Vídeo Industrial para visão EXPANdida em operações à Distância

VIEXPAND
E6.4
VIEXPAND PROJECT CONTRIBUTIONS (PUBLICATIONS, EVENTS, IP, PATENTS AND STADARDISATION) (EN)
CONTRIBUTOS DO PROJETO VIEXPAND (PUBLICAÇÕES, EVENTOS, IP, PATENTES E ESTANDARDIZAÇÃO) (PT)

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Editor:	João Gil (TWEVO)
Authors:	João Gil (TWEVO), Pedro A. Assunção, Lino Ferreira (IT)
Internal reviewers:	Carlos Ribeiro (TWEVO), Pedro A. Assunção (IT)
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SUMMARY (EN):

This Deliverable presents the VIEXPAND's project dissemination and communication contributions.

SUMÁRIO (PT):

Este Entregável apresenta as contribuições de disseminação e comunicação do projeto VIEXPAND.

Keyword list: Publications, events, IP, patents, standardisation

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List of Acronyms

AI	Artificial Intelligence
HEVC	High Efficiency Video Coding
HW	Hardware
IP	Intellectual Property
MD	Machine Directive
POC	Proof-of-Concept
QOO	Quality Of Operation
SW	Software

1. Introduction

This Deliverable describes the overall project dissemination and communication actions, related to the VIEXPAND project. It includes: public demonstration of prototypes and pilots, technical/non-scientific and scientific publications, presence in key national and international technical-scientific events in the context of image processing and industrial applications, participation in fairs, exhibitions and conferences, meetings with potential clients, investors, partners, as well as non-scientific publications in LinkedIn (as a valid professional social-media network). Overall, all have had important roles in the dissemination of information about the project and in building effective liaisons towards potential demonstrations, pilots, client-level Proof-of-Concept (POC). These occasions, events and actions are presently having an effective impact on the recognition of the developed technology, among possible future collaborations as partners, investors and clients.

We hereby list these actions, as technical and scientific publications, events, Intellectual Property (IP), patents and standardisation contributions, framing them along the VIEXPAND context - the 'VIEXPAND ecosystem'. We make reference to important leads that have been acquired during some of those actions, with present constructive results, already taking place before the end of the project, along the final months.

2. Overall Actions

Table 1 summarises the project promotion actions that have taken place, along the project.

Type of action for the promotion and dissemination of results	Number of Actions
Scientific publications (publications)	4 published + 1 submitted
Participation in Conferences (publications)	4
Non-scientific publications (publications)	16
Web Site (publications)	1
Press-Releases / Press Publications (publications)	5
Public demonstration of prototypes and pilots (events)	2
Participation in fairs and exhibitions (events)	3
Others	
Meetings with potential clients, with results (events)	> 6
Meetings with potential investors, with results (events)	> 3
Meetings with potential partners, with results (events)	> 5

Table 1 - Main actions for the promotion and dissemination of results, along VIEXPAND.

As expected, most of these actions took place in the final project year.

3. Publications

3.1. Scientific publications

- Scientific Conference, Keynote presentation
  Carlos Ribeiro, "Taking FPGA Implementations Further, VIEXPAND Project", *REC2022 - XVIII Conference on Reconfigurable Systems*, Leiria, Portugal, July 4-5, 2022.

