ROGERS DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING UNIVERSITY of TORONTO

Face Recognition

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IPSI: Identity, Privacy and Security initiative @ UofT

Face recognition is one of the most passive, convenient, natural, friendly, and noninvasive types of biometrics. It can be used even in situations with large concourse of unaware visitors. Robust face recognition and analysis can find applications in a wide variety of context such as security and surveillance, human computer interaction, video games, virtual reality, video conferencing, access control, network login, ATM.

Changeability and privacy are important factors for the widespread deployment of biometric technology due to the limited number of biometric traits that human possesses, as well as the fact that biometric data reflects the user's physiological and/or behavioral characteristics. One objective of our research is to advance the state of the art in face recognition, and develop methods for changeable and privacy preserving biometric template generation.

Our sorted index number based approach improves the recognition accuracy comparing with traditional appearance based approaches, and can be applied in conjunction with random transformations for producing biometric templates with strong changeability and privacy protection.

Our random projection based approach is data-independent, easy to implement, and does not require the computationally complex procedure for training. It is capable of providing changeable and privacy preserving face recognition, while achieving recognition rate that is comparable to existing approaches.

Our sorted index number based approach in combination with random transformations can achieve 6% equal error rate in user-independent key scenario, and produce zero equal error rate when user-dependent keys are employed. The generated privacy preserving templates can provide strong changeability at all system threshold values.

Another objective of our research is to introduce robust techniques for recognizing expression-variant faces from one image per person. The proposed approach synthesizes other expressions of the input image by effectively projecting it to expression-specific subspaces. The synthesized images are then used to retrain discriminant feature extraction system.

The introduced solution is an appearance-based method and is computationally simple. It does not need priori knowledge of the input's facial expression and is compatible to the facial expressions that are unknown by the training system. For the recognition of a probe with an arbitrary expression from a gallery set of various expressions, the proposed method decreases the verification error rate by 40% to 46% at the false acceptance rate of o.1%. The development of such system shows high potential for surveillance and human-compute-interaction applications that have uncontrolled facial expression.

From top to bottom: input image, transformed to a different expression, and the ground truth image.

Recent Publications:

1. Y. Wang, D. Hatzinakos, "On random transformations for privacy preserving face verification", IEEE Trans. on Systems, Man and Cybernetics, Part B (Submitted in Feb. 2010, revised in June 2010).
2. Y. Wang, D. Hatzinakos, "Sorted index numbers for privacy preserving face recognition", EURASIP Journal on Advances in Signal Processing, Article ID 260148, 16 pages, 2009.
3. Y. Wang, K. N. Plataniotis, "An analysis of random projection for changeable and privacy preserving biometric verification". IEEE Transactions on Systems, Man and Cybernetics, Part B. (accepted in Aug. 2009, online in Dec. 2009, in press).
4. Y. Wang, D. Hatzinakos, "Cancelable face recognition using random multiplicative transform", the 20th International Conference on Pattern Recognition (ICPR), Istanbul, Turkey, August 23-26, 2010.
5. Y. Wang, D. Hatzinakos, "Random translational transformation for changeable face verification", Proceedings of IEEE 16th International Conference on Digital Signal Processing (DSP), July 5-7, 2009, Santorinl, Greece.
6. Y. Wang, D. Hatzinakos, "Face verification with changeable templates", Proceedings of IEEE Canadian Conference on Electrical and Computer Engineering (CCECE), pp. 31-36, May 3-6, 2009, St. John's, Newfoundland, Canada.

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