TRACKING AND AUTOMATIC BEHAVIOR RECOGNITION

person 4 walks
person 4 arrives
person 4 goes to item
person 4 approaches person 1
person 4 passes person 1

TNO innovation for life

The amount of video data is growing exponentially. It is expected that in 2016 every second 1.2 million minutes of video data will cross the internet. For most users, for example camera operators and investigators, the amount of data has already become unmanageable. At TNO we develop technologies that automatically analyze video data, focusing on multi-camera tracking and re-identification, recognition of behavior, and detection of suspicious behavior and possible threats.

MULTI-CAMERA TRACKING

A single camera can tell us whether anything suspicious is happening in one particular location. However, more is needed to track people or vehicles on the move. Covering an area such as an airport or shopping center with multiple camera that party overlap and confirm each other's observations enables us to fix positions very precisely. It allows us to follow people reliably in real-time – the tracks show exactly where they are going. Unusual tracks may indicate undesirable behavior. The tracks also help us to build up a complete picture of a situation.

PERSON SEARCH ENGINE

If an incident has occurred, we will usually want to know if particular individuals or vehicles have also visited other locations. We are dependent for this on images from
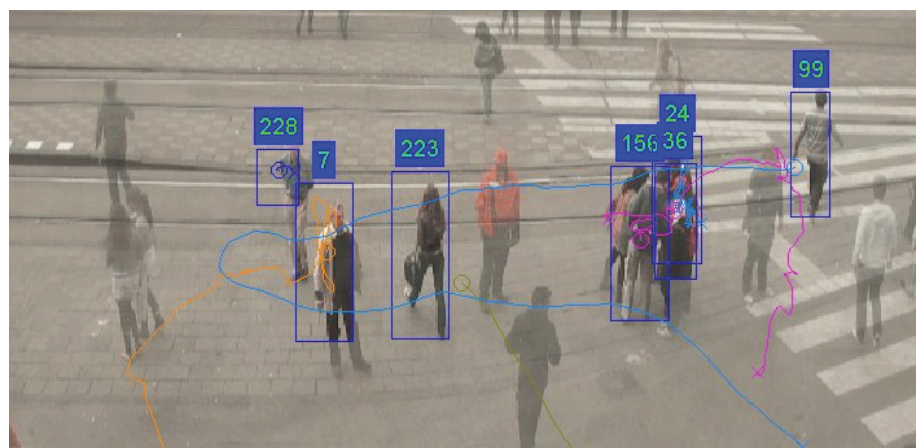
cameras that do not overlap, and may even be kilometers apart. TNO developed a person search engine to tackle this problem. This engine is able to search through large numbers of camera images for descriptions based on color and texture. This generates a shortlist of people, enabling operators to do their work faster and more efficiently.

Automatic detection of behaviour and possible threats

Our performance on the IXMAS dataset

Our performance on the UT-interaction dataset

AUTOMATIC BEHAVIOR RECOGNTION

Searching for relevant events in videos is an essential tool, with applications that range from security (to detect a criminal act) to consumers (to find a particular video on YouTube). Such events are characterized by human actions. At TNO we have developed a technology that recognizes 48 human actions in thousands of videos, including single-person (e.g. fall), person-person (e.g. approach), person-object (e.g. pickup), person-environment (e.g. enter), and person-person-object (e.g. give).

DETECTION OF SUSPICIOUS BEHAVIOR AND POSSIBLE THREATS

Unwanted situations occur in our society, examples are everyday crime, escalating events, aggression in public transport, and the entering of private properties. At TNO we develop technology that automatically analyses walking patterns and behavioral patterns such as interactions. For instance, a person walking around for some time on a parking lot, showing interest in several vehicles, walking up to a particular vehicle are all indicators that are assessed and interpreted by our technology. The final output of the software are hypotheses about threats in the scene.

OUR PERFORMANCE

During two international benchmarks organized by DARPA in 2011 and 2012, we achieved a top-rank position in the event recognition challenge. On the IXMAS dataset, our activity recognition software scores 96% on detailed human actions, which is the world's best score to date. On the UT-interaction dataset our software scores 93% on person-person interactions, which is also the world's best score to date.

HOW WE CAN COOPERATE

We offer you access to a group of world-class professionals that can help from idea generation to implementation and testing. We do this by consultancy, contract research, licensing, development of algorithms, and support with software and hardware implementations. TNO offers several interesting co-financing possibilities for companies, for example so called Technology Clusters (20% self-funding), co-financing proof of principle (10%), proof of concept (25%), and development of a demonstrator (50%). Furthermore, we are a recognized partner in several European and worldwide research programs.

INTELLIGENT IMAGING GROUP

TNO's Intelligent Imaging group works together with partners on technological breakthroughs leading to major innovations in high-priority societal and economic themes. More than 45 professionals work in the Intelligent Imaging research group, which is engaged in image processing, image enhancement, image analysis, visual pattern recognition, and artificial intelligence. We develop applications in the areas of Defence, Safety & Security (video surveillance systems, multi-camera tracking and re-identification software, behavior recognition software, smart cameras), Transportation (traffic management systems, cooperative traffic control, pedestrian and moving object detection), Health care (remote patient monitoring, unattended autonomous surveillance, image-guided interventions), as well as highly complex measurement and control systems. In addition, the research group is also engaged in a wide variety of projects involving complex image processing and computer vision in both 2D and 3D. In these projects, we apply our unparalleled expertise in the area of sensors and sensor systems to develop smart real-time algorithms. We work together with companies to develop complete systems and to implement software on computer platforms (PC, DSP and FPGA).

TNO.NL

TNO is an independent research and technology organization whose expertise and research make an important contribution to the competitiveness of companies and organizations, to the economy and to the quality of society as a whole. TNO's unique position is attributable to its versatility and capacity to integrate this knowledge.

TNO employs about 4.000 professionals and concentrates on seven themes, each of which has a prominent place in the national and international innovation agenda: industrial innovation; defense, safety and security; energy; mobility; healthy living; built environment and information society.

For more information and contact details please visit our website at: TNO.nl/IntelligentImaging