A GPS BASED ARCHITECTURE TO CONTROL BUS THROUGH AN IOS APPLICATION

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Abstract

The use of mobile devices is growing thanks to modern mobile operating systems that enable the development and deployment of applications in various contexts. A lot institutions and universities have already developed applications for Smartphones and Tablet PCs, mainly based on Apple operating system. We developed an innovative approach that will be implemented in official application of university. The traditional bus service is not able to inform users on the current position bus. Therefore this paper describes an innovative iOS application for university campus to control bus service using iPhone, iPod touch and iPad devices.

I. INTRODUCTION

The launch of the modern Smartphones and Tablets PCs has addressed many universities to deploy applications for mobile devices with the aim of improving learning and teaching in various areas. These ideas have encouraged the submission in the App Store of our official iOS application, called "Kore University" (KU) [1], for iPhone/iPod touch [2] and iPad [3]. This application is the first official app of an Italian university, although it is already common practice in other country. Also thanks to the GPS receiver built-in on the devices, new services are designed for students based on geolocation, of which the most important is the location of the bus used for the transportation of students (called "Kore Bus"). The development of vehicle safety and comfort are important research objectives in order to make vehicles more intelligent. In addition, the research has to increase the capability of vehicle to be located through appropriate location detection systems.

GPS has been used for identification [4] and monitoring [5 – 7] in many studies, but it can also be used in applications that involve the use of mobile devices [8]. In addition, recent studies have also been made regarding the positioning of the bus with or without GPS [9 – 11] and many institutions and universities have already developed their app in this area [12 – 14].

This paper will show several features that have already been implemented in KU, but it mainly shows the GPS-based architecture that allows the geolocation of "Kore Bus". This feature, implemented in the new version (English release) of the application, will be available in the App Store as soon as possible.

This paper is so organized: in Section 2 we discuss an overview on KU application. Section 3 describes the potentiality of our GPS-based architecture that allows the geolocation. Section 4 summarizes the paper by discussing several future works.

II. KORE UNIVERSITY APPLICATION

Kore University application [2] brings on the iPhone (Fig. 1) and iPod touch real-time information on all educational and scientific activities, as well as those related to the events of the university.

Fig. 1. KU for iPhone/iPod touch: Splash Screen

Implementing KU application, we decided to build the application for Apple iOS because it is designed and written to run on a specific hardware device, differently from Android, which can be defined as an operating system "general purpose". Android applications do not always run correctly on different brands of devices because the hardware compatibility is not always guaranteed. Symbian, at its birth, was not designed to be used on touchscreen devices, so cannot cope the users demands, while Windows Phone 7 is still too young and its gap against rivals is still high. All these considerations have made us decide to design and implement KU for Apple iOS, an operating system that is really common and a solid market for applications such as App Store encourages it.

The implementation of the application has followed the basic rules of interaction design in order to ensure direct control of it. The goal was to have a navigation carefully designed to be light, practical and at the same time, easy to use. In addition, the interface is very self-explanatory, as for the presence of areas where you can view a legend as because the images chosen for the buttons are intuitively related to the content covered.

KU application is structured through a Tab Bar Application that, in iOS programming, is formed by a modal interface, which allows changing the UIView by Tab Bar Items (Fig. 2).

Fig. 2. KU: Tab Bar Application

"University News" section contains news and information about courses, exams, events and opportunities for students and is constantly updated.

In the "Faculty" area, it is possible to find useful information about each degree course, such as news, course information and active contacts of professors whom it is possible to contact directly from the application.

"University Contacts" area contains addresses, phone numbers and emails of the institutions of the University and administration offices. This section lists the services offered by the University and information about the canteens.

In the "Services" section it is possible to find all the available services for the students. In this sense, for example, is particularly useful for students the possibility to book exams for each course directly through the mobile device. Furthermore, in Podcast area, it is possible to download the media files of the lectures and educational activities, which improve and stimulate student learning through the use of modern multimedia systems.

Kore University HD is the iPad version [3] (Fig. 3) and is not simply a port of the iPhone and iPod touch application. KU HD is a true stand-alone application specially implemented optimizing iPad features. The services presented in KU for iPad are the same as those described in the iPhone and iPod touch version, while the design criteria is different both from a hardware point of view (display bigger and better performance of the processor) as a software perspective (availability of additional libraries).


Fig. 3. KU for iPad: Splash Screen

III. PROPOSED ARCHITECTURE

The new version of Kore University application will be officially released as soon as possible and will implement a mechanism of vehicle location of "Kore Bus", in order to allow students to know the location of the bus real time and see whether or not they are late to reach the bus stop. Each bus has installed a GPS equipped mobile device, which sends to a server, every minute, its Bus ID and its current position. The server has a database that manages information sent by the various busses. The location of the bus in motion is determined real-time on the basis of location information in the database (Fig. 4).

The operation of GPS is based on a military satellites system, which sends a series of digital sequences used to calculate distances.

Actually, the distance is calculated by measuring the time required to receive the satellite signal that issued it. In order to make this positioning system, the two-dimensional point should catch at least three GPS satellites. After that, the distance to each satellite is calculated and the GPS calculates a space in which to place the three spheres of radius equal to the distances available. Two intersections are obtained this way: the first is the point of the GPS station and the second is directly opposite that is discarded. This position is two-dimensional and therefore brings with it a minimum of error, because it is still not taken into account the height above sea level of the receiver. To do this, is necessary a third point, from which is possible to obtain a three-dimensional measurement; this point is achieved by hooking the fourth satellite signal.

