size. However, in the case of applications that require use of GPS, mobile terminals have the advantage since they allow mobility.

Focusing on the application to develop, the goal is to control an individual in an open space through the GPS included on the mobile device. This will require the application development and programming of a server that communicates between a mobile device and a computer that will receive the location data. This will achieve a configurable application with a robust performance, minimum error, and requires very little maintenance by the user.

## 2 State of the Art

In recent years, there have been many advances in the field of telecommunications. These advances have been gradual, starting with the first access to Internet with WAP technology. This was followed by the emergence of e-mail on mobile phones, and later on Smartphones with the arrival of the Internet - giving us an experience of fast navigation.

To achieve this progress, it has been necessary to develop new batteries that allow us a longer duration of use with the minimum possible size. Plus, the emergence of new, large screens allows us to exploit the full multimedia capabilities of the devices. All this has made mobile phones an essential element in everyday life.

With such importance placed on mobile telephones in these times, the existing mobile platforms loom to be large factors in the decision of a particular terminal. While before, the phone design or characteristics made us decide between one terminal or another, now it is the operating system which determines what we buy or develop. The two platforms with the greatest market share are IOS and Android, attempting to cut away other platforms such as Windows Phone and Blackberry. Others, such as Symbian, are in process of disappearing.

The debate between IOS and Android does not have a clear winner and it is up to the consumer to decide which better fits their preferences and/or requirements. In this case, the chosen was the Android platform, allowing the execution of the application on the device without the need to purchase a license.

Android is a project of the Open Handset Alliance, a trade alliance formed by 84 companies in the mobile telephony sector. The most prominent members of this alliance include Google, HTC, Motorola, Intel, Samsung, and LG. This company was founded in November 2007 and is now led by Google. Android has been one of the latest Google acquisitions, owned prior by Android Inc., and touches on the mobile phone industry. The launch of Android was intended to compete with various models such as the iPhone launched by Apple in 2007, the terminal belonging to the Canadian company RIM, the Blackberry, and then the dominant operating system, Symbian.

Android is not a hardware platform. It is an environment of open source software originally created for mobile phones which includes a Linux-based operating system, applications, user interface, and much more. Although the OS is written in C + +, the programming language used to develop is Java and XML is used for the graphics editor.

Following the success of Apple and its App Store, Google tried to encourage people to use its platform to develop and put all possible facilities on their server. This created the Android SDK, which provided the APIs and tools necessary to initiate the development Android. In the era of smartphones, the developers are very important, since they are responsible for taking full advantage of the platforms on which they work, thus improving them.

Unlike IOS where you must have an Apple computer to use for developing, Android will allow the use of any operating system, whether Windows, Mac OS or Linux.

### **3 Approach and solution of the problem**

There are certain situations where we would want to know the location of a given individual.

- Applications in geriatrics: When an older person begins to experience memory loss, which are even more pronounced with the onset of Alzheimer's disease, this could be not only useful but also life-saving. This application would allow the mobile device to tell the server at any time a person's current location in the cases of people who have become lost who have failed to return home.
- Business environment: Many companies use mobile enterprise for their employees. Also, it is very common to keep track of incoming and outgoing employees to know the hours that they have been in the workplace. If we join the two concepts, one can consider the possibility of controlling workers via mobile phone, and also facilitate access to other buildings in the business complex, opening the door to approach a certain distance.
- Children: You can keep parents informed of the status of their children whether on a school trip or if they are in the area near the school.
- Prisons: Given that Android will be included on other devices, not necessarily mobile phones, there is the possibility of creating smart devices, like a shackle, that controls the location of the prisoners at all times, alerting authorities if there is risk of flight.

- Opening of garage doors: As we approached the entrance or exit of the garage, the mobile phone will detect the proximity of the device and open the door accordingly.

Knowing the problem to solve, we can seek the most economical, most efficient and most suited solution to our needs. Taking advantage of the fact that each person usually has a mobile phone, there will be a mobile application which will monitor your situation. This saves having to use an extra device. Also, the knowledge of the data recorded by the telephone from a remote location will choose to send the data to a server running on a personal computer.

