Novel Model for Tracking the Location of Trainee Students in Universities: A Case of Jordanian University Students

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Abstract
The Global Positioning System is one of the most important technologies used in many mobile applications, such as vehicle, employee, and student tracking; soldier monitoring; and distance and location determination, among various applications. This study proposes a new tracking system model to track trainee students in universities. This tracking system activates the user when he or she logs in to the system from the training location. Prior to the activation (or deactivation to calculate the training time of the trainee), the system needs to verify the International Mobile Equipment Identity and Subscriber Identity Module card ID of the student by sending these pieces of information and the user ID to the central server. Upon activation, the student can access the training system to upload and download documents as well as to contact his or her colleagues and supervisor.

Keywords
Mobile computing, Tracking System, Global Positioning System (GPS), Position Detection, Global System for Mobile Communications (GSM), Google Maps

1. Introduction

Mobile technology is one of the most important and widespread technologies today. Many researchers and developers have designed and developed mobile Internet technology applications (apps) for smartphones that are now widely used throughout the world. Accordingly, many network access techniques and applications have been developed for smartphones [1]. Android is a popular operating system used in smartphones, and at present, more than two billion users have Android smartphones [2]. Smartphones are manufactured with many sensors to achieve various tasks in different areas. These sensors include Global Positioning System (GPS), near field communications (NFC), Wi-Fi, Bluetooth, and others [3]. GPS is used to retrieve coordinates and to observe a person's movement in real-time [4]. The current study presents a novel tracking system that uses GPS and Global System for Mobile Communications (GSM) technologies to trace trainee students.

Tracking systems are very important in the modern world. They are useful in soldier monitoring, employee tracking, student tracking, and other various applications. They are also important for monitoring a student's movement in a training location, saving time for supervisors and students and creating an open channel between the two actors. Until now, no system offers these features and procedures. Hence, the current study proposes a tracking system model consisting of GPS and GSM. A GSM modem, which is provided with a SIM card, employs the same communication process as that found in a regular phone [5]. The proposed system is not limited to finding the location of the target; it can also register the check-in and check-out times, construct a channel between the supervisor and the student, and upload reports to or from the supervisor or student.

The rest of the paper is organized as follows. Section II discusses the related work. Section III describes the proposed system and system architecture.

2. Literature review

2.1 Smartphones

Smartphones are a modern means of communication, which can be used anytime and anywhere. The emergence of mobile apps also helped spread the popularity of smartphones. Such apps support the development of Smartphone properties and characteristics, and are generally easy to use and free to download. Apart from convenience, the wide range of resources, small size, power capacity, and low cost of these smartphones helped increase their popularity.

Smartphones are multifunctional cell phones and mobile devices, which are highly developed, have many features, and are better connected than traditional cell phones [6]. The most important feature of smartphones is their ability to improve their functionality through extra mobile software apps. [6]. Similar to laptops and desktops, smartphones have multiple cores and powerful graphics processors. They have many sensor platforms, such as GPS, NFC, Wi-Fi, Bluetooth, and cellular ability. They recently hold large amounts of personal information about social networks, banking, health care, documents (cloud computing), and inter-personal communication [3]. Nowadays, smartphones have become increasingly smarter through the integration of innovative intelligence in the phone, phone applications, and cloud. In fact,

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smartphones are now able to perform such functions as tracking our life patterns, monitoring our health, and navigating (map reading), among others [6].

2.2 GPS and 3G/4G (LTE)

Nowadays, most people use their hand phones to browse the Internet and use other online applications wherever they go via High Speed Packet Access (HSPA) and Long-Term Evolution (LTE) networks [7]. Many researchers have reported on the adoption of LTE technology and its importance in supporting vehicular networking applications [8]. Kim et al. (2012) showed that 3G and 4G standards are suitable in many vehicle speeds. Meanwhile, Trichias [9] showed the possibility of using an LTE standard for intelligent transportation systems (ITS). His work consists of the performance evaluation of LTE and comparing it with the IEEE 802.11p standard (high-level comparison).

For the GPS system mobile data, a previous study [10] has demonstrated the widespread popularity of mobile phones and other portable devices. With a variety of on-board sensors, positioning capabilities achieved through GPS, and the possibility of connectivity through Bluetooth, Wi-Fi Direct, and 3G/4G, these devices can provide a suitable platform for implementing real-time tracking applications.

