Face Identification

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The Problem: The problem is to develop a real-time system for face identification which is able to handle faces rotated in depth.

Motivation: The development of automatic visual surveillance system is a popular research topic in computer vision. Current systems for people detection and identification are primarily based on classifying frontal views of faces, assuming that the person is looking straight into the camera. The main challenge of this project is to develop a system which is able to identify people under different viewing angles in real-time.

Previous Work: Most of the previous work dealt with frontal faces. Some common techniques included single-template matching and eigenfaces. These systems were not real-time and not rotation invariant. Eigenfaces described in [1] reperesented face images in low dimensional feature space using PCA. In [2],back-propagation neural network was used to perform identification.

The more recent research took rotations into account. Elastic grid matching described in [3] used Gabor wavelets to extract features at grid points and used graph matching for proper positioning of the grid. Faces in [4] were represented with templates from multiple model views that cover different poses from the viewing sphere. Their system obtained the locations of eyes and nose and uses them to geometrically register the input with model views. Then it used correlation on model templates to find the best match in the database of people. Multiple support vector machines (SVMs) were used in [5] to identify people in color video sequences in real-time. Identification was based on the assumption that the same person had the same general appearance (i.e. clothing) throughout one day.

Approach: The basic idea is to train a set of SVM classifiers on the whole face image. Due to changes in the pose and viewpoints, there are many variations in the face images of one person which make the recognition task difficult. For this reason, the database of each person is split into a set of clusters. Similar images are grouped into the same cluster, e.g. images taken from similar viewpoints. A binary tree is created by iteratively splitting the database of a person into clusters.

A linear SVM classifier is trained on each cluster so as to distinguish one person from all other people in the database. For each person, a non-linear SVM classifier is then be trained on the outputs of the cluster classifiers.

Difficulty: The identification system must be robust against changes in the appearance of faces due to rotations in depth in real-time.

Impact: Real-time face identification system has potential application in human-computer interfaces and surveillance systems.

Future Work: Our system will be trained to identify people's faces rotated up to about 45 degrees in depth. The system will be validated by a test set which is independent of the training set. Component-based face identification approach will also be developed in order to compare the performances against the whole face approach. Body recognition described in [5] will be added to the system as well, so as to increase recognition rate.

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References:

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Figure 1: Face recognition with rotations

Figure 2: Face recognition with rotations