STARMATE
augmented reality for maintenance, assembly and training

The challenge

Assembling or maintaining complex equipment involves considerable skill on the part of the technicians undertaking the task. If they are unfamiliar with the piece of equipment or the fault concerned, they may have to refer frequently to an instruction manual in order to identify the next steps in the assembly or diagnostic process.

This can often present problems, because the assembly or maintenance actions may require the use of both hands and they may have to take place in a dirty environment, where a paper-based manual will quickly be damaged unless it is kept at a safe distance from the equipment and time is taken to remove protective gloves each time the manual is consulted.

Similar problems can be encountered in training technicians to deal with new types of equipment. It may be impossible to provide hands-on training in a classroom environment where support from tutors or instruction manuals could easily be provided to a group of students. Training with the equipment in its 'natural' environment often implies lengthy and costly one-to-one sessions that will still not cover all of the possible problems that could be encountered in the real world.

The rapid rate of technical progress means that maintenance technicians require frequent training in how to handle the latest equipment, yet are likely to encounter many earlier generations of equipment in the field.

The technical solution

The IST project STARMATE[1] set out to develop a prototype system that would demonstrate how 'augmented reality' could provide:

- support to technicians working on complex maintenance operations
- hands-on training using equipment in its natural environment

Augmented reality essentially involves superimposing a computer generated image on what you are actually looking at. The STARMATE system[2] does this by means of a headset that includes a visor with a head-up display to present the computer generated information on top of the actual scene. The headset also has a laser to detect what the wearer is looking at, and align the computer generated images with what he or she is actually seeing in the real world. A microphone and earpiece allow the users to ask for and receive advice without having to take their hands off the equipment. They can use a standard set of commands, such as 'next step', 'last step', 'display video' and 'display alternative augmentations', to call for advice on what to do next. The advice can be offered as text and images overlaid on their view of the real world or as an interactive audio dialogue to guide them through the next steps of the process.

At the core of the STARMATE system there is a powerful computer that contains an electronic manual with all known information about the system to be assembled or maintained. It is able to detect what the user is looking at, by combining earlier information with current messages from the laser pointer in the user's headset. This allows it to generate images that line up with the user's view of the equipment and offer text or speech messages about what to do next.

A high speed data link provides the communications needed to ensure that users get a genuine real-time response to their requests for support.

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[1] STARMATE is led by the French company 'Thales Optronique' and includes partners from France, Germany, Italy and Spain. The project started early in 2000 and will finish its work in the spring of 2003.

[2] A more detailed description of the system can be found at the project website http://vr.c-s.fr/starmate/

The results

During the project, the partners demonstrated the system in a number of real-life working environments. Thales Optronique, the project co-ordinator, used the system to support the maintenance of opto-electroinic equipment. A Spanish partner, TECNATOM used the system for computer guided maintenance of a nuclear power plant component, namely a valve actuator.

Another demonstration involved applying the system to the wiring of complex aeronautic equipment.

Conclusions

STARMATE has shown how ‘augmented reality’ could support the assembly or maintenance of complex equipment as well as the training of technicians involved in such tasks.

The technology developed by the project shows how such tools could offer:

- More efficient maintenance with fewer errors
- Improved safety for maintenance technicians
- More efficient ways of training maintenance technicians
- Ways in which the nuclear industry could manage its specialist and sensitive maintenance activities.

The tools developed by the project are still experimental. However, the STARMATE partners hope to develop commercial products based on the technology during the next few years.