

AVITRACK



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D.6.4 AVITRACK Integration



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1. INTRODUCTION

Considering the operational AVITRACK prototype, reflection and detailed topics are listed considering the hypothesis of the integration in an airport of the Local Unit Control Area system (LUCA), based on the Avitrack results. Technical, functional and integration topics are envisaged.

2. VIDEO NETWORK AND PROCESSING UNITS

2.1. VIDEO COMPRESSION

As a research project, AVITRACK has set up and improved solution exploiting the latest and best video processing. These methods have been implemented using video capture in a JPEG format. The detection and tracking results are fine, but any implementation in an operation product should envisage the exploitation of a more advanced compression as MPEG-4, which is more and more current in the existing video surveillance network. It offers a very good compression rate.

The evaluation of the tracking module should be lead to validate the efficiency of tracking based on more compressed images.

2.2. TYPE OF VIDEO SENSOR

A particular attention was paid to the choice of the video sensor, which are colour high-resolution sensors. To be cost efficient or to exploit existing video network, B&W or low quality video sensor should be envisaged for any implementation. Another typical aspect of the video surveillance market is that it now moves to IP. IP based solutions are easily integrated and administrated and can also offer some security layers.

2.3. FRAME RATE & PROCESSING UNITS

The necessary units, processing the video frames, are directly dependent of temporal resolution required for the detection of the events. The AVITRACK prototype reaches to process 6 frames per second detection people walking in the area in real-time. This allows to analysis the events involving person in the area. If the expected event to be detect, only concern detection and arrival and departure of the vehicles processing the handling operations, the necessary frame rate can be strongly reduced, the same for the linked units.

2.4. PROCESSING UNITS

At the beginning of the project, 32-bits architecture has been elected for the Avitrack prototype as 64-bit applications needed are still under development or is "too recent". One problem is the availability of libraries on this platform.

After these two years, 64-bit solution should be considered.

2.5. EVENTS TO BE DETECTED / NUMBER OF CAMERAS

Covering all the areas around the aircraft and overlapping points of view were the main criteria to define the number and the position of the 8 cameras installed on Echo-40 for the AVITRACK test site.

This assembly of sensors provides a complete and detailed point of view observing all movements close to the aircraft. People, vehicle, and objects are detected and localised with precision. Considering the end-users point of view, it clearly appears that the automatic detection of the presence of vehicles in the apron and, in some cases, the simple detection of aircraft arrival or departure represent important added value for the management of the apron. Any implementation should then analyse, considering the Avitrack capacities, the number and position of the sensor relatively to the events to be detected.

2.6. ACTIVE VISION: PTZ

Active vision, exploiting pan, tilt and zoom video sensor, offers area focus possibilities for discrete elements recognition in a large open area. PTZ video sensors might complete the video network of fixed cameras. This will allow combining event recognition with “actions” understanding. Human activities are observed and analysed at two different scales for augmented perception and understanding.

3. APRON DEPLOYMENT

3.1. MULTI-APRON DEPLOYMENT

The Avitrack prototype has been designed to operate detection events on one apron. Any LUCA deployment evidently means the deployment on several aprons. This concerns the scalability of the architecture of the video network and the processing units.

Vehicle movement analysis can also be more efficient using the prediction of the appearance of the object in the considered aprons.

The final objective to reach is a global and complete view of the aprons status at any time. Such objective will mainly interest hub airport and airlines with main activities in some airport as Air-France at CDG.

3.2. APRON “AU LARGE”

For tests in the operational Toulouse-Blagnac airport, the apron Echo-40 has been elected as it represents a standard configuration of aprons close to the terminal. The proximity of the root terminal facilitates the implementation of the sensor all around the aircraft. Even, if the Avitrack studies can be transposed to other aprons close to the terminal, the specific case of apron away for the terminal has to be addressed. This case represents a technical challenge for the implementation of the video sensor, which might impose specific focal lens to be solved. Also this case will be more sensible to weather conditions like rain, fog... A solution could be to mix the type of sensors, adding for example IR.

3.3. APRON & MANOEUVRING AREAS

Avitrack tests has been realised considering the apron area or more precisely the “stand” area when the aircraft is stopped. In all airports stand areas are closed each other. Any implementation will so benefit of the observation of the area connecting stands to assure a complement and continue analysis of the movement of vehicle, aircraft and people on the complete apron area.

Moreover, the AVITRACK principle should be extended to manoeuvring part of an aerodrome used for take-off, landing and taxiing of aircraft.

4. AIRPORT INTEGRATION

4.1. GROUND APRON ACCIDENT

Avitrack technology should contribute to the “Apron Safety management”. Increasing real time surveillance, detection of abnormal operator behaviour and checking respect of the handling operation rules.

Recording specific actions and post analysis, providing identification of risk, must become an important source of data for training, prevention of accident, allowing targeted corrective actions.

4.2. A-SMGCS PERSPECTIVES

The AVITRACK system, exploiting optical video network, contributes to the visual surveillance aids of the airport area, therefore it participates to the primary objective of all SMGCS¹ system. Providing detection and 3D location of mobiles, the system can be classified as “a non-cooperative surveillance system”.