- Scientific Conference, paper, peer reviewed
  Carlos Ribeiro, Mónica Figueiredo, Pedro Assunção, Lino Ferreira, João Gil and Xavier Bento, "Real-Time Industrial Machine Vision Supervision using DPU-based Edge Devices", *13th International Conference on Environment and Industrial Innovation (ICEII 2023)*, Vienna, Austria, June 19-21, 2023. Prized as "Best On-Line Presentation" in the event.
  Abstract: *In many modern industries the production lines are very fast-paced environments with repetitive and intricate motions where humans and machines often co-exist. Manufacturers are always looking for ways to minimize breakdowns and failures to improve productivity and efficiency. This work is an outcome of the collaborative R&D project VIEXPAND AI - a real-time AI-boosted solution that complements and expands human supervision with 24/7 'smart eyes' in a container glass industry application. The goal is to reduce production downtime, accidents, waste of raw materials and energy, as well as improve the industrial work conditions. To accomplish this, we propose an architecture where AI methods and techniques are implemented on the edge, to allow realtime supervision of multiple sites with centralized remote monitoring. FPGA System-on-Chip (SoC) devices are used to implement the video processing, multiplexing and encoding/decoding stages, as well as the AI engine used for object detection and classification. This heterogeneous technology allows us to distribute processing tasks over different hardware modules available on-chip (the multi-processor unit, hard-cores and soft-cores), thus enabling real-time operation. This paper evaluates the use of YOLOX models in a Xilinx Zynq®UltraScale+TM Multiprocessor System-on-Chip (MPSoC) Deep-Learning Processing System (DPU). It presents a study on the performance of the models when trained with different input sizes and custom datasets, obtained on the factory floor. The impact of different design choices on performance metrics is reported and discussed.*

- Scientific Conference, paper, peer reviewed
  José Rosa, Rúben António, Lino Ferreira, Mónica Figueiredo, Pedro Assunção, and Carlos Ribeiro, "Rate Control Method for Video Encoders Operating in Industrial Environments", *13th International Conference on Environment and Industrial Innovation (ICEII 2023)*, Vienna, Austria, June 19-21, 2023.
  Abstract: *Video coding technology aims to reduce the bandwidth needed for video transmission and storage while maintaining the maximum possible video content quality. Rate Control (RC) is the mechanism designed for keeping the compressed rate at some predefined level. While in generic video coding, this has been thoroughly investigated in the past, in industrial computer vision applications using fixed cameras, there are not many efficient solutions capable of reaching the target rate in a fast and efficient manner. This paper proposes a RC method specifically tailored for industrial applications where the variability of the visual content is low and transmission to central servers is prone to errors and losses. The proposed algorithm is adaptive to the scene to be encoded through a startup procedure that builds default rate-quantization functions. Then, in normal operation, these functions are used to determine the quantization parameter that produces*

the best matching rate considering the predefined target, which can be dynamically defined from network or storage constraints. The results show that steady-state operation is achieved with low absolute error (1.08%) with respect to the target bitrate (BR) and also with fast setting time when abrupt changes are imposed. Overall the proposed method is flexible enough to match the requirements of a wide variety of industrial applications, namely those where remote video should be delivered in compressed format for cloud processing or storage servers.

- Scientific Conference, paper, peer reviewed
  Rúben António, José Rosa, Lino Ferreira, Mónica Figueiredo, Pedro Assunção, and Carlos Ribeiro, "Enhanced Object Detection in Highly Compressed Images using Regions of Interest", *13th International Conference on Environment and Industrial Innovation (ICEII 2023)*, Vienna, Austria, June 19-21, 2023. Prized as "Best Presentation" in the event.
  Abstract: *With the increasing popularity of digital media, the need to store and transmit large amounts of visual data has also increased. Image compression techniques can reduce file sizes and bandwidth requirements while maintaining an acceptable level of image quality. Classical techniques are designed to optimize images or videos for the Human Visual System (HVS), which takes into account the characteristics of the human eye and brain in perceiving and processing visual information. However, newer compression techniques, aiming not only at HVS optimization but also at improving performance when considering tasks driven by machines, are being developed. In this context, this paper proposes an efficient approach to enhance the performance of object detection Neural Networks (NNs) in highly compressed images, using Regions Of Interest (ROIs). We evaluate the mean Average Precision (mAP) in both Faster Region-based Convolutional Neural Network (R-CNN) and DyHead Neural Network (NN), considering two different application scenarios: generic object detection and industrial supervision. In comparison with the High Efficiency Video Coding (HEVC) standard, the proposed approach allows us to reduce the bitstream up to 40% while achieving a similar accuracy in the object detection task, regardless of the considered network. These results demonstrate that high compression ratios can be achieved while maintaining good image quality for machine visual perception in task-driven systems.*

