Human Re-identification frameworks for aerial devices

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***Abstract*—The development of biometric recognition solutions able to work in visual surveillance conditions, i.e., in unconstrained data acquisition conditions and under covert protocols has been motivating growing efforts from the research community. In particular, substantial efforts have been paid to the development of recognition solutions able to work in data acquired from aerial devices (UAVs), which represent an affordable solution to surveil large public outdoor spaces. This work covered the analysis of some published techniques for non-cooperative recognition and the development of a novel data set (P-DESTRE) that contains annotated data for the project purposes.**

***Index Terms*—Biometric recognition, automated surveillance, unmanned aerial vehicles, identification.**

I. Introduction

Video-based surveillance refers the act of watching a person or a place, esp. a person believed to be involved with criminal activity or a place where criminals gather [8]. Over the years, this technology has been used in far more applications than its roots in crime detection, such as traffic control and management of physical infrastructures. The first generation of video surveillance systems was based in closed- circuit television (CCTV) networks, being limited by the stationary nature of cameras. Hence, efforts in biometrics are being held into extending robust recognition techniques to in the wild scenarios. Nonetheless, and despite being a very attractive goal, human identification in the surveillance context remains an open problem. In particular, there is an increasing attention devoted to the possibility of performing reliable identification using data acquired from unmanned aerial vehicles (UAVs), which are becoming quite cheap and with high processing capabilities.

II. Biometric Recognition in Surveillance Environments

Background Subtraction (BGS) is typically the first phase of the processing chain of such type of systems and holds the feasibility of all the subsequent phases. Hence, it is particularly important to perceive the relative effectiveness of BGS, with respect to the kind of environment. [2] give an objective evaluation of the state-of-the-art BGS algorithms on unconstrained outdoor environments.

In these scenarios is quite common that the number of targets exceeds the available active UAVs, which demands the use of a schedule technique to maximize the number of targets imaged and the number of shots taken from each one. In [1] propose a technique to plan the order to visit each target in the minimum amount of time, in order to start the acquisition process as soon as possible and maximize the number of samples taken from the subjects in the scene. As noted in previous works, the exhaustive solution for this problem is O(N!), N being the number of targets in the scene. Although this brute-force strategy is feasible for a reduced number of targets, the real-time nature of this problem prohibits the use of an exhaustive search for more than six targets. Accordingly, they propose a MRF-based approach to estimate an approximate solution in real-time.

Subsequently, [3] promoted an initiative to support this endeavor, being the first biometric challenge carried out in data that realistically result from surveillance scenarios. The competition relied on an innovative master- slave surveillance system for the acquisition of face imagery at-a-distance and on-the-move. Also, they describe the competition details and reports the performance achieved by the participants algorithms.

Soft biometrics were another topic of interest in this work [6]. As an example, [4] proposed a deep learning based model, able to infer gender trait in wild-conditions, i.e., outdoor environments and without requiring any active participation of the subjects in the image acquisition process. Later, this model was extended [5] to infer multiple labels simoulateously.

As main result of this project, the P-DESTRE [7] set was developed. As a tool to support further advances in video/UAV-based pedestrian analysis, the P-DESTRE is a joint effort from research groups in two universities of Portugal and India. It is a multi-session set of videos, taken in outdoor crowded environments. ”DJI Phantom 4”3 drones controlled by human operators flew over various scenes of both universities campi, with the data acquired simulating the everyday conditions in surveillance environments. All subjects offered explicitly as volunteers and they were asked to act normally and ignore the UAVs. Moreover, the P-DESTRE set is fully annotated at the frame level by human experts

III. Conclusions

The development of biometric recognition solutions able to work in visual surveillance conditions, i.e., in unconstrained data acquisition conditions and under covert protocols has been motivating growing efforts from the research community. In

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this project, we concentrated our efforts in the development of a novel data set, annotated at the frame and at the video level, that can be used for the evaluation of pedestrian detection, tracking and identification. This dataset (P-DESTRE) is publicly available for research purposes.

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