SMGCS could actually take advantages combining data from optical network and existing non-cooperative surveillance as SMR. Moreover, the automatic detection and events recognition enlarge services, which can be provided to alert and monitor ground movement on the airport areas.

But, the main limitation of non-cooperative sensors stays the absence of identification possibility of the mobile. In future, the deployment of the A-SMGCS² systems will require co-operative mobiles. Several technical solutions are envisaged as D-GPS³, ADS-B⁴ or SSR mode S⁵. All these solutions will deliver location data and mobile’s identification, for A-SMGCS level I services.

In any case, data fusion is the key for optimal movement surveillance, collecting information in real time from several sources, and merging them into a suitable position and trajectories map. Safety, security and airport management could then benefit from the circulation of data diffused by future cooperative mobiles to co-operative and non-cooperative surveillance systems.

4.3. RADAR DATA FUSION

AVITRACK investigated the potential using of low power radars for surveillance of airport traffic.

¹ SMGCS Surface Movement Guidance and Control Systems
² A-SMGCS Advanced Surface Movement Guidance and Control Systems
³ D-GPS Differential Global positioning system
⁴ ADS-B Automatic Dependent Surveillance – Broadcast
⁵ SSR Mode S Secondary Surveillance Radar (SSR) Mode Select (Mode S)

It appears that advances in signal processing and radar technology have made possible the introduction of small, inexpensive radar systems using advanced waveforms for detection. The concept of Near-Range Radar Network (NRN) is promising for the Apron area surveillance.

Present-day SMR systems are not able to detect small targets such as people due to the limited resolution and large variation in the backscattered power from buildings. Introducing small inexpensive radars as a supplement to current SMR's thus appears to be a valid approach to improve detection and radar coverage on airports. Low power radar network system (NRN) appears to give good positioning results and will give enhanced detection of small targets. The conclusion is that small radar networks may improve present-day SMR's surveillance of the airport area and hence improve traffic safety and handling when the radar networks are well positioned. Using these data, video detection and localisation results can be fused to improve robustness and situation awareness.

4.4. CDM APPROACH

Avitrack aims setting up an efficient handling operations supervision tool. Our technical demarche meets the CDM concept: Collaborative Decision Making. The "events recognition" approach, core of the AVITRACK researches, fits Level 1 CDM milestones.

CDM considers milestones from landing to take-off, in the middle of which in-block to off block time, is the time AVITRACK project focuses on. Detecting, understanding and reporting current status of the apron operations, AVITRACK process contributes to the airport global management improvement. Prediction and planning can be realised exploiting the real time updated data.

Actual CDM deployment, for example in Stockholm Arlanda, illustrates the exploitation of optical sensor for a direct visualisation of the "stand". Visual observation is used to update stand status in the database, monitoring the traffic. Planning benefits could be obtained exploiting automatic handling operations surveillance. A fine Estimated Off Block Time (EOBT) could be computed for each stand considering the progress of each handling operation under surveillance.

In the future, technical innovations, as Avitrack, will serve airport global management services, established on CDM procedure.

4.5. INSIDE TERMINAL

Passenger supervision

Avitrack focus on an area, which is not yet cover by any system of supervision and caused interest of airlines and airport. Considering this new technology and its potential, always, airlines and airport actors request to use this innovation for the passenger flow supervision.

Avitrack is dedicated to analyse events of people and vehicle around the aircraft, outside the aircraft. Passenger's treatment is also naturally a main point processing the aircraft turnaround. The exploitation of the combination of video, tracking and event understanding appears to have a large potential of added value for the turnaround optimisation. This task could consider passengers from the "register" action, police check, jet bridge queue, to the aircraft's door.

4.6. OTHERS NTIC

The necessity to have a real time reporting of the handling operation status is evident for big airlines.

New tools are deployed based on the participation of the operators, who have to record their activities on mobile tools after each action (based on PALM, pocket PC...). This supposes the collaboration of the human in the loop.

Avitrack proposes to answer to the same requirements using a non-collaborative process. The actual deployment of such new process should highlight the added value of the Avitrack solution combined with manual process.

4.7. STATISTICS POST-ANALYSIS

Considering the new possibilities offered by the AVITRACK concept. Airlines directly envisage both real time processing for direct apron management and post-analysis of event. This post-analysis can be realised using an automatic annotated video database. This application running in parallel with the Avitrack system should record event and time stamps, in connections with meta-data generated by Avitrack understanding module. Exploitation of this information can be envisaged day-by-day activity reviewing, for global airport analysis or the actions of training or preventive actions.

4.8. INSTALLATION RESPONSIBLE

The main point identified during the end-users requirements analysis is to identify the airport actor who will pay for the system: Airport? Airlines? Handlers?

Handlers, who realise the operations observed by the systems, are under contract with the airlines. The Airports provide equipments and resources to airlines to process the turnaround activities, but are not directly involved in the handling process.

Finally, airlines seem to be the Avitrack client.

The fact is that the systems observe a specific airport apron area, which means that the airport should install specific equipment to improve airlines turnaround? Airport should also consider safety and security application based on this new solution offering new services for airports.

The situation, where Avitrack implementation is optimal, corresponds to hub airport, where big airlines dispose of several joint aprons for their particular activities.