B6T8 Algorithm Performance

The following diagrams show the performance of the current B6T8 engine in the closed-set identification, the open-set identification and the verification scenario. All measurements were done using those two subsets of the grayscale FERET database that constitute the so-called Duplicate I test: a gallery including 1196 images of 1181 persons (for a few persons, two images are enrolled in the gallery) and a probe set of 722 images of 242 persons.

The main characteristic of this test is that the probe images and the corresponding gallery image(s) were taken in different sessions of the FERET image collection process. All images show the face in a frontal or nearly frontal pose and were taken in a setting typical for passport photographs. The average resolution of the images is low, with an average distance between the eye centers at 65 pixels. Regarding the age differences between the images, here is a quote from the FERET DB documentation on this test: "The Duplicate I probe set holds 722 images whose matches were taken between 0 and 1031 days after the match. The median is 72 days and the mean is 251 days."

Between gallery and probe set, the images of a person display differences in various aspects such as illumination, facial expression, wearing of glasses, pose (slightly), age (up to 34 months), or resolution of the face within the image. The demographic characteristics of the image subsets seem not to be disclosed. Visual inspection of the images revealed that they cover an age range of at least between 20 and 60 years and that various ethnicities occur in the following proportions: 9% Black (i.e. Afro-American and native Australian), 12% Asian (i.e. East and Southeast Asian) and 79% Caucasian (i.e. all other ethnicities).

The performance measures applied in the diagrams are defined in the ISO/IEC 19795-1 standard: "Information technology -- Biometric performance testing and reporting -- Part 1: Principles and framework", 2006. For more information on the FERET tests, see the articles listed under References.

