Chapter 25
Analysis of Gait Flow Image and Gait Gaussian Image Using Extension Neural Network for Gait Recognition

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ABSTRACT

This paper proposes a new technique to recognize human gait by combining model free feature extraction approaches and a classifier. Gait flow image (GFI) and gait Gaussian image (GGI) are the two feature extraction techniques used in combination with ENN. GFI is a gait period based technique, uses optical flow features. So it directly focuses on dynamic part of human gait. GGI is another gait period based technique, computed by applying Gaussian membership function on human silhouettes. Next, ENN has been used as a classifier which combines the extension theory and neural networks. All the study has been done on CASIA-A and OU-ISIR treadmill B databases. The results derived using ENN are compared with SVM (support vector machines) and NN (Nearest neighbor) classifiers. ENN proved to give good accuracy and less iteration as compared to other traditional methods.

DOI: 10.4018/978-1-7998-0414-7.ch025

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1. INTRODUCTION

Human identification has become a challenging area from the pattern recognition point of view. Over the past few years various biometrics including palm print [Wang X et. al, 2013], iris [Rai H et. al, 2014], face [Luo L et. al, 2015], finger knuckle [Kumar A et. al, 2013] have been worked on for human identification. But the limitation of these modalities is that they use some specific devices to obtain features and their intrusive nature. Unlike the modalities mentioned above, gait a behavioral modality, is a right choice to identify human based on their non-intrusive characteristics. Earlier studies [Cutting J 1977; Murray M et. al, 1964] also show that gait is a unique biometric modality. To obtain gait patterns of a subject, a single camera is enough [Yu et. al, 2014]. Gait recognition can easily identify people at a distance by their walk manner. In today's scenario, terrorism is the main threat for human security [Inbarani et. al, 2015; Sarkar M et. al, 2015]. Therefore Human gait recognition has become an attractive field for researchers and industrialists from the surveillance point of view [Okumara M et. al, 2010; Sundaresan A et. al, 2003].

Two different approaches have been adopted to recognize gait: model-based and model-free. Model based techniques [Cunado D et. al, 1999; Tafazzoli et. al, 2010; Wang L et. al, 2004; Yam C et. al, 2004] work on structural model of the human body. It has the advantage of being non sensitive to outliers and background noise [Lee L et. al, 2002; Yoo et. al, 2011]. But due to complexity present in model based methods, model free methods are more reliable and easy to explore. Model free methods do not require any structure model; it works on information stored in binary silhouettes [Kale et. al 2004, Sarkar et. al 2005, Xu et. al 2012].

There is always need of a system, which can adapt itself according to the unforeseen changes and patterns. Therefore, we are motivated to design a human recognition system by combining best feature extraction approaches with an adaptive classifier. In this work, two model free feature extraction approaches are proposed to combine with a classifier. Gait flow image [Lam et. al, 2011] and gait gaussian image [Arora & Srivastava, 2015] are model free gait period dependent feature extraction approaches. Previously these approaches had been used with nearest neighbor, a nonadaptive classifier, which can be considered as a lacunae of the existing system. So to overcome that gap, we use Extension neural network (ENN) as a classifier to recognize human gait. Extension neural network evolves from extension set theory and neural network. Extension set theory can be used to describe the thinking process associated with quantitative and qualitative change [Cai W, 1999]. It uses extension distance to measure the similarity between data and class center. It has been applied in many domains and proved to bring important effect in knowledge based systems [Lai et. al, 2009; Vilakazi et. al, 2006] and advanced intelligent networks [Shatnawi et. al, 2014; Yang et. al, 2008; Zhang et. al 2015; Zhou et. al 2015]. The best feature of ENN [Wang M et. al, 2003] is that it adapts to a new gait pattern as well as it adjusts the boundaries of classified features. So by combining these feature extraction approaches with ENN we get a system with better recognition rate and faster speed. The performance of GGI and ENN combination is also compared with another combination of Gait flow image and ENN, which was proposed earlier [Arora, Srivastava, & Shivank, 2015]. The proposed work is tested on gait benchmark data sets CASIA-A [Wang et. al, 2003b] and OU-ISIR treadmill B [Makihara et al., 2006] . Lastly ENN is compared with support vector machine (SVM) and nearest neighbor (NN).

So main contributions of our work:

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