

InSPeCT: Integrated Surveillance for Port Container Traffic

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ABSTRACT

This paper describes a fully-operational content-indexing and management system, designed for monitoring and profiling freight-based vehicular traffic in a seaport environment. The 'InSPeCT' system captures video footage of passing vehicles and uses tailored OCR to index the footage according to vehicle license plates and freight codes. In addition to real-time functionality such as alerting, the system provides advanced search techniques for the efficient retrieval of records, where each vehicle is profiled according to multi-angled video, context information, and links to external information sources. Currently being piloted at a busy national seaport, the feedback from port officials indicates the system to be extremely useful in supplementing their existing transportation-security structures.

Categories and Subject Descriptors

H.3.3 [Information Storage and Retrieval]: Information Search and Retrieval – *search process*.

General Terms

Algorithms, Design, Security, Human Factors.

Keywords

Content analysis, indexing, OCR, search and retrieval, HCI.

1. INTRODUCTION

1.1 Background

In the age of increased vigilance concerning homeland defense, transportation intelligence is a hot topic for authorities responsible for seaport security. Whilst, the policing and risk assessment of seaport bound vehicle traffic is clearly aided by CCTV monitoring, manual unaided review of these feeds is a highly inefficient task. Clearly, visual media that is indexed, and therefore index-retrievable, would go along way towards enhancing the efficiency of the risk assessment and evidence gathering abilities of traditional systems. In this demo we showcase InSPeCT: Integrated Surveillance for Port Container Traffic, a user-centric system that automatically indexes vehicular traffic flow using a number of complementary information sources.

1.2 Novelty

In vehicle monitoring systems, image-based technologies such as optical character recognition (OCR) have received significant

attention, together with related sub-applications such as Automatic Number Plate Recognition (ANPR). Equally relevant in the context of seaport traffic surveillance, is Automatic Freight Code Recognition (AFCR), where the OCR methods are targeted towards interpreting the unique identifiers associated with the freight items that port bound vehicles may be transporting - see Figure 1. It should be noted that although ANPR/AFCR-based solutions are increasingly being deployed in real-world applications, the challenge of improving these technologies remains an active field of research: references to a variety of contributions to the state-of-the-art in ANPR/AFCR technologies may be found in [1]. Whilst there are already commercial products exploiting ANPR/AFCR in a seaport context, these systems exhibit limitations with respect to risk assessment, profiling, user-centricity, and overall level of functionality. The inherent value of the InSPeCT system is that it overcomes these deficiencies within an integrated platform.

2. SYSTEM DESCRIPTION

The InSPeCT system operates by capturing video snapshots of passing vehicles and then utilizing software-based ANPR/AFCR tools for indexing the transits according to vehicle license-plates and associated freight codes. The system is currently able to recognize Latin-character license plates (Europe, USA, etc.) as well as the ISO 'BIC codes' that uniquely identify inter-modal shipping containers. The indexed data is then processed and organized according to specially designed content management structures, such that it is efficiently primed for retrieval. At the front-end, the system is realized by a graphical user-interface (GUI), shown in Figure 2, that provides an efficient means for accessing transit profiles via advanced search facilities, various display options, etc.

2.1 Search and retrieval

Users can search through captured vehicle transits (termed 'events') based on a variety of criteria. The search options



Figure 1. Freight-transporting vehicle with corresponding license-plates and container codes highlighted.

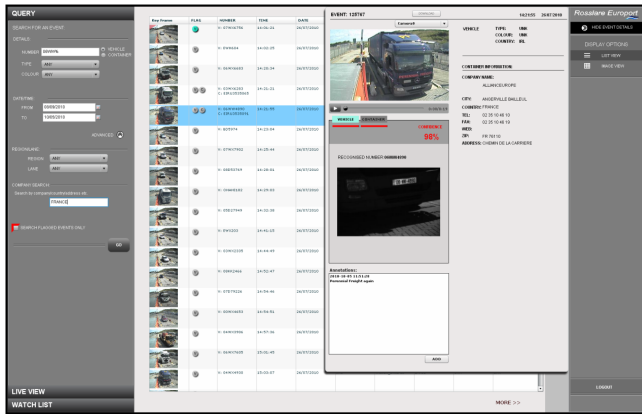


Figure 2. Graphical user-interface.

available relate to license-plate details (partial or complete), freight codes (partial or complete), calendar information (date/time range), geographical information (region/lane specification), and/or shipping company information. Initiating a search returns a results set, where each element corresponds to a unique event (captured and profiled by the system) that matches the search criteria entered.