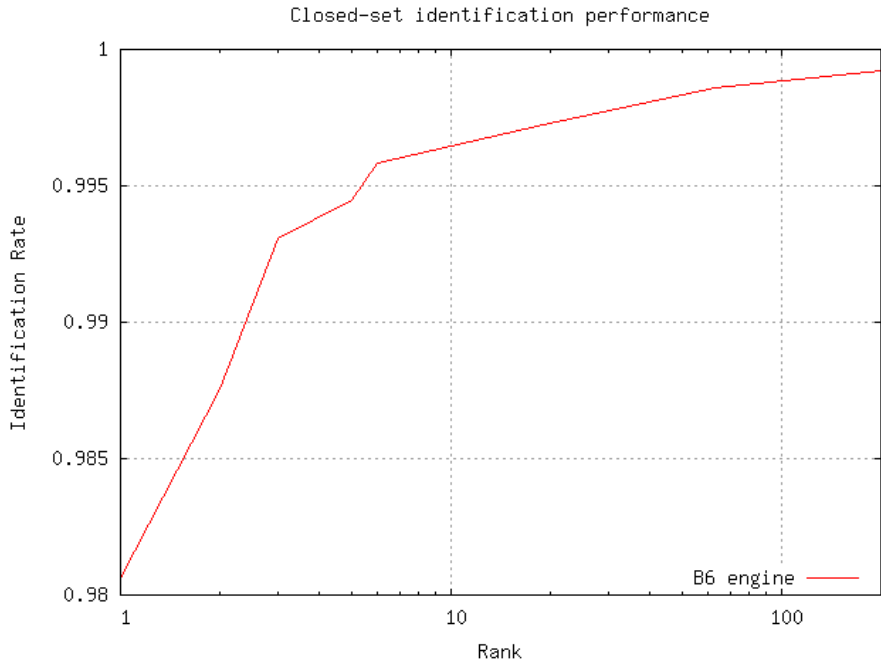

Diagram 1: Closed-set identification performance with FERET database

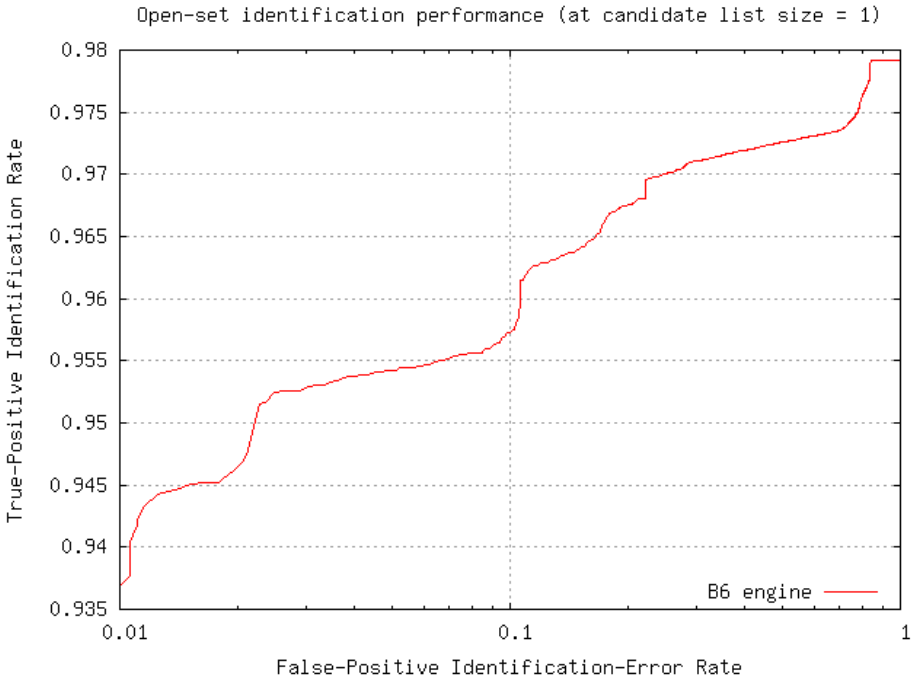

Diagram 2: The open-set identification performance curve reflects application scenarios for passport/visa or driver's license issuance.

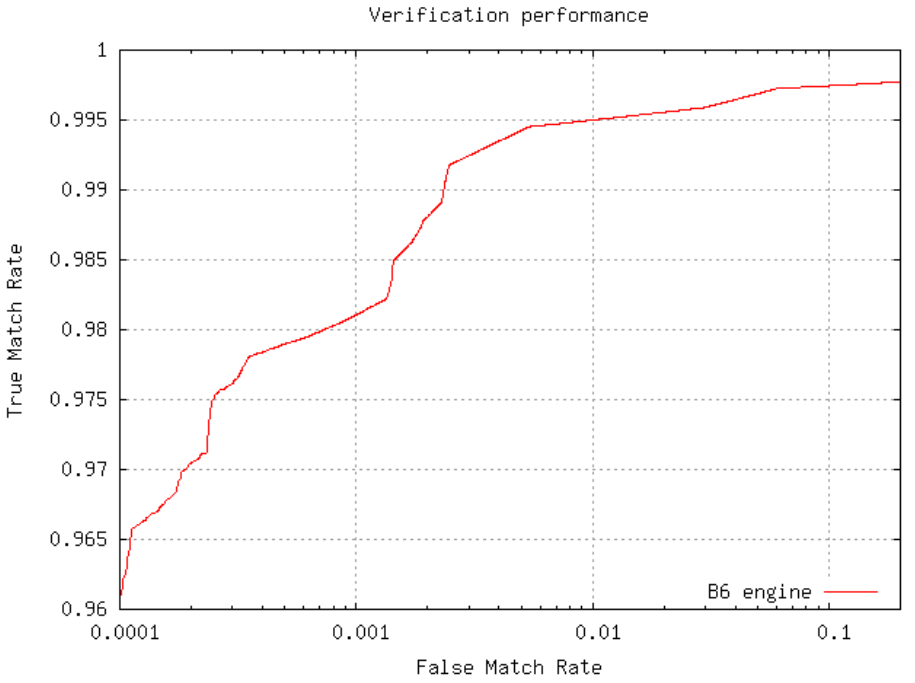

Diagram 3: The ROC curve reports on the biometric performance in verification applications typical for access control.

The current B6T8 algorithm delivers a True Match Rate of more than 98% at a typical False Match Rate of 0.1%.

Improvements over the previous engine B5

In the development of the engine B6 we focused on improving the recognition performance on difficult image material, in particular images with faces in low resolution or in non-frontal poses, which are typical e.g. for video surveillance applications. The four diagrams on the next two pages show the performance increase over B5 on such images.

In diagrams 4 and 5, the performances of B5 and B6 are compared under head pose variation, using a set of 994 frontal pose images in the color FERET database as the gallery. The probe set consists of all non-frontal pose images from the color FERET database in which both eyes are visible. Head poses up to half-profile are included in the probe set.

