



urban
people
network

technology

access

mobility

facility

information



ITS

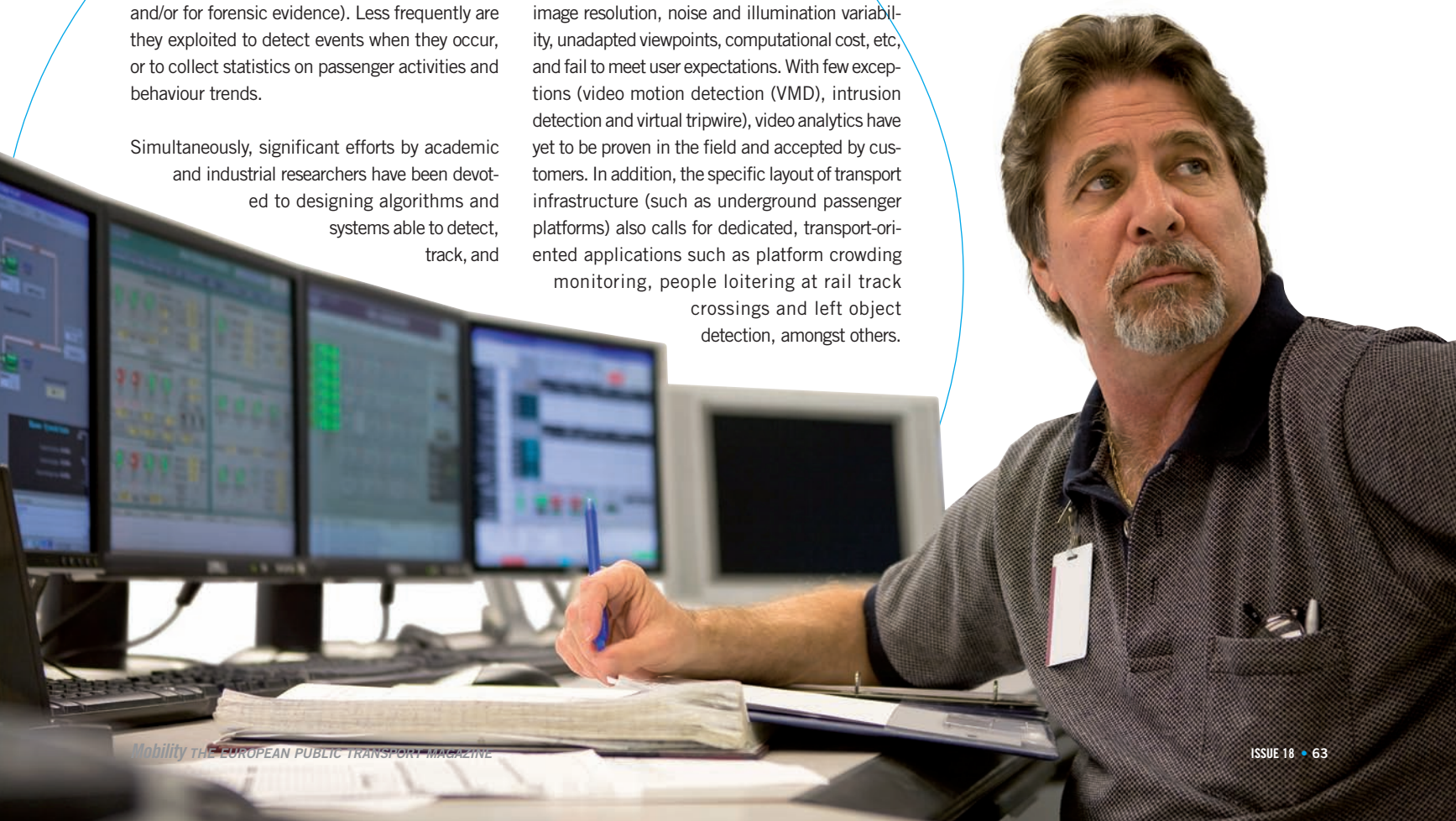
CCTV SURVEILLANCE PLATFORM INTEGRATING INNOVATIVE AUDIO/VIDEO ANALYSIS

From single camera and monitor to complex surveillance networks with hundreds of cameras, microphones and network video recorders, more and more surveillance systems are deployed on a daily basis. This is obvious from those already prevalent in shopping malls, parking lots or public transport facilities. However when dealing with large infrastructures, the primary role of automatic surveillance systems is usually to handle specific security issues, e.g. monitoring track rails between metro stations, and generate recorded material for *a posteriori* investigation (mainly for clarifying what happened after an incident and/or for forensic evidence). Less frequently are they exploited to detect events when they occur, or to collect statistics on passenger activities and behaviour trends.

