

## Progress Report 2: 1<sup>st</sup> January 2009 – 31<sup>st</sup> August 2010



The Surveillance of Unattended Baggage and the Identification and Tracking of the Owner, (SUBITO), project is a research & development project funded by the European Commission Framework 7 programme. It is classified as an European Union capability project and has been designed to research and further develop novel

technology for automated, real-time detection of unattended baggage and the fast identification of the individual responsible (the 'Owner'), their subsequent path and current location. The project is guided by end-user driven requirements to ensure that security personnel receive the technologies they need in order to deliver improved threat security.

The project will culminate in a demonstration at an end user site, of semi-automated, human-in-the-loop data processing operating with existing closed circuit television technology and demonstrating:

- Fast detection of baggage that has been abandoned,
- Fast identification of the individual who left the baggage, and
- Fast determination of their location or path they followed.

The key project objectives for SUBITO are:

- To understand the threat scenarios involving unattended goods from a user perspective, identify alarm and non-alarm conditions related to these and the decision logic applied by human operators in taking proactive or reactive actions.
- To determine the key measures of performance which a fielded system should attain and produce test plans which demonstrate the function and performance expected of the SUBITO system in real applications.
- To undertake a Privacy Impact Assessment process as part of the system design, including consideration of general theoretical and practical aspects of the social, legal and ethical issues of surveillance.
- To analyse the benefits to system function and performance to be gained by the use of improved camera technology, additional sensors or distributed processing schemes.
- To support the operator with a set of tools to detect abandoned baggage, identify and track the person who left the baggage and provide corresponding warnings or alarms.
- To develop algorithms that provide the capability to robustly detect, segment, track and classify moving objects within the monitored scene.
- To develop threat analysis algorithms for classifying potentially critical situations, given positional and classification data about the objects and people within the sensed environment.
- To demonstrate an integrated system operating against realistic scenarios in a typical end user facility.

**CLASSIFICATION:**

**PU**

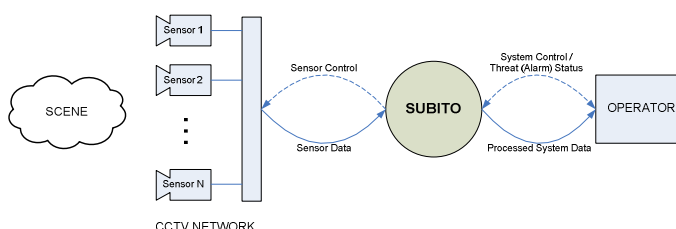
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The key requirements for the SUBITO system were derived from a series of discussions held with end-users, and from recommendations resulting from previous work in this area. Through these discussions a view on the decision logic applied by system operators to the problem of unattended baggage has been generated. The resulting Systems Requirement Document was delivered on schedule.

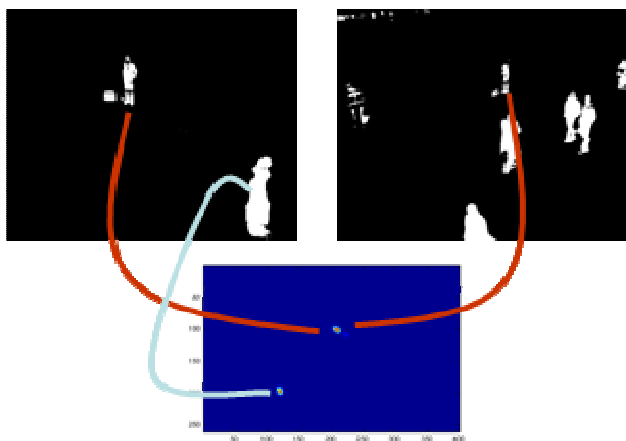
Building on the defined requirements, the system architecture design has been completed with the production of the Systems Architecture Document which defines the main system components, functions and data flows. This document also contains details of supporting modelling



activities carried out to verify the major design decisions and ensure that the system architecture complies with the system requirements. A Privacy Impact Assessment will be carried out based on the system architecture to ensure that privacy issues, either legal or ethical, resulting from the design process are identified and can be addressed. Work is ongoing on the data protection requirements for a potential demo site.

An analysis of the system requirements has been performed to develop a test methodology that will allow system function and performance to be tested and demonstrated in a cost effective manner. Testing will incorporate a range of scenarios designed to display realistic interaction and behaviour in a systematic and controllable way. A baseline test and demonstration plan has been delivered on schedule.

Work is continuing on developing algorithms with the capability to robustly detect and segment all moving objects within the monitored scene. Several detection schemes are being studied, using techniques such as facial detection, carried object detection, dual-background static object detection and detection using pan-tilt-zoom (PTZ) camera ‘tours’ to improve detection robustness.



