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Multispectral + 2.5D/3D Image Fusion

Research Aims

The combining of images from multiple sensors is well known to produce images that are much more adapted to computer processing than the component images alone. More specifically, it has been established that the fusion of images from sensors working in different ranges within the electromagnetic spectrum (multimodal sensors) can overcome the disadvantages inherent in each individual range. Our research is concerned with the fusion of multispectral and depth images for improved face recognition under varying light and pose conditions.

Research Methodology

We have designed and constructed a novel multispectral and depth camera system which is capable of capturing spatially registered visible (VIS), long-wave infrared (LWIR) and Depth (2.5D/3D) video and still images (see Figure 1).

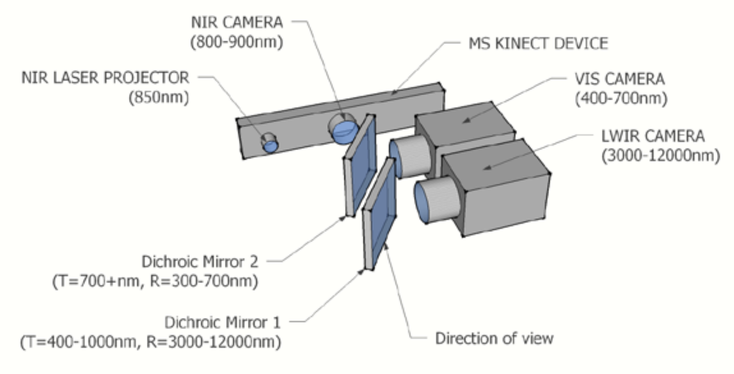

Figure 1. The design of our novel camera system

Using this camera system we have imaged subjects under varying pose and illumination conditions. The poses consist of: head front, head left, head right and head front wearing eyeglasses (where the subject did not have eyeglasses a pair was supplied). For each pose images are captured under front, left side, right side and low lighting conditions. Illumination is applied via two 12W halogen lights which are operated by two computer controlled power supplies. The lighting variations and image capture are all computer controlled. For each subject there are two of these image sets. Thus for a current population of 28 subjects, there is a total of 2688 face images.

Research Approach

Due to the design of the camera system the images are inherently spatially registered. VIS, LWIR and Depth images are pre-processed by normalising for eye position and head rotation along the x-axis. We can then conduct image fusion experiments by decomposing the images using multiresolution transforms such as Discrete Wavelets (DWT) and combining the transform coefficients. The fused image is then produced by applying the inverse transform.

We are currently focused on two areas of research:

- The automatic and adaptive selection and weighting of the transform coefficients during fusion in order to optimise the fused image for face recognition.
- The ability to use information from different spectral images to compensate deficiencies in others that hinder accurate face recognition. Specifically the ability to synthesise occluded LWIR image information (see Figure 2).

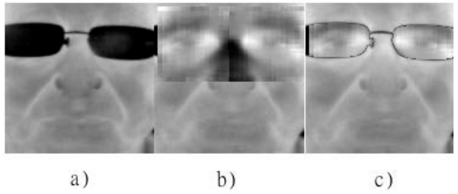

Figure 2. Eyeglass compensation in LWIR images(a)original LWIR image, b)LWIR image with eye areas synthesised from VIS, c) LWIR image with synthesised eyeglasses.)

Preliminary results show that our fused images using non-adaptive fusion methods have outperformed single spectral mode images in >93% of our experiments for four established face recognition algorithms. Similarly, recognition rates were seen to improve using fused images that used our LWIR eyeglass compensation algorithm.

Further work is required to expand our face database and conduct additional experiments using more state-of-the-art recognition algorithms.