

See discussions, stats, and author profiles for this publication at: <https://www.researchgate.net/publication/220938036>

Design of a Cooperative Working Environment for Mobile Devices

Conference Paper · January 2005

DOI: 10.1007/11555223_13 · Source: DBLP

CITATIONS

2

READS

28

5 authors, including:



Miquel Mascaró

University of the Balearic Islands

24 PUBLICATIONS 36 CITATIONS

[SEE PROFILE](#)



B. Estrany

University of the Balearic Islands

11 PUBLICATIONS 39 CITATIONS

[SEE PROFILE](#)



Yuhua Luo

University of the Balearic Islands

38 PUBLICATIONS 139 CITATIONS

[SEE PROFILE](#)

Some of the authors of this publication are also working on these related projects:



Multimodal human computer interface [View project](#)



GEMMA: Cooperative Control System to Collect Environmental Marine Waste [View project](#)

Design of a Cooperative Working Environment for Mobile Devices*

M. Mascaró, B. Estrany, J. Laredo, E. Sidaner, and Y. Luo

Universitat de les Illes Balears, Departament de Matemàtiques i Informàtica,
07122 Palma de Mallorca, Spain
{mascport, tomeu.estrany, dmilyu0}@uib.es

Abstract. GEMMA is a cooperative control system developed to manage and coordinate a fleet of mobile resources (boats, planes, employers, etc) dedicated to maintain clean coastal and beach waters in the Balearic Islands. All the process is supervised by a control center in several workstations. In addition, a cooperative working environment was designed and developed for a group of mobile devices. In this article we present a project extension that involves the control tasks of mobile computers. Using portable computers, PDA and mobile phones, controllers can develop their control tasks supervising the coastal state and be online with all the system and resources in the Gemma project. All the communication processes are established by TCP-IP connections via GPRS/UMTS.

1 Introduction

The Balearic Islands have become one of the most important vacation resorts in Europe in the Mediterranean Sea area. The Balearic Government in collaboration with the University of Balearic Islands, has been designed and developed a system to control and maintain the quality of their coastal area, "The GEMMA System". GEMMA is an interactive and cooperative real time IT system to collect environmental marine waste.

GEMMA project offers an integral solution to implement a control and management system for mobile resources (ships, planes, employers, etc) to reach our environment maintenance goal.

During the year of 2005 a new step has been made. A cooperative working environment was designed and developed to adapt GEMMA for a group of mobile computers (PDA, mobile phones and notebooks) by GPRS/UMTS communication support. Controllers, mechanics and others employers can monitor the actual situation and work online in real time no matter where they are, without any equipment more than a mobile computer with the GPRS/UMTS support. In addition, portable devices can update all the information by themselves in real time in the display and show to the final user the real time situation. Even for the PDA users, we provide the real aspect orthographic photographic information on the PDA's. This is supported by the Orthographic Photographs Web Map Server in our control center.

* This project is an extension of the GEMMA project, supported for the Government of the Balearic Islands.

2 General Cooperation and Coordination Support

The implemented system allows cooperative work of 3 controllers, 12 coastal boats, 27 beach boats, 1 mechanic and 1 plane. The controllers can manage the efforts of all the mobile resources using GPRS and phone call connections. In all time controllers can verify the state and locations of all mobile resources. Simultaneously mobile resources are connected to each controller to inform them of the possible actual incidences and their response.

2.1 The Cooperation Support Between the Control Center, the Controllers and Other Mobile Resources

All the events are placed into the system in real time. The following explains the coordination of the tasks of the cooperative work in the GEMMA system.

Boats and planes situation: One MOVILCOM¹ device is installed on each boat. To maintain the always updated information in the system and considering the average speed of the boats, each MOVILCOM sends its position to the SCDT Server in the control center every 60 seconds. The SCDT Server updates all the ship positions in the Data Base Server immediately when it gets any position change event. On the other hand, each controller’s GUI application (GEMMA GUI) makes an update every 15 seconds of the information displayed on the monitor according to the information stored in the Database Server. The real time situation of the mobile resources in the system is delayed in the worst case only 15 seconds. Therefore, the real time state of the elements in the system is guaranteed (see figure 1).