2.3 Tracking systems and models

Multi-target tracking is an important problem especially in the domain of employee or student tracking as well as sport-teams tracking. This problem results in the need for applications that could cover these multi-target tracking capabilities. On the one hand, Jingchen et al. [11] and Collins [12] illustrated pedestrian tracking. They have confirmed promising results by formulating multi-target tracking via data association. Various methods have been proposed to resolve the problem of associating tracking capabilities across time, including the Hungarian algorithm [13], linear programming [14], cost-flow networks [15], higher-order motion models [12], maximum weight independent sets [16], and continuous-discrete optimization [17]. Meanwhile, Huang and Nevatia (2008) [13] resolved the problem of tracking in crawling structured scenes with floor field estimation and Motion Structure Tracker (MST), whereas Rodriguez et al. (2009) [18] used a Correlated Topic Model (CTM) for crowded, unstructured scenes.

Recently, multi-object motion models have been used in pedestrian tracking to promptly determine the manner by which people can adjust their routes to avoid collisions [19] or to appraise whether a couple of routes are on interrelated motions [16].

3. Proposed System Architecture

Tracking systems are considered as one of the most important research areas in this era [1]. Accordingly, researchers have proposed a new architecture for tracking systems to be used in tracking physicians, nurses, students, soldiers, and others. The proposed Trainee Student tracking system architecture is shown in Figure (1).

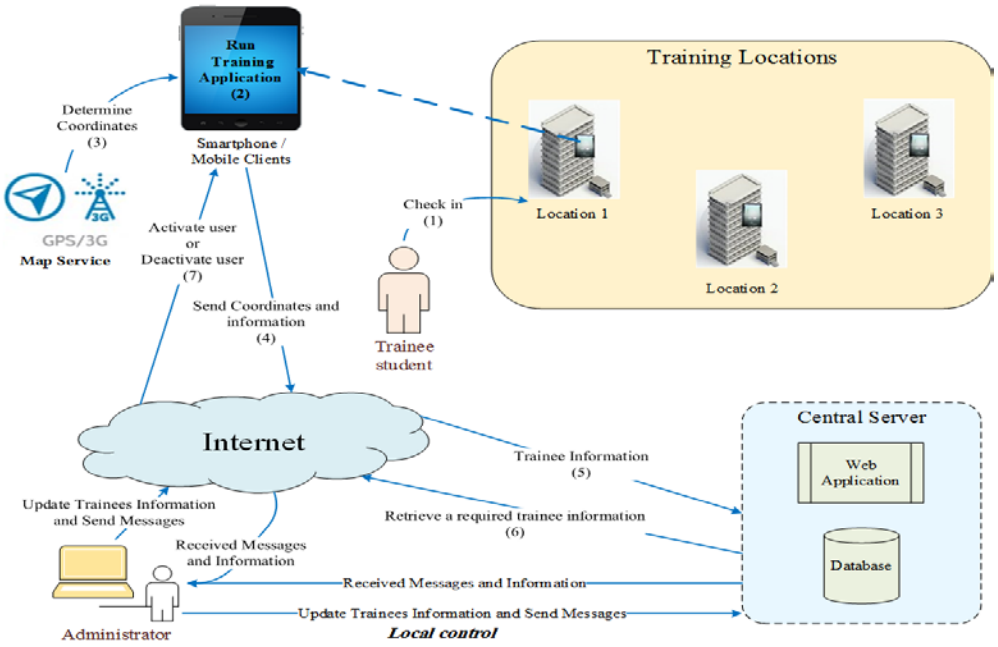

Figure 1: Student Tracking System Architecture

The new novel system architecture consists of three main modules: Smartphone/mobile clients, map service, and central server. The mobile clients consist of Smartphone, mobile application, and GPS. The first objective of this module is to verify the student information by retrieving Smartphone information, such as International Mobile Equipment Identity (IMEI), and the mobile model and Subscriber Identity Module (SIM) information, such as the serial number and phone number (calling number), through an application designed for this purpose. The second objective is to retrieve the coordinates of the student through a GPS receiver and then store them in the database.

The map service is agent-based, thus providing the tracking system application with map data. This service uses GPS to retrieve the students' positions. Here, location information is continuously refreshed by the Smartphone to the web application. The central server consists of two parts: the web application and the database. The database works as a repository that stores all students' information, such as Smartphone information, SIM information, students' location, training coordinates, login time, logout time, students' documents, and messages.

Using the retrieved information about the students' location, the tracking system sends all required information about the Smartphone, SIM, and the students' location to the central server to verify the information. If these information is valid, then the system activates the students' identification and stores the activation time. Thereafter, a student gains permission to upload his or her documents and data to the system. Otherwise, the user remains disabled. The figure below shows the information flow in the students' tracking system.

