



Incident Linking and Analysis

1. Background

The Project

Project REACT was a part of a European-funded project from September 2006 to February 2009. Its aim was to identify three new technological concepts to enhance incident handling by emergency service operators in the command and control room. These were:

- incident linking (clustering)
- interoperability
- voice technologies

with the aim of assisting the Emergency Services across Europe, particularly where the attendance of more than one emergency service is required.

This article outlines the work carried out by Oxford Computer Consultants Ltd (OCC) for one of these technologies, *incident linking* (ie the linking of multiple calls relating to one incident), for use in a command and control room environment. Several project partners were involved in this part of the development, including Northgate Information Solutions UK, who provided GIS mapping to emergency service users, and ACPO ITS who represented the Police user community.

Clustering

Currently, incidents are linked by control room operators. There are a number of reasons why incident linking is important to the emergency services:

- better real time understanding of what is happening operationally
- identifying links between seemingly unrelated incidents and vice versa
- more efficient resource management
- improved information for incident investigating and post incident analysis

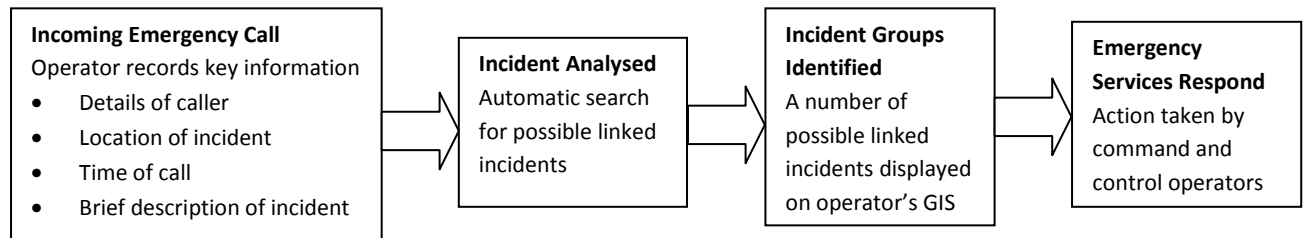
The most common way this is achieved is where the command and control system looks through time/location relationships of incoming incidents so that if the new incident occurs within a prescribed geographical range or time zone of an existing group, the potential linkage is highlighted on the command and control screen. This link or cluster between incidents can then be further investigated by the controller to see if they relate to the same group. In addition staff intuitively identify where incidents might be linked as part of their role.

One of the aims of REACT was to research and develop a method of automated linking through the analysis of several thousand police incident logs, by training the system to group the incidents according to four key parameters:

- Time
- Location
- Incident type
- Text analysis

2. How incident linking works

Each time an incident is received by a Command and Control operator, the following process takes place:



Each incident is analysed using a weighted gradient for each of the key parameters:

Distance/Time

Two incidents occurring in the same place at the same time often display a high probability of correlation; however, this information alone is often not enough. The emergency services respond to disparate calls within a small geographic region on a regular basis. For example, a housing estate with a high population density may increase the probability of incidents occurring; rush hour on a motorway may increase the likelihood of accidents occurring due to increased levels of traffic. As a result a gradual scoring system is used so as the distance/time increase the calculated likelihood of incidents being linked decreases.

