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A Multi Agent-Based System for Securing University Campus: Design and Architecture

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***Abstract*—A multi-agent system (MAS) is a system composed of multiple interacting intelligent agents. Multi-agent systems can be used to solve problems which are difficult or impossible for an individual agent or monolithic system to solve. In this paper, we propose a security system based on multi agents and wireless sensors to secure the buildings and faculties of a University campus.**

***Keywords*-Multiagents, Sensors, Security Systems, ACCESS Architecture, University Campus.**

I. Introduction

It is assumed that most of organizations such as a University campus have critical positions and rooms and therefore require to be secured. Securing a University campus could be achieved based upon a number of security guards making security checking rounds (on foot or by vehicles) inside the university campus. Other way is to use security camera-based systems. Nonetheless, such systems need to be monitored on the fly by a person and the attacker otherwise may be wearing a mask or dressed as a security guard which makes it unreliable.

The objective of this paper is to build an effective and low cost security system made by wireless sensor network based on multi agents to secure the buildings and faculties of a University campus.

A wireless sensor network (WSN) is a wireless network consisting of spatially distributed autonomous devices using sensors to cooperatively monitor physical or environmental conditions, such as temperature, sound, vibration, pressure, motion or pollutants, at different locations, and are now used in many industrial and civilian application areas, including industrial process monitoring and control, machine health monitoring, environment and habitat monitoring, healthcare applications, home automation, and traffic control.

A multi-agent system (MAS) is a system composed of multiple interacting intelligent agents. Multi-agent systems can be used to solve problems which are difficult or impossible for an individual agent or monolithic system to solve. Agent systems are open and extensible systems that allow for the deployment of autonomous and proactive software components. For instance, they have been applied to several application areas such as context-aware and infomobility services. The term *context* refers to any information that can be used to characterize the situation of an entity, where an entity is either a person, place, route, train, or any relevant object [1]. So, context-aware services could be defined as those services that deliver "up to the minute" information about a given entity. Such services include location-based services, travel assistance and planning, impaired people mobility assistance.

The remainder of the paper is organized as follows. We introduce in Section II the ACCESS architecture and location based services and their applications. Then we introduce our system in Section III. After a review of related work in Section IV, we conclude in Section V.

II. Research Background

In this section, we present the ACCESS architecture since our system is built on top of it as well as Location-Based Services (LBS) that could be used in our system to locate security guards.

A. ACCESS architecture

The Agents Channeling (or Conveying) ContExt Sensitive Services (ACCESS) architecture [2], as shown in Figure 1, consists of two agent categories: system agents and ACCESS agents.

The System Agents manage the platform. The Agent Management System manages the creation and deletion of agents and provides a white pages directory service for agents that reside on that platform. The Directory Facilitator Agent provides a yellow pages service for agents, it has information about agents and the services they provide.

The ACCESS Agents consists of generic agents responsible for channeling context sensitive services. The Device Aware Content Delivery Agent manages the local cache and the user interface to ensure real time content delivery to the user. The Position Agent determines the users physical position and informing specified agents of the userŠs location and direction. The Location Aware Agent receives location information from the position agent. It also acts as a hotspot manager, where a hotspot is an area of physical space

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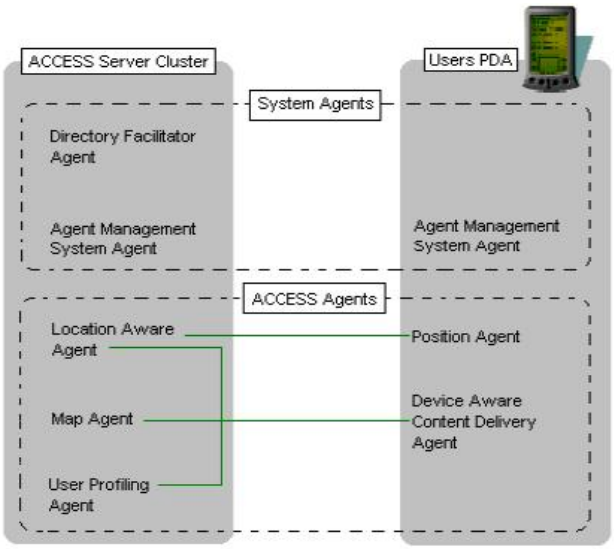

Figure 1. ACCESS architecture.

limited by specific boundaries. It can inform specified agents of when the user enters or leaves a hotspot and provides functionality to allow agents register and delete hotspots. The User Profiling Agent tries to determine what type of user it believes is using the system. It monitors the userŠs location preferences, available hardware and services used. The Map Agent is responsible for dynamically generating maps merged with service specific overlays.

