Multimedia Communications Group (COMM)

HEAD OF THE GROUP RESEARCH REPORT

The history of the Multimedia Communications Group (COMM) started in 2004, and nowadays 5 researchers belong to this group. The main research lines are always involving multimedia systems and Quality of Experience (QoE) topics. During the last year 2020/2021 the group has continued with its work lines focused on the distribution of multimedia content using protocols like Dynamic Adaptive Streaming over HTTP (DASH) and studying low latency variants; carrying out more in-depth studies and developments related to the Internet of Things (IoT), specifically about Smart Cities and other projects based on the collection of data from monitoring devices and developing specific dashboards for visualization; analysing and proposing new metrics for estimating the QoE; and developing new functionalities for multimedia systems based on DRM and cross-layer techniques.

These lines of action have been articulated through the execution of different research and development projects, as well as scientific publications. In addition, in order to promote the main activities of the group, we have been continuously updating the webpage and being very active in social networks (Facebook, Twitter, Youtube, LinkedIn and Instagram).

Following, the main results of the group are summarized, which are accessible through the COMM webpage (www.comm.upv.es).

1.- Project activities

Internet of Things and Smart Cities

Smart cities entail a combination of people, technology and strategies that makes the city more sustainable regarding strategic pillars, such as mobility, health or energy. For this to be feasible, the application of Internet of Things (IoT) is a key factor to improve the life of citizens. IoT technologies comprise sensors to acquire data but are not limited to that. For a full comprehension of IoT applied to Smart Cities, a wider vision is needed, including data storage, analysis and presentation. Data can be collected with sensors, but this data must be processed and analysed in order to be transformed into information. Afterwards, citizens and city managers need an assortment of tools to manage this information to take advantage and transform it into knowledge. It is only with this full path when data can be transformed into knowledge and be fully profitable, and this should be the focus of a modern Smart City.

Following this approach, during this year, the group has been collaborating with Valencia City Council on tasks related to Valencia Urban Platform (VLCi). Within the context of MAtchUP project, we aim at improving the performance of the city, decision making or citizen participation, among others, guaranteeing interaction between the city of Valencia and its citizens, designing new data models, datasets and APIs for the new services and devices integrated into the urban platform.

Monitoring of information in real-time

Following the footsteps from previous years, we have delved into applications for monitoring in real-time information collected from sensors. The objective is to develop solutions that, apart from collecting and processing data in real-time, display information neatly in order to allow users to consult this data in a clear and simple way. For this purpose, we have joined forces with other groups in the iTEAM and other UPV spin-off.

Particularly, we have been working in a monitoring tool to collect, analyse and present data obtained from optical sensors installed in several railway bridges. All the gathered information serves as deep knowledge to understand the forces applied to the bridge when trains come over, and more important, this data is used to trigger alarms when a weakness is detected in any of these bridges.

Also related to monitoring activities, we have been working in a project with the aim of monitoring asphalt condition to determine the deterioration of the road. Optical sensors installed beneath the asphalt send signals to the monitoring device. These signals are analysed and presented in dashboards for the future study. All of this is very useful in the early detection of road faults.

Audio and video synchronization in production systems

Last year, we developed an application to carry out an automatic realization of a recording in real-time. This year, this tool has been tested in real scenarios, such as city council plenary sessions, where the application detected the active microphones in each instant of time and, considering certain parameters as the number of cameras or the refreshing time, decided which camera should be on air. The tests have been very successful and this year we focus on develop new improvements to the application, adding further

Dashboards for bridge sensor monitoring

compatibility to new microphone brands and systems and starting a mobile app development to manage the production system from a smartphone.

