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CROWD DNA

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Executive Summary

Deliverable D3.3 is a demonstration of the analysis tools produced by WP3 - Macro-to-micro crowd analysis - as part of the CrowdDNA project. In this report we describe the components of the final demonstration, and how it was carried out. We have chosen to demonstrate the detection of anomalies in crowd movements (URJC - D3.1) based on feedback from crowd observatories (CDI - D4.1). The demonstrated analysis tool is also embedded in the prototype "Information system for Authorities" (CDI – D4.3). Here we provide visual elements to help appreciate the nature of the demonstration. By nature, the deliverable is not a report but a demonstration, this document is short and descriptive.

1. Introduction

1.1. Purpose and Scope

The purpose of this document is to describe how the crowd movement analysis tool can be demonstrated in practice, based on several elements built by the project. These include: the crowd observatories, which provide access to real crowd motion data (captured through video); the simulation tools, which provide synthetic data sets for training the detection system; the analysis technique itself, which detects anomalies in crowd video data; and the prototype of the information system for authorities, in which the analysis tool is embedded.

Let us finally remind that the deliverable is not the current report, but the demonstration itself.

1.2. Goals

The goal of the demonstration is to:

- Show how several components resulting from the project come together to build a concrete demonstration of the project achievements.
- Show in practice how the output of the crowd movement analysis can be exploited to assist crowd managers.

2. Components of the demonstration

The demonstration includes several components of the project. They are organized as follows.