Simultaneously, significant efforts by academic and industrial researchers have been devoted to designing algorithms and systems able to detect, track, and

recognise meaningful objects and events from audio and video streams, e.g. cars and people activities and behaviour, etc. This quest for smart camera and intelligent video systems that actively extract relevant information from the currently passive sensor stream has roused great interest with huge commercial consequences. Indeed today there are hundreds of companies working on audio/video analytics software in the field of surveillance. However in reality the effective deployment of such analytics is somewhat different; so far video analysis features tend to be used more for enriching product descriptions, to enhance propositions, rather than being really used by customers in an operational context. Video analysis is still very much in its infancy, with analytics capable of reliably performing functions of interest often limited by severe constraints, e.g. image resolution, noise and illumination variability, unadapted viewpoints, computational cost, etc. and fail to meet user expectations. With few exceptions (video motion detection (VMD), intrusion detection and virtual tripwire), video analytics have yet to be proven in the field and accepted by customers. In addition, the specific layout of transport infrastructure (such as underground passenger platforms) also calls for dedicated, transport-oriented applications such as platform crowding monitoring, people loitering at rail track crossings and left object detection, amongst others.

In this context, the integrated project VANAHEIM (Video/Audio Networked surveillance system enhancement through Human-cEntered adaptive Monitoring) is studying and integrating innovative audio/video analysis tools in a CCTV surveillance platform typically in use in urban transport environments (metro and railway stations). Its multidisciplinary team comprises eight partners – four research institutes, two companies and two public operators from six different countries – with complementary competencies – computer vision and audio processing researchers, surveillance system designer, public transport operators (metros) and human behaviour researchers. They are working on the three specific application areas:



1. Automatic sensor selection for videowall management
2. Human-centered monitoring using audio/video analysis
3. Long-term statistics collection for infrastructure understanding and planning applications

Automatic sensor selection for videowall management

Most of the time videos from large surveillance networks are never watched. For instance, in the case of Turin metro, 28 monitors are used in the control room to supervise more than 800 cameras; the probability of watching the right streams at the right time is therefore close to zero. Moreover, vigilance studies show that operators who spend hours 'screen gazing' at static scenes tend to become bored and less attentive. They are thus likely to miss low-frequency events such as a falling people or fights, which reduces the overall effectiveness of CCTV.

Thus, along with *user-based protocols* to visualise and browse the surveillance cameras on videowalls, there is a need for automatic, content-based selection systems that choose the most informative/relevant data streams and deliver them to the surveillance operators within an adaptive real-time process. The need for such



 Innovative audio/video research for transport



Planning oriented applications

Collective behaviour building

Autonomous stream selection

Real-time applications

Situational awareness reporting



processes is even more explicit when dealing with audio streams, for which 'mosaicing' of data is not possible due to the transparent nature of sounds. VANAHEIM will address this issue by combining a bottom-up approach (detection of predefined events; or of abnormal situations contrasting with typical activities automatically learned from the large amount of video logs) with the top-down browsing rules and habits used by operators.

Human-centric monitoring using audio/video analysis

One of the factors limiting the development of CCTV is the slow advance of technology in the field of video content analysis. Besides the core difficulties mentioned earlier, there is also a lack of research into the use of more accurate cues for modelling human interaction in order to reach the spatio-temporal reasoning usually required to achieve the user-desired applications. For example, when targeting an application such as fighting detection, the need for human-centered cue extraction, e.g. where are people looking? What is the type and dynamics of their interaction? is obvious. Using only people location is inadequate. While significant academic research is ongoing and corresponding literature already proposes algorithms partially addressing the human and interaction modelling topics, studies have been mainly conducted in restricted environments with synthetic or little data (and which is often 'acted', i.e. acquired in a real environment, but with simulated scenarios).

