Available online at www.sciencedirect.com

ScienceDirect

Procedia Computer Science 83 (2016) 300 – 304

Procedia Computer Science

The 7th International Conference on Ambient Systems, Networks and Technologies (ANT 2016)

Resource Usage Analysis of a Sensor-Based Mobile Augmented Reality Application

Ahmet Karaman[a], Doga Erisik[a], Ozlem Durmaz Incel[a,*], Gulfem Isiklar Alptekin[a]

[a]Department of Computer Engineering, Galatasaray University, Ciragan Cad. No:36, Ortakoy, Istanbul, 34349, Turkey

Abstract

In this work, design of an Android-based augmented reality application is presented and particularly its performance is analyzed in terms of resource usage in comparison to similar applications. The application displays merchant, branch information of one of the Turkish banks, as well as related sales campaigns of the merchants on the screen that are within the proximity of the user's location. The developed application uses GPS, compass, gyroscope, accelerometer sensors and it utilizes an accurate tagging algorithm. We examine the resource and battery consumption of the application. Accordingly, we propose methods for improving the resource usage. The proposed improvements reduce the resource consumptions up to 35% and the application performs considerably well compared to the state of the art commercial applications. We believe that the suggested improvements can be useful for other sensor-based mobile augmented reality applications.

Peer-review under responsibility of the Conference Program Chairs

Keywords: Augmented reality; mobile application; mobile phone sensing; performance evaluation.

1. Introduction

Augmented reality (AR) applications help users interact with their surroundings via mobile devices. Many of these applications; using phone's GPS (Global Positioning System), compass and other sensors (gyroscope, accelerometer etc.), show information on the display identifying the user's whereabouts and provide direction/navigation information. In most of the studies in the literature that utilize sensors on smart phones, data is collected on the phone and more powerful processes in the data processing is performed off-line on a computer. When the limited processing capabilities and battery capacity of the phones are taken into consideration, such a scheme may not be efficient especially if real-time performance is required. Thus, for the development of real-time applications, resource constraints on the phones should be considered.

In spite of the increase in processing power, feature set, and sensing capabilities, the smartphones continue to suffer from battery life limitation, which hinders the active utilization of LBA's (location-based application)[1]. Unfortunately,

* Corresponding author. Tel.: +90-212-2274480
E-mail address: odincel@gsu.edu.tr

Peer-review under responsibility of the Conference Program Chairs
doi:10.1016/j.procs.2016.04.129

GPS, the core enabler of LBAs, is power-intensive, and its aggressive usage can cause a complete drain of the battery within a few hours. The LBA developers are suggested to reduce the use of GPS by increasing the location-update intervals (say, to more than a minute), thus allowing GPS hardware to sleep between successive location-updates. Such a simple solution can improve battery life by forcing applications to request location information less frequently, but it has a fundamental limitation[1]. In AR applications, location fixes must be taken more frequently. At the same time, other sensors must be working all the time.

In this work, we focus on an AR application entitled “SARAS (Sensor-based Augmented Reality Application Software)” which shows the bank merchants and branch information on the device screen. We particularly analyze the resource consumption of the application and aim to improve its performance in terms of energy and resource consumption. The application works as follows: the user gets the viewing angle (or framing) within the camera to be launched in SARAS by looking at a direction in shopping centers, on the street or on the road (highway, city). If there are points of interest (POIs) related to the bank in the viewing angle (also inside framing), this information appears as a list on the screen. If a point is selected from the list, detailed information (such as a campaign) is displayed.

The main contribution of this work is to analyze the energy and resource usage of AR applications, particularly SARAS. First of all, a detailed performance analysis was performed to find the battery and power consumption by using Android platform performance tracing tools. It was observed that keeping the resources on and calling the location-distance function for each POI were the most CPU consuming factors. Therefore, it was provided as a solution to close resources on the activity passings and to calculate location-distance on the web service call. After various improvements the application is observed to consume 35% less energy. Besides, different GPS and sensor processing, and an accurate tagging algorithm are applied to the application and then resource consumption is re-examined. Overall, resource consumption on SARAS is shown by making comparisons to several similar applications.

2. Related Work

Zhuang et al. study the energy efficiency of location sensing in[1]. First, they put forth of battery effects of location sensing, then they suggest new location sensing methods. They explain that these methods improve the battery life by up to 75% by reducing the number of GPS invocations. This work is close to our study in terms of location sensing. However, in our work other factors in AR applications are also considered and different GPS and sensor processing methods are analyzed in terms of energy consumption.

Sarmiento et al. evaluate the performance of Android systems for AR applications[2]. For image capturing, they offer to use native code processor to improve velocity of execution and they analyse the performance with different image formats and capture frequencies. For the tracking sensors (accelerometer, compass), they measure values while the user is walking and for the GPS they analyze type of network connections on Android platforms. Since they use image rendering-based AR for the testing, they mostly concentrated on image capturing and Android graphics performance. Finally, they present the experimental results and conclusions over the basic test application.

Wagner et al. also study AR on mobile phones over image rendering-based methods in[3]. They also examine the performance of rendering, memory, bandwith usage and networking with different type of image rendering programs (OpenGL and Direct 3D). Another interesting research in this area is based on cloud computing[4]. Chen et al. claim that AR over the cloud computing has a great potential and the power of cloud computing can solve the limitation problems of AR applications. Some computational tasks can be performed on the cloud with service as a server method. These two AR studies are based on the image rendering conventional applications. Whereas our solution utilizes a GPS-based solution and we analyse its performance considering many different factors. There are also commercial applications similar to the SARAS application, such as LAYAR[5], Wikitude[6]. We provide performance comparisons with LAYAR in Section 4.

3. SARAS Application

The augmentation data source is the bank merchants and the campaigns available. This data is stored in a remote database and loaded via the RESTful web services to the phone’s local database. The data stored in the database includes the merchant/branch id, name, location (latitude, longitude, floor) and campaign codes. While testing the application, database included information on 296 merchants and branches. SARAS uses the front camera, current location info, motion and direction of the device for augmentation data. Doing so, device camera API’s, graphics