



HAVi Newsletters

#10 - June 2018

TEC2014-53176-R HAVideo (2015-2017-2018)

High Availability Video Analysis for People Behaviour Understanding

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

Project extension

In order to complete pending tasks, we asked the Ministry for an extension of the project, that was accepted in March (till September) and in May (till December).

The main objectives during the project extension are:

- Development of applications and demonstrators within WP4
- Development of applications and extensions of the simulator of WP1
- Dissemination Workshop
- Web update
- Publication of Newsletters (June and December 2018)
- Final version of D4.3 "Results Report" version 7 (December 2018)
- International Publications

Extension period first semester progress report

During this period several publications have been accepted and others are in review process. After solving the problems for incorporating additional technical staff, we have been working since April 2018 in the development of several applications and demonstrators within WP4:

- People Density and Occupancy Estimation using multicamera detections
- Long-term tracking with target re-identification (additionally we have participated in the VOT2018 main challenge, VOT-RT2018 realtime subchallenge and VOT-LT2018 long-term subchallenge)
- Long-term abandoned object detection
- Automatic evaluation of people detection

Since June 2018, two additional applications are under development:

- Camouflage detection based on the similarity between foreground objects and scene context
- Context-based dynamic adaptation of algorithms
- System for previsualization of multicamera deployment projects over existing scenarios (over the multicamera simulator system developed within WP1)

These developments are working on plan, and they will be shown during the Dissemination Workshop to be organized after summer (tentative schedule, late September).

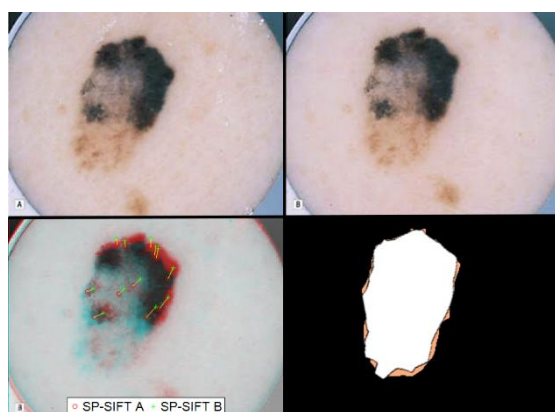
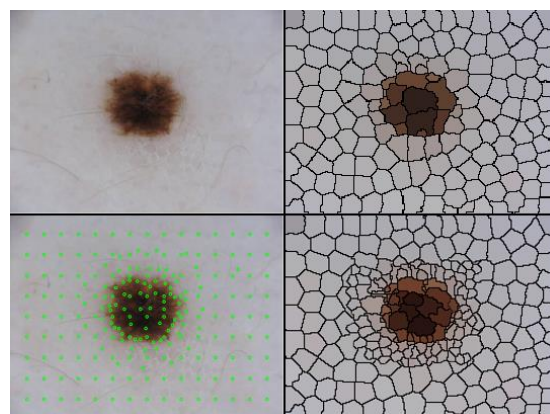
Extension period first semester progress results

Journals

Fulgencio Navarro, Marcos Escudero-Viñolo, Jesús Bescós, “Accurate segmentation and registration of skin lesion images to evaluate lesion change,” *IEEE Journal of Biomedical and Health Informatics*, (online April 2018), IEEE, ISSN 2168–2194 (Print) 2168–2208 (Online), (DOI [10.1109/JBHI.2018.2825251](https://doi.org/10.1109/JBHI.2018.2825251))

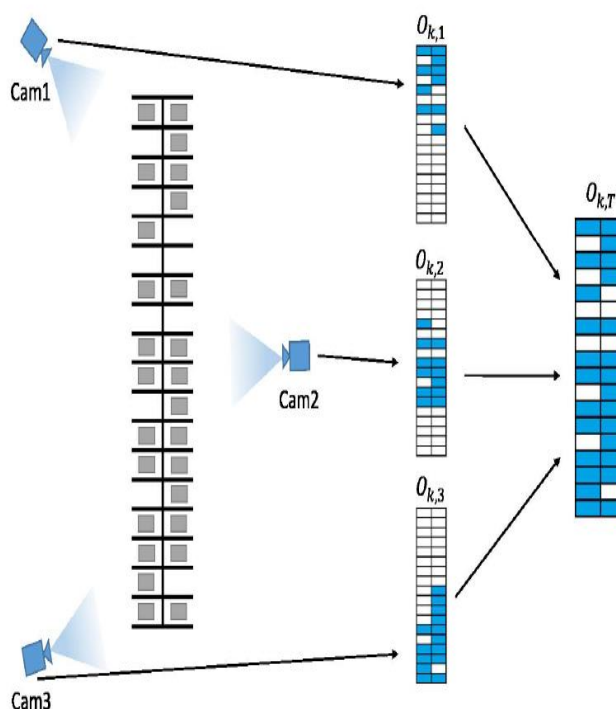
Abstract: Skin cancer is a major health problem. There are several techniques to help diagnose skin lesions from a captured image. Computer-aided diagnosis (CAD) systems operate on single images of skin lesions, extracting lesion features to further classify them and help the specialists. Accurate feature extraction, which further depends on precise lesion segmentation, is key for the performance of these systems.