2.2 Event details

Mouse-clicking on a particular result reveals a separate panel (see Figure 3) that displays detailed information relating to the selected event. Besides placeholders for context information (time/date, etc.), at the bottom-left of the panel is an annotation box, which can be used by the operator to tag the event item with text-based comments. Above this is another sub-panel, which is designed to provide feedback (capture details, confidence values, etc.) pertaining to the OCR capture(s) associated with the event. Above this again is an integrated video player, which provides the user with the ability to playback video of the transit from multiple angles of capture (selectable via drop-down menu). Finally, to the right of the video player is a placeholder dedicated to displaying information regarding the shipping company to which the identified freight is registered. This information is retrieved at query time from an online registry of shipping companies (and their respective identifiers).

2.3 Other Features

In addition to the retrieval of event profiles, the system supports real-time alerting functionality via email/SMS targeted towards alerting security officials to the arrival of specific vehicles/freight. This is achieved by maintaining an inventory of full/partial license-plate and freight-code patterns (a 'watchlist'), against which newly captured event data is compared. The GUI features comprehensive tools for managing watchlist entries. Finally, real-time event monitoring is supported, whereby the operator is afforded the ability to examine live video feeds whilst observing the real-time capture/processing of events.

3. DEMONSTRATION

The demonstration will show a fully interactive version of the InSPeCT system, which will illustrate the features of the system as described; multi-modal querying, retrieval and browsing of events (as captured from the deployed system in Rosslare

Europort, Ireland), live video streaming, watchlist management (alerting), visualisation options, etc.

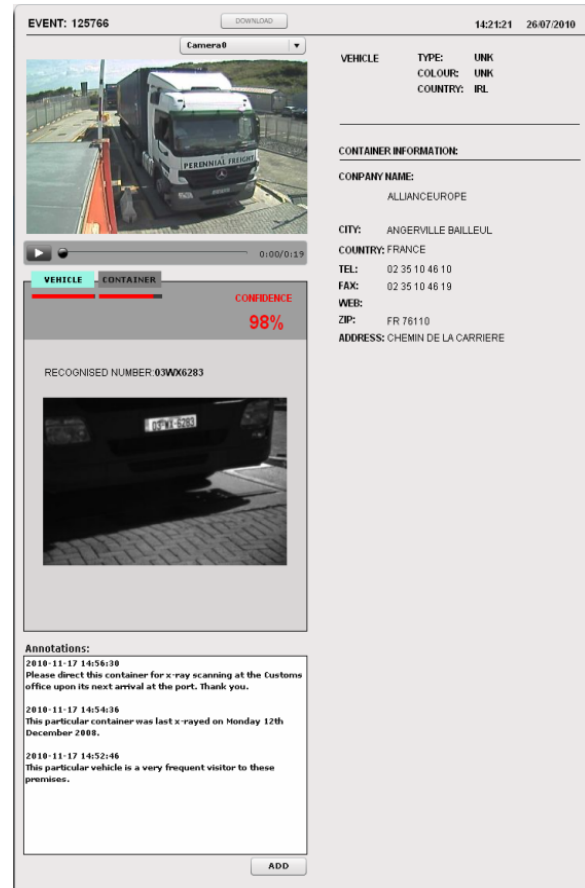


Figure 3. Event details panel.

4. CONCLUSIONS

Currently being piloted in a busy national seaport, the initial feedback indicates the system to be very useful in how it extends the port's existing security resources. Overall, the InSPeCT system represents an optimization of how technology can support the transportation-security remit of port authority officials, and thus exhibits genuine market potential for systems targeting such applications. Future work will involve extending the modality of the system to support the capture of different freight modes (e.g. trailers), incorporating more external resources linking in the system (e.g. to vehicle registry), and investigating interesting research areas such as automatic watchlist generation.

5. ACKNOWLEDGEMENTS

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6. REFERENCES

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