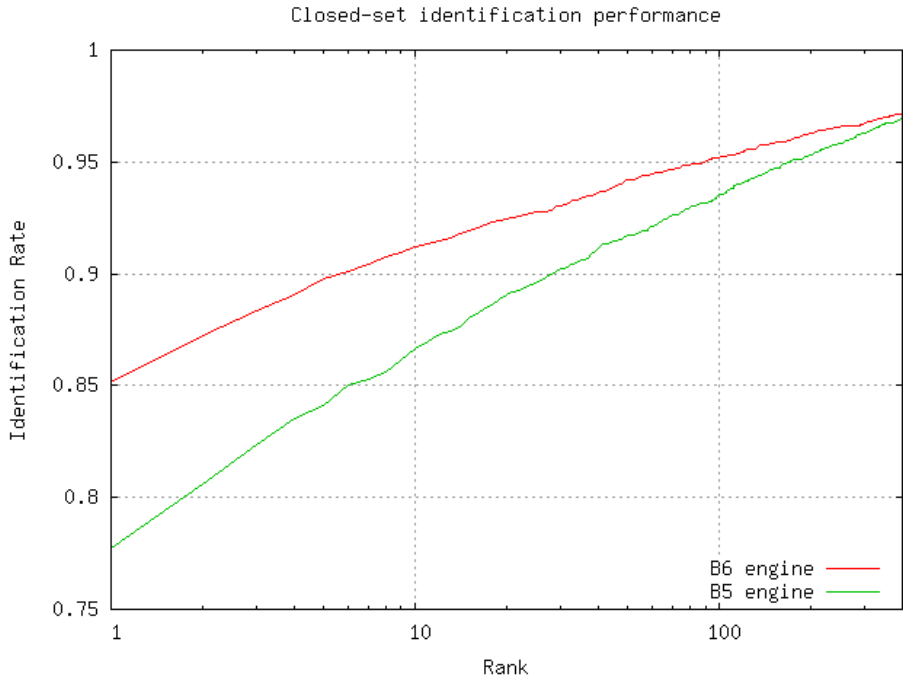

Diagram 4: Closed set-identification performance in the pose variation test

The rank 1 identification rate has increased from 75% to 85%.

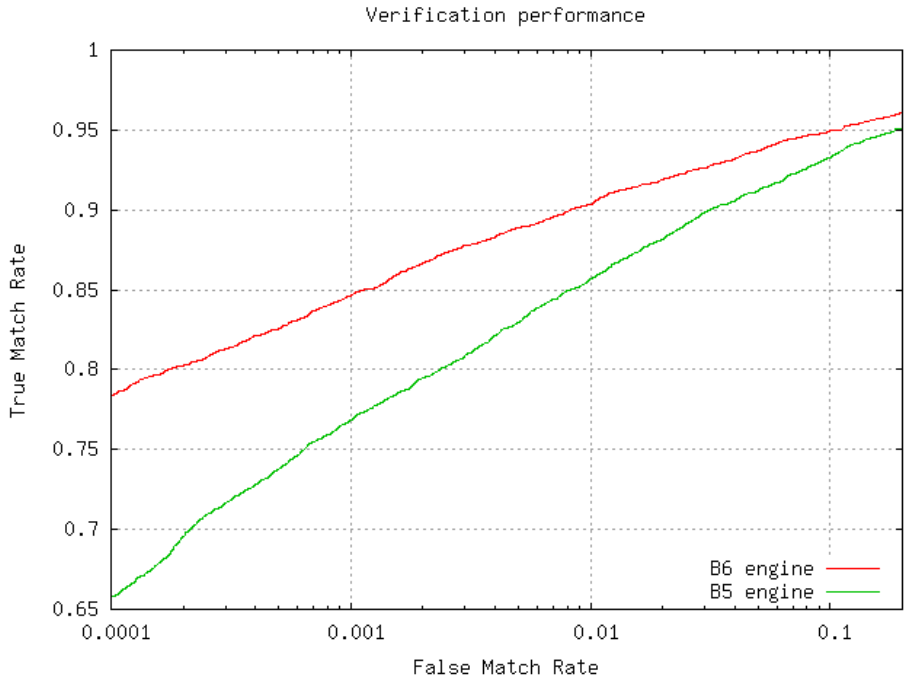

Diagram 5: Verification performance in the pose variation test

At a typical False Match Rate of 0.1%, the True Match Rate rose from 77% to 85%.

The following diagrams (Diagrams 6 and 7) show the performance on faces in low resolution. For the measurements, a gallery of 10016 faces of 10016 different subjects was matched with a probe set of 882 different faces of 843 different subjects (all subjects occur in the 10016 subjects of the gallery), resulting in 882 genuine scores and more than 8.8 million imposter scores. The images are in passport style, partly affected by noise such as hot spots or pixel noise, and mostly of Caucasian and African-American adults.

All probe images were scaled down to achieve a face resolution of 25 pixels, measured as the number of pixels between the eye centers. This corresponds, for example, to a video surveillance situation where the gallery consists of good quality photographs and the probes are extracted from video footage taken with a typical video camera.

