ADAPTIVE CROWD BEHAVIOUR ALARM USING INTELLIGENT ALGORITHM

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Abstract: This paper focuses on detecting and localizing anomalous events in videos of crowded scenes, i.e., divergences from a dominant pattern. Both motion and appearance information are considered, so as to robustly distinguish different kinds of anomalies, for a wide range of scenarios. A newly introduced concept based on swarm theory, histograms of oriented swarms (HOS), is applied to capture the dynamics of crowded environments. HOS, together with the well-known histograms of oriented gradients, are combined to build a descriptor that effectively characterizes each scene. These appearance and motion features are only extracted within spatiotemporal volumes of moving pixels to ensure robustness to local noise, increase accuracy in the detection of local, nondominant anomalies, and achieve a lower computational cost. Experiments on benchmark data sets containing various situations with human crowds, as well as on traffic data, led to results that surpassed the current state of the art (SoA), confirming the method's efficacy and generality. Finally, the experiments show that our approach achieves significantly higher accuracy, especially for pixel-level event detection compared to SoA methods, at a low computational cost.

Key Words: Swarm intelligence, crowd, anomaly, traffic.

I. INTRODUCTION

The widespread use of surveillance systems in roads, stations, airports or malls has led to a huge amount of data that needs to be analyzed for safety, retrieval or even commercial reasons. The task of automatically detecting frames with anomalous or interesting events from long duration video equences has concerned the research community in the last decade. Event, and especially anomaly detection in crowded scenes is very important, e.g. for security applications, where it is difficult even for trained personnel to reliably monitor scenes with dense crowds or videos of long duration. Numerous methods have been proposed to assist in this direction.

The analysis of motions and behaviors in crowded scenes constitutes a challenging task for traditional computer vision methods, as barriers like occlusions, varying crowd densities and the complex stochastic nature of their motions are difficult to overcome. Computational cost is one more complicating factor, as it has to be kept within reasonable limits. In many practical situations, it is crucial to analyze crowded scenes in real time, or at least as fast as possible, considering the fact that security personnel should act quickly if something seems to be "not as usual." Furthermore, the ambiguity of the term "anomaly" sets its own limitations in our effort to identify it, as there is no commonly accepted definition, and it varies significantly depending on the given scenario. This means that an "anomaly" pattern in one video sequence may often be part of the "normal" pattern of another. In order to address these issues, we define as "anomalies" the events that display a low probability of occurring based on earlier observations. We deal with the challenging problem of detecting abnormal patterns in videos of crowded scenes that emerge as spatiotemporal changes, both in motion and appearance. An appearancerelated anomaly would be, e.g. a bicycle passing through a crowd. Moreover, sudden changes in velocity, like an abrupt increase of its magnitude and the dispersion of individuals in the crowd are detected, indicating that something unusual and potentially dangerous may have occurred. In this work we propose a novel method for anomaly detection and localization that incorporates both motion and appearance information. We introduce a descriptor created from Histograms of Oriented Gradients (HOG) to capture appearance, and the newly introduced Histograms of Oriented Swarms (HOS), to capture frame dynamics. Swarm intelligence has been used in the past only in the framework of Particle Swarm Optimization (PSO) in [1], where PSO optimizes a fitness function minimizing the interaction force derived from the Social Force Model (SFM). However, in our work, swarms are used in a very different way: the core idea is to construct a prey based on optical flow values over a specific time window and deploy a compact swarm flying over it to acquire accurate and discriminative information of the underlying motion. The agents' motion is determined by forces acting on the swarm (Sec. IV), which, unlike [1], do not correspond to the SFM, but are used to determine the swarm motion and location.Thus, this work introduces an innovative deployment of swarm intelligence, which, together with the HOG descriptor, forms a new feature capable of successfully determining a region's "normality" in an SVM framework. In order to capture "anomalies" appearing in a small part of the frame, our algorithm is applied only on regions of interest, and temporal information is incorporated to improve accuracy. Even though benchmark datasets of human crowds were mainly used for the algorithm's validation, results on other kinds of videos of crowded scenes, e.g. traffic, reveal that the proposed method can be extended and generalized to different scenarios. The experimental section shows that our algorithm outperforms state of the art (SoA) algorithms in accuracy and at a low computational cost. Our contribution can be summarized as follows:

1) Swarms are used in an original way, via Histograms of Oriented Swarms (HOS) that are introduced to characterize crowd motion for anomaly detection. They lead to credibly filtered flow in videos of crowds, resulting to very few noisy flow values. Thus, swarm intelligence captures the motion of crowded scenes in an efficient way that can be extended to other types of videos.

2) The method can be efficiently applied even when the motion in the crowded scene is non-uniform in space and

time, and "anomalies" appear locally in a changing context.