- Scientific Journal, paper, submitted to *International Journal of Industrial Engineering and Management (IJIEM)*, peer reviewed
  Carlos Ribeiro, João Gil, Xavier Bento, Mónica Figueiredo, José Rosa, Ruben António, Lino Ferreira and Pedro Assunção, "VIEXPAND – Industrial Video for Expanded Vision in Remote Operations".
  Abstract: *Manufacturers are always looking for ways to minimize breakdowns and failures to improve productivity and efficiency. VIEXPAND is a multiview AI-enhanced video processing and transmission system, operating in real-time, for industrial supervision, inspection, surveillance and security applications, on the road to Industry 4.0. It focuses on professional applications where monitoring of large industrial areas requires wide fields of view and multiple views, demanding for efficient data transmission, in real-time. This paper covers a use case in a glass bottle production industry to reduce material and energy waste, and improve safety of operations.*

3.2. Non-Scientific publications

- 7 publications in the professional social media network LinkedIn, with the hashtag #VIEXPAND
- 1 pitch presentation during Hannover Messe, *VIEXPAND AI — The smart supervision solution for the industry*, on the 'Portugal makes Sense - Pitch Session of Portuguese startups', April 2023 [source]
- 8 public project deliverables: E1.1 – "Progress Report - First Period", E1.2 – "Progress Report - Second Period", E1.3 – "Final Project report", E2.2 – "Market Vision for Improvements in Future Architectures", E6.1 – "Current Standardisation and Evolution I", E6.2 – "Current Standardisation and Evolution II", E6.3 – "VIEXPAND PROJECT Website", and this one, E6.4 - "VIEXPAND PROJECT Contributions (publications, events, IP, patents and standardisation)".

3.3. Web Site

- 1 Web Site project presence, in https://www.twevo.net/projects-2/viexpand/.

3.4. Press-Releases / Press Publications

- 1 national newspaper "ECO" news [source];
- 1 regional newspaper "Jornal de Leiria" news [source];
- 3 press-releases in TWEVO's site, 'News' page [source].

4. Events

4.1. Public demonstration of prototypes and pilots

We are considering 'Public demonstrations' as any demonstration towards people that have not been involved in the project, whose knowledge of the project details is reduced or none, but whose interest in the project outcomes is large. We believe that these are worthy of mention as promotion actions, since these have real impact on industrial acceptance. This is the case of situations where the pilot was installed in the VIDRALA factory, leading to acquiring confidence from among the technical directors, field engineers and workers. It is also the case of the demonstration during an industrial fair, with the system running with a local camera and on-site recorded industrial video.

These are also the cases where TWEVO installs and puts a commercial VIEXPAND's project outcome running in an external potential client's factory (already out of the scope of the VIEXPAND project). TWEVO is planning several installations with a running VIEXPAND pilot evolution in several potential client's industrial locations, presenting results to such external parties.

According to initial plan and Technical Annex, the VIEXPAND project did not include any formal public demonstrations and pilots (only internal, among partners). The planned internal demonstration has been extended to be a public demonstration of prototypes and pilots event,

among technical directors, field engineers and workers, some of which had not followed the project up to then. A journalist from "Jornal de Leiria" newspaper was also present. Such demonstration has taken place once, with the pilot installed and in operation in Vidrala Gallo factory, Marinha Grande, Portugal, June 2023, for Scenario 1 (production line solution).

Also, during the Hannover Industrial Fair (mentioned below), TWEVO has demonstrated the final prototype working in the rent booth. The setup included the VIEXPAND final prototype, running with a network internet protocol camera and a saved Scenario 1 (production line solution) video. It was a simpler demonstration, as a tool for marketing and disseminating the VIEXPAND project.

