Chapter 12
Smart Surveillance Systems

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ABSTRACT

To enable effective and efficient command and control in military operations it is necessary to have full awareness of all the actions in the field. In traditional C2 systems, human operators play key roles varying from observation in the field up to semantic interpretation of observed data in the Command and Control Centre. Networks are mainly used to transmit data between different components of the network. Observation by human operators will be replaced by sensor networks. The huge amount of incoming data is far beyond the capacity of operators, so the heterogeneous, multimodal data from the different sensor systems has to be fused, aggregated, and filtered. Automated surveillance sensor networks are discussed in this chapter. Sensors are modelled as a distributed system of smart agents. Methods and technology from Artificial Intelligence such as expert systems, semantic networks, and probabilistic reasoning is used to give a semantic interpretation of the sensed data from the environment.

INTRODUCTION

In the military domain many C2 networks are used. These networks are used to convey information from sender to receiver. In case of hierarchical networks the command and control centre is at the top of the network. To get full context awareness it is necessary to process the incoming information. Operators in those centres are confronted with a tsunami of messages and are supposed to process the incoming data 24 hours, 7 days in a week. Obviously, there is a need of automated systems to support operators during their work.

A special type of C2 networks are surveillance networks. The use of sensor networks has been proposed for military surveillance and environmental monitoring applications. Those systems deploy a heterogeneous set of sensors to observe the environment. For example, unmanned vehicles (UAV's) such as the ScanEagle (see Figure 1) are able to survey an environment with their high tech video camera system. The recordings are transmitted to the ground station which is connected to the control room via a C2-network. To navigate the drones and to inspect the video recordings many operators are needed in the ground station. In general, observed data has to be processed automatically, and finally has to be displayed in a control room.

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Figure 1. ScanEagle launched from Zr.Ms.Rotterdam

In the control room observed data is monitored by human operators. They are supposed to give a semantic interpretation to the observed data. In case of suspicious or unwanted behaviour they start an alert procedure. The increase of surveillance cameras in the military domain requires an exponential growth of the number of human operators which is far beyond available human and financial resources. So there is a need to automate the semantic interpretation process of sensor data. Most distributed networks of video sensors are wireless connected and suffer from limited bandwidth, storage and processing capacity. To transfer the data from point to point, the data has to be filtered and aggregated to short messages. Information captured from different sensors from different complexity and modality has to be fused.

Most networks support smart search agents. Those agents are able to search automatically and independently for relevant information. Smart agents are also used to control the information flow and to secure the network. Nowadays, agents can be designed that are able to read coded text in different formats. The automated processing of pictures and video is more complex (VSAM, 1996). Video footage of surveillance cameras is still processed by human operators. A surveillance system must be able to detect and track objects in the field of views (FOV) of the cameras, classify these objects and detect some of their activities. It should also be capable of generating a description of the events happening within its field of view. But the ultimate challenge is to give a semantic interpretation of the observed events. That is why human operators are usually needed in control and command centres. But as stated before, constantly monitoring by human operators is no longer an option.

In this chapter smart agents are defined in C2 networks. They are modelled after human model and replace the role of human operators. A great advantage of such agents is that they can easily by defined in great numbers, they are able to operate continuously with a high quality of performance all the time. Another advantage of the use of such agents is that they are not localized on specific places as human operators in control stations, but are able to operate throughout the whole network. The use of agents transforms C2 networks into smart networks with a hierarchical structure of locally processing independent units, solving the common drawbacks of human operators.

As a proof of concept an automatic surveillance project will be discussed in this chapter. The project is about the AIS-Automated Identification System (Vessel tracking, 2013) which will be used to monitor ship movements. Since the increase of terroristic attacks, also in Europe there is a need for a surveillance system along the coast of Europe to detect intruders and suspicious ship movements. AIS was designed for the safety of ships. Visibility of ships, even in bad weather conditions is necessary to prevent collisions. At this moment even small military ships and unmanned surface vehicles will be equipped with AIS transponders. This increases the context awareness of the C2 network. Ships and their movements will be displayed in real time automatically. How to handle such a huge amount of data, to monitor these data and generate a semantic interpretation, is the main research topic of this chapter.

Currently, ship movements are monitored by human operators in control rooms. To automate this surveillance system some questions have to be

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