Supporting decision making in security forces' command centre at large-scale events via video-based situation monitoring and base data supply

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Extended Abstract Prevention of disasters like crushings or stampedes in dense crowds during large-scale events as well as the efficient and unambiguous presentation of the current general situation to security personnel are the key motivators for this work. A command support system which uses video based airborne monitoring in order to analyse crowd dynamics presented to security operators is discussed. The key requirement for joint targeted actions in crisis situations is comprehensive and objective situation awareness on the basis of a digital situation map which presents all information required for decision-making in a spatio-temporal context. Therefor we describe the iterative development of a desktop application for a security operator.

A short description of the data providing base system ARGUS[1] is followed by the description of the core idea of representing crowd density and "interacting" with a selected density region. Expert interviews, field observations, and a focus group discussion using a preliminary system version were the basis for the conducted development.

Video analysis and near real-time geo-processing of aerial images taken during an event is the basis of the estimation of crowd density and pedestrian movement evaluation. The aim of the system is an early detection of critical situations, presentation of localization of operating resources and landmarks to the operator

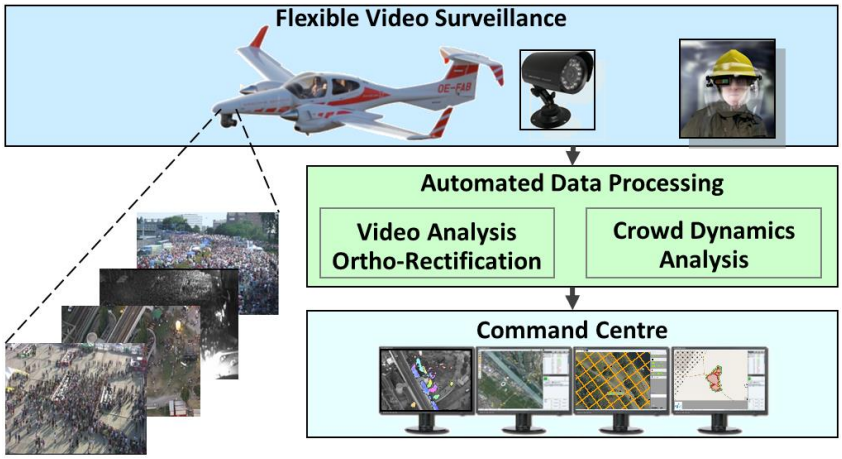

Figure 1: Information flow from a data provider to the Command Centre App

[1] https://www.joanneum.at/digital/referenzprojekte/fernerkundung-und-geoinformation/argus.html (Accessed: 24.08.0217)

in an efficient way, so that he is aware of the special context of any incident at all time while being able to distribute information to personnel of all involved organisations in error-free manner.
Figure 1 gives an overview of the data flow beginning at aerial data acquisition by ARGUS followed by the projecting of aerial images onto the earth's surface and the video analysis of pedestrian density and motion estimates for each video frame are transformed a two dimensional Cartesian grid with a cell size of 1x1 meter holding density, velocity and pressure information. The operator application presents the whole event area like a weather map, showing populated regions in gradually changing colours representing density, and empty or unknown regions transparent or greyed. Coherent coloured regions are treated as cells with properties that the operator can interact with on the digital map. By that he can see meta-information of a cell (person count estimation and time) and issue internal (remind me in x minutes) or external (send unit to cell) commands.
Interviews with two experts of the Austrian fire department and a private security company were conducted twice which lead to the selection of implemented and presented features. After a first demonstration of the desktop system as functional mock-up exhibiting features described above field observations were executed by accompanying security personal during two large-scale Austrian events (Nova Rock 2016 and Donauinselfest 2016). The insight regarding the mode of operation of the involved organisations led to a shift of focus in in further feature development in order to mitigate observed flaws. The primary ones were the non-digital lookups within the vast number of landmarks and staff members are hard to execute in stressful moments and verbally exchanged information that was observed to tend to get lost or fragmented due to its volatile nature. Hence our empirical work led to two major additions to the core solution idea, (i) the incident localization by which during radio communication the operator and the interlocutor can orient themselves mutually by naming landmarks, persons and plan grid names which the operator see from the spatial context of the mouse cursor and an entity text search; (ii) distribution of annotated screenshots of the operators findings depicting a current situation to partner organizations.
An interesting key element in all discussions with experts and security personnel was that any decision support system should not automate decisions; note also that automatically detected crowd density would be more concretely evaluated by sending ground staff to a cell and reporting on the actual situation on ground. The reason is not only a technical one, so even if an affordable technology existed for measuring crowd density, and maybe even crowd “mood”, it would still be preferable to send ground staff to a cell. The reason is, that security staff in this case does not only serve as “measurement tool” but also as intervention by their mere presence. Second, of course, available technology is neither that precise, nor that affordable. Overall, we note that there is very little wish and room for more automation. Finally, we conclude that video based situation overview and automatic crowd density analysis can indeed reasonably support situation awareness and decision making in command centres of security forces in large-scale events. One promising idea for future implementation and research is for instance to automatically identify ground based surveillance cameras that have line of sight to an incident in order to start monitoring before ground personnel arrives at the incident.