Therefore, the platform chosen and the method by which we get the information will together be the pieces to make this robust and error free.

It is of great importance to know the laws in force in countries where the application is to be distributed in order to avoid legal violations. Due to ignorance of the laws in other countries, the application will only be distributed initially only in Spain.

Being an application that can find the location of another person, the subject being controlled must be informed of this practice as provided in Law 15/1999 of December 13 Data Protection, particularly in paragraph 6.1: The processing of personal data requires the consent of the affected. Otherwise it would violate the privacy of a person since it would control your location without your consent. There are several types of penalties, from mild fines of 600 € to more harsh fines of 600,000 €.

## **4 Design and development**

The safety area is a circle formed by a center and a distance limit. The distance calculation is carried out with the Haversine formula that will give us a rough measure of the distance between two points on a spherical surface.

The main screen will consist of a map provided by Google APIs and data with our location and distance to the center.

The application should be configurable by the user to suit their control needs. Therefore, it was decided to include a button on the main screen which sends a second activity that varies the distance at which we set the area and the center, the frequency

with which the GPS gets its location, and the necessary parameters to connect to server: IP and port.

To access this screen, the user of the device would enter a password for the individual who is to be controlled. Without altering the configuration, they can then bypass security. The password can be set and changed from within the application, provided that there is no password initially.

In the configuration screen, the user would be allowed to send messages to the server to indicate whether there is any error or whatever is convenient. In addition, you can also insert and remove doors.

The application will run even if not always in the foreground, allowing the user to open other applications without affecting the use of it.

To call the attention of the individual who is leaving the secured area, there will be a warning from the mobile device, emitting an alarm until it returns to the safe zone. The alarm playback is done through a service, as it requires no graphical interface and is executed whenever the individual leaves the zone.

Sending information to the server is done with an AsyncTask, asynchronous task in Spanish. This solves the problem that arises when performing multiple tasks requiring greater use of the processor and helps to avoid blocking the main application that is running. For the server, the idea is a small Java application that is always open and collects the data sent by the mobile terminal. In addition, the server will interpret the messages received and notify the user (i.e. the screen will turn red if the individual leaves the safe area and stay white if it is all right). For communication between client and server, the platform will use a Socket where two programs can exchange any data flow reliably and orderly.

For the location of the server by the client, it is necessary to know the Network Protocol address. In the case of using the TCP/IP, this is the IP address in addition to knowing the port number that is assigned to a program within a computer. With the main parameters already defined, communication starts when the customer requires or sends information to the server. The server will then always remain pending requests.

## 5 Results and future lines

This section presents the tests on different parts of the application. It has been tested in two different environments - first, by the emulator and the corresponding simulation and secondly, the position on the campus of the University Carlos III in Leganes.

The aim was to check the operation of the mobile application and proper connection with the server installed on a laptop. During the tests, we had to modify the code in order for proper operation.

In both tests, with the emulator being used as those in a real environment, it has been concluded that the application meets all its functions and it is extremely reliable. The only errors can come from network failures or data from the accuracy of the GPS system.

It is a simple application but at the same time fulfills all of the intended functions. The complete development of the application and the server is done with freeware tools.

The whole of this client-server application differs from the type of applications you can find on the market. As opposed to a central server that handles requests from different users, it is a custom server installation and each user has the freedom to manipulate it as they wish.

In conclusion, one can summarize that with the very basic knowledge of programming for mobile platforms and after the completion of this work, a student knows and has the tools necessary to implement any ideas that emerge, fulfilling the main objective of this work, which is none other than learning.

Possible suggested application improvements would be to add the telephone network as a location provider. Later the decision can be made as to which has a lower error rate and facilitates positioning indoors since satellite makes this very complicated.

On the server, you can also include some improvements such as developing the server via a web application that allows the user to log on and access it from anywhere in the world. Another possible improvement would be to configure the application from the server. This would avoid the need to access the device to change the parameters of distance, wireless, doors, etc.