RA.3: Real Time Video Surveillance for Threat Detection and Mitigation

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SENTRY Challenge

Video is often the first line of defense in soft-target environments. This project addresses several key questions:

- Where should we deploy and direct **cameras** to best detect threats?
- What type of **crowd behavior** is unusual for a given hour, day, and location?
- What **individual actions** and behaviors are anomalous in a given environment?

We will leverage long time-scale data from wide-area multi-camera networks in real soft-target environments to design robust, fair, accurate and explainable computer vision algorithms.

Accomplishments

- **Real-world data collection:** nine months of videos of several soft-target environments including baseball stadia, plazas and traffic intersections
- **Contextual crowd analysis:** time-dependent appearance, motion patterns, and dominant trajectories
- **Anomaly detection:** detecting abnormal appearance and behavior specific to the context
- **Multi-view detection:** detecting multiple persons using information acquired by two or more cameras
- **Cross-view action recognition:** recognizing actions from previously unseen views.

Addressing the Challenge

(a)

(b)

(c)
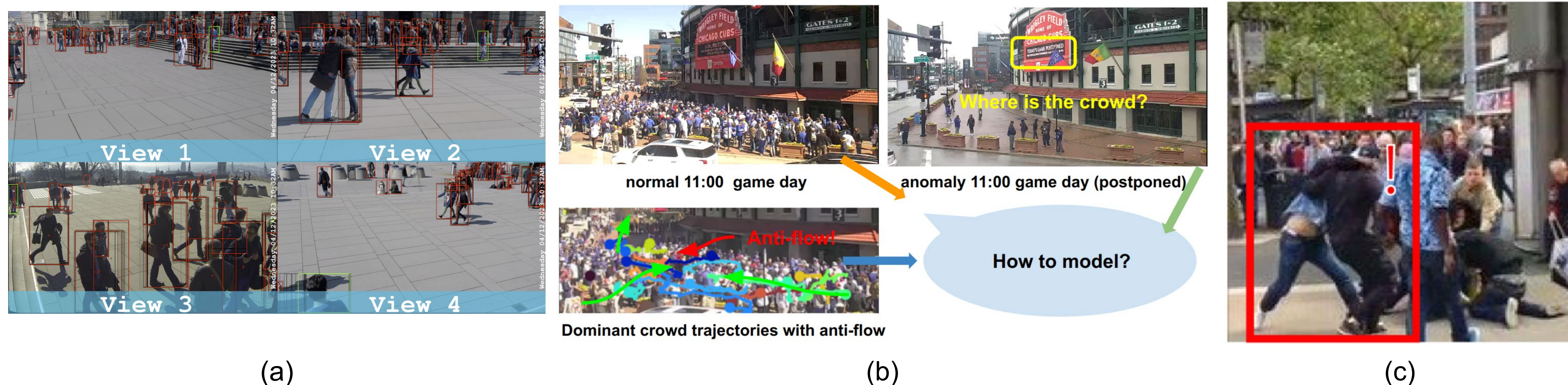
(a) The coverage area of a single video surveillance camera is severely limited. We are extending our previous work in multi-target detection and tracking to **locate malicious actors in real-time** in a collaborative manner using a network of pan-tilt-zoom cameras that observe the environment from **optimal dynamically adjusted perspectives**.

(b) Behavior that is common on Monday morning may be highly unusual on Sunday afternoon. We are extending our research on **detecting anomalous motion in crowds** to soft-target environments that exhibit **time-varying characteristics**, leveraging hundreds of hours of video collected from publicly available webcams.

(c) We are leveraging **dynamics-based invariant representations** to recognize human behaviors, designing algorithms that are fair, unbiased, trustworthy, and explainable, balancing real data with under-represented attributes.

Next Steps

- The project will produce **benchmark datasets** for use in developing the Virtual SENTRY, as well as help develop testbeds for large-scale camera network research in soft target environments. In Year 3 we will begin collection of video data from public areas at Albany International Airport.
- Since CCTV security systems are already in use in many locations, our work is **scalable, adaptable, and allows for broad distribution** across STCPs. We will investigate partnerships with security teams at universities, arenas, and museums, as well as with internal partners such as the Guardian Centers.
- This work will facilitate **real-time interdiction** in places where forensic evaluation is currently the norm. This project's focus is of high interest to TSA Security Operations as well as the Secret Service, which could leverage the work in this project to safeguard places relevant to its mission.