Obviously, increasing the number of satellites contacted the percentage error decreases.
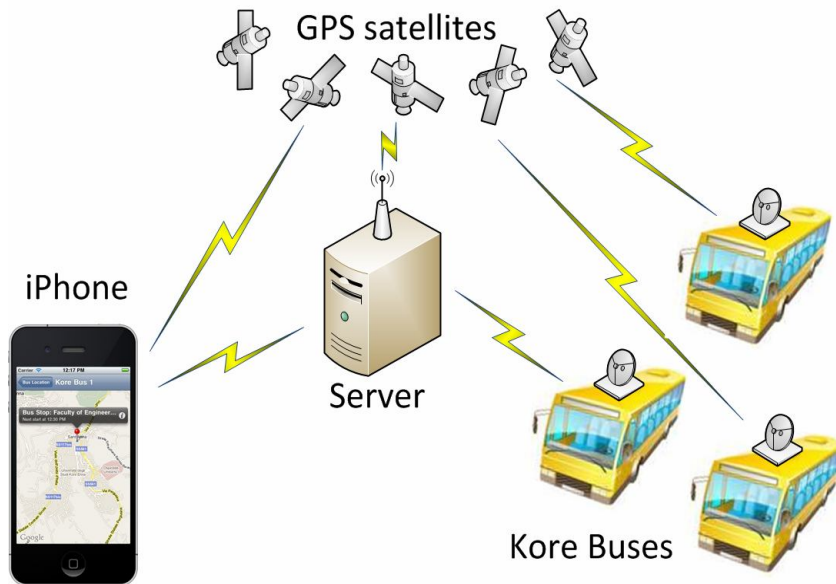
Fig/ 4. GPS Architecture

The next version of the Kore University application will implement (in "Services" section) the approach shown in this paper.

So in [1] it will be possible to have real-time information regarding the locations of several "Kore Bus". This approach allows several advantages for the user of [1] application: students, professors/researchers and employees. Fig. 5 shows the interface of the application discussed in this paper.
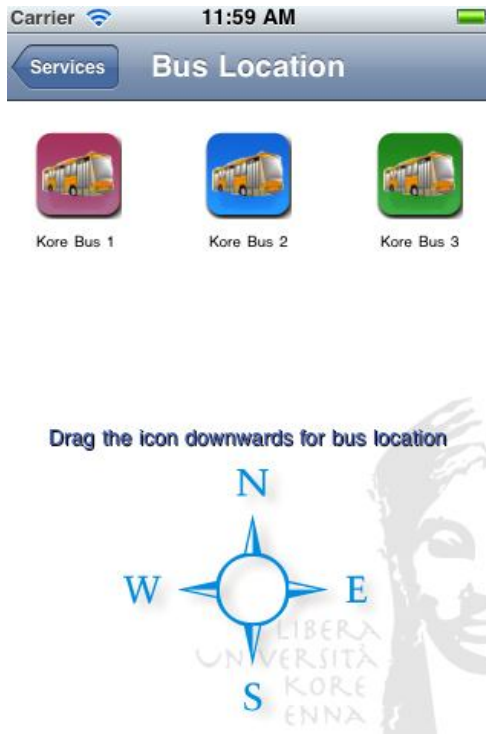

Fig. 5. KU: Bus Location

In particular, we implemented an architecture that allows the control both of the current location of the bus

the departure/arrival times, the entire route and stops (Figure 6). This service definitely helps students who live in residential areas away from the university.

To reduce journey times, the various bus routes have been carefully chosen after detailed studies on the areas where students live and their travel time to reach the campus.
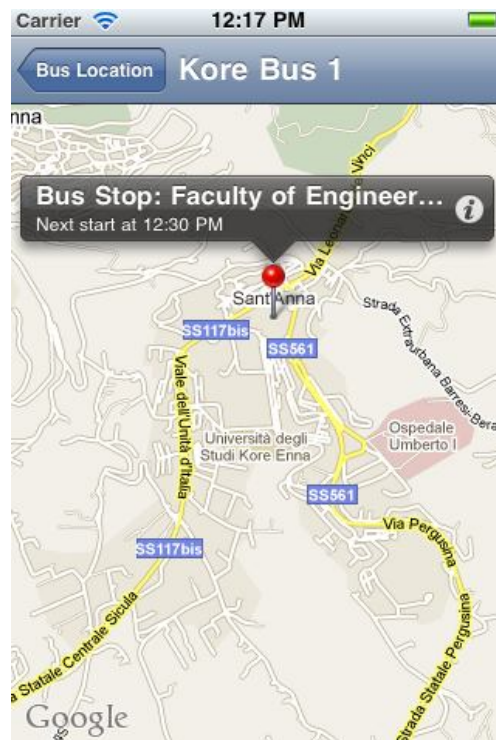

Figure 6. KU: Current bus Location

The number of buses and their frequency on each route were also chosen to balance many factors such as user charges, travel times to the university and costs. In any case, all citizens can also use this type of service.

IV. CONCLUSIONS AND FUTURE WORKS

In this paper we showed a real implementation of iPhone, iPod touch and iPad application "Kore University". The students showed interest and appreciation towards the application since it helps them on various aspects of university life. This is a clear signal that the future of mobile platforms is in Information Technology (IT). We have developed a system that allows locating "Kore Bus" through the GPS. Through their smartphones and/or tablets, students can obtain real-time information not only on the position of the bus but also about its times of departure and arrival, its routes and its stops. In this way, they can easily understand if they are in late or not or whether it is the bus. This system of geolocation of the bus has been implemented in the new version of Kore University for iPhone, iPod touch and iPad, which will be available in the near future. The main goal is to continue and keep up the excitement of the students by introducing new approaches to learning and by the presence of new useful services because of an effective management of university resources.

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