What can be done with Augmented-Reality?
Two applications @ the Cebit 2003

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German Abstract

In diesem Artikel werden zwei verschiedene Anwendungen von Augmented Reality (AR) vorgestellt. Die erste Anwendung ist aus dem Bereich »Service und Wartung komplexer Maschinen«. Neue Methoden und Techniken zur effizienten Informationsvermittlung werden auf Basis des Augmented-Reality-Systems »ArBrowser« entwickelt und im Rahmen von Reparatur- und Service-Szenarien umgesetzt: Schritt für Schritt wird der Servicetechniker durch eine reale Reparaturaufgabe geführt. In einer Datenbrille werden ihm die zusätzlichen Informationen lagerichtig zur Umgebung direkt im Blickfeld eingeblendet. Der zweite Anwendungsbereich von Augmented Reality betrifft Design- und E-Commerce-Anwendungen. Eine nahtlose Integration des virtuellen Objektes in Bilder der realen Umgebung wird auf Basis einer konsistenten Lichtsimulation der Szene erreicht. Virtuelle Möbel werden in Bilder eines realen Raums eingefügt. Verschiedene Designs können so effizient verglichen werden.

Application 1: Context-related performance with Augmented Reality

The efficient transfer of information for the training of service technicians and/or the documentation of work processes, for example, has become increasingly difficult as products become more and more complex. This problem particularly affects sectors such as the automobile, aircraft and machine construction industries, and it requires improved diagnosis and maintenance tools. »Augmented Reality« technology (AR) offers a decisive improvement in the presentation of information. Augmented reality supports context-related performance. Computer-generated information for a maintenance task is presented step-by-step and displayed directly on the real object. This makes it possible to present a service technician with a complex maintenance workflow in a visual and immediately understandable form (see illustration 1).

The ArBrowser

The whole ArBrowser can be regarded as a complete virtual reality system supplemented with specific Augmented Reality capabilities encapsulated in an Internet plug-in. Thus, the ArBrowser can easily be integrated into the existing diagnostic tools and web infrastructures of a company. The Web-based approach allows any desired services and information systems to be connected to the AR-system.

Optical tracking

In order to correctly display the virtual information in the real scene, a computer vision-based tracking module has been developed and integrated in the ArBrowser. A camera mounted on a Head Mounted Display or on a laptop detects well-defined markers placed in the scene and uses them to determine the current camera position and orientation.

ARVIKA

The German economy has recognized the potential of Augmented Reality technology: 20 companies and research institutes have joined forces in the ARVIKA project and established the world's largest AR consortium. The goal of ARVIKA is to develop AR techniques for industrial applications, in particular for construction and maintenance tasks in

Figure 1: The virtual animation shows the step-by-step reparation procedure

Figure 2: ARVIKA Consortium

the area of automobiles, airplanes, machines and plants. The project is funded by the German Federal Ministry for Education and Research (bmbf). The presented mobile AR system has been developed in the framework of ARVIKA *(www.arvika.de)*.

Application 2:
High realism and light simulation for design applications
Reliable Light Simulation
Lighting simulation methods increase the realism of computer-generated scenes by computing shadows and inter-reflection. Efficient hierarchical so called »radiosity« with clustering is essential for handling large and complex scenes, while a reliable visibility classification algorithm will prevent typical artefacts such as missing shadows or floating objects.
However, for an everyday use of such visualization methods, e.g., for design and review, mere visual quality is insufficient. Physical reliability has to be ensured through photometrically and colorimetrically correct lighting simulation. Based on correct input data, such as light distribution, spectra and intensities of light sources, the whole simulation has to be performed within a consistent colour space.

Display calibration
However, a correct simulation alone does not ensure correct visualisation. Every output device has to be calibrated according to its distinct properties. The colour gamut must be determined, simulated values must be converted, gamma correction must be carried out and non-uniform brightness distribution must be eliminated. Only then can a reliable one-by-one visualization of the simulated data be guaranteed.

Overall System
A consistent input, simulation and representation pipeline on the one hand and a geometrically reconstructed scene with correct lighting values on the other hand enable the user to simulate virtual objects, such as furniture, using consistent lighting and to seamlessly integrate them into photographs of the real environment.

E-(motion) commerce
In contrast to existing e-commerce solutions, where products can mainly be listed in catalogues, the developed e-(motion)-commerce enables the presentation of products in the context of their future environment (e.g., virtual furniture for a living room, new and virtual light sources for an office, etc.). The seamless integration of the virtual object gives the user the feeling that the object exists in the scene and thus makes design decisions possible.

ARIS Project
This work has been developed in the European research project ARIS (Augmented Reality Image Synthesis, IST-200-28707).

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Figure 3: Image of a real living room

Figure 4: Seamless integration of a virtual armoire taking into account the lighting effects