In this paper, we present a skin lesion segmentation algorithm based on a novel adaptation of superpixels techniques and achieving the best reported results for the ISIC 2017 challenge dataset. Additionally, CAD systems have paid little attention to a critical criterion in skin lesion diagnosis: the lesion's evolution. This requires operating on two or more images of the same lesion, captured at different times but with a comparable scale, orientation and point of view; in other words, an image registration process should first be performed. We also propose in this work an image registration approach that outperforms top image registration techniques. Combined with the proposed lesion segmentation algorithm, this allows for the accurate extraction of features to assess the evolution of the lesion. We present a case-study with the lesion-size feature, paving the road for the development of automatic systems to easily evaluate skin lesion evolution.



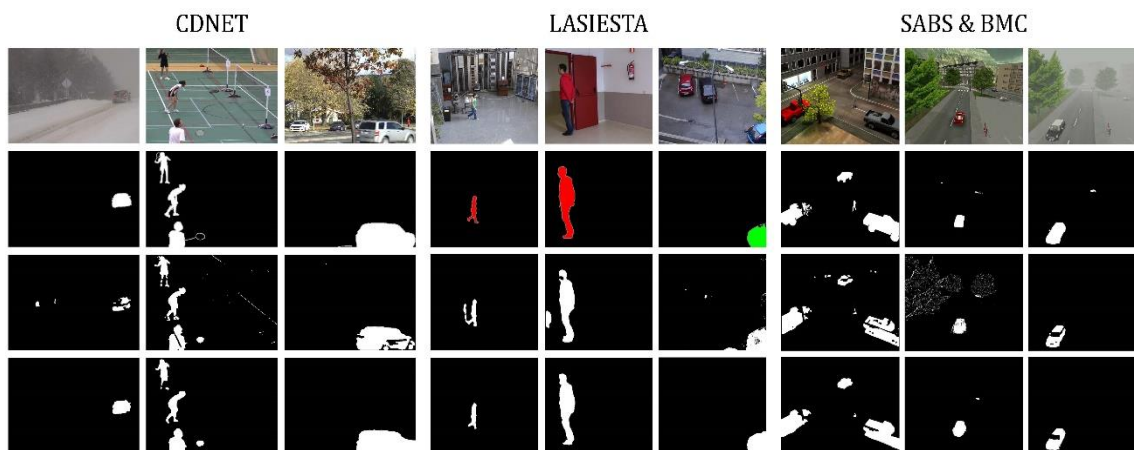
Rafael Martín-Nieto, Álvaro García-Martín, Alexander G. Hauptmann, José M. Martínez, "Automatic vacant parking places management system using multicamera vehicle detection", *IEEE Trans. On Intelligent Transportation Systems*, (accepted May 2018; online June 2018), IEEE, ISSN 1524-9050 (Print) 1558-0016 (Online), (DOI [10.1109/TITS.2018.2838128](https://doi.org/10.1109/TITS.2018.2838128))

Abstract: This paper presents a multicamera system for vehicles detection and their corresponding mapping into the parking spots of a parking lot. Approaches from the state-of-the-art system, which work properly in controlled scenarios, have been validated using small amount of sequences and without more challenging realistic conditions (illumination changes and different weather conditions). On the other hand, most of them are not complete systems, but provide only parts of them, usually detectors. The proposed system has been designed for realistic scenarios considering different cases of occlusion, illumination changes, and different climatic conditions; a real scenario (the International Pittsburgh Airport parking lot) has been targeted with the condition that existing parking security cameras can be used, avoiding the deployment of new cameras or other sensors infrastructures. For design and validation, a new multicamera data set has been recorded. The system is based on existing object detectors (the results of two of them are shown) and different proposed postprocessing stages. The results clearly show that the proposed system works correctly in challenging scenarios including almost total occlusions, illumination changes, and different weather conditions.



