## *ARVIKA@Audi*

## *AR-based prototyping in engineering and design (Augmented MockUp)*

The Audi Demo at ISMAR 2002 shows the actual status of Audi's prototypes within the ARVIKA-project. We are evaluating scenarios in the field of car development and design, focussing on immersive augmentation and immersive interaction under the ARVIKA working title *„AR-based prototyping in engineering and design"*.

**Motivation and AR Approach**

In the beginning of a new car project, a lot of sketches and scribbles are done by the car designers. They are visualised in 3D first as clay models or rapid prototyping models in a small scale and later as a final design prototype in full scale. The process from the large number of sketches up to the final design proposal takes a lot of time, effort and expenses. So the 3D visualisation should be done efficiently in order not to risk losing initial design ideas because of time limitations.
Our approach to support the design process by using augmented reality technology is to increase the amount of information that is being visualised in the physical models by augmenting the physical design mock-ups with alternative design variations as virtual datasets. So certain design proposals can be checked in the context of an already existing 3D physical model. Colours and textures of materials can be checked in the context of a 3D-shape as well.
So it would be possible to decrease the number of physical mock-ups and the time up to the final design proposal. Moreover, a higher number of design variations can be visualised at the same time.

The second scenario that is being build up within the ARVIKA-project is a scenario that supports processes in the prototype-shop.
There, tool-fabricated parts are mounted together for the first time. Although the tool fabricated parts are verified by DMU-methods, errors due to the production process are usually not recognised until that stadium. Late error detection extends and complicates the process to build up the physical prototype.
Our approach to support the prototyping process is to verify the tool-fabricated parts before they are mounted together by augmenting the corresponding 3D-CAD model. Therefore, it is planned to use a video-see-through head-mounted-display that provides a stereographic augmented view. Currently, such a video-HMD is being produced as a custom prototype. So, the geometry of the tool fabricated parts can be checked very easily and intuitively for feature- and surface correctness.

**Demo Scenarios**

Our ISMAR Demo will show examples out of both scenarios, the design scenario as well as the prototype-shop scenario.
The example taken out of the design scenario shows a physical model that has been used when designing the TT-Roadster. This physical model will be augmented by several virtual 3D models, like for instance the convertible top which can be opened and closed (fig.1).

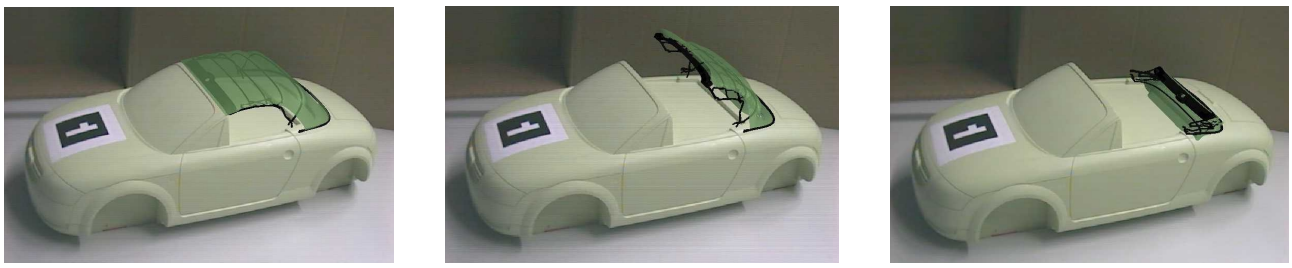

*fig.1 physical design model augmented by a virtual convertible top*

To demonstrate how different design variations can work in the context of an existing shape, the front-lights of the new Audi A4 are subject for the augmentation as well. So, the TT-Roadster model will get an entirely new face and appearance.

The demo example taken out of the prototyping scenario shows a congruent augmentation of a bumper (optional: dashboard) with the corresponding 3D-CAD geometry (fig.2).

*fig.2 data preparation and augmentation of a bumper*

Before mounting the bumper to the prototype, the geometry itself can be checked for errors and the mounting-areas for collision.

**Software and Interaction**

Both scenarios will be controlled by an adaptable and intelligent GUI. For the design augmentation, the GUI provides basic features like interactive placement of models, interactive adjustment of environmental influences into the virtual model or switching between several design variations.
For the prototyping scenario, the GUI will additionally provide functionalities known from DMU-tools. Here the focus lies in working with clipping planes, measuring, adding annotations or capturing the scene by screenshots and exporting them.

The screenshots of the actual work (fig.1 and fig.2) are based on the ARVIKA-system with single camera feed. A basic requirement for a productive AR use at Audi is a good performance when working with large 3D models. Furthermore, it must be possible for the AR-System to use file formats and data which is used in the current VR-workflow without further adjustment in order not to lose time for AR-data preparation.
So, the software platform for our future AR-system is the VR-software Virtual Design 2 (where a camera feed is being implemented).
As a first approach, a single camera feed is used. Future work will be to implement a double video feed to provide a stereoscopic representation of the real environment.
All interactions such as data preparation, augmentation and exportation of working results can be done by using a flystick which is optically tracked.

**Future Work**

The focus of future activities will be to provide a basic and flexible AR-System which can be used for either design tasks or engineering tasks. Therefore, the GUI has to be advanced to a flexible control tool and the Head Mounted Display for stereoscopic visualisation has to be implemented.
Finally, the scenarios have to be evaluated within usability tests which will be conducted by designers as well as engineers.