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José M. Molina
José Ramón Casar Corredera
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Ana M. Bernardos Barbolla (Eds.)

# User-Centric Technologies and Applications

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# User-Centric Technologies and Applications

## Proceedings of the CONTEXTS 2011 Workshop

Springer

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# Preface

The idea of living, working or relaxing in fully sensitive and connected environments led at the end of the eighties to the exploration of technologies to design ubiquitous 'user-centric' applications. Later, Schilit and Theimer in 1994 coined the term 'context-awareness' (sensibility or adaptation to the context) to describe how ubiquitous applications could react and adapt themselves to the changes of the environment and the user's situation. Context was then defined as 'any information that can be used to characterize the situation of an entity' (A. Dey, 1999).

Nowadays, the increasing availability of sensor networks, the miniaturization and the progressive reduction of sensors' price and the penetration of advanced mobile personal devices make possible to collect and process data from multiple sources and combine them in order to provide the applications with a sufficiently good Quality of Information about the user's context.

Thus, the CONTEXTS Workshop aims at gathering advances on key elements that enable the design and deployment of personalized and ubiquitous context-aware services and uses natural non-intrusive methods for interaction. In this Volume, the reader will find contributions on the following topics:

1. Tools to facilitated the design, deployment and operation of the context measurement elements and networks.
2. Sensor fusion methods to intelligently process context data: techniques for positioning with emerging technologies, cooperative management of the user-mobile-environment interaction and distributed context inference.
3. Context representation and management: data models to represent context information, methods to reason with uncertain information and techniques to manage the quality of service of context-aware systems.
4. Techniques oriented to identification and personalization, including biometry and other techniques with no-cooperative sensors like cameras or RF measurement devices.

The Workshop is organized and funded by the CONTEXTS Programme, one of the largest cooperative research initiatives in Madrid, with the participation of institutions from all over Spain and with the support of international experts. This programme focuses on advancing the key elements in frontier communications and location technologies, data processing and multisensor fusion and the paradigms for intelligent/adaptative management, which will make 'feasible' the development of advanced applications for ambient intelligence. On one hand, the concept of 'feasibility' gathers together technology and service requirements and business model viability. On the other hand, the broad concept of 'ambient intelligence' should be

here understood as one where mobile services, whichever they are, are provided to the final user in a transparent, ubiquitous, continuous and personalized way.

From the conceptual point of view, this programme intends to contribute to the 'user-centric' approach associated to ambient intelligence, from the 'network-centric' approach of cooperation and resource-sharing on which distributed systems are based ('shared situational awareness', networks of users and ad-hoc networks).

From the application point of view, the programme intends to contribute to the development of context-aware services in security, crisis management and disaster recovery (civil defence, security forces, etc.), air traffic and airports (enhanced surface mobility, intelligent management), tourism and natural environment, telemedicine and telecare (hospitals and smart homes) and e-mobility applications (large scope applications). Technologies developed in the CONTEXTS project will be validated in these challenging scenarios, which offer wide possibilities to deliver advanced applications based on new interaction and fusion technologies.

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# Contents

# Integrating Multicamera Surveillance Systems into Multiagent Location Systems

José Luis Guerrero, Antonio Berlanga, and José M. Molina

**Abstract.** Users are increasingly demanding personalized services based on their context, being one of the key features of that context the user's position. There are a wide number of possible solutions to deal with the positioning issue, which, for different situations, may have different accuracy requirements. This paper presents this issue from the point of view of an existing multicamera surveillance system which requires to be integrated into a multiagent positioning system, including a tracking example with the presented architecture.

**Keywords:** Multicamera systems, PTZ cameras, multiagent systems, tracking.

## 1 Introduction

A well known trend in nowadays computing is the requirement of users to obtain different ranges of services according to their position, preferences, past actions, etc, which is usually known as context aware computing. Pioneer works in this field in the early nineties [1], [2] introduced and used concepts like ubiquous or pervasive computing [3], dealing with the automatic availability of different computers in an invisible way to the user.

The definition of context can be divided into different categories, regarding the information processed. In [4] the three main categories considered were computing context (accessible services and communication issues), user context (user location and profile) and physical context (external conditions). In [5] an additional important category is included, the time context (current date and time). The definition included at the beginning of this introduction deals with the most sensible category for the final user, its own context.

Among the user context responsibilities, one of the key processes is to be able to successfully determine the user location. Location systems [6] have been designed

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for this task, both for indoor and outdoor locations. Probably the best known location system for outdoor positioning is GPS [7], whereas indoor location systems may range from radio frequency locating systems [8] to active bats approaches [9]. An important feature to compare the different available systems is the infrastructure requirements which the different locating systems require in order to perform their location procedures. In surveillance scenarios the most common infrastructure found is a set of cameras (currently commonly used for human guided surveillance) leading to the possibility of positioning using that already installed set of cameras in order to automate and improve the surveillance task [10].

Along with the positioning system, context aware systems may require a tracking procedure to determine the user's current position, according to the current information provided by the sensing device and the previous positions obtained. This need leads to the use of methods which can handle the inaccuracies of the positioning system and predict the user position according to certain mathematical models. Kalman filter [11] is one of the most extended techniques used for this task, even though (at least in its basic version) it is only suited for linear movement tracking.

As previously overviewed, different locating systems may provide the system with different information sources with different accuracies and different characteristics. When choosing a single one of those systems does not provide us the location quality required by our system, we may resort to a joint use of different systems, trying to keep their different benefits while minimizing their handicaps. This is performed by information fusion systems [12], which combine the information of these different systems in a variety of ways depending on the requirements of the final locating system. These systems frequently use some tracking function as an intermediate step in their fusion cycle.

The operation of the context aware system will require different services (which may or may not have dependencies among them) to be run at the same time, which, along with the ubiquous computing statements, requires to set up a distributed computing architecture. For this particular task, multi-agent systems [13] are particularly well designed, since they allow an easier automatic adaptation to the different environment situations which systems may develop. In [14], the benefits of developing multi agent systems as an information fusion system to guide Unmanned Aerial Vehicles (UAV) [15] are discussed, while in [16] a multi agent based system for location is presented.

The objective of this paper is to present the required architecture and functions to include multi-camera based surveillance system into a context-aware architecture. This architecture will deal with the control requirements for the different cameras, the access interfaces, both locally and remotely, and finally present an example regarding a tracking system for an object based on its color print.

The structure of the paper will be divided in the following sections: initially a system overview will be presented, detailing the components of the built system and detailing the architecture presented. The general architecture will be followed by a section containing the detailed proposal for the automated handling of the different cameras, leading to a final example showing the overall function of the presented system and the conclusions which the previous sections lead to.