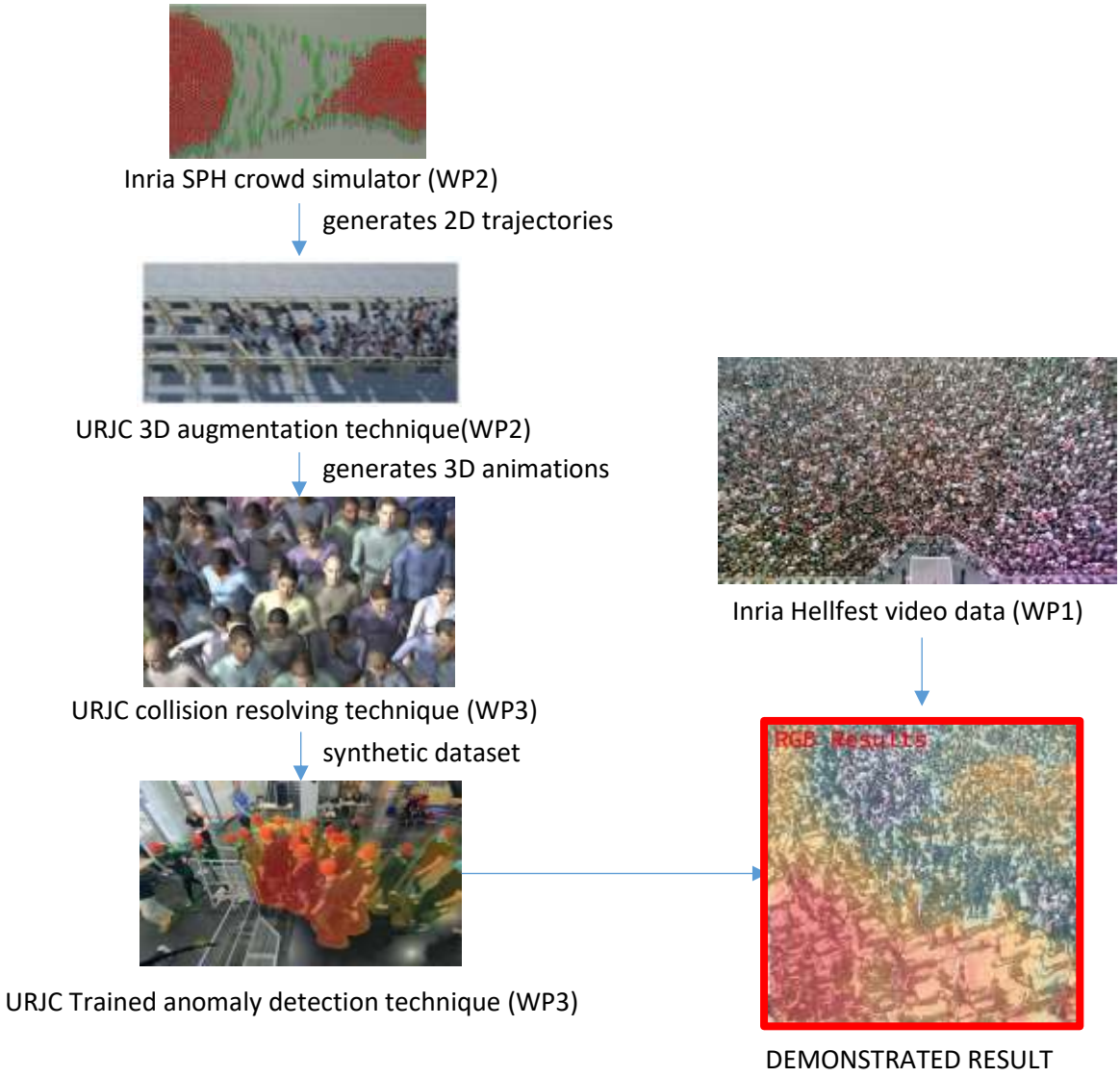


Figure 1. Components involved in the D3.3 demonstration of crowd motion analysis.

As shown in Figure 1, the demonstration highlights the role of several technological building blocks in the operation of crowd motion analysis. During the course of the project, we highlighted the need for crowd simulation tools to enable detectors to be trained, due to the difficulty of obtaining large quantities of relevant data showing a variety of situations and correctly annotated to enable analysis.

In this demonstration, we do not directly show how these synthetic data sets are generated, but the aim is to prove that the analysis of real scenes can be carried out without ever having had real data on the subject. However, the next step beyond the CrowdDNA project will be to take advantage of the videos of real scenes used for the demonstration to better align the training data with the analysis objectives.

3. Demonstration results

The demonstration is an opportunity to discuss the results of the analysis tool on real data. In the following sections, we describe the sequence that was used for the demonstration, as well as the results obtained based on the demonstration.

3.1. Input Sequence

Note that in the initial design of this demonstration, our idea was to process a real video stream capturing crowd movements. In order not to require our presence at an event, which would severely limit our ability to demonstrate, we are working on a sequence recorded on June 30, 2024, at the Hellfest festival, which shows a dense crowd in front of the festival's main stage.

The crowd was recorded from a camera placed at a great height, on the structure of the stage (front light bar), about thirty meters high. An average of a thousand festival-goers are visible on the screenshot. In the recorded sequence that caught our interest, we see the formation of several phenomena: first, the crowd is dense and compact, second, a "circle-pit" forms in its center and leads to the rapid movement of a group of the crowd (which turns while running forming a large disk). Later, the crowd reformed compactly, then the singer of the band on stage went down into the pit and formed a new "circle-pit" of very large size. Several hundred festival-goers are caught up in this very particular movement. Figure 2 illustrates those different phases.

