HAVi Newsletters

#06 – December 2016

TEC2014-53176-R HAVideo (2015-2017)

High Availability Video Analysis for People Behaviour Understanding

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

Sixth four-months period progress report

Again, the workplan has been slightly modified; causing some delays in three deliverables that have been rescheduled for March 2017:

- D.2.2 "Contextual modelling and extraction for people behavior understanding" version 2
- D3.1 "Online adaptive people behaviour understanding based on contextual and quality information" version 1
- D.3.2 "Collaborative approaches for people behaviour understanding" version 1

The 2016 Dissemination Workshop organized for being held November 25th 2016 at the Escuela Politécnica Superior of the Universidad Autónoma de Madrid, was cancelled due to the reduced number of registered companies.

Besides these bad news, the project has been working on plan (below, the main achievements from each workpackage are enumerated) and several planed deliverables due December 2016 have been published: D2.1 "People Behaviour understanding in single and multiple camera settings" version 2, D4.1 "Evaluation methodology and datasets" version 2, and the semestral D4.3 "Results Report" version 4.

WP1 "Video Analysis Framework"

For workpackage WP.1, the work has been on two main lines:

- the virtual camera network simulator using the Unity tool has been advanced and a first version was made available. Additional work for obtaining a final version has been scheduled for the first semester 2017.
- a network camera simulator has been developed to model the communication and computational resources required by collaborative cameras.

WP2 "Video analysis tools, models and performance indicators"

For workpackage WP.2, the main achievements are:

- Development and evaluation of a people density estimator in crowded scenarios.
- Development and evaluation of an interactive detection and tracking application for basketball players.
- Analysis of tracking objects in long-term sequences.
- Use of semantic segmentation to constraint people detection proposals.
- Design and implementation of a shadow detection algorithms that perform quality analysis for self-adaptation.
- Implementation of an abandoned object detection system under sudden illumination changes.
- Development of a discriminative tracking using the combination of RGB and depth information.

WP3 "Self-configurable approaches for long-term analysis"

For workpackage WP.3, the main achievements are:

- Adaptation of people detection thresholds during prediction time (publication pending).
- Design and implementation of models to estimate the resources required for collaboration, enabling the adaptation of self-configurable approaches in multi-camera settings.

WP4 "Evaluation framework, demonstrators and dissemination"

For workpackage WP.4, the main achievements are:

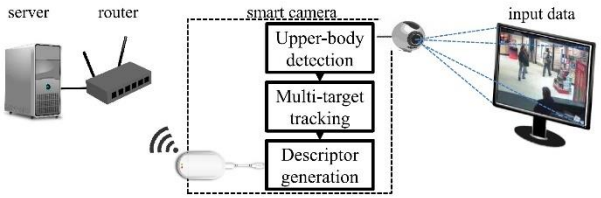
- Participation in the International tracking challenge VOT 2016.
- Participation in the International background estimation challenge SBMnet 2016.
- Design and evaluation of a configurable abandoned-stolen object detection system in security-video that integrates the most relevant techniques in each one of its stages.

Sixth four-months period results

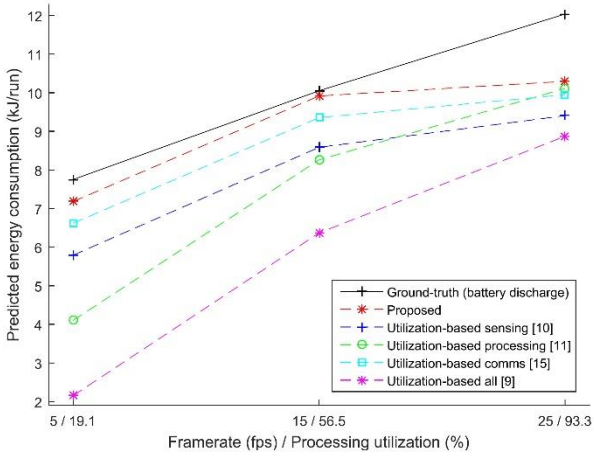
Journals

Juan C. SanMiguel, Andrea Cavallaro, "**Energy Consumption Models for Smart-Camera Networks**", IEEE Transactions on Circuits and Systems for Video Technology, (online September 2016), IEEE, ISSN 1051-8215 (DOI 10.1109/TCSVT.2016.2593598)