Diego Ortego, Juan C. SanMiguel, José M. Martínez, "Hierarchical improvement of foreground segmentation masks in background subtraction", IEEE Trans. On Circuits and Systems for Video Technology, (accepted June 2018), IEEE, ISSN 1051–8215, (DOI [10.1109/TCSVT.2018.2851440](https://doi.org/10.1109/TCSVT.2018.2851440))

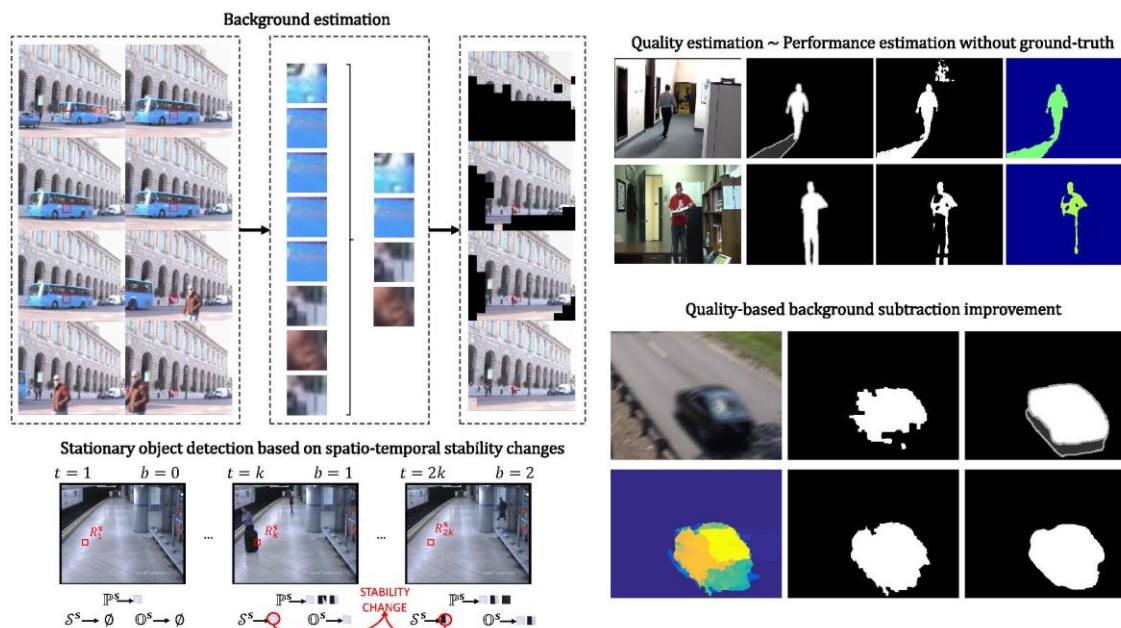
Abstract: A plethora of algorithms have been defined for foreground segmentation, a fundamental stage for many computer vision applications. In this work, we propose a post-processing framework to improve foreground segmentation performance of background subtraction algorithms. We define a hierarchical framework for extending segmented foreground pixels to undetected foreground object areas and for removing erroneously segmented foreground. Firstly, we create a motion-aware hierarchical image segmentation of each frame that prevents merging foreground and background image regions. Then, we estimate the quality of the foreground mask through the fitness of the binary regions in the mask and the hierarchy of segmented regions. Finally, the improved foreground mask is obtained as an optimal labeling by jointly exploiting foreground quality and spatial color relations in a pixel-wise fully-connected Conditional Random Field. Experiments are conducted over four large and heterogeneous datasets with varied challenges (CDNET2014, LASIESTA, SABS and BMC) demonstrating the capability of the proposed framework to improve background subtraction results.



PhD thesis

Quality-driven video analysis for the improvement of foreground segmentation, Diego Ortego Hernández (advisors: Juan C. SanMiguel, José M. Martínez), Tesis Doctoral (PhD Thesis), Univ. Autónoma de Madrid, Jun. 2018.