II. LITRATURE REVIEW

Latent Hierarchical Model of Temporal Structure for Complex Activity classification [1] Modeling the temporal structure of sub-activities is an important yet challenging problem in complex activity classification. This paper proposes a latent hierarchical model (LHM) to describe the decomposition of complex activity into subactivities in a hierarchical way. The LHM has a tree-structure, where each node corresponds to a video segment (sub-activity) at certain temporal scale. The starting and ending time points of each sub-activity are represented by two latent variables, which are automatically determined during the inference process. We formulate the training problem of the LHM in a latent kernelized SVM framework and develop an efficient cascade inference method to speed up classification. The advantages of our methods come from: 1) LHM models the complex activity with a deep structure, which is decomposed into sub-activities in a coarse-to-fine manner and 2) the starting and ending time points of each segment are adaptively determined to deal with the temporal displacement and duration variation of subactivity

Detecting Anomalous Trajectories From Highway Traffic Data [2] We propose a method to identify anomalies under a probabilistic framework. Instead of determining anomalies based on the size of each cluster, they are determined in a probabilistic framework. Moreover, we present our findings on using different features when analyzing real highway vehicle trajectory data. Based on real highway traffic video data we demonstrate that the inclusion of certain features, brings us closer to identifying events that are both anomalous and abnormal (based on driving rules).

Anomaly Detection In Crowded Scenes Using Dense Trajectories [3] Abnormal crowd behavior has become a popular research topic in recent years. This is related to a rise in the need for electronic video surveillance. Many methods have been proposed to detect abnormalities, but these methods rely on optical flow or classical classification techniques. We propose to follow the general pipeline used by previous works, but upgrade several components with state-of-theart techniques. Specifically, we use dense trajectories in place of optical flow, robust features such as social force, HOG, HOF, and MBH, and a single-class support vector machine. We achieve significant improvements in abnormality detection when compared with prior works.

Activity Modeling Using Event Probability Sequences [4] Changes in motion properties of trajectories provide useful cues for modeling and recognizing human activities.We associate an event with significant changes that are localized in time and space, and represent activities as a sequence of such events. The localized nature of events allows for detection of subtle changes or anomalies in activities. In this paper, we present a probabilistic approach for representing events using the hidden Markov model (HMM) framework. Using trained HMMs for activities, an event probability sequence is computed for every motion trajectory in the training set. It reflects the probability of an event occurring at every time instant. Though the parameters of the trained HMMs depend on viewing direction, the event probability sequences are robust to changes in viewing direction. We describe sufficient conditions for the existence of view invariance. The usefulness of the proposed event representation is illustrated using activity recognition and anomaly detection. Experiments using the indoor University of Central Florida human action dataset, the Carnegie Mellon University Credo Intelligence, Inc., Motion Capture dataset, and the outdoor Transportation Security Administration airport tarmac surveillance dataset show encouraging results.

III. PROPOSED METHOD

In order to overcome the problem in the conventional method, the proposed system is employed. In proposed system Direction invariant appearance features (HOGs) decrease intra-class variation, e.g. for walking, which is the predominant activity in human crowds, resulting in similar appearance descriptors for motions in opposite directions. This leads to more robust appearance descriptors that are suitable for the needs of anomaly detection in crowded videos, which can describe, for example, the density or sparseness of a crowd more effectively by ignoring directionality (which is not relevant for appearance). The HOG descriptor is applied in ROI blocks that are tracked over time and are extracted as described in the previous section, so the final HOG descriptor for each block also incorporates temporal information.In order to evaluate the effectiveness of our method, we applied it on four benchmark datasets of surveillance where different kinds of anomalies were detected. Our algorithm's speed and accuracy on a frame and pixel level were calculated and compared with the SoA, demonstating its effectiveness. An extensive sensitivity analysis has also taken place to examine the effect of varying all parameter values, showing that they do not significantly affect the accuracy of the results.