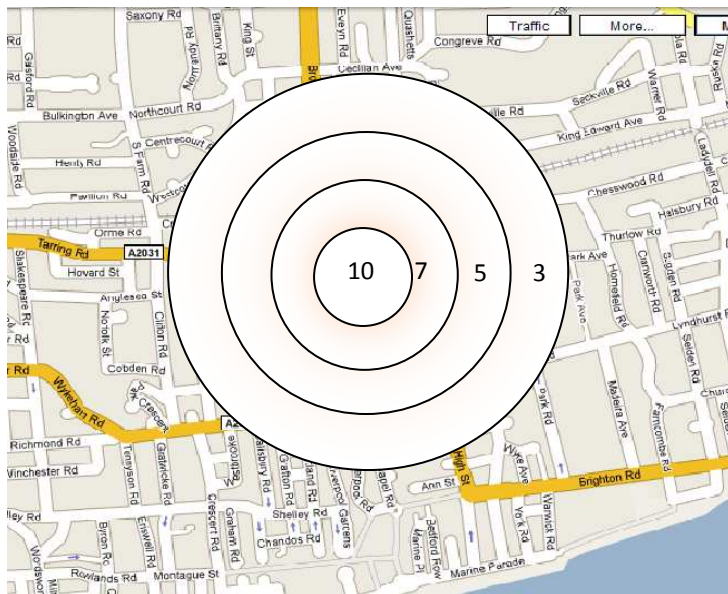


Diagram: How the gradual scoring decreases

with distance from the source

Incident Type

The accuracy of incident linking can be improved further by using more of the information provided by the operator. A good example is the incident type: that is, two incidents related in time and geographical region which also share a common 'type' are more likely to be related than incidents where one is a 'burglary' and another is a 'Road Traffic Collision (RTC)'.



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The scores used by the system are customised for each type of incident. For example, an incident classified as 'ROWDY' considers only incidents nearby as significant, whereas 'ROAD' or 'RTC' incidents consider a larger area as reports tend to be more spread out. The distances and their scores are determined using data from past incident logs and contributions from emergency service users.

Text Analysis

One of the innovative areas OCC explored within project REACT was to incorporate text into incident analysis. This was carried out by creating a relationship between certain words specific to the emergency services, in particular, the Police.

Examples of word sets for *Anti-Social Behaviour* are shown below:

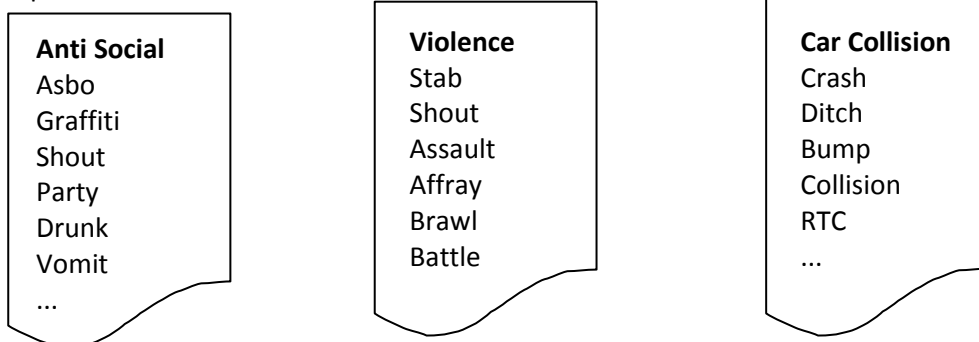


Diagram: Example word sets

3. Intelligence Behind the Text Analysis

Relationships can be built up between a number of word sets: words that are different, but similar in meaning (within the emergency context) can be compared. The relationships between word sets can be positive (suggesting the incidents should be grouped, e.g. Anti Social and Violence) or negative (the incidents should not be grouped e.g. Anti Social and Car Collision). In the diagram below, positive scores are achieved between 'car' and 'Golf' or 'car' and 'Escort' since they could be referring to the same car. However, negative scores are achieved between 'Golf' and 'Escort' since they refer to different cars.