To move one step beyond location-based behaviour analysis, and to cope with the task of human behaviour monitoring in the surveillance context, VANAHEIM will investigate three different levels for human behaviour characterisation:

'Individual level' (see photo below) will focus on the capability to efficiently and reliably detect, track and characterise the behaviour and state of an individual.



→ Visions

for the Future of Mobility.

UITP 2011

Dubai, 10 - 14 April 2011

Booth No. 4 A 300

Visit our booth to learn how our integrated ITS technology assists RTA Dubai in running a trendsetting public transportation system.

RTA Dubai's state-of-the-art Automated Vehicle Management and Real-Time Passenger Information System offers:

- ▶ Unique Service Quality
- ▶ Enhanced Management Suite
- ▶ Real-Time Passenger Information
- ▶ Buses that arrive on time



Proud supplier of RTA Dubai's AVM and RTPI system



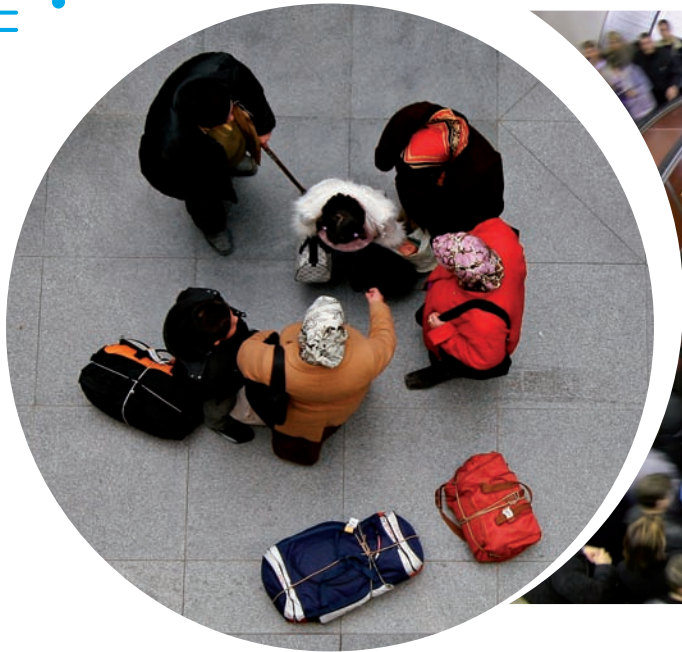
As leading supplier in Intelligent Transportation Systems (ITS) and Fare Collection Systems, INIT assists transportation companies worldwide in making public transport more attractive, faster and more efficient.

For further information please contact:

Ms. Julia Senger
Tel: +49.721.6100.118
jsenger@init-ka.de

init

www.initag.com



'Group' and 'crowd' levels



'Group level' research will cover the detection and identification of interaction within small groups of individuals. Researchers will explore the use of different non-verbal cues to infer if and how several people interact with each other. These cues include the person's head pose and body shape, as well as the immediate, individual physical space (a.k.a. *'personal space'*) between people, which is a key factor involved in regulating social interaction. Lastly, behavioural cues, individual tracks and contextual information will be used to recognise whether people are part of the same group or interacting with each other. Characterising interaction with other people, as well as global audio features representative of particular situations of interest (e.g. arguing situation), will also be studied.

'Crowd level' VANAHEIM will also investigate dedicated approaches to monitoring crowd/flow of people, considering that the characteristics of the independent individuals making a human flow can be described by a common behaviour. To do so, sets of local feature descriptors located in crowd regions will be automatically tracked and used to characterise the dynamics of collective people flow. Behaviour of interest such as crowd boarding/alighting, congestion or panic will then be inferred using a collection of predefined motion patterns corresponding to related anomalies or by detecting abnormal flow patterns.

Long-term statistics building for planning applications

While a reliable CCTV monitoring system could meet safety/security concerns, it could also be of great help to infrastructure designers and managers. More precisely, transport planners and public transport operators have become aware of the need to evaluate their infrastructure based on a variety of criteria (regularity, efficiency, capacity, accessibility, quality of service...). Nonetheless the bottleneck of such analysis is due to the wide variety and complexity of passenger behaviour in the infrastructure; this is not easy to quantify and analyse. By way of example, passengers with the same destination will have different routes depending on their entry points, the time of day, the passenger density in the area, their interaction with the infrastructure equipment or with other users, and so on. Furthermore, while particular transport equipment such as turnstiles or ticket vending machines can provide information on 'localised behaviour', they are clearly unsuited to providing a finer understanding of the infrastructure usage, for example in terms of static and dynamic space occupancy (people walking, waiting...), passengers' in-station routing behaviour, etc.