At the date of completion of this report, discussions are undergoing to execute pilots in an intralogistics warehouse of a major Portuguese distribution enterprise group, among technical directors, field engineers and workers, for the intralogistics solution.

4.2. Participation in technical fairs and exhibitions

TWEVO has presented VIEXPAND and participated in 1 national event and in 2 international fairs and exhibitions, in areas key in the industrial markets relevant to the future commercialisation of the project's outcomes. These have been:

- TICE Technological Demonstration Event, at the Polytechnic of Leiria, Leiria, Portugal, Jan. 25, 2023 (important leads acquired);
- Hannover Messe Trade Fair, Hannover, Germany, April 17-21 2023 (active presence with dedicated booth, public presentation, meetings and networking, several important leads acquired);
- GIFA, 15th International Foundry Trade Fair with Technical Forum, Düsseldorf, Germany, June 12-16 2023 (meetings and networking, several important leads acquired).

4.3. Other events

Numerous meetings or presentations with potential clients, with potential investors or partners, have taken place, physically and remotely. These have been at regional, national and international level, with effective results - future partnerships, planning of pilots and investment (under way, at the time of this reporting).

We should mention the active roles of the following institutions, helping on those meetings:

- CRINOVE – *Catalisador Regional de Inovação do Centro*, *Comissão de Coordenação e Desenvolvimento Regional do Centro* (CCDRC), regional and national;
- AICEP - *Agência para o Investimento e Comércio Externo de Portugal*, national and international;
- IPN - *Instituto Pedro Nunes*, Incubator, Coimbra, Portugal, national and international;
- Lanzadera - Business Accelerator, Valência, Spain, international.

5. IP and Patents

Relevant IP has been generated. The Consortium is evaluating means of IP protection.

We have undergone research on the application of Artificial Intelligence (AI) in/with patents, according to the European Patent Office (EPO) [source] [source], and are evaluating their suitability in the VIEXPAND context, for possible post-project actions.

6. Standardisation

After initial analysis and at the final project stage, the Consortium has analysed the relevant standards. Namely on video coding, CE marking, safety norms in industrial safety alarm systems.

As previously confirmed along the project, ways of contribution to video coding standardisation were evaluated. During the project, a new standard (Versatile Video Coding) was approved, not being an option to the project. Also, the standardisation activity that remains regarding High Efficiency Video Coding (HEVC) does not focus on aspects relevant to the project. But, most importantly, the technical innovations developed in the project were all compatible with standard encoders, thus no changes to standards were required. This is a crucial positive aspect, that in fact had to be guaranteed by the project, because any standard encoder can be used in the technical framework of the project and beyond, without modifications.

Concerning CE marking and safety norms in industrial safety alarm systems, the Consortium has analysed current standardisation and directives. Relevant decisions have had impact on the project execution and in the final prototypes, concerning CE marking for a final product outcome. Namely, concerning the adopted modular Hardware (HW) and Software (SW) approach.

In respect to the application to safety alarm systems, the Consortium has registered that, when providing a smart product/service for safety purposes based on VIEXPAND, special care and commitment need to be put into following the EU Machine Directive (MD), in order to effectively provide its main function towards all stakeholders dealing with health, safety, and security in the factory. These include workers, owners, investors, insurance companies, machine manufacturers, medical professionals. For this, future effort needs to be undertaken in these senses, for the safe, failure-proof and responsible adoption and use of such product.

7. Conclusions

All contributions and dissemination outcomes fit into the initially planned, among the inevitable initial unknowns. Now in a phase of gaining momentum, all of those actions have had their impact in pursuing the most important three tasks that the project Consortium has permanently kept in mind, form the start:

- develop a product required by the industry, close to the industry;
- obtain a commercially valuable product, with the perspectives of diversifying industrial application and market;
- reach and meet potential clients, in the several markets, including for the implementation of pilots;
- prepare the next immediate step, with the extraction of effective results of applying R&D to the industry, e.g., improvement in Quality Of Operations (QOOs), reduction in energy and materials waste.