Location–Based Multimedia Content Delivery System for Monitoring Purposes

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INTRODUCTION

Advances in mobile communications enable the development and support of real-time multimedia services and applications. These can be mainly characterized by the personalization of the service content and its dependency to the actual location within the operational environment. Implementation of such services does not only call for increased communication efficiency and processing power, but also requires the deployment of more intelligent decision methodologies.

While legacy systems are based on stationary cameras and operational centers, advanced monitoring systems should be capable of operating in highly mobile, ad-hoc configurations, where overall situation and users roles can rapidly change both in time and space, exploiting the advances in both the wireless network infrastructure and the user terminals' capabilities. However, as the information load is increased, an important aspect is its filtering. Thus, the development of an efficient rapid decision system, which will be flexible enough to control the information flow according to the rapidly changing environmental conditions and criteria, is required. Furthermore, such a system should interface and utilize the underlying network infrastructures for providing the desired quality of service (QoS) in an efficient manner.

In this framework, this article presents a *location-based multimedia content delivery system* (LMCDS) for monitoring purposes, which incorporates media processing with a decision support system and positioning techniques for providing the appropriate content to the most suitable users, in respect to user profile and location, for monitoring purposes. This system is based on agent technology (Hagen & Magendanz, 1998) and aims to promote the social welfare, by increasing the overall situation awareness and efficiency in emergency cases and in areas of high importance. Such a system can be exploited in many operational (public or commercial) environments and offers increased security at a low cost.

SERVICES

The LMCDS provides a platform for rapid and easy set up of a monitoring system in any environment, without any network configurations or time-consuming structural planning. The cameras can be installed in an ad hoc way, and video can be transmitted to and from heterogeneous devices using an Intelligent decision support system (IDSS) according to the user's profile data, location information, and network capabilities.
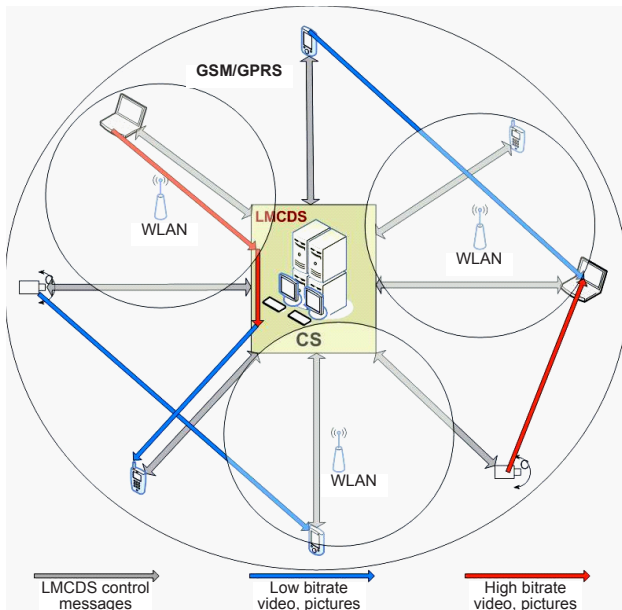
Users can dynamically install ad-hoc cameras to areas where the fixed camera network does not provide adequate information. The real-time transmission of still images or video in an emergency situation or accident to the available operational centers can instantly provide the necessary elements for the immediate evaluation of the situation and the deployment of the appropriate emergency forces. This allows the structure of the monitoring system to dynamically change according to on-the-spot needs.

The IDSS is responsible for overviewing the system's activity and providing multimedia content to the appropriate users. Its functionality lies in the following actions:

- identifying the appropriate user or group of users that need access to the multimedia content (either through user profile criteria or topological criteria);
- providing the appropriate multimedia content in relevance to the situation and the location; and
- adapting the content to the user's needs due to the heterogeneity of the users devices—that is, low bit rate video to users with portable devices.

The LMCDS can evaluate users' needs and crisis events in respect to the topological taxonomy of all users and provide multimedia content along with geographical data. The location information is obtained through GPS or from GPRS through the use of corresponding techniques (Markoulidakis, Desiniotis, & Kypris, 2004). It also provides intelligent methodologies for processing the video and image content according to network congestion status and terminal devices. It can handle the necessary monitoring management mechanisms, which enable the selection of the non-congested network elements for transferring the appropriate services (i.e., video streaming, images, etc.) to the concerned users. It also delivers the service content in the most appropriate

Figure 1. System functionality and services

simple, development of the necessary interfaces with external location mechanisms.

In order to describe the above services in a more practical way, a short list of available options and capabilities of the system is given below. The target group of the LMCDS consists of small to medium businesses that seek a low-cost solution for monitoring systems or bigger corporations that need an ad hoc extension to their current system for emergency cases and in order to enhance their system's mobility. Even though the users of the system consist mainly of security staff and trained personnel that are in charge of security, the system's ease of use, low user complexity, and device diversity allow access even to common untrained users.

The system offers a range of capabilities, most of which are summarized in Figure 1, such as:

- User registration and authentication.
- User profile (i.e., device, network interface).
- Location awareness:
  - User is located through positioning techniques.
  - User is presented with appropriate topographical information and metadata.
  - User is aware of all other users' locations.
  - User can be informed and directed from a Center of Security (CS) to specified locations.
- Multimedia content:
  - Video, images, and text are transmitted to user in real time or off-line based on situation or topological criteria.
  - User can provide feedback from his device through camera (laptop, PDA, smart phone) or via text input.
  - Content is distributed among users from the CS as needed.
- Ad hoc installation of cameras that transmit video to CS and can take advantage of wireless technology (no fixed network needed).
- Autonomous nature of users due to agent technology used.

format, thus allowing the cooperation of users equipped with different types of terminal devices.

Moreover, the LMCDS provides notification services between users of the system for instant communication in case of emergency through text messaging or live video feed.

All of the above services outline the requirements for an advanced monitoring system. The LMCDS functionality meets these requirements, since it performs the following features:

- location-based management of the multimedia content in order to serve the appropriate users;
- differentiated multimedia content that can be transmitted to a wide range of devices and over different networks;
- lightweight codecs and decoders that can be supported by devices of different processing and network capabilities;
- IP-based services in order to be transparent to the underlying network technology and utilize already available hardware and operating systems platforms;
- intelligent delivery of the multimedia content through the LMCDS in order to avoid increased traffic payload as well as information overload; and
- diverse localization capabilities through both GPS and GPRS, and generation of appropriate topological data (i.e., maps) in order to aid users.

However, the system architecture enables the incorporation of additional location techniques (such as WLAN positioning mechanisms)) through the appropriate, but

LMCDS ARCHITECTURE

The LMCDS is designed to distribute system functionality and to allow diverse components to work independently while a mass amount of information is exchanged. This design ensures that new users and services can be added in an ad hoc manner, ensuring future enhancements and allowing it to support existing monitoring systems.

Multi-agent systems (MASs) (Nwana & Ndumu, 1999) provide an ideal mechanism for implementing such a heterogeneous and sophisticated distributed system in contrast to traditional software technologies' limitations in communication and autonomy.

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