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TEC2011-25995 EventVideo (2012-2014)

Strategies for Object Segmentation, Detection and Tracking in Complex Environments for Event Detection in Video Surveillance and Monitoring

<http://www-vpu.eps.uam.es/eventvideo/>

### Twelfth trimester progress report

The final trimester of the project has been focused on closing the final deliverables describing the project outcomes and completing several publications of the main scientific results.

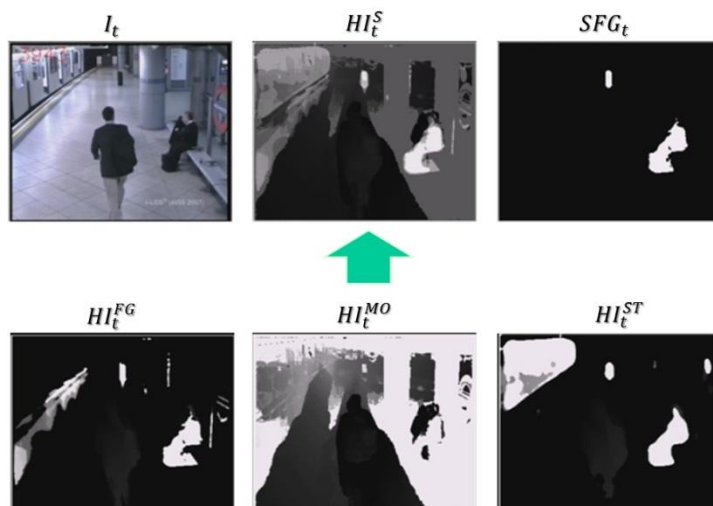
Several papers have been published and accepted for publication in the next months. Some papers are still in revision, some of them in second round, so we hope to have additional publications of project outcomes early 2015.

### Twelfth trimester results

#### Publications

Diego Ortego, Juan Carlos San Miguel, "Multi-feature stationary foreground detection for crowded video-surveillance", in Proc. of 2014 IEEE International Conference on Image Processing, ICIP 2014, Paris, France, 27-30 Oct. 2014 , pp.2403-2407

**Abstract:** We propose a novel approach for stationary foreground detection in crowds based on the spatio-temporal evolution of multiple features. A generic framework is presented to detect stationarity where history images model the spatio-temporal feature patterns. A feature is



proposed based on structural information over each pixel neighborhood for dealing with shadows and illumination changes. A multifeature detector is composed by combining the history images of three features (namely, foreground, motion and structural information) to estimate the foreground stationarity over time, which is later thresholded to detect stationary regions. Experimental results over challenging video-surveillance sequences show the improvement of the proposed approach against related work as structural information reduces false detections, which are common in crowded places.

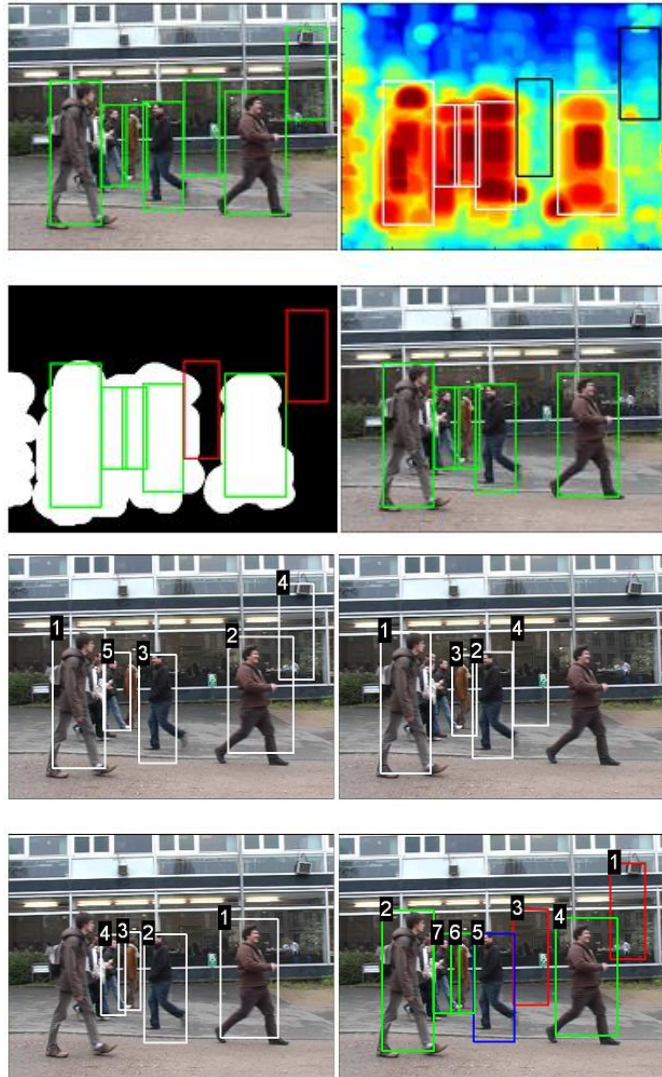
Antonio González, Rafael Martín-Nieto, Jesús Bescós, José M. Martínez, "Single Object Long-term Tracker for Smart Control of a PTZ camera", in Proc. of 2014 ACM/IEEE International Conference on Distributed Smart Cameras, ICDSC 2014, Venezia, Italy, 4-7 Nov. 2014, pp. 121-126 (DOI 10.1145/2659021.2659043)

**Abstract:** In this paper, we present a single-object long-term tracker that supports high appearance changes in the tracked target, occlusions, and is also capable of recovering a target lost during the tracking process. The initial motivation was real time automatic speaker tracking by a static camera in order to control a PTZ camera capturing a lecture. The algorithm consists of a novel combination of state-of-the-art techniques. Subjective evaluation, over existing and newly recorded sequences, shows that the tracker is able to overcome the problems and difficulties of long-term tracking in a real lecture. Additionally, in order to further assess the performance of the proposed approach, a comparative evaluation over the VOT2013 dataset is presented.