RESOURCE POSITION UPDATE PROCESS

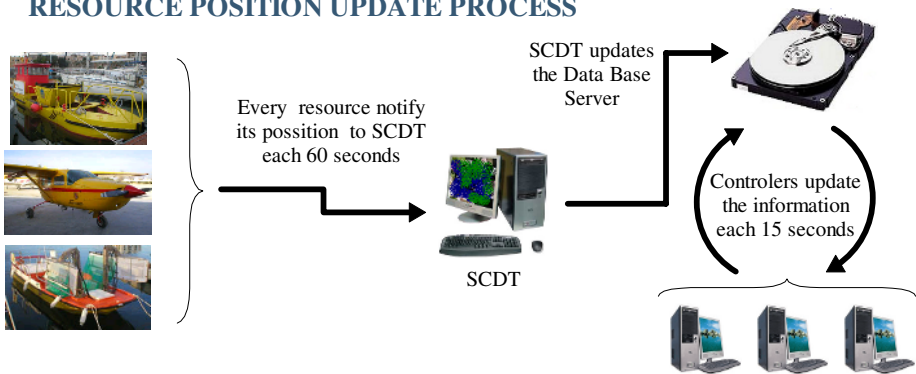


Fig. 1. Resource position update process

¹ MOVILCOM: Mobile communication device of the ships. This device can send the GPS position and several events to the Control Center. It can be make call phones. All the communications take place by GPRS/UMTS using voice or a TCP-IP channel.

Control Center sends an event to some ships: When any of the GEMMA GUI applications wants to send an event to one mobile resource, it can send a message to the SCDT² Server. When the SCDT receives a message from a controller, a TCP-IP communication is established with the MOVILCOM of the target mobile resource (see figure 2). Controllers can send several events to the mobiles. The most relevant events are:

- Reprogram MOVILCOM sentences.
- Text messaging.
- Ask for a phone call conversation.
- Establish a work route.
- Ask for the state of the MOVILCOM.
- Informs about some incidence (waste, emergency, weather, etc).

CONTROL CENTER EVENT PROCESS

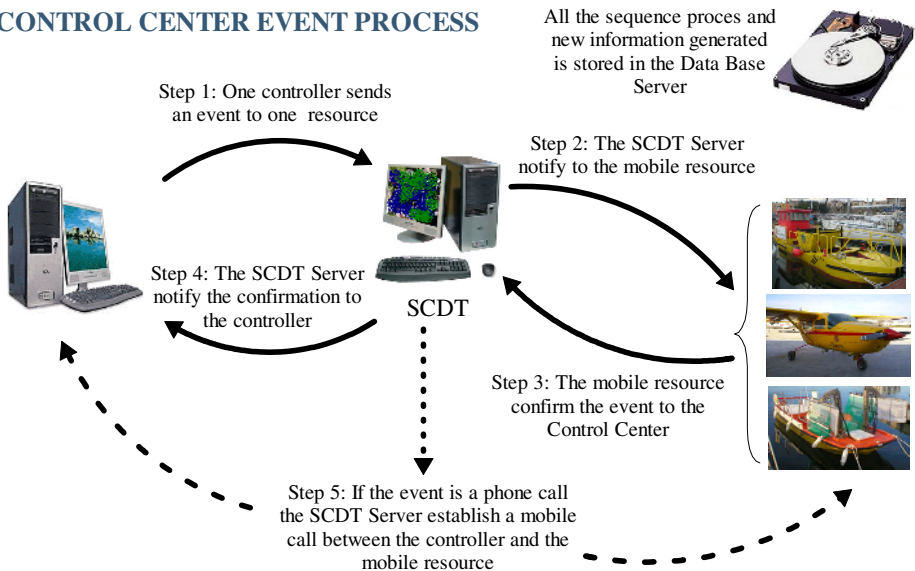


Fig. 2. The steps of how a controller sends an event to one mobile resource

When some MOVILCOM receives an event message, it starts the correspondent task and sends a confirmation event to the Control Center (SCDT). While the SCDT doesn't receive confirmation of any message during the security interval of time, it tries to send the message to the MOVILCOM another time, until it gets an answer from the target MOVILCOM. After that, the SCDT Server confirms the action to the controller.

² SCDT: Communication Server: controls all the communication messages and phone calls that take place in the GEMMA System. All the communications takes places by GPRS/UMTS devices.

In the case that the controller sends phone call event to some ships, when the SCDT receives the confirmation of the mobile resource, it starts to manage a conversation process between the two entities. The conversation stops when one of the members of the communication, controller or marine (or pilot), hangs up the phone device.

One Ship sends an event to the Control Center: It's the same process as before but in the reverse direction.

Fly ships can send geographical referenced images to the control center: Fly mobile resources has been equipped by a laptop and a geographical reference camera. It can take pictures and associate the GPS position to them. The images in EXIF³ format are posted by an SCP action (Secure Copy) to the Control Center Server. When GEMMA server receives an EXIF image, it extracts the geographical reference information, and creates a new incidence at this geographical point in the Database Server. After notifying to the SCDT this new incidence, the new incidence appears immediately in all the GEMMA GUI applications. The controllers can then study the picture of the new incidence in their display if necessary.