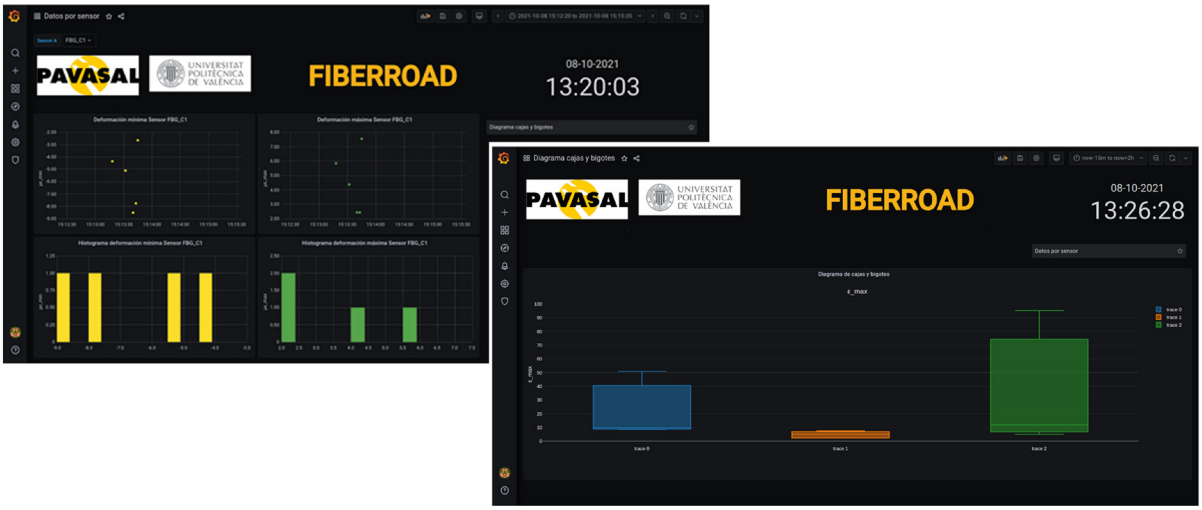
1.1.- Ongoing projects

Name of the project: *MAtchUP: MAximizing the UPscaling and replication potential of high level urban transformation strategies (774477, Call H2020-SCC-2017)*

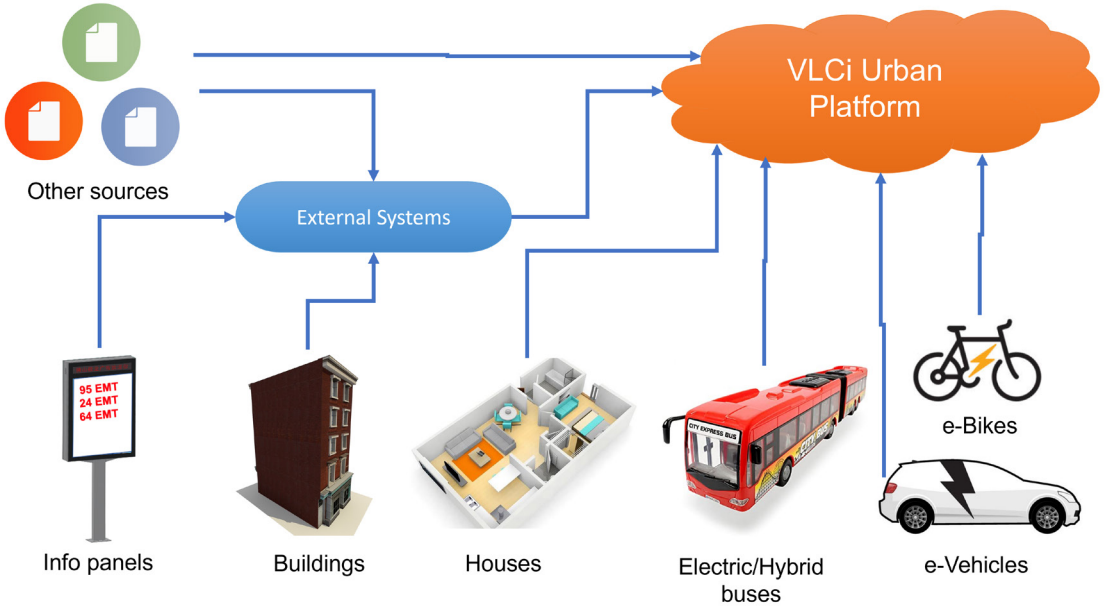
Webpage of the project: http://www.matchup-project.eu