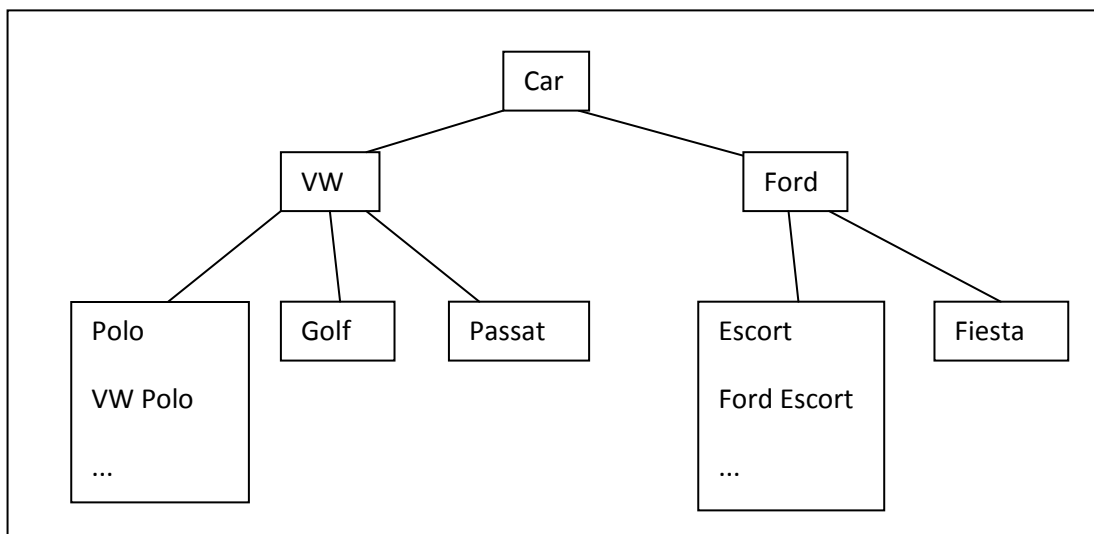


Diagram: Example of a word tree, to deal with different car models

Below is a worked example of text analysis carried out by the REACT system. There are two incident reports: in each case a black car has been involved in a road collision with an injured male at the wheel (in green) but the car identified at the scene is different (in red). Whilst the make/model of car might disconnect the two incidents, the positive links from the other four words and their relative weighting will suggest to the REACT system that the two incidents are likely to be linked.

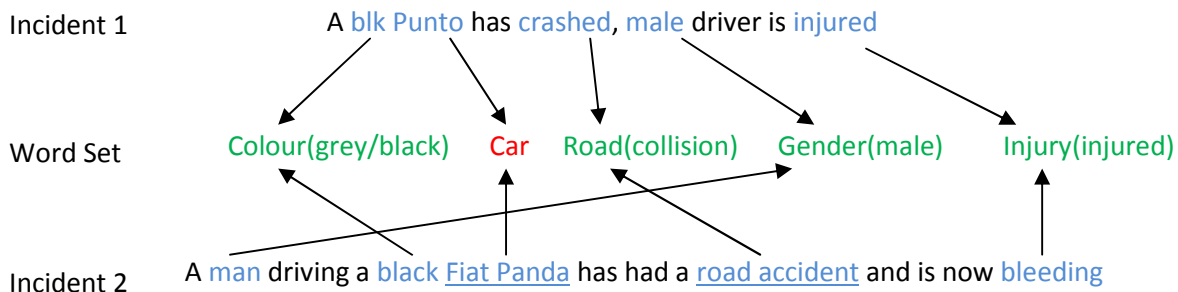


Diagram: Worked text analysis example

4. Issues encountered

Generally within text analysis handling abbreviations and misspellings are very difficult to handle. Since command and control operators are required to log information as fast as possible short hand and typing errors are common, for example, in the incident logs analysed there were 25 different spellings of the word 'yesterday' and he/she was commonly incorrect. The use of custom word sets allowed most of these common errors to be included and handled correctly.

5. Displaying of Linked Incidents

One of the benefits of clustering, developed in project REACT, was the ability to display the linked incidents on a GIS screen. Linked incidents were grouped by the use of coloured icons so the controllers had a clear visual overview. The REACT system could be customised to the user's needs, for example, the ability to turn the linked incident function on or off and to restrict the display to certain organisations or incident types in order to prevent information overload for the control room staff.

6. Feedback on Incident Linking

In February 2009 users from the three Emergency Services (Fire and Rescue, Police and Ambulance) attended a UK demonstration of REACT at Lancing Police Station, West Sussex. Attendees included personnel from operational, supervisory and technical backgrounds.

Feedback from the all services was positive. The concept of incident linking was of great interest to the Police Service in particular, who saw how real time incident handling could be of real benefit in a command and control environment as well as 'slow time' incident analysis.

Nevertheless, all three services believed the system required further development before it could be operationally used.

7. Future Work

The success of the work on incident linking, led by OCC, within project REACT has generated considerable interest within the emergency services. ACPO ITS is now exploring opportunities to develop the incident linking concept, together with interoperability (incident forwarding and receiving between multiple emergency services) within the UK in order to improve handling within the Police service and potentially for all three emergency services.

As part of the research, OCC is also investigating applying the work incident linking to a “Fact Finder” tool to assist with short and long term intelligence, gathering during major incidents and by the crime analysts.

8. Special Thanks

Oxford Computer Consultants would like to thank ACPO ITS, Sussex Police, Strathclyde Fire and Rescue and South East Coast Ambulance for their help and support during this project.

9. More Information

For more information please visit the project website: www.react-ist.net or contact:

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