Abstract: Nowadays, the huge amount of available video content demands the creation of automatic systems for its understanding. In this context, the research community continuously improves the performance of these systems developing new algorithms that are methodologically evaluated in benchmarks via annotated ground-truth data. However, little interest is directed towards understanding the performance of the results when ground-truth is not available (stand-alone evaluation or quality estimation), which enables both an evaluation without costly annotation processes and an online understanding of errors that might be useful to improve results during run-time. In particular, the segmentation of objects of interest in videos or foreground segmentation is a relevant research area motivated by its variety of applications in topics such as video-surveillance or video edition. This thesis addresses tasks related to foreground segmentation that can improve its results while being independent of its internal details, background estimation from video frames and stand-alone quality estimation of foreground segmentation masks. Furthermore, it proposes a foreground segmentation improvement framework based on quality information. In the first part of this thesis, two algorithms are proposed for both overcoming background estimation and applying it to stationary object detection. Therefore, this part starts by developing a block-level background estimation algorithm robust to stationary objects due to the combination of a temporal analysis to obtain a set of background candidates and spatial analysis to enforce smoothness constraints selecting the right background candidate in each image location. Then, a practical use of background estimation for stationary object detection is explored by continuously estimating background images at different sampling instants and comparing them to determine stationarity. This approach is based on an online clustering that enables fast adaptation to scene variations while analyzing spatio-temporal changes to detect the stationary objects. Experiments on a variety of datasets demonstrate the efficiency of the two proposed background estimation related approaches proposed. In the second part, this thesis estimates the quality of foreground segmentation algorithms from a stand-alone perspective and proposes a post-processing framework that exploits quality information to improve algorithm results. Firstly, this part addresses the stand-alone evaluation of foreground masks by extracting properties over their connected components (blobs). In particular, an extensive comparison in terms of correlations with ground-truth based evaluation metrics and capabilities for quality-levels discrimination for 21 measures, revealing that fitness between blobs and segmented image regions (fitness-to-regions) is a good quality estimator. Afterwards, this thesis proposes a post-processing framework to improve foreground segmentation performance exploiting fitness-to-regions.



To do so, a motion-aware hierarchical image segmentation of each frame is built to allow quality estimation at different degrees of detail (without merging foreground and background image regions). This hierarchical framework enables the estimation of a combined quality. Finally, this foreground quality is transformed and exploited together with spatial color relations to improve the foreground mask via an optimal labeling process. The experiments conducted over large and heterogeneous datasets with varied challenges validate the utility of this approach.

Graduate thesis

Segmentación objeto-fondo mediante redes convolucionales (**Object-background segmentation via convolutional networks**), Alejandro Peña Almansa (advisor: Álvaro García-Martín), Trabajo Fin de Grado (Graduate Thesis), Grado en Ingeniería de Tecnologías y Servicios de Telecomunicación, Univ. Autónoma de Madrid, Jun. 2018.

Abstract: This work aims to develop a two-class segmentation algorithm, background and object, based on convolutional neural networks, with the goal of guaranteeing that no object or object parts are miss-classified as background, instead of the traditional detection and segmentation approach, which is to obtain a high performance on the object classification. We implemented the algorithm with a multi-scale object detector that applies parts based models as convolutional neural network over a feature pyramid, constructed by a second convolutional neural network from the input image. On top of this detector we developed two segmentation methods that generalize the people-background segmentation proposed in the work we started from, so that they can operate with any object class. Our experiments are divided into two different evaluations:

one with the people class and another one with a collection of different object classes. The people class evaluation shows that our approach not only outperforms the traditional approach from which we proceed, but also obtains comparable results with the deep learning semantic segmentation state of the art, and significantly outperforms it when a higher false positive penalty factor is used. For its part, the generic object evaluation shows the same performance improvement over the previous work, getting to obtain successful segmentation masks in cases where the previous approaches didn't work, although it shows a slight increase in the false positive rate compared to the people class evaluation.

Desarrollo de escenarios para simulador multi-cámara basado en Unity (Development of scenarios for a multicamera simulator based on Unity), Francisco Lobo García (advisor: Juan Carlos SanMiguel), Trabajo Fin de Grado (Graduate Thesis), Grado en Ingeniería Informática, Univ. Autónoma de Madrid, Jun. 2018.

Abstract: The objective of this Final Degree Thesis is to provide a virtual testing environment with synthetic data, useful in the investigation of algorithms for Computer Vision, where different situations can be simulated in a wide variety of environments and conditions, something difficult to replicate in the real world. Therefore, this project presents the creation of virtual scenarios based on the Unity 3D graphics engine and the integration in a distributed multi-camera system based on this graphic engine, specifically, in the simulator designed and implemented by Mario González in 2017 for the VPU laboratory of the Autonomous University of Madrid called: Multicamera System Simulator (MSS). Throughout this document, we describe the design and implementation to develop a scenario simulating crossroads in a city environment where numerous situations of interest happen, such as coordination, collisions and illegal actions between people and vehicles. Combining the MSS simulator with the proposed scenario provides an alternative in the research of Computer Vision, in order to solve the technical and flexible limitations of the most common testing environments. Finally, an evaluation of the computational resources required by the city scenario is performed to understand its technical limits whilst comparing this new scenario with the base one available in the MSS simulator.

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