Surveillance Technologies in Public Transport

IPSOTEK

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Background

- Company founded by Dr. Sergio Velastin
- Research in public transport dating back to 1995
- Commercial company since 2005
- Based in Wimbledon
- Focused on behavioural recognition for large public CCTV and transport operators
- Active partnerships with Kingston University and other major EU research organisations
A very active area of work in Europe

- EU project CROMATICA: demonstrated feasibility of event detection using CCTV+Image Processing (London Underground, Paris Metro)
- EU Project ADVISOR: system to detect situations such as overcrowding, violence (Brussels Metro, Barcelona Metro)
- EU project PRISMATICA: solutions that integrated technology, legislation, operations, sociology, education, ... also involving key stakeholders such as passengers and non-passengers (London, Paris, Prague, Lisbon, Brussels)
- Implementation and test of pilot system in London Underground
- Implementation and test of pilot system in Rome Metro
The Current Situation

- **Antisocial behaviour. Some examples from the UK:**
  - Estimated to cost ~€4.5b p.a.
  - ~8,000 graffiti/vandalism incidents in one day (~€920M annual damages).
  - In Glasgow vandalism = 1/5 of all crime.
  - 44% of women feel unsafe to use bus stops by night.
  - In one year, a bus company had to replace 8,000 windows and 18,000 seats and had 128 passengers and 34 staff injured by vandals.

- **Equipment protection ...**
  - Suicides in urban railway: estimated to cost €2.2M/incident (~50 p.a. in a major European city)
  - For an Underground it costs ~5,000 person-days (~€1M pa) to align platform cameras
  - 2 station/evacuations per day (due to abandoned packages) ~ €3.4M pa

- **Terrorism (but ... We should not let the dramatic (9/11) to overcome the effect of volume. In a year in a population of 10,000 people, 300 die of cancer and 0.09 by terrorism).**
Conventional CCTV Surveillance
How CCTV systems have grown

- In 2001 there were ~ 1m cameras in public spaces in the UK. In 2006, around 6m
- Wandsworth Council: 700 cameras (high street, residential areas)
- Metro Roma/Turin: 900 cameras each
- Heathrow Airport: 6,000 (not counting new terminal 5)
- London Underground: 6,000, target 10,000
- Paris Transport: 10,000, target 25,000
- London Buses: 5 cameras/bus
- SouthWest Trains ~1,750 cameras (€750K p.a. cost of vandalism)
- Councils: in 1991: 3 CCTV control centres, now ~600
- Private shopping Malls: ~ 800 centres

How to monitor all of this while assuring the public that the urban environment is safe and secure?

- The flooding of public spaces with cameras might be necessary but not sufficient condition for timely responses to events
• People analyse a situation as it unfolds
• But have a limited attention span (~20-40 mins)
• Incidents are rare: boredom, too many cameras
  – Liverpool: 250 cameras, 3 operators (83:1)
  – Newham: 600 cameras, 6 operators (100:1)
  – If each operator can deal with 5 simultaneous cameras: 6% detection max.
• “Reactive” mode
• Areas where crime and antisocial behaviour are infrequent but possible are not well covered
• In urban situations movement is normal. Conventional motion detection systems do not work in public spaces
Proposed Solution

Computer-based audio processing

Alarm:
The operator is guided to what is relevant

Computer-based image processing
Strengths

– Powerful processor platform
– 8x faster than most commonly used processor. Allows more complex behaviour models in real-world conditions

– Works effectively in crowded and ‘noisy’ conditions
– Crucial for public facing and outdoor CCTV networks

– Robust scenario based detection
– Corresponds with the way behaviour is observed by operators and avoids false alarms
Ipsotek’s Technology

- **1st generation – Transport Safety Solution (V7)**
  - Targeted towards metro safety and security requirements
  - Mainly indoor applications using – TM1300

- **2nd generation – Intelligent Pedestrian Surveillance (IPS-V9)**
  - Robust detection of incidents in busy public areas using – PNX1302
  - Abandoned package, Intrusion, loitering, abnormal motion direction, overcrowding and congestion.

- **3rd generation – Visual Intelligence Suite (VI-V10)**
  - Flexible Incident detection platform using – PNX1702
  - Scenario based parameterisation of incidents.
  - On-line Video annotation based on visual and audible cues.
  - Fully distributed processing solution based on client/server design.
  - Native compatibility with 3rd party DVR, CCTV management and camera control software.
  - A modular design that addresses a wide range of end-users requirements.
Modules and Applications

Tracker module

- Traffic management and infringement detection.
- Trajectory parameterisation for the detection of abnormal behaviour.
- Loitering and persistence.

Abandoned and/or removed object detection module

- Detect stationary objects introduced to the scene.
- Detect objects removed from the scene.
- Object classification based on size and shape

Motion direction and speed detection module

- Running
- Illegal entry

Visual cues filter module

- Intrusion
- Overcrowding
- Loitering in crowded scenes
- Congestion
- Obstruction
- PTZ ego motion

Audio Module

- Aggression
- Panic/fear
- Vehicles
- Scooters
- Airplanes
- Gunshots
- Alarm tones
- Call for help
- Breaking glass
Detection Examples

- Abandoned vehicle
- Abandoned Package
- ATM
- Excessive movement
- Loitering in Platform
- Stationary people
- Loitering car park
- Multiple events
- Intrusion
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- Intrusion
- Multiple events
- Intrusion
- Stationary person
- Abandoned Package
- Dangerous Intrusion
- Graffiti
- Congestion
- Stationary Person
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Conclusions

• Improvements in public transport are crucial to help growth and sustainability.

• Transport systems need to be safe/secure and be seen to be safe/secure.

• CCTV and communication systems allow observation, prediction and intervention.

• Monitoring capacity is ultimately limited by cost and physical ability of human operators.

• Intelligent image and audio processing empowers operators by providing better and more timely information.
Thank you