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AN AUGMENTED REALITY SYSTEM APPROACH FOR MOBILE DEVICES

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Abstract- Augmented Reality (AR) is an emerging approach in experimentation, in which the real world is enhanced by computer-generated data linked to specific places or activities. That is, augmented reality allows digital content can overlaid and mixed perfectly with our perceptions of the real world. Therefore, in this paper we propose an augmented reality system for mobile devices, which enables to enrichment the content of books and printed magazines by superimposing virtual objects, allowing to increase the user knowledge according to its environment. The system can be implemented on mobile devices with touch screen, such as smartphones and tablets based on the Android platform.

Keywords **–** Augmented Reality, mobile devices, virtual object.

INTRODUCTION

Augmented Reality (AR) is a technology that allows to superimpose computer graphics into the real world [1, 2]. Opposite to virtual reality, the AR interface allows the users see the real world at the same time as they see virtual objects attached to places and real objects [3]. Therefore, the main objective of an augmented reality system is to enhance the perception and user's interaction with the real world through complement the real world with virtual objects in 3D, which appear to coexist in the same space that the objects of the real world. According to Azuma [4], to define an AR application, three main features has to be considered: the combination of real world elements and the virtual environment, the elements must be interactive in real-time, and which are to be recorded on 3D; this means, that the visualization of the objects, the virtual elements, or information are intrinsically linked to the localization and real world orientation.

Then, augmented reality enable to overlay and mix digital content with our perceptions of the real world. In addition to that, 2D and 3D objects, digital assets (audio and video files), textual information and tactile information can be incorporated into real-world perception by users of augmented reality applications [5].

The current features of mobile devices male possible the implementation of software applications for augmented reality. Among these features include high-resolution touch screens, cameras and Internet connection devices and the movement and localization sensors (like GPS, accelerometers, compasses, etc.). These sensors have influence over the classification of mobile applications of augmented reality, i.e. applications based on object recognition or GPS-based applications [6]. In both cases, applications use these features of the mobile device to superimpose virtual objects.

The development of augmented reality applications for mobile devices is complex due to a set of factors. On the one hand, the processing and storage capacity through different memory types affects directly the augmented reality system. On the other hand, the type of the method used for capture and processing the image to be analysed, on which subsequently a virtual image is superimposed.

In this work we propose an augmented reality system for mobile devices based on visual recognition. This approach consists of the superposition of virtual objects over the real world which is seen through a camera, the one which feed directly the screen of the mobile phone. First, it must allow identification of the object in the real world through the mobile device screen. Then, carried out the object tracking. Afterwards, the scene is augmented with virtual objects. This process requires the estimation of the coordinates from the object in the real world, in 2D or 3D, for accurate superposition of virtual objects for augmented reality.

MATERIALS AND METHODS

The augmented reality system for mobile devices proposed is focused on the recognition of printed images from books and magazines. In where the tasks of object recognition and tracking of this object on the mobile device screen is divided into the task execution on the server-side and client-side, respectively.

The capabilities and performance of client-server approach based Web technologies are demonstrated with a prototype using the Android platform [7, 8], which is available to

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augment non-stationery objects, that is, the covers or front pages from books or selected magazines.

The server-side database is composed by thousands of reference points, which are tracked using a pattern mining to recognize images from photo collections printed media, to perform this function is implemented the algorithm SURF [9]. To improve performance in real time augmented reality system, it incorporates a method proposed in [6], which improves the time of geometric verification for matching characteristics of the identified objects, those objects will later be augmented. In addition, tracking of the objects on the client-side is based on a multimodal combination of visual features and measurements of mobile sensors.

RESULTS AND DISCUSSION

The proposed framework architecture contains 4 layers:

- Web application,
- Mobile application,
- Web Rest API, and
- Content-based image retrieval system.

The proposed architecture for the augmented reality system is shown in Figure 1. The Web application functionality plays with upload and download the required images, by application client-side, in these images will apply augmented reality. The mobile application selects and recognize the specific area, in which is going to put the digital content. After load the image, and select the recognition area, the Web application access to the API and stores the image, the recognized area and their characteristics, inside the Content-based image retrieval system.