IV. HARDWARE DESCRIPTION

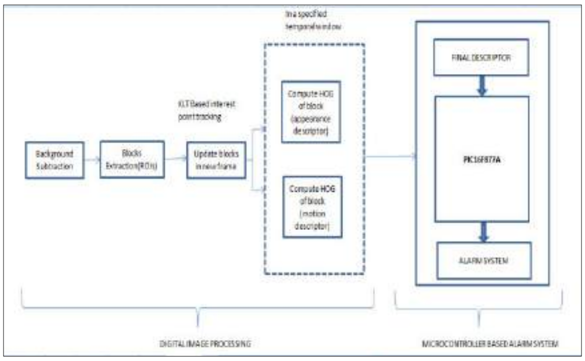
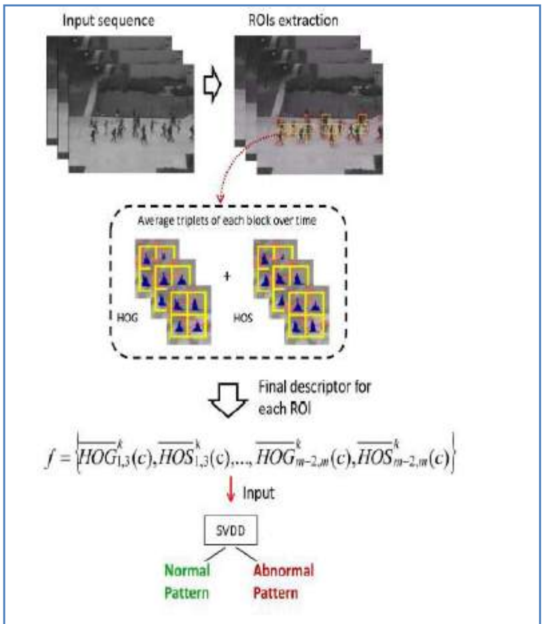


Fig. 1 Block diagram of Proposed System

In order to form the HOS descriptor, we examine the evolution of the agents' positions, determined by prey motion patterns and the forces affecting



Overview of method proposed in a time window of m frames.

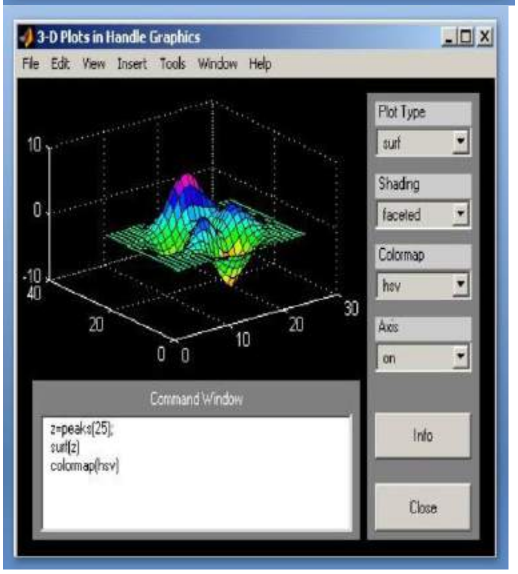
Fig. 2 Block diagram of Method proposed in Time

In order to extract the appearance characteristics of a video sequence, the Histograms of Oriented Gradients (HOG) proposed in [29] are used, as the HOG descriptor has several advantages over there appearance features: it is color invariant as it uses gray scale images, and is also invariant to illumination and local geometric transformations as a result of the normalization that takes place. At the same time, it effectively captures the local edge and gradient structure, so it can distinguish variations in appearance even in small areas of the image. The implementation of HOG that is adopted is that of [30], as it creates direction invariant HOGs by following a mirroring technique, where mirrored shapes are mapped into the same bin.

V. RESULTS ANALYSIS

MATLAB

MATLAB is both computer programming language and software environment for using that language effectively. MATLAB is matrix-oriented, so what would take several statements in C or Fortran can usually be accomplished in just a few lines using MATLAB's built-in matrix and vector operationswhich is available for MS Windows, Macintosh personal computer, Unix and other operating systems. which stands for MATrixLABoratory, is a powerful, general-purpose system or environment for doing mathematics, scientific and engineering calculations. MATLAB is a "High-Performance Numeric Computation and Visualization Software" package.MATLAB is an interactive system whose basic data is a matrix that does not require dimensioning.



MATLAB supports many types of graph and surface plots:

- line plots (x vs. y),
- filled plots,
- bar charts,

- pie charts,
- parametric plots,
- polar plots,
- contour plots,
- density plots,
- log axis plots,
- surface plots,
- parametric plots in 3 dimensions and spherical plots.
- MATLAB has a number of add-on software modules, called *toolbox* , that perform more specialized computations.

MATLAB has remarkable graphics capacities, gallery is one of them:

- The Gallery is a place to hang particularly elegant examples of graphics visualization in MATLAB.
- Knot,
- Quiver

VI. CONCLUSION

We propose a novel framework for anomaly detection in different scenarios, recorded from staticSurveillance cameras. Swarm intelligence is exploited for the extraction of robust motion characteristics and together, with appearance features, form a descriptor capable of effectivelydescribing each scene. Its remarkable performance in 4 completely different kinds of datasets proves the method's generality and its applicability in real life situations. The high detection rate in the UCSD dataset, that greatly outperforms various state-of-the-art approaches, especially on the most challenging pixel level criterion, demonstrates that the proposed algorithm can be effectively used for challenging crowd videos with many occlusions, local noise and local scalevariations. This fact in combination with its low computational cost and its effectiveness in different environments, make our algorithm very appropriate for a variety of surveillance applications.

VII. REFERENCE

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