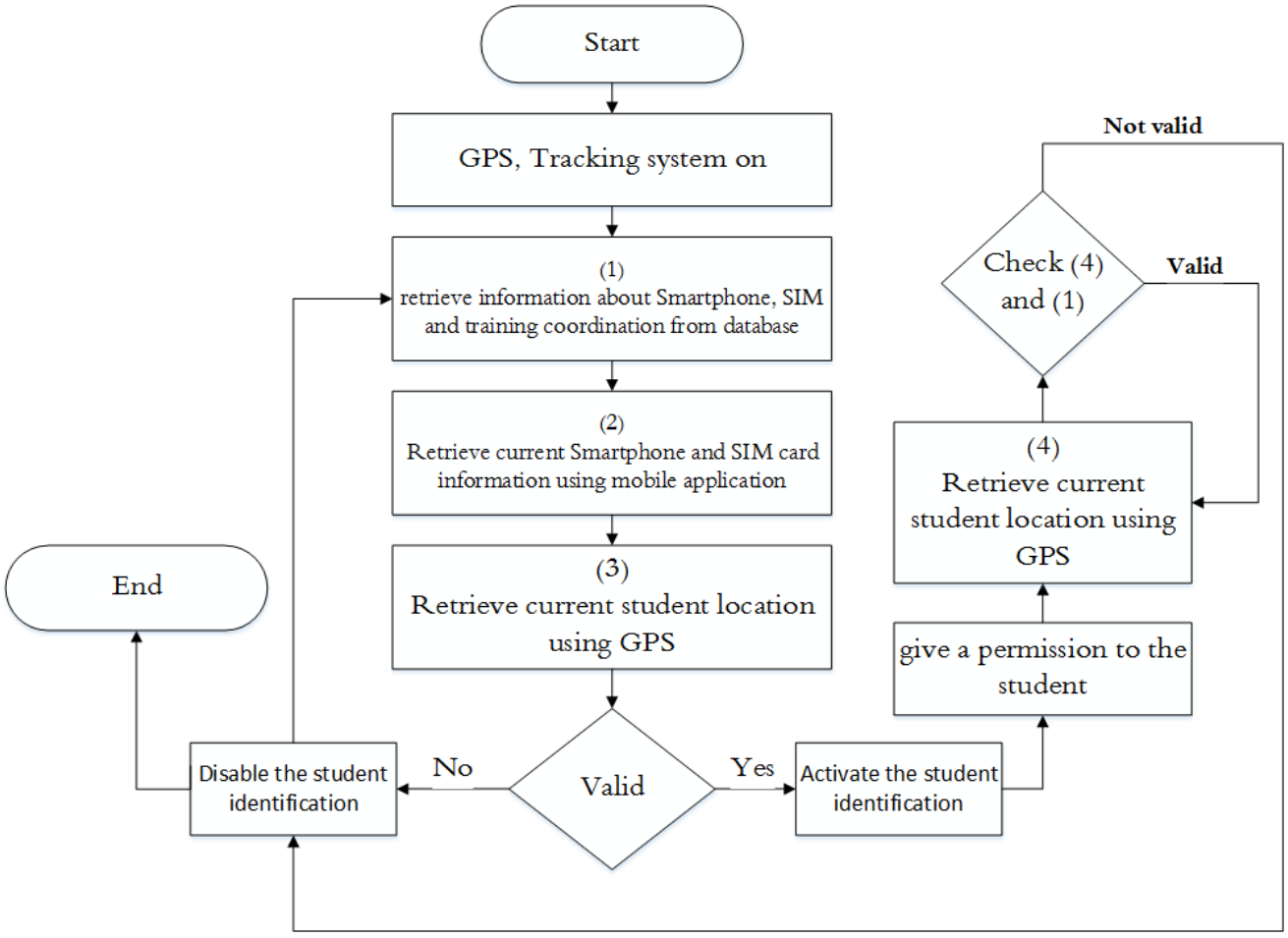

Figure 2: Flowchart of the Student Tracking System

4. Future studies

At present, many researchers have studied tracking systems from different perspectives. In the current study, new tracking system architecture is proposed to track the trainee students using Smartphone techniques. In this architecture, new techniques and features for tracking are added, and they should be considered for development, evaluation, and verification.

The proposed tracking system architecture can be utilized in a wide range of applications, such as soldier tracking, patient tracking, trainee tracking, and others.

5. Conclusion

The tracking system model proposed in this paper focuses on GPS, GSM, mobile application, and web technology. The aim of this work is to help the developers build a new tracking system with novel features and to improve the rate of resulting benefits from registering training courses for students. These goals are achieved by monitoring the students at any time to verify whether they are in the training location and to open a channel among the students to control and enhance their daily progress. The proposed system has major important features such as security and privacy. The system protects student information by increasing the security level. This system verifies mobile information such as IMEI and SIM card ID. Therefore, no other student can login to the system without using the authorized student ID and mobile device.

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