3 Heavy Cooperative Action Control

The communication manager in the SCDT controls all the processes in a cooperative mode. Several controllers can interact with all the entities (boats, plane and other controllers) in GEMMA system in real time. Without cooperative action control, undesired events can appear. The most important undesired events and some policies are explained below.

3.1 Several Commands Given to the Same Mobile Resources

All the events in the cooperative GEMMA system can appear any time. How to guarantee there is no conflicted commands given to the same mobile resource? In GEMMA the answer is simple and clear – there is a central control. For example, when two commands are send to the same mobile resource at the same time from different controllers, two message events arrives to the SCDT. The Communication Server (SCDT) puts them in a priority FIFO list. The message list in SCDT has a FIFO policy. However, some critical events can be put at the head of the list immediately (SOS, important event). Messages are sent to the ships, by turn, using the process exposed in section 2.1.

3.2 No More Than One Controller Can Modify the Same Data at the Same Time

All the commands applied to the Server Database are made by a java function. This java function accesses the Data Base via servlets⁴ using the “synchronized” java

³ EXIF: Image format that can take associated to the JPEG image some GWS84 information (lat/Lon).

⁴ Servlet: Java application located in a Java Server Pages Server. Java Server Pages is a Web Server extension.

feature. This feature guaranties the exclusive access to the Data Base. If some data-base modification petitions arrive at the same time, they are managed in a FIFO policy. This process is entirely transparent to the application which modifies the database.

3.3 The Information That all the Unit Receives is Up-To-Date

All the information changes in a several parallel processes in real time. How to guarantee the information that all the unit receives is up-to-date? The requirement of the system guarantees a delay within 15 seconds in the updated information process. That's the maximum delay that can occur in the system as we have explained in section 2.1.

4 Light Cooperation Control

A reduced small version of the GEMMA GUI (little GEMMA GUI) has been developed to enable a pocket PC access to the information of the GEMMA System.

SYSTEM ACKNOWLEDGE BY MOBILE DEVICE

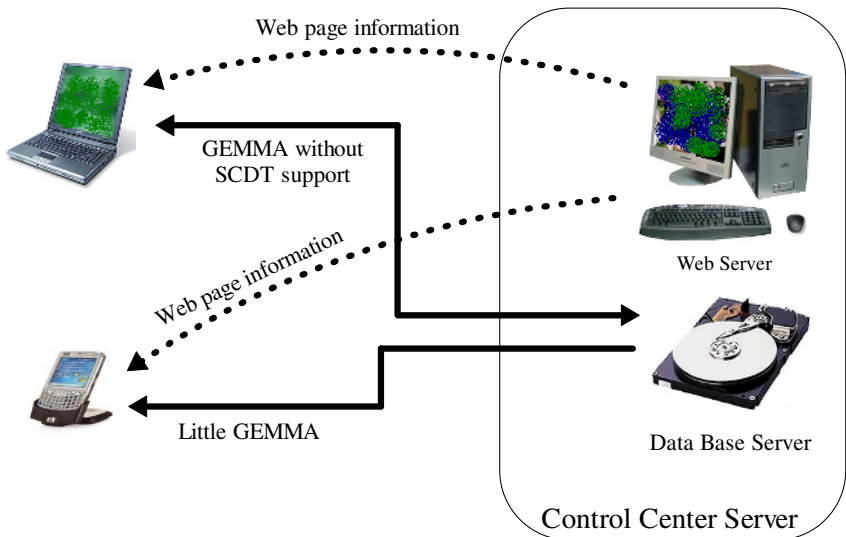


Fig. 3. Access to the GEMMA System information by a mobile device

4.1 The GEMMA Laptop Version

Controllers can run the GEMMA application on a laptop or a workstation outside the Control Center connected to the internet by a mobile Ethernet card. In this mode all the GEMMA application capabilities are available except the communication with the SCDT features (See figure 3).

4.2 Special Treatment in Programming on PDA and Mobile Phone

To develop the reduced version of GEMMA for Pocket PC we adapt the java application to the requirements of the JVM⁵ for the mobile devices. Little GEMMA requires a JEODE JVM installed on pocket PC. This JVM can manage a Java program compatible with the JDK 1.3 version, but can't support the SWING Java API. To solve this problem, special treatment has been taken. We modified the GUI features of the application to adapt them to another GUI library (AWT). In addition, the Little GEMMA version can interact with all the information and can display it but it can't modify any data (see figure 4). Unlimited number of such pocket PC's can use the GEMMA system.