Abstract: Camera networks require heavy visual-data processing and high-bandwidth communication. In this paper, we identify key factors underpinning the development of resource-aware algorithms and we propose a comprehensive energy consumption model for the resources employed by smart-camera networks, which are composed of cameras that process data locally and collaborate with their neighbours. We account for the main parameters that influence consumption when sensing (framesize and framerate), processing (dynamic frequency scaling and task load) and communication (output power and bandwidth) are considered. Next we define an abstraction based on clock frequency and duty cycle that accounts for active, idle and sleep operational states. We demonstrate the importance of the proposed model for a multi-camera tracking task and show how one may significantly reduce consumption with only minor performance degradation when choosing to operate with an appropriately reduced hardware capacity. Moreover, we quantify the dependency on local computation resources and on bandwidth availability. The proposed consumption model can be easily adjusted to account for new platforms, thus providing a valuable tool for the design of resource-aware algorithms and further research in resource-aware camera networks.



Overview of the system we used to collect power measurements from the battery discharge of a smart camera with a sensing block (USB QuickCam Ultra Vision), a processing block (Toshiba Portege R-700, CPU i5-450M), and a communication block (AC600 wireless USB adapter). The processing block is further divided into its application elements (detection, tracking, and descriptor generation).

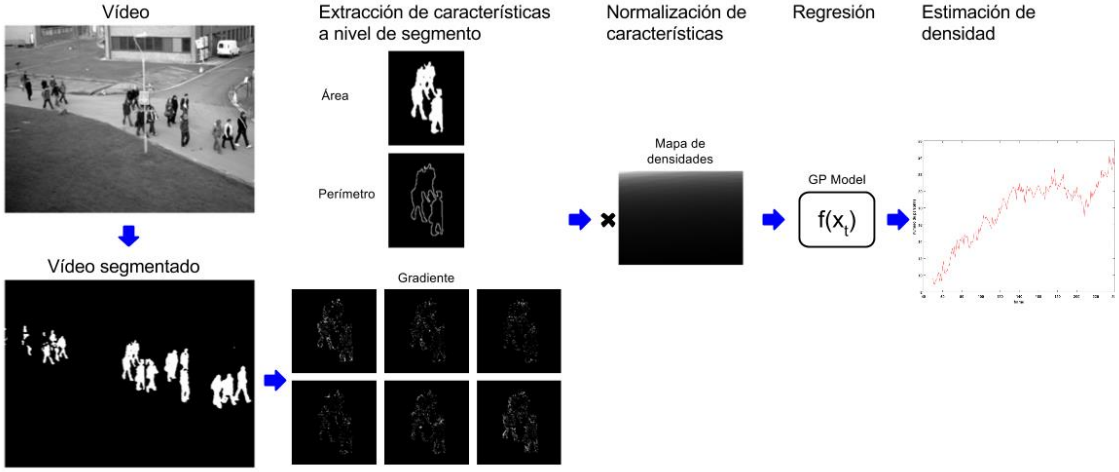


Energy consumption predicted by the proposed model and the utilization-based models. The top black curve corresponds to the ground-truth data obtained from battery discharge readings.

Conferences

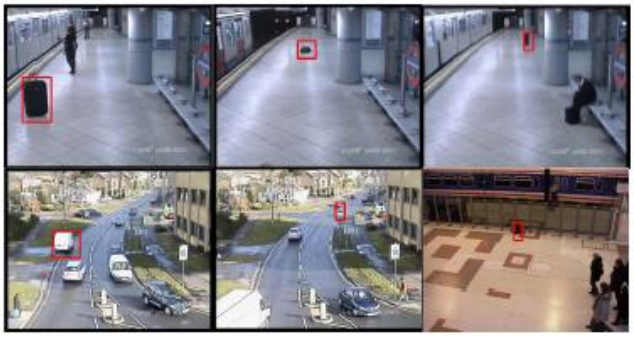
Álvaro García-Martin, Rosely Sánchez Ricardo, Jose M. Martinez, "**Estimación densidad de personas basada en segmentación persona-fondo (People density estimation based on people-background segmentation)**", Actas del XXXI Simposium Nacional de la Unión Científica Internacional de Radio – URSI 2016, Madrid, Spain, Sept. 2016.

