BOCA – Body-Worn Camera Analytics in Public Safety

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Introduction

Body-worn, or wearable cameras have been increasingly adopted in public safety - an estimate 6K-18K public safety organizations (PSO) worldwide [1]. The advantages of such adoption are myriad, as discussed in our community whitepaper [2], including transparency and increase in public trust; officer protection from false claims; forensic analysis; and future increased real-time situational awareness between HQ and the edge.

We believe that **the key bridge** to realizing these advantages is the analytics involving human activities as observed through the body-worn cameras. Although great progress has been achieved in general third-person-view human activity recognition, the transition of these methods to body-worn cameras is non-trivial. Body-worn camera video is more complex, with a greater range of motion, the activities are often only partially observable, the context is harder to infer, and the availability of annotated data is limited.

Activity Recognition
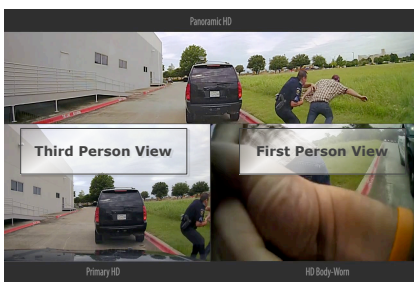
Objective

The objective of our project is to develop a new level of analytical capability in body-worn cameras for public safety. BOCA will analyze human activity from body-worn cameras with minimum human effort for data annotation by leveraging available regularity in the data as well as preexisting labeled data from third-person fixed-camera-view scenarios.

Approach

Challenge 1: Body-worn cameras produce a huge amount of data - unannotated data, the annotation of which would require a massive human effort.

Solution: Consequently, BOCA proposes a regime based on transfer learning and multi-task to realize unsupervised and semi-supervised analytics.

Challenge 2: Body-worn camera video has a high range of motion, partial observability and varying context; existing standard feature descriptors and models do not transfer well.

Solution: BOCA will establish body-worn-camera-specific features and it will leverage other information, such as presence/absence of objects, or side-knowledge.

Challenge 3: There is no existing activity recognition dataset in the literature that supports body-worn activity recognition benchmarking, nor with synchronized third-person view data.

Solution: In cooperation with our PSO partner, BOCA will we collect a new large-scale dataset for the proposed project and share with the new PSIAP community and beyond.

The relationship of the proposed research tasks, targeted challenges, and outputs.
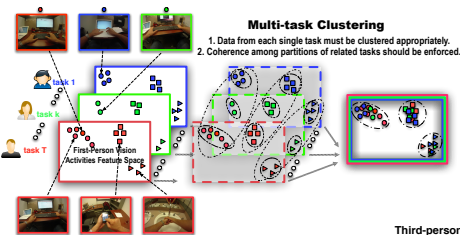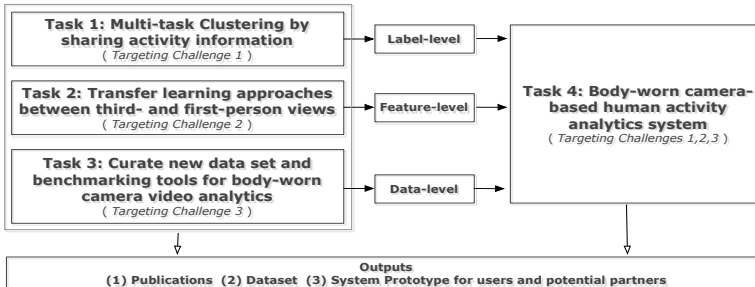
Task 1: Multi-task clustering by sharing activity information
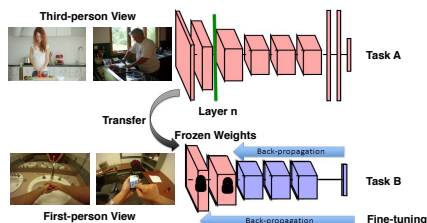
Task 2: Transfer learning approaches between third- and first-person views

Milestones

Milestone 1 (3 months) – Initial prototype of the body-worn camera-based human activity analytics system running on preliminary data from PSO.

Milestone 2 (6 months) – Version 1 of the data set and KPI benchmarking completed.

Milestone 3 (9 months) – Initial implementation of the multi-task clustering methods integrated into system.

Milestone 4 (12 months) – Domain prototype of initial system with a PSO problem-set leveraging multi-task clustering methodology.

Milestone 5 (15 months) – Initial implementation of the transfer learning approaches tested on our benchmark and integrated into the PSO problem-set.

Milestone 6 (18 months) – Version 2 of the data set and KPI benchmarking, informed by extensive interaction with PSO and the problem-set.

Milestone 7 (21 months) – Advances in technical methods to support new challenges in Version 2 of the dataset.

Milestone 8 (24 months) – Domain prototype of a second-generation system with an evolved PSO problem-set based on further interaction after Milestone 4 system.

Impact

Social Impact

- The proposed research is critical and innovative for the broader public safety community, not just law enforcement.
- PSOs will be able to efficiently process and store indexed body-worn camera data, search it via semantic queries, and use it in forensic analysis.
- We will work closely with our PSO partner, Oakland PD, to hone BOCA's impact on society.

Research Impact

- Research on activity recognition using body-worn cameras will benefit greatly: BOCA will open up a new research direction for computer vision and multimedia understanding to enrich frontier technologies.

References

[1] Tod Newcombe. For the Record: Understanding the Technology Behind Body Worn Cameras. Online; accessed 8 September 2015.

[2] J. Corso, A. Alahi, K. Grauman, G. Hager, L. Morency, H. Sawhney, and Y. Sheikh. Video analysis for body-worn cameras in law enforcement. In Computing Community Consortium White Paper, 2015.