GEMMA Little GUI



Fig. 4. Gemma reduced version for mobile devices

5 Rendering all the Information in the Graphical User Interfaces

The main Control Center application was developed entirely in Java. This feature makes possible the use of GEMMA in any platform with J2SDK installed. From a

⁵ JVM: Java Virtual Machina.

free Java application to render static GIS information application, the “Alov Map” [1], a new interactive render system GEMMA GUI, was developed. GEMMA GUI is able to render GIS information and refresh some contents when the system requires it. In this way, the system can show the real positions of the entities, boats, planes and incidences. It can offer the controller extra information about them. In addition, the system is capable of establishing a phone call or sending a message selecting any item on the screen [5] [6].

6 Group Communication Support

The system offers several concurrent tools to manage the communication between the controllers, boats and the rest of entities. It supports the communication between mobile resources and control center by GPRS, GSM and SMS.

6.1 Communication Manager (SCDT)

The communication manager manages all the communications between the Control Center and the rest of entities which can interact with the system – the cleaning boats, police, observer planes, coast guard, city councils, etc. The communication system is the module that was not developed using free software tools in order to satisfy the requirements of the communication supplier company. The communication manager in the SCDT was developed in Delphi under windows platform. It offers several concurrent tools to manage the communication between the controllers, boats and the rest of entities. By using the GPRS/GSM technology the system manages text message, data files, and phones calls to implement direct communication between the entities in the process. All the communication process is completely integrated in the graphical user interface, automatic and transparent to the final users.

SCDT can create point to point TCP-IP connections with all the MOVILCOM – the communication device of the mobile resources using a private virtual network. It can make several actions: to establish a communication between two entities, to program the mobile devices tasks remotely, to send SMS messages, periodical event notification tasks, etc.

7 Results

The GEMMA System is full operability since 06/01/2004. The response and results of the Cooperative GEMMA Control System are satisfactory.

To see the actual state of the GEMMA project and a real time information about the system functionality visit <http://80.39.95.27/gemmaweb/index.html>. You can see complete 2004 collected marine waste statistics in the Menorca Island in figure 5.

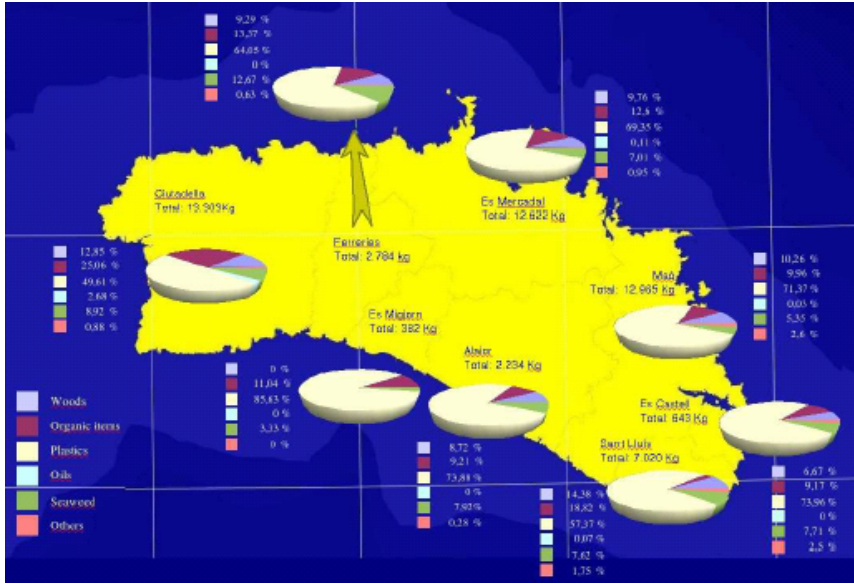


Fig. 5. Statistics of collected marine waste in year 2004 (Menorca Island)

References

1. Alov Map. <http://www.alov.org/>. University of Sydney, 1999-2004.
2. MITOrthoServer. <http://ortho.mit.edu/mitorthoserver>. Massachusetts Institute of Technology, 2001.
3. OpenGIS Consortium. <http://www.opengis.org/>. 2004.
4. Fernández P., Bejar R., et al. Web mapping interoperability in practice, a Java approach guided by the OpenGIS Web Map Server Interface Specification. University of Zaragoza. European Project TIC98-0587, 2000.
5. Estrany B., Mascaró M., Bibiloni A., Serra G., Sideaner E., Laredo J., Capo B., Alcover B., A Cooperative Control System to collect environmental marine waste. University of the Balearic Islands (Spain). CDVE2004, Palma de Mallorca, España. 2004
6. B. Estrany, M. Mascaró Portells, J. M. Aguiló, L. Arqueros and Y. Luo. An integral IT system for large scale coastal environment control. Proceedings of the Fourth IEEE International Workshop on Soft Computing as Transdisciplinary Science and Technology (WSTST'05), pp.755-764, Takeshi Furuhashi, Mario Koppen, Azuma Ohuchi, Yukio Oh-sawa (Eds.), Springer-Verlag, 2005..