Tracking and Re-identification of People Using Soft-Biometrics

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***Abstract*—The goal of this work is proposing a method of biometric identification using soft-biometrics, that aims the extraction of physical characteristics and estimation of the pose as unique traits of each individual, to name and trace that specific person trough the scene. In this work we partially used the public database CASIA Gait Database-A, which has several frames of people, already classified, walking in different directions and angulations, along with a set of silhouettes that were extracted from these scenes and the background used at recordings. Besides, we used a private database of the project sponsor, Petrobras, containing videos of security cameras used to demonstrate the daily routine of workers at an oil platform. The biggest challenges of performing biometrics in this dataset are the quality of the provided images and the heavy clothing used by the workers on the platform, that often hinders the processing quality of the algorithm, explaining why we chose to work with soft-biometric. The algorithm used in this method is PifPaf, made to estimate the human pose and extract features and capable of performing the detection in environments with noises, low illumination or low resolution. With its help, we mean to extract parts of the workers bodies in the private database and from the actors in the scenes from the CASIA Gait Database-A. For our methodology we used the Euclidean and city block distance calculations, obtaining 70% hits with a combination between the PifPaf algorithm and Euclidean distance.**

***Index Terms*—biometric, soft-biometric, machine learning, neural network, convolutional neural network**

I. Introduction

Nowadays, the need to utilize biometrics as a form to associate a subject with its identity has gained a great deal of interest. Most of that interest rests on systems built with face and fingerprint as a biometric characteristic, which can be explained due to the fact that both characteristics are biological and harder to imitate than a behavioral characteristic. On the other hand, there are characteristics such as gait, a soft behavioral characteristic, that has the advantage of needing very low user cooperation and can be captured at a distance in a discreet way [1]. This differs from fingerprint, which needs some user cooperation, and face, which does not need user cooperation but has more constraints in the sense of distance, image quality, illumination, and pose.

The individual gait has gained interest as a way of recognizing subjects identity [1]–[6]. Systems that utilize such characteristic can be categorized as: model-based or motion-based [3]. Model-based systems focus on extracting features in a robust way, this is mainly to avoid noise. Motion-based avoids modeling based on the human movement, which can be complex [3].

On motion-based systems, it is important to keep track of the subject's motion. This can be done with techniques that do pose estimation and when applying such systems to real environments, it is necessary to perform pose estimation in several subjects, for this task, both Open Pose [7] or PifPaf [8] can be utilized. Open Pose utilizes Part Affinity Fields (PAFs) to learn how to associate parts of the body with individuals that are detected within at an image. PifPaf utilizes Part Intensity Field (PIF) to detect the body part of an individual and a Part Association Field (PAF) to associate parts of the body and build a whole human. Both approaches work in real time and can be utilized as a part of the feature extraction in Gait Recognition.

The current work proposes measurement of body parts extracted from the human pose estimation techniques, to perform the biometric identification of each individual and to track and trace the individual identified in the scene using bounding box and labels assigned to him. Experiments were made utilizing the publicly available CASIA Gait Database-A [9].Also, we conducted tests in the private database of the project sponsor, Petrobras, which it contains videos of security cameras that films the daily life of workers. However, on Petrobras database it is not possible to know the distance workers are in relation to the camera for more precise measures. We compare the results utilizing Open Pose and PifPaf as part of the recognition system.

The rest of this paper is organized as follows: in Section II some related works are briefly presented. Section III discusses Human Pose Estimation, focusing on PifPaf. Section IV gives a brief introduction to gait. Section V describes the proposed approach. Section VI shows the carried out experiments in