

## Virtual Mirror

A Virtual Mirror has been developed that enhances the visualization of customized sports shoes. Instead of viewing yourself in a real mirror, highly sophisticated 3D image processing techniques are used to verify the appearance of new shoe models. A camera captures the person and outputs the mirrored images onto a large display which replaces the real mirror. The 3D motion of both feet are tracked and computer graphics models of the shoes are augmented into the video such that the person seems to wear the virtual shoes.

Ein Virtueller Spiegel wurde entwickelt für die Visualisierung individuell gefertigter Sportschuhe. Anstatt sich selbst in einem realen Spiegel zu betrachten, werden hoch entwickelte 3D Bildverarbeitungstechnologien eingesetzt, um das Aussehen der neuen Schuhmodelle zu überprüfen. Eine Kamera nimmt dabei die Person auf und stellt dessen gespiegeltes Bild auf einem großen Display dar, das den realen Spiegel ersetzt. Die 3D Bewegungen der beiden Füße werden verfolgt und Computer Graphik Modelle so in die Videoszene integriert, dass die Person die virtuellen Schuhe zu tragen scheint.

The Virtual Mirror developed by the Image Processing Department is a system for the visualization of customized shoes that a person can try and watch in front of a mirror although they do not exist in reality. The system shown in Fig. 1 has been created for adidas and runs in their new store, opened in October 2006 at the Champs Elysées, Paris, France. In this innovation center, a customer cannot chose only shoes from the shelf but design personalized models. Besides particular fitting to the left and right foot, the client can change the design and colors of a shoe model at a special terminal and add individual embroideries and decorations. In order to give the customer an impression

how the shoes finally look like after being manufactured, the user can step in front of the Virtual Mirror.



Fig. 1: Installation of the Virtual Mirror in the adidas store, Champs Elysées, Paris.

There, a camera captures the customer wearing fitting boots with a standard design. A display replaces a real mirror and outputs the horizontally flipped camera image. The display is mounted such that the person appears at the same position, where the user would expect to see himself when looking into a real mirror. In order to enhance the virtual feeling of the framework, the background is segmented and replaced by a synthetic environment. A novel 3D motion tracker estimates the position and orientation for each foot using a model-based approach that is very robust and can easily be adapted to new shoe models. Once the exact foot position in 3D space is known, the computer graphics models, that have been configured and colored according to the customer's wishes, are rendered and integrated into the video stream such that the real shoes are replaced by the virtual ones. Special care has to be taken for this augmentation, since the real scene in the 2D video can occlude parts of the virtual 3D scene. Therefore, visibility for all parts of the shoe has to be computed for a given position. Since all algorithms have been implemented with real-time constraints, the customer can move freely and watch himself/herself with the new shoes that have been designed just some minutes earlier.

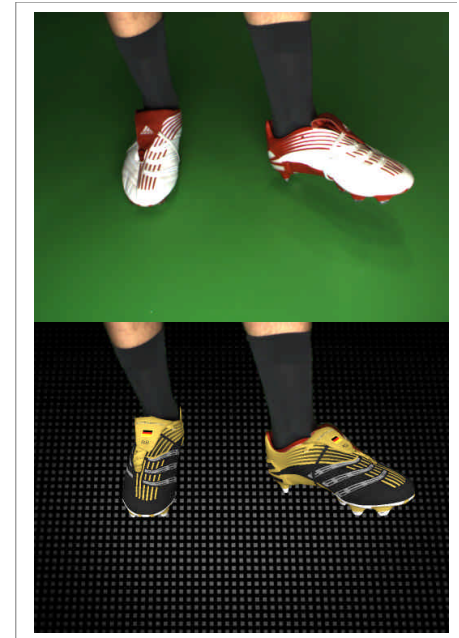


Fig. 2: Upper: Part of the original scene captured with a single camera; Lower: Virtual Mirror output augmented with customized shoes.

The framework uses high-end augmented reality techniques that combine real video content with computer generated material in real-time. The concept of a mirror realizes the augmentation without the need of the customer to wear glasses, but the user can move freely as in front of a real mirror. No additional equipment has to be used but you can just step into the application. This significantly enhances the acceptability and immersiveness and reduces the effort for supervising such an application. The system has been designed and optimized to show customized shoes, but can also be generalized to visualize other clothes or a new hairstyle. In contrast to existing approaches, the system works three-dimensionally and shows all virtual equipment from the correct viewing direction and pose. The output is not restricted to a fixed frontal view as in other 2D systems, giving the user much more the feeling to be present in a real environment.