B. Overview of location based services

As a result of the huge numbers of mobile phone users, it becomes possible to use the mobile in specifying the location of the mobile users. One method that can be used to accomplish this task is the use of location based services (LBSs). A location-based service (LBS) is an information service that can be accessed using mobile devices through the mobile network and utilizes the ability to make use of the geographical position of the mobile device [3], [4], [5].

There are a number of services included in LBS such as specifing other people positions, other resources, and the position of the user itself, etc. The primary service is obtaining the position of the user itself in order to use a given service such as finding the nearest restaurant.

There are different types of location based services [6], [7], [8], [9]:

Pull services: this type of service is initiated by the client himself by requesting the service from LBS and giving the permission to the LBS to know his/her location. One example of a Pull service is traffic information requested by sending an SMS to a given number such as 1000 that is specialized in this service. The service provider need to know the location of the client to provide him with information that fulfil the request of the client.

Push services: this type of service is initiated by the service provider as a result of previously getting the authority from the client to receive the requested information from the service provider, that is a client must be registered to receive this service. For example, a client can register in a traffic service. Every morning when she/he is going to work at 7:30AM, the service provider supplies her/him with information regarding traffic movement at that time depending at her/his current location. Consequently, if there is a huge number of vehicles at a given street it will provide her/him with possible alternatives that she/he can go on so that she/he can arrive at her/his work on time.

Tracking services: this type of services allow someone to request the location of another one. In such type of services, the person whose location is required has to permit the first one to follow him. Such a service is provided by UMNIAH (a mobile phone company in Jordan). A client can press a number and send an SMS message to specify a given person location, if the person replay, the client will receive his location via SMS.

Emergency Services: such kind of services provide an automatic or manual call to civil defense in case of an accident or risk. This service should be provided to all mobile clients registered in this mobile company. In USA when you dial 911 from your mobile this service will allow the emergency personnel to specify the location of the caller directly.

III. Campus-agents security system

In this section, we present the system requirements, its architecture and a typical scenario of the Campus-agents security system.

A. System Requirements

The main components of the system are:

- Wireless sensors and receivers: the wireless sensors will be distributed in critical rooms to detect and to alert the system in case of a security attack.
- Database: the database contains information about sensor flags and locations, security guards, critical campus rooms in which there are senosrs. PDAs and/or mobiles: security guards will be provided with PDAs or mobiles[1].

B. Campus-agents Service Architecture

Due to the fact that the ACCESS architecture is generic, application specific Service Agents, which use the ACCESS architecture must be added to the system. The Service Agents for this application are (see Figure 2):

- Alarm Management Agent: its function is to receive the signal from the wireless sensor and determine the code of that sensor and get the building code from the

[1]Note that it is assumed that everyone posses a mobile and hence this requirement could be ignored.

sensor table and send it to the Building Position Agent, it will also get the floor number, the room number and security degree and send them to the Security Guard Call agent.

- Building Position Agent: its function is to receive the building code from the Alarm management Agent and will get the building name and position from the building table and send them to the Security Guard Call agent.
- Security Guard Call agent: it receives the information form the Alarm Management Agent and the Building Position Agent and will find the shortest distance between the building in which the alarm activated and the nearest free guard (by checking the security guard position table), then it will send the building position to the Map Agent to highlight the building on the map displayed in that guard's PDA and send a text message to the same PDA telling the guard to go to that building and to the room where the sensor is located.

C. Typical Scenario of the System

The principal use of the Campus-agents will be detecting security attacks. Basically, the system will work as follows. One of the wireless sensor detects an attack occurring to some room in one of the university campus and send signals to the system. The Alarm Management Agent receives the signal and determines the room code by searching the sensor table of the database based on the identifier of the sensor sending the signal.

The Building Position Agent receive the code from the Alarm management Agent and will get the building name and position from the building table and send them to the Security Guard Call agent.

Then the Security Guard Call agent receives the information form the Alarm Management Agent and the Building Position Agent and will find the shortest distance between the building in which the alarm activated. Also it identifies the nearest free guard by checking the security guard position table, pass the building position to the Map Agent to highlight the building on the map displayed in that guard's PDA, and send a text message to the same PDA telling the guard to go to that building and to the room where the sensor is located.

One usage of the Position agents and Location agents is to check whether a given security guard is out the zone of the University campus or no with use of location-based services. Based on that information, the system will allocate other security guards to fill his position.

