A Mobile-Based Face Verification System

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Intelligent mobile phones equipped with a camera are very popular in our daily lives now. Face verification running on mobile phone provides not only a tool for the protection of the owner’s authority but also an approach for verification from a distance. The combination of biometrics and telecommunication technologies possesses broad application potentials in information exchanges. However, there are also some critical issues needing solving. Usually the processing power and memory size of a mobile phone system are limited, and the acquisition images are suffered from the illumination changes.

An acquisition image \( I(x,y) \) can be modeled as a product of the reflectance \( R \) and Illuminant effect \( L \) shown as \( I(x,y) = R(x,y) * L(x,y) \). The reflectance attribution \( R(x,y) \) is the inherent feature of a human face for verification. Compared with the reflectance changes rapidly across the contour of a face, usually the illumination changes smoothly and slowly. If two pixels are located nearby, the ratio of the reflectance between these two pixels can be calculated via the ratio of their illuminations, which is approximately independent from illumination changes. Based on this invariant property of the ratio of illumination at a pixel to its surrounding neighbor illuminations, an illumination normalization technique was developed and adapted to the mobile system.

A dedicated scheme composed of special wavelets called Gab features was proposed for representation of human faces. Gabor features reveal more structure information of images; however, the data dimensionality is becoming very high. An optimization processing was designed for searching the optimal Gabor node configuration and reducing the number of Gabor nodes effectively.

To fit the limitation of the phone processor, all the floating point calculations were implemented with integer calculations, the feature extraction and discriminating verification algorithms were carefully designed to accelerate implementation and control the heap and stack sizes. A mobile based face verification system was developed and embedded in the Lenovo ET980 mobile phone, which is equipped with CPU Intel XScale PX270, memory 128MB Flash/64 MB SDRAM, and a 4 million pixel camera. The experiments testing on FERET fafb dataset show that the system Equal False Accept Rate and False Reject Rate achieved 1.51%; and the False Accept Rates achieved 2.12% and 6.81%, while the False Reject Rate at 1% and 0.1% respectively. The processing time is about 1 second. The performance of this system is quite well.

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