

ARVIKA – Augmented Reality for Development, Production and Service

Reiner Wichert

Overview

The focus project ARVIKA, partially funded by the BMBF (Federal Ministry for Education and Research), uses augmented reality (AR) technologies to research and create a user-oriented and system-driven support of operation procedures. Augmented Reality is a new approach to human-machine interaction. Here, the user is given supplementary visual information, for example, using a head-mounted display. This supplementary information is displayed context-sensitive, i.e. drawn from and fitted to a viewed real object, such as a part of an assembly. What a technician actually sees will be complemented by a visual representation of the relevant fitting instructions for the component. In this case, augmented reality can replace the old-style handbook. In addition to this, wearable computers can be applied in AR areas where mobility is very important and, for example, when data concerning processes, measurements and simulations are needed to support the task at hand.

The project ideas will be realized in various application areas of German industry, such as automobile manufacturing and aircraft construction, mechanical engineering and system development. The

prospects offered by this technology are of particular benefit to middle-sized businesses which, through improved diagnosis and servicing capabilities can act and react more flexibly and more efficiently and therefore improve their ability to compete globally.

The ARVIKA-Consortium consists of 17 partners, with large companies and SMEs in the aircraft and automobile industry, outstanding representatives from the tool makers and production-machines industry, important institutes for research and science, SMEs and servicing providers. The consortium is headed by Siemens. An overview of ARVIKA partners is given in Figure 1.

Project goals

ARVIKA aims to research and realize Augmented-Reality-Technologies (AR) which will support development, production and servicing related to complex technical products in a user-oriented and use-motivated manner. The main application-related tasks of ARVIKA aim to verify augmented reality in the different life cycles of the used products. This also includes a service of the machines and systems which are required for the production environment. The project concentrates on the following areas:

German Abstract

In dem vom BMB+F geförderten Leitprojekt ARVIKA »Augmented Reality für Entwicklung, Produktion und Service« werden Augmented-Reality-Technologien zur Unterstützung von Arbeitsprozessen in Entwicklung, Produktion und Service für komplexe technische Produkte und Anlagen benutzerorientiert und anwendungsgetrieben erforscht und realisiert. Durch die virtuelle Überlagerung realer Objekte mit rechnergenerierten virtuellen Objekten erlauben AR-Techniken im Sinne einer erweiterten Realität das situationsgerechte Agieren in realen Arbeitsumgebungen. Die Projektideen werden in für die deutsche Industrie relevanten Anwendungsfeldern wie Automobil- und Flugzeugbau, Maschinen- und Anlagenbau umgesetzt. Unsere Darmstädter Institutionen IGD, ZGDV, sowie vrcom sind an diesem Projekt beteiligt und dieser Artikel soll einen ersten Überblick über die Ziele des Projektes, sowie unsere Tätigkeiten geben.



Figure 1: Partners of the ARVIKA consortium



Figure 2: IGD prototype development for the AR support of a manufacturing process

- Product development: automobile and aircraft
- Production: automobile manufacture and aircraft construction
- Service and maintenance: system techniques, in this case power stations and the tools and machines required for the production.

This covers major application areas of AR, avoids duplicate developments, and enables a profound, application-oriented verification of this novel technique.

Certain problems in product development can only be solved by using AR technology, for example, direct comparisons between test results and calculation results. After a crash test, the AR system superimposes the deformation that is predicted in the simulation onto the actual crashed vehicle so that the development engineer can compare the images. Differences can thus be identified and evaluated »at a glance«.

In the production cycle, work is facilitated as information on the state of the respective job is given and received directly in connection with the related products on site. For the installation work, the individual steps in a procedure can be presented to the technician in a mixture of real and virtual. With regard to this, a comparison of real installation work with simulation results could, for example, lead to a comprehensive optimization which would both improve the quality of work planning and simplify and accelerate critical phases.

In the service cycle, AR technologies make it possible to acquire information for maintenance from digitally based sources and to transmit that information to a technician. By superimposing real objects, it is possible to explain the necessary fitting procedures. With regard to co-operative work, AR technology will improve the shared problem solving. The technician on site can contact an expert who maybe far away but still has the same view of the problem as the technician – enabled by the remote transmission of actual data and video.

R & D by IGD, ZGDV and vrcom

IGD's work at the ARVIKA project will concentrate on research and development of fundamental technologies in Augmented Reality. The goal is to realize an AR-system which consists of three main components – object and user tracking, information rendering and new kinds of interaction, suited for AR systems. This basic AR-system will serve as basis for industrial applications.

Above all, new solutions for highly accurate and robust tracking will be designed. The approach focuses of the development of vision based tracking and the combination of different already available sensor technologies.

The main goal of Computer Graphics Center (ZGDV) is the development of AR related methods for a mobile data access and the localization of objects. The mobile wireless access is a major step towards the acceptance of AR-systems in various application

areas, as the integration of AR adapting the natural working method of the user will be enabled. Only the support of mobile data access allows the freedom of movement together with an access to distributed information. The mobile data access is based on the use of different wireless communication channels and, therefore, limited transfer rates and other restrictions will have to be considered. This will lead to the development of a suitable middleware for mobile AR-scenario, fitting to mobile communication and taking different context parameters into account. Furthermore, the development of adaptation concepts will be a main topic in the future.

The work of vrcom concentrates on the adaptation and inclusion of components from the VR-System Virtual Design 2 into the AR-System as modules for visualization, animation and interaction with 3D-objects. Based on these consisting VR-modules and on the project results, vrcom will develop and commercialize an AR-System. A further goal is to take part in the development of base components with the main focus on interaction techniques and the event handling.

Project state

The work on ARVIKA has begun in July 1999. Currently, the focus is on a specification of the system architecture. The whole project will take four years and is divided into two main development cycles.

The first prototype of the ARVIKA system will be available in 2001. For further information, please see <http://www.arvika.de>

Points of contact

Dipl.-Inform. Norbert Gerfelder
ZGDV Darmstadt, Germany
Email: norbert.gerfelder@zgdv.de

Dr. Stefan Müller
Fraunhofer IGD Darmstadt, Germany
Email: stefan.mueller@igd.fhg.de

Dipl.-Ing. Heike Ziegler
vrcom, Darmstadt, Germany
Email: ziegler@vrcom.de