IV. Related Works

A. Sensor-based Systems

These systems can be used to automatically notify emergency centers of a given problem. They are commonly equipped with distributed sensors and used to collect incident severity information. The system then communicate with an emergency dispatcher to assist in determining the appropriate emergency personnel.

As an example of such systems is OnStar [10]. It has been designed in 1996 to deliver safety, security and information services using wireless technology and the Global Positioning System (GPS) satellite network.

OnStar services include but are not limited to automatic notification of air bag deployment, stolen vehicle location assistance, emergency services, roadside assistance with location, and remote door unlock. It also allows drivers to make and receive voice-activated wireless calls and access a wide range of other information services through a nationwide cellular network.

However, such systems cannot be directly applied every where because it is required to identify each country' section in order to use the Global Positioning System (GPS) satellite network. Where a section can be a street, subway, university campus, etc.

B. Vision-based Systems

Other systems are vision-based traffic accident detection systems (such as traffic Accident Recording and Reporting Systems (ARRS) [11], [12], [13], [14]). Such systems are either image-based or video-based and used for detecting, recording, and reporting an incident. They consist mainly of a charge coupled device (CCD) camera (located at several places) for monitoring purposes and/or a digital video recorder (DVR) that has recorded all the situations at a given place, and finally an image processing unit that detects images which could be related to an incident.

Nonetheless, the usages of such systems are limited since cameras (CCD) and digital video recorders (DVD) can not be distributed everywhere. Additionally, it is required to have at least one person to monitor the system and alert the security guards in case of a security attack.

V. Conclusion and Future Work

We have proposed in this paper a novel system that can be employed to build an effective and low cost security system made by wireless sensor network and multi agents. The intelligent agents are responsible for detecting (with the aide of sensors) and alerting security guards if a given security attack. Consequently, there is no need for a human to monitor the rooms and the buildings of the University campus. Although it is applied to secure a University Campus, the system could be used to secure any organization.

As a future work, we plan to investigate the use of cameras in conjunction of this system and therefore use the image processing techniques to extract security attacks features.

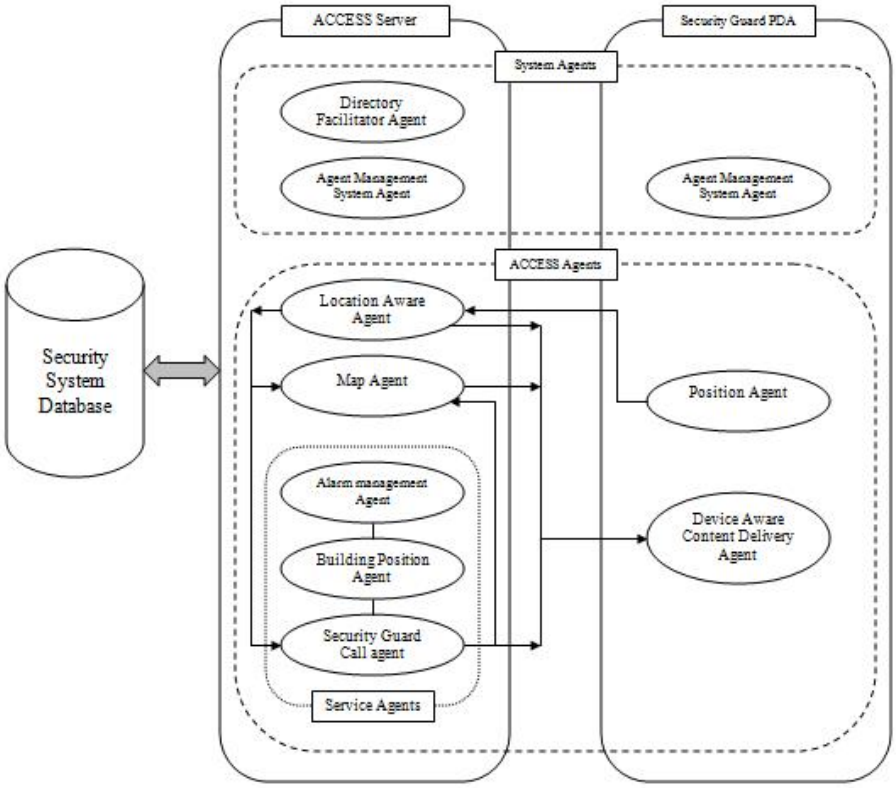

Figure 2. Campus Service Architecture.

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