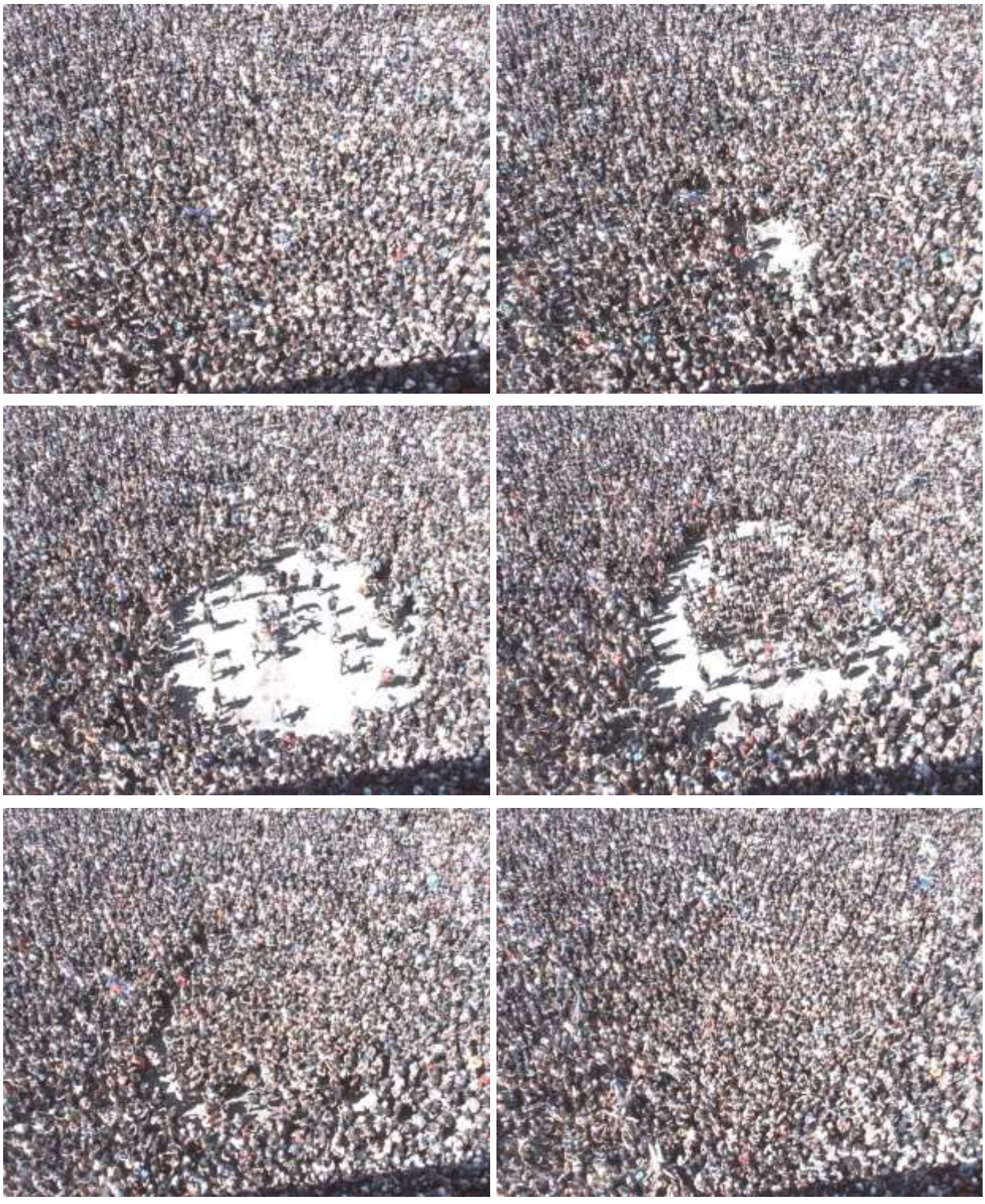


Figure 2. Sequence of images from the recordings of the crowd in front of Mainstage, Hellfest 2024, June 30. Focal length is 6mm.

In total, this sequence represents 11515 images, the recording made at about 10 frames per second, i.e., a total duration of about twenty minutes.

Figure 3. Sequence of images from the recordings of the crowd in front of Mainstage, Hellfest 2024, June 30. Focal length is 25mm.

The sequence was also filmed with a higher focal lens, the camera was oriented towards the center of the scene shown above. Figure 3 shows two samples of images coming from this second camera.

3.2. Analysis of results

The anomaly detection tool (D3.1) was applied to this sequence, we here report few examples of output, together with their comments. For visualization purpose, the central part of the video to which the algorithm was applied was selected. As a reminder, the detector was trained on the speed at which people move in a sequence. What is considered normal or anomalous is depending on the training data. The anomaly detection threshold is not an important matter in this demonstration, nevertheless, we explain how results can be interpreted given how the detector was trained.

At this moment of the sequence, the public is running to form a circle-pit. Running people are marked in red. This behavior appears unusual, as large groups of people aren't typically expected to run around, especially inside a concert venue. This unusual activity suggests that something unusual may be happening.

After a while, the crowd begins to slow down, and the density increases, creating a more 'normalized' movement pattern.

People continue moving but at a more typical pace, so the red labeling disappears.

Later on, the crowd begins to grow more excited and strats forming a new circle-pit, causing the colored labeling to reappear.

The crowd in the upper part of the video begins moving faster again, contrasting with the slower movement of the crowd in the lower part. This difference is also highlighted by the labeling.

As before, the circle-pit dance vanishes, and so does the red color labelling.

In another part of the input video, one can observe again the same pattern of crowd behavior, when the singer of the performing band goes into the public, to ask it to form an even bigger circle pit. We comment below 3 images extracted from this sequence.