Funding entity and duration: *European Union's Horizon 2020 Research and Innovation Programme. 2017-2022.*

Summary of the project: *The project aims at strengthening the planning processes for urban transformation, consolidating the benefits of deploying large scale demonstration projects of innovative technologies in the energy, mobility and ICT sectors, by means of substantially improved models for replication and upscaling, based on impacts evaluation, and ensuring the bankability of the solutions by means of innovative business models, which lead to achieve real deployment further than the pilots carried out in the lighthouse cities. With this, it is sought a high penetration of the validated technologies in those cities less prepared to adopt very innovative solutions and formalize it in a standard commitment, accompanied by capacity building strategies, to guarantee*



Fiber road sensors monitoring in real-time



MAtchUP architecture and data flow

at least medium-term implementation. The project started in October 2017, with an expected duration of five years. COMM focuses on actions related to ICT.

As sensor installation progresses, more and more types of sensors have been tested and included in the data flow of the urban city platform. New sensors and devices installed include energy consumption, comfort, energy storage, energy generation, energy accumulation, smart controller, electrical bus data, hybrid bus data, electric bike data and electric vehicle data. Data collected from the IoT devices in several project interventions is being stored in the urban platform database. Hence, additional devices and services have been monitored such as eBikes, electric and hybrid buses, and also from services such as modal information in multimodal hubs and status of the deployed charging stations.

Name of the project: *Sistema de realización audiovisual automatizada y desatendida* (Automated and unattended audiovisual production system)

Webpage of the project: *https://esveu.es*

Funding entity and duration: *Generalitat Valenciana IVACE (Institut Valencià de Competitivitat Empresarial).*

Summary of the project*: The main objective of the project is the design and development of a new multimedia system for automated and unattended audiovisual recording and production. At the same time, the recording is timestamped with the start and end of each participant in the meeting. The new solution is designed for environments in which the recording of a session or meeting involving several participants, such as a municipal plenary session of a city council, a conference or a meeting of the board of directors of a company, is carried out.*

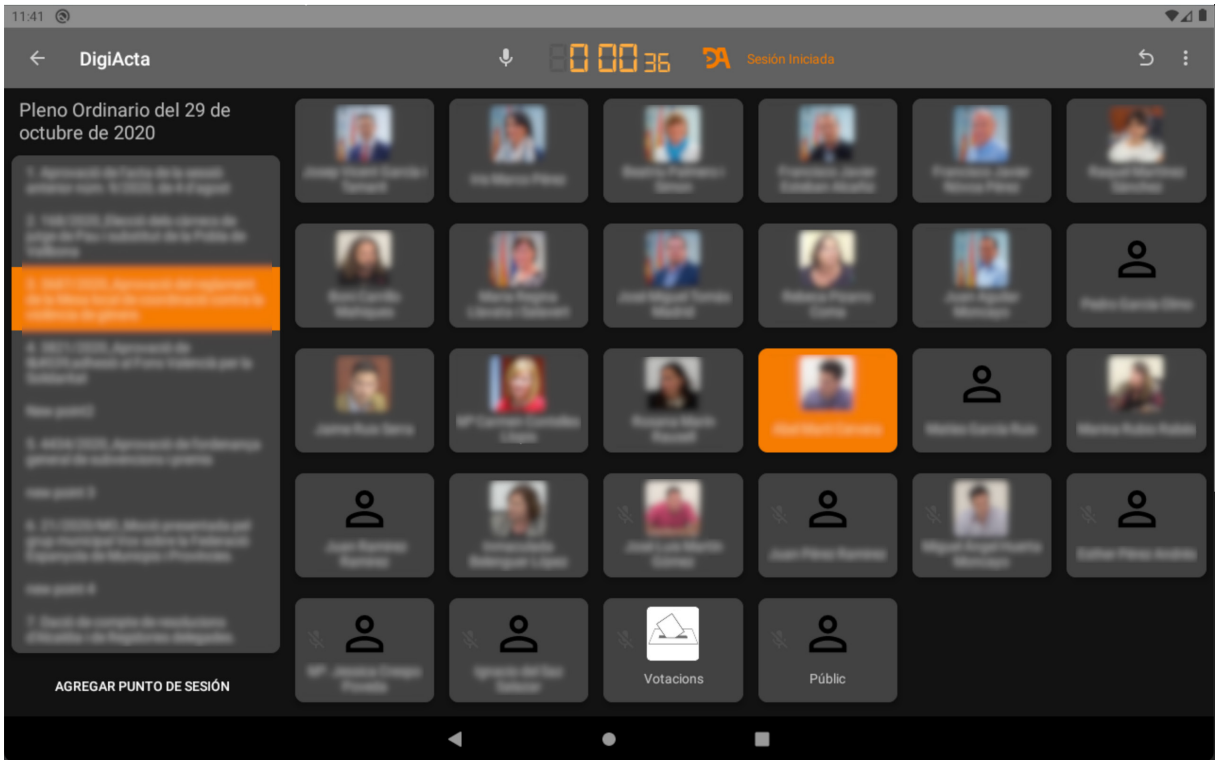
The main novelty of this solution is that it allows an automated and unattended management of the production process, i.e., without requiring a dedicated person to carry out the realization of the different shots that make up the video. Also, by enabling the generation of timestamps of the video recording, it allows the identification of the person involved for subsequent location in a concrete and immediate way. The project thus aims to implement a new application responsible for managing the entire process of making and recording a session.

