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The Third International Workshop
2008) presented the most recent dev
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advances and real-world applications

This volume of *Lecture Notes on*
papers presented at HAIS 2008 held i
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The global purpose of HAIS confe
plinary forum for hybrid artificial int
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areas.

Since its first edition in Brazil in 2
researchers working on fundamental a
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This conference featured a number
Negotiation and Social Network Mode
Uncertainty, Hybrid Intelligent Syste
Genetic Fuzzy Systems: Novel Appr
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HAIS 2008 received over 280 techn
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a testimony of the vitality and attractive
in the HAIS conferences themselves.

As a follow-up of the conference, w
pers in special issues scheduled for the
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Research (IJCIR).We would like to ex
whose members did an outstanding job
the keynote speakers: Bogdan Gabrys fr
Herrera from the University of Granada
Vermont (USA), and Hujun Yin from the

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Invited Talks

Agents and Multi-agent Systems

Multi-agent System for Management and Monitoring of Routes Surveillance

Sara Rodríguez and Javier Bajo

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Abstract. This paper presents a multi-agent system for security control on industrial environments. The system uses a set of wireless technologies and software agents which integrate reasoning and planning mechanisms. It has the ability to obtain automatic and real-time information about the context to schedule the security guards activities. The combination of technologies enables users to interact with the system in a simple, natural and intuitive way.

Keywords: Industrial Security, Agents, Surveillance Routes Calculation, Monitoring, Radio-Frequency Identification.

1 Introduction

In recent years there has been an expansion in the industrial sector, especially in developed countries. In such an important and growing sector, it is necessary to establish security policies to manage risks and control hazardous events, providing better working conditions and an increase in productivity.

Recent studies [4] have revealed that at least 3% of the working shifts time is spent because of the lack of time control systems that supervise the real working time. Implementation of time control systems have a good influence in productivity, since the workers optimize their potential and enhance the process where they collaborate.

Multi-agent systems and intelligent mobile devices architectures are suitable to handle complex and highly dynamic problems in execution time. Agents and multi-agent systems are successfully implemented in areas such as e-commerce, medicine, oceanography, robotics, etc. [2][3].They have been recently explored as supervision systems, with the flexibility to be implemented in a wide diversity of scenarios, including industrial sector. The current application of multi-agent systems in real-time environments is an area of increasing interest. In general, the multi-agent system represents an appropriate approach for solving inherently distributed problems, whereby clearly different and independent processes can be distinguished. The use of wireless technologies, such as GPRS (General Packet Radio Service), UMTS (Universal Mobile Telecommunications System), RFID (Radio-frequency identification) , Bluetooth, etc., make possible to find better ways to provide mobile services and also give the agents the ability to communicate using portable devices (e.g. PDA's and cellular phones) [10]. Nowadays, there is a great growth in the development of

E. Corchado, A. Abraham, and W. Pedrycz (Eds.): HAIS 2008, LNAI 5271, pp. 38–45, 2008.

agents-based architectures, evolved
environments and computational netw

This paper presents the application
tem to manage and monitor surveilla
ronments. The system uses a set of
These technologies, increase the mob
them to access resources (programs,
their physical location.

The rest of the article is structured
describing the development of a multi-
lems that affect the industrial sector. Se
the system, describing its architecture
and, lastly, the evaluation is presented a

2 Multi-agent System for Ind

A multi-agent system has been design
veillance routes among available secu
over the activities performed by the
environments. The routes assigned are
sure the accomplishment of the securi
with users through a set of mobile c
technologies (Wi-Fi, GPRS and RFID
distributed way, providing the users a fl

Depending on the security guards av
be covered in the facilities, the agents i
A supervisor (person) can set the possi
pervised, which can be modified accor
ment. The system has the ability to re-
security guards available. It is also po
completion) over the Internet.

Radiofrequency Identification (RFID
RFID is an automated data-capture tec
trieving data. It is most frequently use
distribution, and warehousing industries
health care [11]. As can be seen in Figu
presented within this paper consists of a
Each tag, named "control point" is relat
security guards. Each security guard carr
the completion of each control point. Th
to a central computer where it is processe

The case study has been successfully
3 and 4 present the main characteristics
well as the surveillance routes planning m

Table 1. Time and distance calculated for security guards and multiple control points sets

Security guards	Control Points	Users		System	
		Time (min)	Distance (m)	Time (min)	Distance (m)
1	15	39	1285	28	944
1	20	64	2124	44	1451
1	25	76	2535	53	1761
1	30	79	2617	63	2088
1	35	96	3191	77	2551
3	100	357	11900	253	8415

The system provides optimized calculations, so the time and distance are reduced. A complete working day shift can be fixed according the system results, for example, if the route calculated is too long or the time exceeds eight working hours, a new guard must be incorporated.

Extending these results, Figure 4 (left) shows the average number of estimated security guards needed to cover an entire area, which consisted on a mesh from 20 to 100 control points, with an increment of 5 control points. The results are clear, for example, for 80 control points, the users estimated 4 security guards, but the system recommended only 3.

As shown on Figure 4 (right), the differences are bigger when there are 3 security guards and 100 control points to determine the level of accuracy compared with the users' predictions. The reason is that the system calculates the optimum route for each security guard and not for the entire control points set.

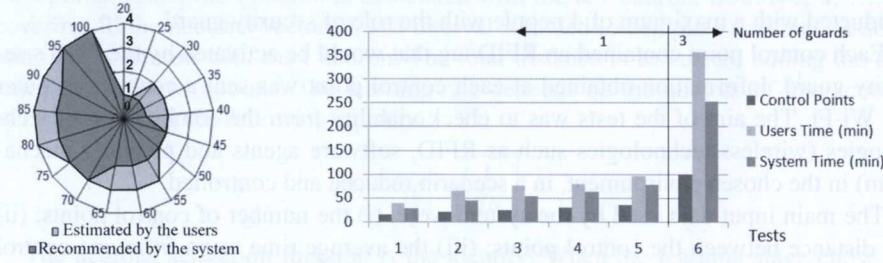

Fig. 4. Average number of estimated security guards (left) and time calculated by the users and the system with different number of control points (right)

The results obtained so far are positive. It is possible to determine the number of security guards needed to cover an entire area and the loops in the routes, so the human resources are optimized. In addition, the system provides the supervisors relevant information to monitor the workers activities, detecting incidences in the surveillance routes automatically and in real-time.

The use of wireless technologies, such as Wi-Fi, RFID, or GPRS provides an adequate communication infrastructure that the agents can use to obtain information about the context. With this information, the system can adapt services and interact

with users according a specific situation in an easy, natural and ubiquitous way to solve some of daily life problems.

The system presented can be easily adapted to other scenarios with similar characteristics, providing a simple but powerful tool to optimize human resources and monitor the staff activities. However, this system is still under development, continuously adding new capabilities and services to have the enough robustness to implement it on other scenarios.

Acknowledgments. This development has been supported by the project GERMAP (IMSERSO 137/2007). Special thanks to Telefónica Móviles and Sokymat for the technology provided.

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