Human Identification using Motion Information and Digital Video Processing

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Abstract: *Motion information as a biometric has the advantage of identification at distance and low resolution images. This paper proposes a simple and effective approach for the human identification based on the statistical shape analysis. We use the overlapped image of the contours of thinned silhouettes for each image sequence as the feature for identification. To reduce the dimension of the feature space, we apply eigenspace transformation based on PCA. For improvement of the efficiency, we add a new feature based on periodicity of the motion. For an image sequence, this feature is extracted by the correlation of each frame with the first frame where PCA algorithm is applied to reduce its dimension. Experimental results on the CASIA database showed the efficiency of the proposed approach.*

Keywords: Human identification; Motion information; digital video processing; Biometrics; Gait recognition.

1. Introduction

Due to daily increase in the demand of the automatic human identification systems, researches about human identification using biometrics has been very important. Compared to the other biometrics, identification using motion information or gait recognition has the advantages of being difficult to conceal, has no need to any contact, and is also the only observable biometric at distance for personal identification. Gait recognition may be based on the static shape of the human body as well as the motion information. The approaches based on the static shape of the human body does not directly analyze the dynamics of gait, but implicitly use the action of walking to obtain the structural characteristics of gait, especially the shape cues of body biometrics. The approaches based on motion information make use of the human body dynamic during the walk for identification.

2. Related Work

Gait recognition approaches can be generally divided into the model based and model free approaches. Model based approaches utilize information about the mechanism of movement, determined either by known structure or by modeling [1-5]. Model free approaches are further divided into algorithms, which make use of only motion information, or algorithms, which integrate shape and motion [6-21]. One advantage of model-based methods is the immunity to the effects of clothing as well as slight change in viewpoint, but the computational cost is high [22].

Lee et al. used ellipsoidal fits to human silhouettes, the average values across all frames of a gait sequence of certain parameters of seven ellipses that fit silhouette regions are used for identification [1]. Bhanu et al. used kinematic and stationary features by estimating 3D walking parameters by fitting a 3D kinematic model to 2D silhouettes [2]. Han et al. used the Gait Energy Image (GEI) formed by averaging silhouettes and then deployed PCA and multiple discriminant analysis to learn features for fusion [3]. Tsuji et al. proposed a method of gait silhouette transformation from one speed to another to cope with walking speed changes in gait identification [4]. In this method static and dynamic features were extracted from gait silhouettes by fitting a human model and then a factorization based speed transformation model. The dynamic features are created using a training set for multiple persons on multiple speeds [4]. Kim et al. presented a gait recognition system using infra-red (IR) images to provide constant recognition performance regardless the amount of illumination [5]. Kale et al. and Sundaresan et al. employed Hidden Markov Models (HMM) which consider two different image features: the width of the outer contour of a binarized silhouette and the entire binary silhouette itself [6, 7]. Ben Abdelkader et al. utilized self-similarity and structural stride parameters (stride and cadence) [8]. Sarkar et al. performed recognition based on temporal correlation of silhouettes [9]. Vega et al. used the change in the relational statistics among the detected image features. The relational statistics were modeled using the probability that a random group of features in an image would exhibit a particular relation [10]. Collins et al. used key frame analysis for sequence matching [11]. Liu et al. used "frieze patterns" derived from image sequences by compressing images into a concatenated pattern [12].