2.- Research results

2.1.- Featured publications

FIWARE based low-cost wireless acoustic sensor network for monitoring and classification of urban soundscape. P. Arce, D. Salvo, G. Piñero, A. Gonzalez. Computer Networks, vol. 196, article 108199, doi https://doi.org/10.1016/j.comnet.2021.108199, 2021.

This work presents a wireless acoustic sensor network (WASN) that monitors urban environments by recognizing a given set of sound events or classes. The nodes of the WASN are Raspberry Pi devices and the classification task is carried out by a convolutional neural network (CNN). Regarding the underlying WASN, it has



Automatic video production system

been designed according to the open standard FIWARE, which was developed to create a smart and open solution for sensor network. Therefore, the whole system can be deployed without the need of proprietary software.

A Low-cost Wireless Acoustic Sensor Network for the Classification of Urban Sounds. D. Salvo, G. Piñero, P. Arce, A. Gonzalez. Proceedings of the 17th ACM Symposium on Performance Evaluation of Wireless Ad Hoc, Sensor, and Ubiquitous Networks (PE-WASUN'20), November 16–20, 2020, Alicante, Spain. Pp 49-55, doi https://doi.org/10.1145/3416011.3424759, 2020.

We present in this paper a wireless acoustic sensor network (WASN) that recognizes a set of sound events or classes from urban environments. The nodes of the WASN are Raspberry Pi devices that not only record the ambient sound, but they also process and recognize a sound event by means of a deep convolutional neural network (CNN). We propose to introduce a pre-detection stage prior to the CNN classification in order to save power consumption. Experimental results have been carried out in the city of Valencia, achieving a six-times reduction of the Raspberry Pi CPU's usage due to the pre-detection stage.

Look ahead to improve QoE in DASH streaming. R. Belda, I. de Fez, P. Arce, and J. C. Guerri, Multimedia Tools and Applications, vol. 79, pp. 25143-25170, 2020.

When a video is encoded with constant quality, the resulting bitstream will have variable bitrate due to the inherent nature of the video encoding process. This paper proposes a video Adaptive Bitrate Streaming (ABR) algorithm, called Look Ahead, which considers this bitrate variability in order to calculate, in real time, the appropriate quality level that minimizes the number of interruptions during the playback. The algorithm is based on the Dynamic Adaptive Streaming over HTTP (DASH) standard for on-demand video services. The evaluations presented in the paper reflect: first, that Look Ahead outperforms other ABR algorithms in terms of number and duration of video playback stalls, with hardly decreasing the average video quality; and second, that the two Quality of Experience (QoE) models proposed are more accurate than other similar models existing in the literature.