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A Real-Time Neural Network-based System for Pushing Detection in Crowded Event Entrances

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Abstract

Pushing is a behavior that is often used by some pedestrians, especially in crowded event entrances, to gain faster access to events. Such behavior increases the crowd's density, affecting crowd comfort and safety. Real-time detection of pushing behavior is crucial for event organizers; to react to pushing behavior at an early stage, hence avoiding uncomfortable and unsafe situations in the crowd. Recently, some approaches have been proposed to automatically identify pushing behavior from videos of crowded event entrances. However, these approaches could not detect the behavior in real-time or near real-time. Accordingly, in this research, we present a real-time system for automatically detecting and localizing pushing behavior in video frames. As shown in the figure below, the proposed system includes three main modules: 1) Target frames retrieving and processing, which first aims to select the required frames and then extract the entrance area from them. 2) Spatial motion extraction uses deep optical flow based on GPU to estimate the spatial visual motion with speed and direction information from the entrance area. 3) Pushing detection is based mainly on a supervised CNN-based classifier and the extracted motion information; to identify and annotate pushing behavior. We build a dataset from several real-world experiments (videos with ground truth) to evaluate the proposed system. Experimental results show that our system achieves promising performance in terms of accuracy and computational time.

Keywords: Artificial Intelligence Application; Deep Learning; Crowd Behavior Analysis; Pedestrian Dynamics; Pushing Detection; Deep Learning-based Optical Flow

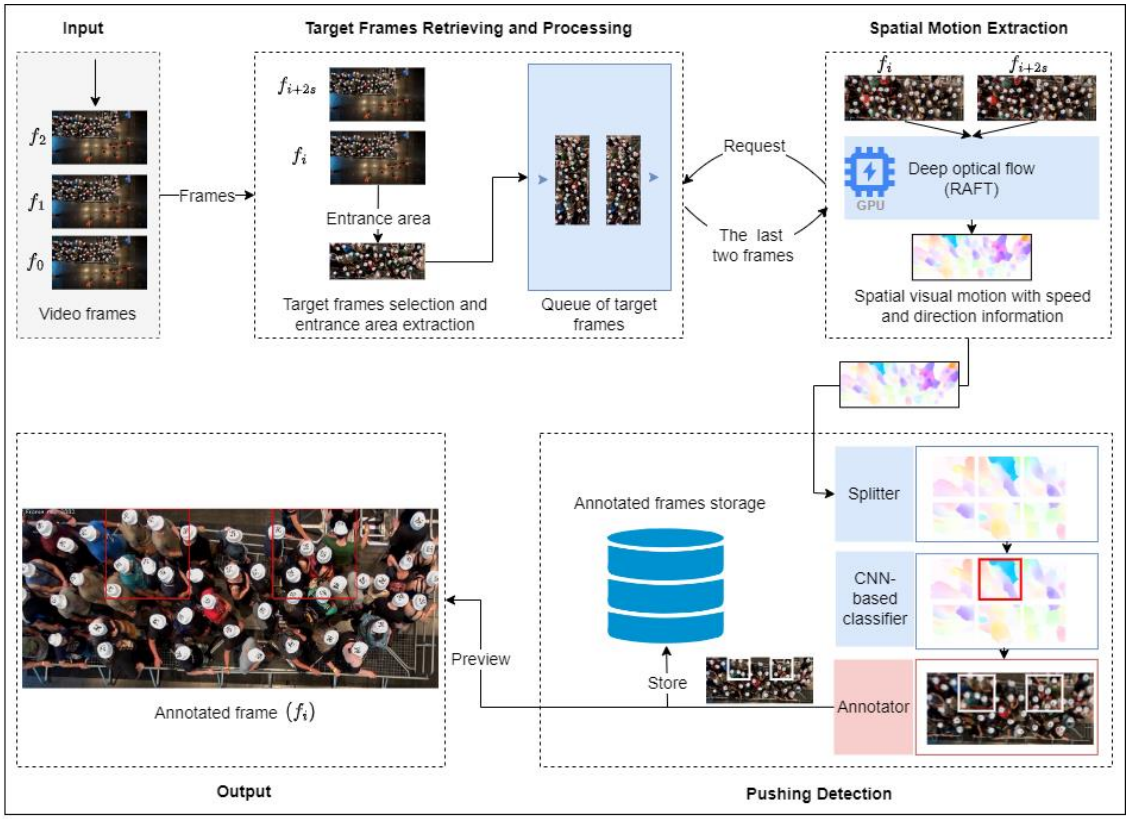

Figure 1: The proposed system architecture. fi: f refers to frame, and i represents the order of frame f. s means a second. RAFT is Recurrent All-Pairs Field Transforms for Optical Flow technique.