Abstract: Most people density estimation algorithms include a preliminary step of object/person extraction in order to estimate their density. Unlike traditional algorithms based on foreground-background segmentation, we propose to use a people-background segmentation, specifically designed to determine the areas of the scene where there are no people, regardless of the typical problems encountered in real world scenarios such as lighting changes, shadows, dynamic backgrounds, etc. We demonstrate our approach and compare the results using both different segmentation algorithms over several public datasets. The results show clearly an improvement in people density estimation using people-background segmentation.



Sergio López, Diego Ortego, Juan Carlos Sanmiguel, Jose M. Martinez, "**Abandoned Object Detection under Sudden Illumination Changes**", Actas del XXXI Simposium Nacional de la Unión Científica Internacional de Radio – URSI 2016, Madrid, Spain, Sept. 2016.

Abstract: We present a block-wise abandoned object detection algorithm to operate under sudden illumination changes. First, image blocks are grouped via statistical variation of pixels ratios, while discarding those blocks related to moving objects. Then, spatio-temporal stability changes of the most repeated clusters at regular sampling instants provide candidates for abandoned objects. Subsequently, entropy theory is used to detect sudden illumination changes and filter erroneously detected candidates. Finally, a People History Image is used to filter stationary pedestrians and refine the abandoned object set. Unlike previous work, robustness against sudden and gradual illumination variations and stationary pedestrians is achieved without foreground segmentation. The experimental work validates the performance of the proposed approach against related work.



Fulgencio Navarro, Erik Velasco, Jesús Bescós, "**Seguimiento basdo en modelado dual RGB-D (Enhancing discriminative tracking via RGBD dual-model)**", Actas del XXXI Simposium Nacional de la Unión Científica Internacional de Radio - URSI 2016, Madrid, Spain, Sept. 2016.

Abstract: Visual object tracking in wide baseline scenarios (VOT-WB) is a challenging task. As shown in recent surveys and contests, discriminative strategies are ranking top in VOT-WB. However, the discriminative capacitity of those algorithms is biased by the space where their features are built. Even algorithms that may overcome this limitation have to maintain a trade-off between discriminativeness and repetitiveness in order to handle target self-variations. Our approach is built on features extracted in low-correlated spaces, color and depth. Self-variations on the target are not shown in both spaces simultaneously, so high-discriminative features are proposed, not at the cost of repetitiveness. The proposal combines spatial-color characterized with superpixels, with spatial-depth information using weigthed-confidence maps. Experimental evaluation sufficiently supports this thesis even through most challenging situations.

Matej Kristan et al. "**The Visual Object Tracking VOT2016 Challenge Results**", in: Hua G., Jégou H. (eds) Computer Vision – ECCV 2016 Workshops, Lecture Notes in Computer Science, vol. 9914, Springer, Oct. 2016, pp. 777-823 (DOI 10.1007/978-3-319-48881-3_54)

Abstract: The Visual Object Tracking challenge VOT2016 aims at comparing short-term single-object visual trackers that do not apply pre-learned models of object appearance. Results of 70 trackers are presented, with a large number of trackers being published at major computer vision conferences and journals in the recent years. The number The Visual Object Tracking VOT2016 Challenge Results 779 of tested state-of-the-art trackers makes the VOT 2016 the largest and most challenging benchmark on short-term tracking to date. For each participating tracker, a short description is provided in the Appendix. The VOT2016 goes beyond its predecessors by (i) introducing a new semi-automatic ground truth bounding box annotation methodology and (ii) extending the evaluation system with the no-reset experiment. The dataset, the evaluation kit as well as the results are publicly available at the challenge website (http://votchallenge.net).