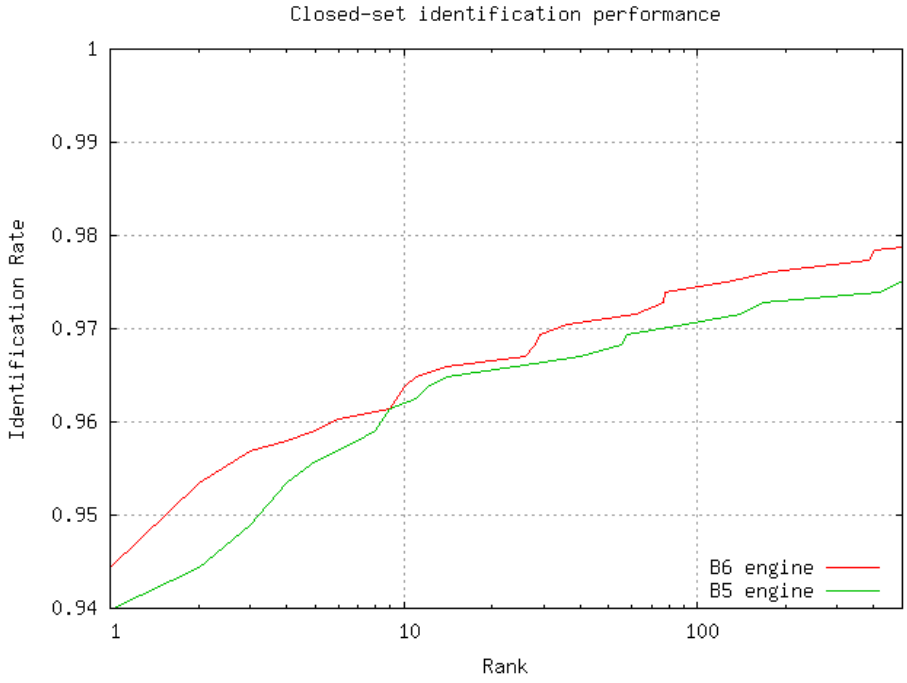

Diagram 6: Closed set-identification performance in the low resolution test

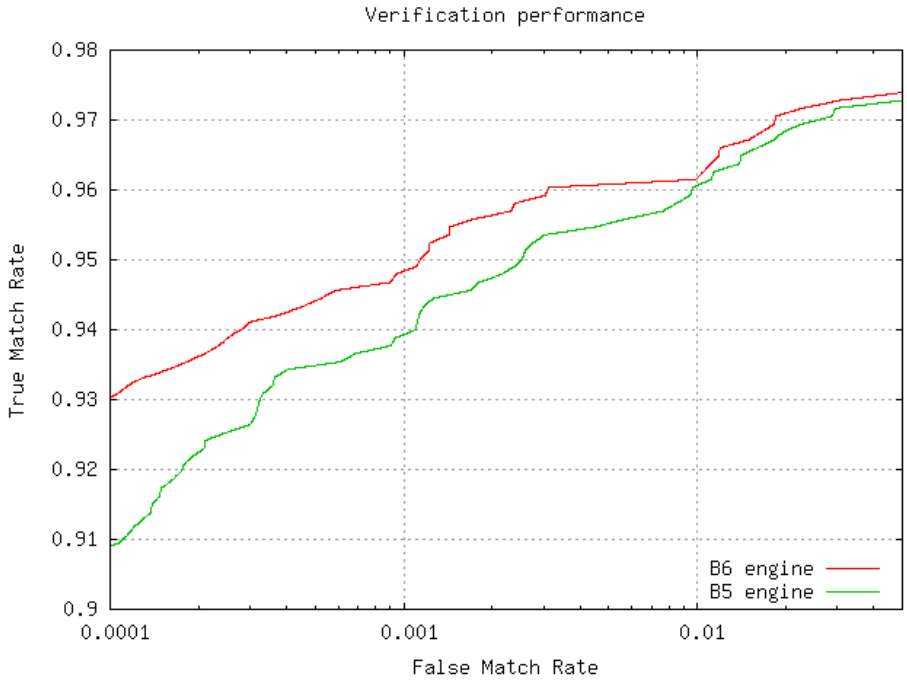

Diagram 7: Verification performance in the low resolution test

At a typical False Match Rate of 0.1%, the True Match Rate rose by 1%.

Acknowledgement

The research in this paper uses the FERET database of facial images collected under the FERET program [6].

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