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Enabling Tracks in Location-Based Smart Mobile Augmented Reality Applications

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Abstract

To assist users through contemporary mobile technology is demanded in a multitude of scenarios. Interestingly, more and more users crave for mobile assistance in their leisure time. Consequently, the number of mobile applications that support leisure activities increases significantly. Mobile augmented reality applications constitute an example for user assistance that is welcome in these scenarios. In the AREA (Augmented Reality Engine Application) project, we developed a kernel that enables sophisticated location-based mobile augmented reality applications. On top of this kernel, various projects were realized. In many of these projects, a feature to enable tracks was demanded. Tracks, for example, may assist users in the context of mountaineering. The development of an AREA algorithm that enables track handling requires new concepts that are presented in this paper. To demonstrate the performance of the developed algorithm, also results of an experiment are presented. As a lesson learned, mobile augmented reality applications that want to make use of the new algorithm can be efficiently run on present mobile operating systems and be effectively realized by engineers using the AREA framework. Altogether, the new track feature is another valuable step for AREA towards a comprehensive location-based mobile augmented reality framework.

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Keywords: Mobile Augmented Reality; Location-based Algorithms; Mobile Application Engineering; Track Handling

1. Introduction

More and more scenarios shall be assisted by mobile technology [1,2,3]. For example, when walking around in New York with its numerous tourist attractions, a smart mobile device shall detect these attractions to provide related information to them. In such a scenario, location-based mobile augmented reality is one appropriate concept to properly assist users. In the AREA project [4], we developed a kernel that enables sophisticated location-based mobile augmented reality applications. To be more precise, AREA detects predefined *points of interest* (POIs) within the camera view of a smart mobile device, positions them correctly, and provides additional information on the detected POIs. This additional information, in turn, is interactively provided to the user. Furthermore, an architecture was

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realized, which enables the rapid development of location-based mobile augmented applications on top of the kernel[4]. In general, AREA is used for various scenarios in everyday life[1] and it has revealed practicality in these projects. Recently, a feature for AREA that enables so-called tracks was often demanded. A track, in turn, may be used as the cycle path a user wants to perform in a certain area. Therefore, we developed a track algorithm for the AREA kernel that is presented in this work.

Section 2 presents fundamental aspects of the AREA framework. In Section 3, the coordinate system and the track notion used by AREA are introduced. The algorithm developed for the track handling, in turn, is presented in Section 4. A conducted experiment that evaluates the performance of the new track algorithm is presented in Section 5, while Section 6 discusses related work and Section 7 concludes the paper.

2. AREA Project

The AREA framework (cf. Table 1) basically consists of a mobile augmented reality kernel that enables location-based mobile augmented reality applications. In addition, it provides a sophisticated architecture to create location-based mobile augmented reality applications on top of the kernel. Four technical issues were crucial when developing the kernel. First, POIs must be correctly displayed even if the device is hold obliquely. Second, the approach to display POIs correctly must be provided efficiently to the user. To be more precise, even if multiple POIs are detected, the kernel shall display them without any delay. Third, the POI concept shall be integrated with common mobile operating systems (i.e., iOS, Android, and Windows Phone). Fourth, the kernel allows for the handling of points of interest clusters. So far, the AREA kernel mainly consists of three developed algorithms: The POI algorithm, the clustering algorithm, and the track algorithm. The first two algorithms were already presented (cf. Table 1;[4]).

Table 1. AREA Project

	AREA	**References**
Android App	√	5,6,7
iOS App	√	5,6,7
Windows Phone App	√	5,6,7
POI Algorithm (all mobile OS)	*AREARenderingPipeline Algorithm*	5,6,7,4
Clustering Algorithm (all mobile OS)	*AREACluster Algorithm*	4
Track Algorithm (all mobile OS)	*AREATrack Algorithm*	**this work**
Sensor Management (all mobile OS)	$SensorFusion(Compass, Gyroscope, Accelerometer)$	5,6,7,4
Architecture (all mobile OS)	$Version\ 2$	5,6,7,4
Overall Sensor Management Android	*Own approach*	5,6,7,4
Overall Sensor Management iOS	$Built-in\ functions\ OS$	5,6,7,4
Overall Sensor Management Windows Phone	$Built-in\ functions\ OS$	5,6,7,4

3. AREA Coordinate System and Track Notion

The concept of AREA to relate a user to the objects (i.e., POIs, tracks) detected in the camera view is based on five aspects. First, a virtual 3D world is used to relate the user's position to the one of the objects. Second, the user is located at the origin of this world. Third, instead of the physical camera, a virtual 3D camera is used that operates with the created virtual 3D world. The virtual camera is therefore placed at the origin of this world. Fourth, the different sensor characteristics of the supported mobile operating systems are covered to enable the virtual 3D world. On iOS, sensor data of the gyroscope and the accelerometer are used, whereas on Android sensor data of the gyroscope, the accelerometer and the compass of the mobile device are used to position the virtual 3D camera correctly. Fifth, the physical camera of the mobile device is adjusted to the virtual 3D camera based on the assessment of sensor data.

[1] See http://www.liveguide.de for mobile applications that use AREA.