A Model-Based Architecture for Supporting Situational Diagnosis in Real-Time Surveillance Systems

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OBJECTIVE

Real-time syndromic surveillance systems require adapted dataflow organization and tools for supporting data processing in real time, from their acquisition until the counter-measure building process. This work explores the capabilities of a specific model-based architecture for fulfilling these requisites and its results during a real-size international disease surveillance exercise.

RATIONALE

A pilot syndromic surveillance system, called ASTER [1], currently monitors for health events the French Forces in Djibouti and French Guiana. However, technical support of syndromic surveillance for early warning cannot be restricted to data collection and detection of signal aberrations. It must support all the cognitive process of situation awareness, which includes the detection of aberration, the comprehension of current situation, the projection of future status [2], and extends from the perception of alarms until the release of alerts. For a military point of view, this phase of situational diagnosis must allow the quick issuing of adequate counter-measures within a favorable time window, called "window of opportunity".

Considering these requisites, we have drawn up a global model of operations in situational diagnosis, which relies on three specific models: surveillance system frameworks, data fusion model, and cognitive situation awareness model. It allowed the building of a model-based dataflow architecture that is task centered, tailored for operation support, and aims at organizing the collecting of diverse information to be timely combined into a single operating picture.

SYSTEM DESCRIPTION

The resulting model-based architecture of our Situational Diagnosis System (SDS) is shown in Figure 1. It has been implemented on top of ASTER, which ensures the sensing and signal processing levels. The model organizes the SDS into three successive levels, representing a chronological framework for the dataflow and for structuring the operators' accesses to software ressources and other data sources (e.g. medical intelligence and traditional surveillance) during their attempt to verify if an alarm issued from the surveillance must be transformed into an epidemiological alert.

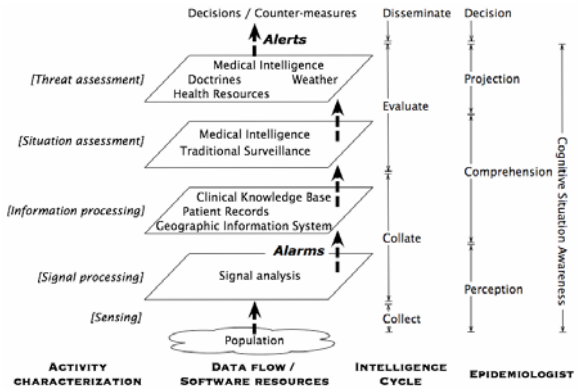

Figure 1: Schematic overview of the model-based architecture of the Situational Diagnosis System..

This SDS has been materialized as an Epidemiological operation center, using COTS and specific softwares.

FUNCTIONAL DEMONSTRATION

The full system (ASTER and SDS) has been involved in an international disease surveillance exercise organized by NATO for testing in real size, from outbreak detection until countermeasure applications, an inter-allied real-time surveillance for biological threats. During the virtual deployment of a join British and French NATO contingent in Northern Afghanistan, a natural outbreak (dysentery) and a biological attack (anthrax) were simulated over the normal epidemiological signal in a time span of several days. The system was able to make an early warning for the two outbreaks, within two hours (including the building of counter-measures) after the first cases for the anthrax outbreak, showing a noteworthy time and resource saving and an increased quality control of the alert process.

REFERENCES

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