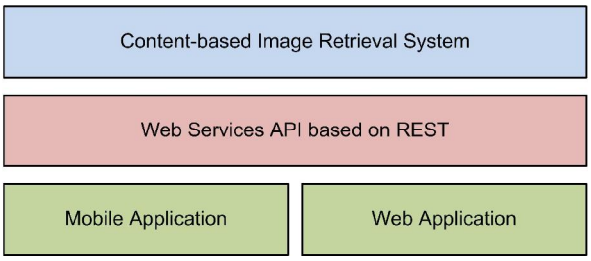

Fig. 1. Architecture augmented reality system.

When the image and its characteristics are stored in the database, then the mobile application sends the extracted features of the image (captured by the video camera) to Content-based image retrieval system using the API. This System processes the features received, and then searches it on the database. Then, when processing is complete, sends the results to mobile devices with digital content, in where it will superimposed the book or magazine.

The definition of the framework is through the layers, allowing each layer to work independently. This enables a scalable and compatible against other augmented reality systems, such Kooaba [10]. To achieve this functionality, every layer has to include a set of configurations that allow integration with external layers. The Web application was built using the JavaScript programming language. This software application extracts the features from the image. Next, these features are sent through an interactive application based on AJAX.

The mobile application is an augmented reality application developed with the Java programming language, using the Android SDK and OpenCV 2.5 (Open Source Computer Vision) libraries [11]. OpenCV is an open source library that contains more than 500 algorithms optimized to analyse image, and video [12]. This mobile client application contains the necessary functionalities to recognize an object inside the image, insert the digital content over that object, and tracks the object.

The operative requirements for the mobile client application are the following:

- The video capture mode must be activated on the mobile device.
- The camera should focus on the printed content.
- Press the capture button to get a frame from the actual video.

The server-side implementation is composed of two layers: the Web services API and the Content-based image retrieval system. The first layer contains the Web services API, which was developed using REST [13, 14]. REST is an architecture of Web development, which is supported in the HTTP standard, allowing to create services and applications that can be used by any device that understands HTTP. In the second layer, the implementation of the Content-based image retrieval system, which was developed using the PHP programming language, allowing a dynamic Web content on the server-side. The Web server also uses the MySQL database engine to build (with the help of PHP) an efficient dynamic website.

In the Figure 2 shows an image of a book detected using a tablet with Android platform. The real world object is searched and retrieved from the database, then the virtual object is displayed on the mobile device screen. Addition, in the Figure 2 are illustrated all points of coincidence between the object in the real world and the image found in the server-side database. Afterwards, the book is augmented with 2D/3D content and digital information.

CONCLUSIONS

In this work we proposed an augmented reality system for mobile devices applied to a printed media content environment, such as books and magazines. The augmented reality system allows to enrich the book covers information by superimposing virtual 3D objects. In order to aim of developing an augmented reality system with high performance, the layered-based architecture that allows to extends and increase the system, was proposed.

Finally, augmented reality systems can be used to assist and improve the people's knowledge, and also provide a comprehension about what is happening on their environment. For some people these system can seem out-topic, nevertheless, inherent digital limits augmented reality allow users to perceive, without divisions, the real world with augmented objects.

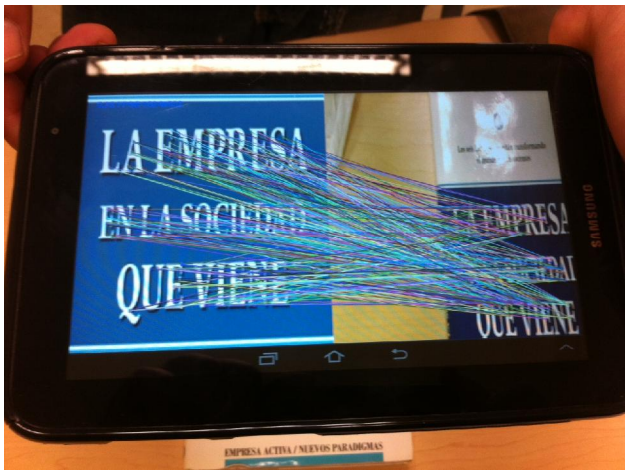

Fig. 2. Image recognized using pattern mining.

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