Michael Felsberg et al., "**The Visual Object Tracking VOT-TIR2016 challenge results**", in: Hua G., Jégou H. (eds) Computer Vision – ECCV 2016 Workshops, Lecture Notes in Computer Science, vol. 9914, Springer, Oct. 2016, pp. 824-849 (DOI 10.1007/978-3-319-48881-3_55)

Abstract: The Thermal Infrared Visual Object Tracking challenge 2016, VOT-TIR2016, aims at comparing short-term single-object visual trackers that work on thermal infrared (TIR) sequences and do not apply pre-learned models of object appearance. VOT-TIR2016 is the second benchmark on short-term tracking in TIR sequences. Results of 24 trackers are presented. For each participating tracker, a short description is provided in the appendix. The VOT-TIR2016 challenge is similar to the 2015 challenge, the main difference is the introduction of new, more difficult sequences into the dataset. Furthermore, VOT-TIR2016 evaluation adopted the improvements regarding overlap calculation in VOT2016. Compared to VOT-TIR2015, a significant general

improvement of results has been observed, which partly compensate for the more difficult sequences. The dataset, the evaluation kit, as well as the results are publicly available at the challenge website.

Diego Ortego, Juan C. Sanmiguel and José M. Martínez, "**Rejection based Multipath Reconstruction for Background estimation in SBMnet 2016 dataset**", Scene Background Modeling Contest - SBMC2016, Proc. of 2016 International Conference on Pattern Recognition, Cancún, México, Dec. 2016 (in press).

Abstract: Background Estimation in video consists in extracting a foreground-free image from a set of training frames. In this paper, we overview a temporal-spatial block-level approach for background estimation in video and present their results in the SBMnet dataset. First, the employed approach uses a Temporal Analysis module to obtain a compact representation of the training data that is later clustered by a threshold free technique to generate background candidates at each block location. Then, a Spatial Analysis module iteratively reconstructs the background using a multipath reconstruction guided by background smoothness constraints. The experimental results in the SBMnet dataset demonstrates the utility of the employed approach against stationary objects and its weaknesses when motion information is involved.

copyMachine *busStation* *AVSS2007*

Master thesis

Seguimiento de objetos en vídeo a largo plazo (**Long-term objects tracking in video sequences**), Borja Maza Vargas (advisor: Juan Carlos San Miguel), Proyecto fin de Carrera (Master Thesis), Ingeniería de Telecomunicación, Univ. Autónoma de Madrid, Sept. 2016.

Abstract: In this master thesis an analysis of tracking objects in long-term sequences is proposed. Recently, the development of video tracking algorithms has been focused on short videos. However, the need to operate for long times (e.g. 24/7 video-surveillance) have increased need to study mechanisms to improve and update existing tracking algorithms for their use in long-term sequences. The main aim of the project is the study, design and evaluation of an algorithm that combines other trackers sequences previously developed both

short and long term. For this objective, first it has conducted a study of the state of art related to object tracking, focused on the case of long-term videos. After, this project focuses on the selection and description of the chosen tracking algorithms to evaluate and compare the set of videos of this project. Once these trackers have been studied, a fusion algorithm is implemented which examines the behavior of the combination of algorithm under the long-term framework. Finally, this project proceeds to evaluate the combination-based algorithms on numerous sequences in order to make a comparison with the individual algorithms. Because long-term sequences have a large number of problems, the performance obtained mostly by all trackers are relatively low.

Detección de sombras en secuencias de vídeo-seguridad (**Shadows detection in video-surveillance sequences**), Guillermo Rodríguez Yrezabal (advisor: Juan Carlos San Miguel), Proyecto fin de Carrera (Master Thesis), Ingeniería de Telecomunicación, Univ. Autónoma de Madrid, Sept. 2016.

Abstract: The main goal of this master thesis is the design and implementation of a shadow detection algorithm. Many computer vision applications such as video-surveillance require the detection and object tracking where background substraction is commonly applied for background/foreground segmentation. However, cast shadows from moving foreground objects usually result in errors for such applications. To address these problems, this work proposes the design and implementation of a shadow detection algorithm, exploiting the colour information by means of calculating the ratios between pixels under shadow regions and background pixels for different colour spaces. For this purpose, the author first studied, implemented, adapted and evaluated the main and most relevant techniques of background substraction and shadow methods that form the basis of most detectors in the literature, highlighting the main gaps they present in detecting and removing shadows from image sequences. It is described later the proposed algorithm explaining each of the process steps such us the calculation of ratios, histograms, colour spaces channel correlation and optimization of thresholds. The results associated to every process of the algorithm will be presented in four experiments, performing a comparative evaluation with some of the algorithms found in the literature.

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