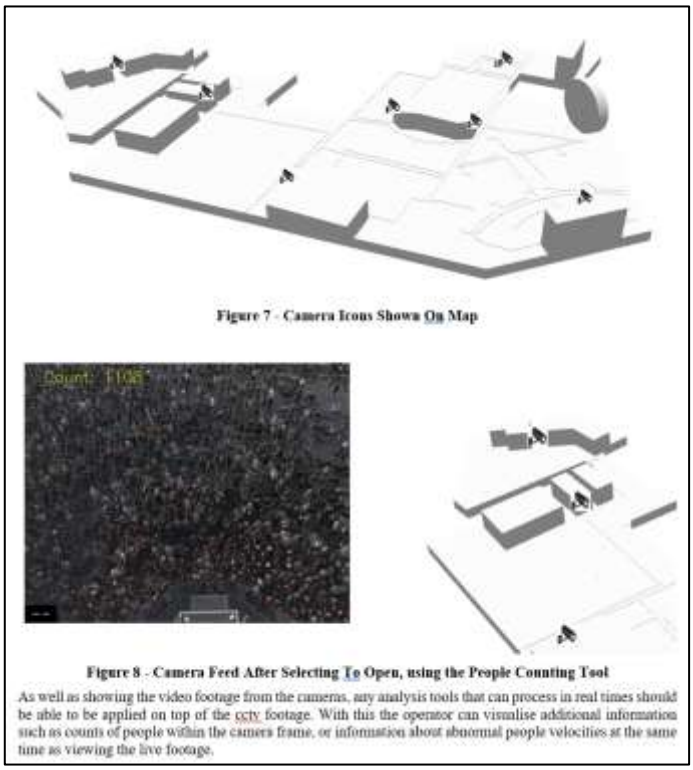
At this moment of the input video, the singer stands at the top right corner of the image, and communicates with the crowd around him to get them forming a circle-pit. Two very different behaviors are observable: people are running on the left side of the scene, while the crowd in the center-right remains static and calm.

Later on, one can see how this behavior evolving; for approximately 20 seconds, the crowd splits into an excited region in the bottom part of the scene and a calmer region in the upper part.

Afterwards, the crowd becomes much more static, except for the bottom right side of the scene. One can observe a sudden convergence of multiple people near the center-left of the scene, creating a very dense region highlighted in orange.

3.3. Integration in a larger scale online management system

A final remark concerns the integration of this demonstration into the model presented in deliverable D4.4. The deliverable illustrates how a large-scale event can be monitored, how camera feeds can be integrated and an alert system based on the occurrence of alerts can be integrated into such a system. Visual excerpts of the deliverable are included below to allow autonomous reading of this deliverable.



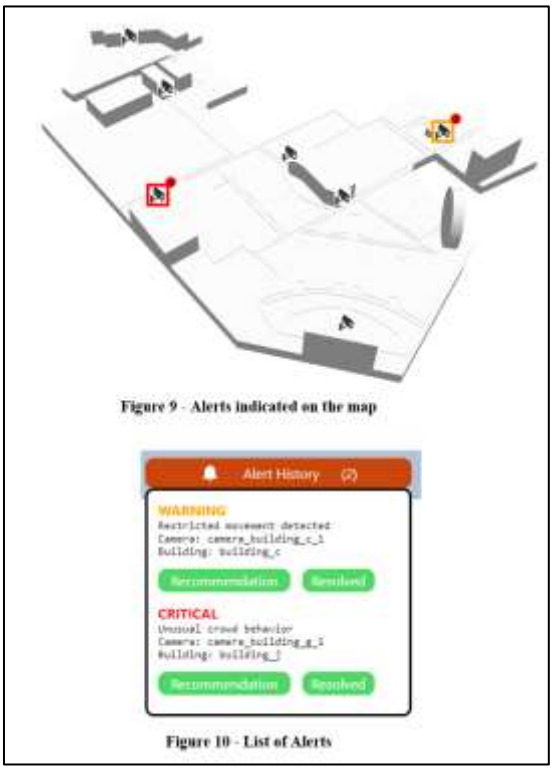


Figure 3 – Excerpts from deliverable D4.3 to illustrate the integration of the alert system based on the anomaly detector presented in deliverable D3.3 and subject of the demonstration presented here.

4. Conclusion

In this deliverable, we describe the demonstration of a major result of the CrowdDNA project, and which concretely shows that all the work of the project is integrated to form an example of a technology useful for assisting the operational management of mass events.

This demonstration is a key tool for the project's exploitation plan, and will illustrate the project's progress in order to help design the future of the project, in particular towards innovation.