State of the art algorithms are being developed and tested that operate using multi-view detection that will better handle occlusions and provide more accurate localisation of detected objects within the scene. Where low frame update rates are likely, i.e. with the use of PTZ cameras, detection algorithms have been developed that are shown to be robust and capable of handling sudden changes in illumination while still accurately segmenting objects of interest from the background. Improvements have also been made in the ability

for facial detection algorithms to operate under situations where image resolution is reduced and head pose varies considerably from the existing norm.

The robustness of object tracking and classification is also being addressed. A multi-view tracker has been implemented to track detected objects in 3D, while comprehensive track management is provided by a multiple hypothesis tracker. Operating in real-time results from evaluation of the

tracking is demonstrating the ability to resolve short term occlusions and reduce the number of false alarms.

Robust classification of objects is provided by algorithms designed to discriminate people and objects and to perform facial recognition. Object classifiers have been implemented and improved to provide reliable baggage classification of detected objects while an iterative approach to facial recognition is demonstrating promising results in accurately classifying individuals.

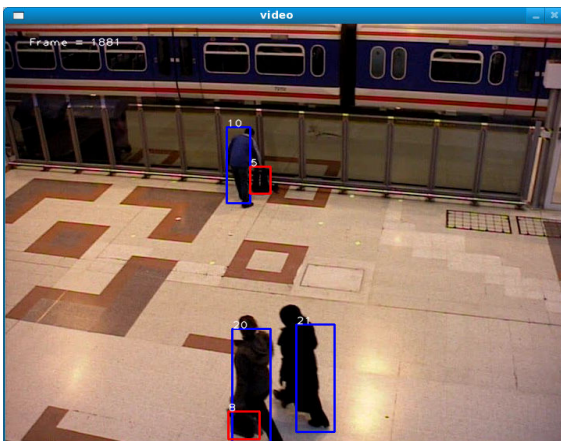
To analyse the data produced by the detection, tracking and classification algorithms, an initial ontology has been defined and implemented for the spatial and temporal relationships between objects and places, allowing the algorithms to classify potentially critical situations. A rule based system has also been created that evaluates these critical situations and generates a reliable threat assessment.



Evaluation of the threat assessment algorithms show that by introducing the notion of ownership between unattended baggage and individuals, the performance is greatly improved to accurately detect threat situations and report alarms to the operator.

Future work will look to enhance the threat assessment performance by inferring intentionality of moving persons in the monitored scene. For complex situations where individuals or crowds create dynamic obstacles and prevent pre-computation of likely paths, SUBITO is developing agent based pedestrian simulations to generate real-time predictions of likely paths for the tracked individual and aid the threat assessment.

A user interface has been developed for the system that enables the operator to view live video feeds, display analysis data provided by the SUBITO system, display video annotations and replay recorded video streams along with relevant annotations or analysis data.



A series of supporting studies has been completed that investigate the potential performance benefits to be gained through the use of enhanced closed circuit television, other sensors (such as acoustic, chemical etc.) and distributed processing in the system. A study of the potential legal and ethical issues is also being performed. The results from some of these studies have been used to refine the system specification and design, particularly in the area of object detection, in order to enable demonstration of beneficial technologies.

Collection of demonstration requirements has been completed. Completion of the first phase of the hardware integration has been achieved with the installation of the various component algorithms on the demonstration computing network, and successful test of the system ability to access the installed cameras and recording equipment. End to end testing of this baseline system will commence shortly with a view to providing feedback to

the algorithm development for improvements to be made as the project moves toward the final demonstration.

The output from the SUBITO project is expected to significantly improve the capability beyond the state of the art, robustly detecting an unattended bag and identifying and tracking its owner. This will offer security improvements that can be adopted by industry, integrating new surveillance software into existing and future closed circuit television, thereby benefiting the security of all European citizens.

SUBITO is also expected to generate technologies in the areas of closed circuit television image segmentation and analysis, facial recognition across multiple cameras, behavioural analysis and people tracking in crowded scenes. While primarily addressing civil security and surveillance, this work has a wider reaching application into world wide counter-terrorism and the military.

The emphasis of SUBITO is to develop and demonstrate the incremental improvements that can be achieved by adding layers of increasing sophistication to already existing technology and infrastructure, This approach recognises that a high level of investment in new technologies has been made in this area and yet the systems still fall considerably short of meeting the end users requirements. The output from the SUBITO project are designed to produce a robust yet scalable solution that can be built around an end users previous investment offering improved security at reduced cost.

For further information see the project website: [www.subito-project.eu](http://www.subito-project.eu), or contact the project coordinator:

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