B11 Personal Identification by Superimposition and Metrical Analysis: Practical Experience

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After attending this presentation, attendees will better understand the technique of personal identification by morphometric comparison between recorded images of a robbery and 3D photogrammetric facial avatars of the suspect.

This presentation will impact the forensic science community by showing an objective, repeatable, and non-invasive method for robber personal identification based on facial superimposition and facial landmark metrical analysis.

Among the available techniques for personal identification—morphological classification, metrical analysis, and facial superimposition—the latter seems to be the most reliable; however, very often courts require a quantification of the correspondence between recorded images and a robber's face.

The described method exploits digital photogrammetry for facial scanning. Photogrammetric 3D capturing works by multiple and synchronous photo-shooting and represents the most suitable technology for face capturing in living persons, while laser scanning is largely affected by slight movements of human faces.

In January 2010, two criminals armed with paper cutters, burglarized a bank in Bari. Their faces were covered by balaclavas when they entered the bank; however, a small camera was hidden in the bank security entrance doorpost and partially captured the robbers' faces before they were disguised.

Some months later, police officers recognized the two robbers as two local criminals who were already spending time in jail for similar offenses. The judge authorized the research group to go to the jail for the 3D acquisition phase. In order to do this, the suspects' authorization was requested and obtained.

The equipment transported to the prison consisted of four cameras (12.1 Mpixel), a proper support, the lighting system, a calibration grid, and a notebook for the synchronization of photo-shooting and data storage. The suspect 3D avatars were created with a suitable software program and were then saved as ".obj" files.

In the next step, recorded images of the robbery were carefully analyzed and only frames with a better view of facial landmarks were chosen for the 2D/3D comparison.

The hidden camera had a fisheye lens and, to proceed to the superimposition phase, fisheye distortion removal was needed. To do this, an on-site inspection of the bank entrance facilities was carried out, with accurate measurements taken of the bank entrance room furniture and walls. The selected frames were then normalized through comparison with the obtained data.

The 3D avatars of the two suspects were then spatially oriented in the same position as the robbers in the normalized frames. To check the correct spatial orientation, the 2D frames and the snapshots of the 3D avatars were superimposed and gradually blended.

In the next step, for each face and avatar at least five objective landmarks were chosen (both in lateral and in frontal view), such as glabella, exocanthions, endocanthions, pronasal point, subspinal point, and gnathion and pogonion. Repeated landmarking by different observers allowed detection of random errors and controlled the quality of the landmarking within and between operators, minimizing variability.

Finally, the absolute and relative distances between the marked points, the perimeters and the areas of the triangles obtained by connecting the points, and the compactness indexes were automatically calculated on both images in the analysis using suitable software. The correlation coefficients between the suspects' avatars and the robbers' faces values that were higher than 0.995 were judged to be consistent with a positive personal identification.

Identification, Robber, 3D

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