Estimating Grayscale Face Image from Thermal Image using Canonical Correlation Analysis

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I. INTRODUCTION

Nowadays, the human face is widely used in biometrics, surveillance and other areas. The usage of the human faces is common in the visible spectrum, but this is not the case for the far-infrared spectrum, also known as thermal imaging.

Thermal imaging measures the temperatures of shot objects, and is not affected by the lighting conditions. This mechanism is different from that in visible spectrum, which captures the light reflected by shot objects. This makes thermal cameras a better option in poorly lit surveillance areas. Also, in outdoor environments, thermal cameras are more robust in weather changes such as smoke and fog.

The research purpose is to estimate the visible face image from their respective thermal image and possibly to use the result as an input to face recognition systems.

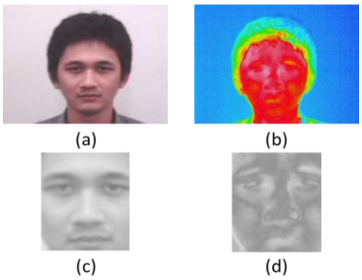

Figure 1 Images examples (a) Raw visible image (b) Raw thermal image (c) Pre-processed visible image (d) Pre-processed thermal image

A. Methods

The algorithm used for this research is as follows. First, we use Principal Component Analysis to extract the features from each of the grayscale and thermal face training data. The PCA is known for its Eigen Face, which is a reconstruction of face image using its Eigen values and Eigen vectors. The extracted features from the training images are projected in Eigen space.

Next, we find the correlation between the grayscale value and thermal value using Canonical Correlation Analysis (CCA). The CCA is used to maximize the correlation of elements between the grayscale value and thermal value. Note that they are both in Eigen space, and the results of the CCA method are the projection of all training data in what we will call the Coherent space.

After that previous training phase, we can now estimate the grayscale face from a given unknown thermal face image. Using the same transformation processes as in the training phase, we can project the thermal image into Eigen space, then into Coherent space respectively. In the Coherent space, the reconstruction of the visible image is done using sophisticated Locally Linear Embedding (LLE) method which explained in [1].

B. Experimental Setup

The data used contains 89 persons, with 5 thermal and 5 visible images for each person, for a total of 890 images. These images will be separated into training and testing data.

II. CONCLUSION

The experiment result can be seen in Figure 2. On current state, there is still a need for improvements, especially when the tested persons are not included in the training phase.

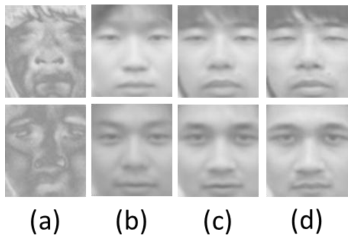

Figure 2 (a) Thermal test images (b) Estimated images when the persons are not included in training phase (c) Estimated images when the persons are included in training phase (d) Ground Truth

REFERENCES

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