The objective here is to determine if the overall knowledge inherent to human behaviour and available in audio/video data can be learned and

interpreted by computer systems. To achieve this, VANAHEIM will investigate new, adaptive monitoring technologies to analyse passenger dynamics, activities and behaviour in the infrastructure over a mid/long period of time. This research thread will rely on investigating learning strategies to continuously analyse and categorise newly-observed human behaviour, and provide comprehensive and up-to-date, collective behaviour models.

VALIDATION AND ASSESSMENT IN REAL-SCALE INFRASTRUCTURE

Turin/Paris pilot sites

The evaluation/assessment of the sub-systems developed by VANAHEIM will be covered thanks to the participation of Turin (GTT) and Paris (RATP) metro operators. The project system/sub-systems will be deployed at both sites, and will enable on-site evaluation of how the integrated components perform. In addition, this functional validation stage will be complemented by technological (latency, usability...) and user-centric evaluation trials. The deployment will be conducted on two, complementary test-bed sites with different IT architecture and passenger behaviour – IP-based, sensor network and medium passenger traffic activities in Turin metro, versus analogue sensors and a continuously increasing



stream of passengers in Paris. Hence the dual integration will also allow the genericity and scalability of the integrated system to be assessed.

Following the assessment/validation stages, several technical and live demonstrations will be organised at both pilot sites – around project mid-term at the GTT site (spring 2012), and at the end of the project on both sites (summer 2013) – in conjunction with the User Board meetings described below.

User Board activities

One priority of the project is to ensure its practical outcomes are disseminated to the appropriate target communities and any others likely to contribute to developing, assessing and exploiting the system. To do so, a User Board

has been created (see right) and will be maintained during the project lifetime to keep in contact with potential external stakeholders. The Board consists of representatives from the CCTV end-user community (security/safety operators, public infrastructure managers), CCTV system designers, manufacturers and suppliers and Intelligent Video Surveillance (IVS) solution providers. It plays a dual role in VANAHEIM: internally by assisting in, advising on and reviewing project developments; externally by liaising with the stakeholder community●

Dr. C. Carincotte, project coordinator (Multitel)

**Dr. J.M. Odobez, senior researcher (Idiap)
on behalf of the VANAHEIM consortium**

All illustrations ©VANAHEIM

User Board

Member organisation	Area of expertise	Country
ACIC	IVS/VCA supplier	Belgium
Sec-Control Group	IVS/VCA supplier	Finland
Keeneo	IVS/VCA supplier	France
Thalès Transportation System	Transportation system designer	France
ACTS Linea	System end-user	Italy
Azienda Mobilità e Trasporti AMT (Genova)	System end-user	Italy
Azienda Trasporti Milanesi ATM	System end-user	Italy
Maipetel	CCTV vendor	Italy
GE Security (formerly VisioWave)	CCTV vendor/VCA supplier	Switzerland
Niklas	CCTV vendor	Switzerland
Sony Overseas	CCTV vendor	Switzerland
swisspro	CCTV vendor	Switzerland



Current members of the VANAHEIM User Board

- You represent CCTV end-users (security/safety operators, public infrastructure managers...), CCTV system designers, manufacturers and suppliers or Intelligent Video Surveillance (IVS) solution providers?
- You are active in CCTV/IVS and/or urban transport?
- You want to be informed of project developments?
- You are interested in participating to CCTV/IVS specifications and/or evaluations?
- You want to be invited to on-site mid-term and final demonstrations?

Subscribe to the VANAHEIM user board at www.vanaheim-project.eu/user-board and you will be

- informed of the project progress
- solicited to perform exclusive review of the project developments
- invited to on-site demonstrations (Turin & Paris), possibly with coverage of expenses

VANAHEIM is a collaborative project funded by the European Community's 7th Framework Programme FP7/2007-2013 – Challenge 2 – Cognitive Systems, Interaction, Robotics, under grant agreement N° 248907.
Project type: large-scale integrated (IP)
Duration: 42 months (February 2010–July 2013)
Budget: €5,471,851 (EU contribution €3,717,998)

For more information, please visit www.vanaheim-project.eu