Álvaro García-Martín, José M. Martínez, “Post-processing approaches for improving people detection performance”, *Computer Vision and Image Understanding*, (accepted September 2014) Elsevier Science Inc., ISSN 1077-3142.

**Abstract:** People detection in video surveillance environments is a task that has been generating great interest. There are many approaches trying to solve the problem either in controlled scenarios or in very specific surveillance applications. We address one of the main problems of people detection in video sequences: every people detector from the state of the art must maintain a balance between the number of false detections and the number of missing pedestrians. This compromise limits the global detection results. In order to reduce or relax this limitation and improve the detection results, we evaluate two different post-processing subtasks. Firstly, we propose the use of people-background segmentation as a filtering stage in people detection. Then, we evaluate the combination of different detection approaches in order to add robustness to the detection and therefore improve the detection results. And, finally, we evaluate the successive application of both post-processing approaches. Experiments have been performed on two extensive datasets and using different people detectors from the state of the art: the results show the benefits achieved using the proposed post-processing techniques.



## Master Thesis

Background initialization for the task of video-surveillance, Diego Ortego Hernández (advisor: José M. Martínez), Trabajo Fin de Master (Master Thesis), Master Universitario en Investigación e Innovación en TIC (i2TIC), Escuela Politécnica

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Superior, Universidad Autónoma de Madrid, Oct. 2014.

**Abstract:** In this work, we propose a region-wise and batch processing approach for background initialization in video-surveillance based on a spatio-temporal analysis. First, the related work has been explored. Then, the efforts are focused on developing a new background initialization approach to outperform the literature performance. To this end, a temporal analysis and a spatial analysis are performed. In the first stage, we use a previous work techniques adding motion information to increase performance. In the second stage, a multipath iterative reconstruction scheme is performed to build the true background under the assumption of background smoothness, i.e. the empty scene is smoother than the scene with foreground regions. Finally, the results over challenging video-surveillance sequences show the quality of the proposed approach against related work.

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Segmentación persona-fondo usando información de segmentación frente-fondo (People-background segmentation using foreground-background segmentation information), Raúl Lara Arranz (advisor: Álvaro García Martín), Proyecto Fin de Carrera (Master Thesis), Escuela Politécnica Superior, Universidad Autónoma de Madrid, Oct. 2014.

**Abstract:** Nowadays the video processing and analysis is in full developing, this is mainly due to the massive installation of video cameras for multiple tasks. For this reason, the algorithms of the video processing and analysis have gained importance. Currently People-Background segmentation algorithms are not spread out, however the Background-Foreground segmentation has been developed more than the firsts ones. Therefore, the main objective of this project is to enhance the People-Background segmentation using Background-Foreground segmentation information as both segmentations have different objectives. So after an extensive analysis of the State of Art, in the case of People-Background segmentation the algorithm available in the VPULab, the functioning of the segmentation was studied in both cases. After that, various options of attaching the information to improve the People-Background segmentation was developed. Once an optimal method was obtained, it was applied to the Foreground-Background segmentation to obtain also an improvement. Once the optimal methods were obtained, an evaluation was made for both kinds of segmentation independently. Later one of the method was evaluated obtaining not enough improvement. After this, both optimal methods were evaluated with a dataset made by videos of the State of Art, obtaining good results.

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### Main achievements of the project

The TEC2011-25995 EventVideo project, focused on segmentation, detection and tracking in video sequences for complex environments, has covered its objectives, yielding 14 articles in international journals, 2 book chapters and 11 articles in

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international conferences, as well as several evaluation datasets of utility for the scientific community.

In the segmentation stage, a multimodal technique for foreground segmentation robust to light changes and camouflage has been developed. An algorithm based on RANSAC has also been designed for estimating camera motion when the background is smaller than the moving objects or it contains homogeneous regions. A background generation algorithm based on iterative analysis of visual features has also been proposed.

In the people detection stage, various state-of-the-art algorithms have been evaluated. In addition, an algorithm that applies tracking to retrofit the fusion of motion and appearance has also been developed. Moreover, a technique for person-background segmentation has been proposed. Finally, two post-processing techniques (fusion of independent detectors and use of person-background maps) and a detector of people in groups have been proposed for dense environments.

In the event detection stage, various algorithms based on anomalous and static regions have been designed, as well as some finite-state machine models to define sets of rules.

As horizontal tasks, several techniques have been developed to assess the quality of both generic and specific tracking algorithms (Particle filter and MeanShift). Feedback techniques for skin detection through dynamic integration of detectors have also been proposed. Finally, both the hardware and software (DiVA platform) of the distributed video surveillance system have been updated, adding an application development environment.

A very active collaboration with Dr. Andrea Cavallaro from the Queen Mary University of London has been carried out all over the project and a new collaboration with Dr. Thomas Sikora from Technische Universität Berlin has been established.

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