Design and Implementation Parameters of Mobile VR/AR Platforms for Cultural Heritage Applications

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Virtual and augmented reality have found their way into the cultural heritage sector for the delivery of multimedia information and interactive guided tours. Two main applications can be identified; static and mobile. The former usually takes the form of infokiosk presenting virtual exhibitions and other information on touch screens, or CAVE installation where the user is immersed into synthetic 3D worlds where navigation and visualization are achieved with special devices. The second type of such systems is based on mobile computing platforms suitable for location-based content delivery and guided tours during the visitor's visit at museums, archaeological sites and other places of interest.

INTRACOM, the leading telecommunications hardware manufacturer and software developer in Greece, has taken an active role into the area of cultural VR and AR systems. The company has built considerable expertise in this field with a strong R&D team and participation into various national and international research projects and product design and installation. Its interest in the field is mainly in the management of cultural multimedia content and the design and integration of mobile AR/VR guide platforms and communications infrastructure.

The back-end of our systems includes relational multimedia databases with GIS (Geographic Information System) support and custom-made cultural database architectures and data representations conforming to the latest and most widely used cultural metadata standards like Dublin Core. This way, the source content (text, sound, images, 3D models, video) can be archived along with standard descriptive terms, thereby facilitating its search and retrieval, organization into integrated tours and reuse in other applications ranging from multimedia publishing to video games.

Graphical authoring tools facilitate data manipulation, metadata creation and editing, and support content personalization. This feature is implemented with appropriate metadata terms, which create correspondences between the primary content and user's profiles. The same tools enable the creation of guided tours where audiovisual content can be synchronized to each other and to the user's behaviour as it is manifested by his position, orientation, walking speed, requests, etc. These parameters play an important role as they provide input to a statistics module whose output can be used to dynamically adapt the tour offered to the system user. The very same statistical data can be used to automatically re-categorize primary content and relate it to different users' profiles.

The functionalities performed so far enable the implementation of AR and VR guided tours for presentation to museum and archaeological site visitors. These devices are, in essence, special AR/VR platforms built around portable computers. The top-of-the-range AR device is built around a notebook computer equipped with a 3D graphics accelerator

to handle complex real time 3D graphics and enough processing power and storage space to handle multimedia applications.

The device integrates a user-tracking mechanism for accurately identifying his position, orientation and perspective. It is based on an adaptable configuration employing one or more of the following, depending on indoor or outdoor use and desired accuracy: DGPS receiver for outdoor use, WLAN, RF tag or IR for indoor positioning, digital compass for heading calculation, and video tracking for refining the previous estimates. The combined outcome is accurate user tracking used for navigation purposes and real-time adaptation of graphics and animations for mixing with the real scene. For instance, the user of this device may view his path, current position and heading in a plan of the site or museum he is visiting together with the main points of interest. At the same time, his natural view is augmented with monument reconstructions, animated scenes and other related information in a way that the synthetic worlds seamlessly blend with reality and explain it to the visitor. Avatar humans take the role of narrating and guiding the user through his tour making the experience more user-friendly and appealing especially to first-time users.

The visualization of this information is done with special visualization units in the form of glasses or binoculars integrated with web cameras for capturing the users field-of-view and interaction mechanisms. The system operates automatically according the user's profile and tracking input. It necessitates no interaction at all. Nevertheless, the user may take control of the presentation and request additional information (e.g. related exhibits from various museums) or alter the visualization parameters (e.g. remove or change the transparency of the virtual objects, view and manipulate 3D objects). This interaction can be achieved using special buttons on the visualization device, which control a graphical menu. The interaction is minimized by making efficient use of dynamic personalization of the tour. The objective of the system is to accurately guess and adapt to the interests and behaviour of its user so that he will be kept satisfied and will not place any request.

The same type of presentation can be given using a tablet computer (e-book) with touch screen and integrated user tracking mechanism. In this case the video tracking is obsolete as the DGPS and compass reading are sufficient to synchronize the pre-calculated screen view to the real view in front of the user. As a result, panoramic views, augmented with synthetic information and 3D worlds can be automatically navigated simply by walking and looking towards items and places of interest.

Finally, the same content can be visualized in smaller resolution, but always accompanied by synchronized narration, on PDAs and even 2.5 and 3G mobile phones. In all devices, real-time content downloading is enabled using intelligent software agents and WiFi networks.

All solutions are scalable and adaptable to the needs of each specific installation and existing content can be exploited and reused on any existing or new platform. Currently INTRACOM is working towards the extension of the personalization features, user friendliness and implementation of lighter and more powerful AR and VR platforms with new intuitive interaction mechanisms.

Trials and installations have been made in major sites in Greece and abroad and new commercial installations are under way.