C26 Current Developments in 3D+2D Facial Recognition

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Participants will be briefed on the possibilities of 3D facial models for facial comparison. This presentation will impact the forensic community by demonstrating the limitations and opportunities of the use of 3D face models for image based identification will be shown.

The majority of automatic face recognition research has been focused on the use of two-dimensional intensity images. However, the current state of the art in face recognition is not sufficient for forensic applications. Although some of the techniques reach reasonably high levels of recog- nition under controlled circumstances with frontal face images, of course surveillance images hardly ever capture a suspect frontal face, with good lighting conditions, and a neutral facial expression. Therefore, current research in facial recognition focuses more on 3D methods including pose correction, lighting modeling and facial expression modeling.

In order to find the landmarks that are best suited for automated facial comparison, an analysis of 3D data from the facial area of 3D whole body scans is analyzed. Eight facial landmarks were manually annotated, and recorded in the scanning process. Absolute distances between these land- marks in the 3D models are measured.

To find a measure of the discriminating value of the distance mea- surements, the authors calculated the probability that the measurements of two subjects are not significantly different. If the measurements of a subject are close to the mean (i.e. a 'common' face), there is a probability that the same measurements are found in 1 of 2 subjects of the present data. If the measurements of a subject are in the tail of this distribution (i.e. a rare face), the probability that the same measurements are found on another subject is 1 in 12 subjects. Also experiments in which 3D models were used to estimate camera parameters using a least-squares estimation algo- rithm based on photogrammetric principles gave disappointing results: the remaining distance between corresponding points can be larger in the case where the scan model and the photo originate from the same person than in the case where the scan model and the photo are from different persons. The main reason for these disappointing results can be found in the level of measurement error due to landmark positioning, which is in the 2-4 mm range (own measurements and ICAO image resolution standards), com- pared to the standard deviation in the population, which is in the 5-10 mm range (own measurements and literature data). These relatively large mea- surement errors can be caused by landmark detection errors, low image res- olution, but also facial expression and physical condition changes.

From these data it is clear that landmark distances, either 2D or 3D, will not suffice for forensic identification purposes. However, of course still other shape and texture features are available for facial comparison. In forensic comparison of a facial images, preferably reference images are used in which the head is positioned corresponding to the disputed facial image. 3D imaging techniques, together with 3D modeling software, offer the possibility of flexible and reproducible positioning of the head of a person corresponding to the face and camera position of the 2D facial images. This creates the opportunity to more accurately compare relatively unique features, like moles and scars, with respect to there shape and positioning on the face.

3D Models, Facial Recognition, Identification

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