Demo Abstract: Hazard Control in Forest Fire Fighting Operations

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Abstract— **The EIDOS system is a WSN-based support system proposed for reducing hazardous situations for people working in forest fire fighting operations. This paper describes a tool that demonstrates the functionality of the system. In particular, the behavior of the applications running at sensor nodes and handheld devices is shown by means of user-friendly graphical interfaces, which will be available for the attendants to the demonstration session.**

I. INTRODUCTION

Forest fire fighting operations frequently lead to hazardous situations in which firefighters are not aware of the evolution of the fire in the surroundings, risking their lives. To avoid (or reduce) these situations, the EIDOS (*EquIpment Destined for Orientation and Safety*) system [2] was proposed to directly provide the firefighters with real time information about the behavior of the fire fronts. A wireless sensor network (WSN) collects and processes environmental data that is displayed on the firefighters' handheld devices.

This paper describes a demonstration session of the overall functionality of the EIDOS system. Obviously, it is not feasible to spread a wildfire for demonstration purposes. For this reason, we have developed a forest area simulation environment, in which we can spread a wildfire and place firefighters and sensor nodes. Handheld devices (real or simulated) can connect to this tool to show the evolution of the fire fronts as perceived by the firefighters. Attendants will be able to interact with the system, checking its functionality by themselves.

Next, we describe the global architecture of the EIDOS system. Then, an outlook of the modules composing the demonstration tool is presented, including its graphical user interface.

II. THE EIDOS SYSTEM

Once a wildfire spreads through a forest area, the EIDOS system proposes the deployment of a large and dense WSN from the air by using aerial vehicles. This network is composed of thousands of small microelectronic devices, commonly called "motes". These motes are equipped with several sensors that are able to monitor environmental physical magnitudes, such as temperature, pressure, and humidity. Optionally, they are also equipped with GPS (*Global Positioning System*) receivers. In addition, motes have computing and wireless communication capabilities.

At the same time, the firefighters involved in the extinction activities carry handheld electronic devices, such as phones, PDAs, or UMPCs. These mobile devices are able to wirelessly interact with the network motes under coverage. Next, we describe the functionality of the two applications developed for the EIDOS motes and handheld devices, respectively.

A. Mote Application

The first task performed by the mote application is to determine its own spatial localization. It can be either obtained directly from an internal GPS receiver, or estimated running a distributed localization process [3]. After that, environmental data sensed is efficiently broadcasted, so that in each moment all motes know the set of points reached by the fire [7].

The mote application has been developed in NesC [5] over the TinyOS [8] operating system. A detailed description of this application can be found in [4], and it is out of the scope of the demonstration session.

B. Device Application

Handheld devices are able to access and process the information provided by the sensor network. The information gathered is displayed through an intuitive graphical interface, consisting of a compass showing four concentric rings (representing distances of 50, 100, 200, and 400 meters, respectively), which are divided into eight sectors (see Fig. 1). Green sectors represent secure areas, whereas red sectors represent burning areas. Moreover, an animated fire icon explicitly represents the last change listened. As will be shown

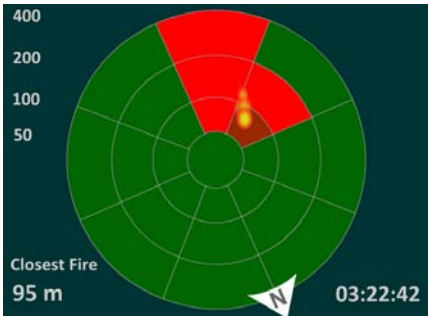

Figure 1. EIDOS handheld application.

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in the demonstration session, this information is updated in real time as the wildfire evolves. Of course, the application supports the device internal GPS and digital compass, in such a way that firefighter movements or rotations are instantly updated into the graph.

The EIDOS device application has been developed in Adobe Flash (with ActionScript 2.0), and published to Adobe Flash Player 7. This guarantees its compatibility with a wide range of handheld devices currently available in the market.

III. The Demostration Tool

It is very dangerous to spread a wildfire only for demonstration purposes. At the same time, it is not economically feasible to deploy the required WSN with the commercial motes currently available. For this reason, we have developed a forest area simulation environment, in which we can deploy a WSN, spread a wildfire, place firefighters, and see the evolution of the fire fronts that they perceive.

As shown in the Fig. 2, the demonstration tool is composed of a forest area simulator and a handheld device simulator. Both simulators run at the top layer the software developed for the real EIDOS architecture, as described below.

A. *Forest Area Simulator*

The forest area simulator is composed of three independent and interconnected modules, which share information by means of a global MySQL database.

First, a wildfire is simulated over a particular area, by using real geographical, environmental and vegetation data. The tool employed for this purpose is FARSITE [1].

After that, a WSN simulator executes the EIDOS application for each network mote. It has been developed in Python/TOSSIM [6].

Finally, a browser (Fig. 3) allows us to graphically show the evolution of the simulation along time. We can observe the fire spreading in the area. We can also see how the WSN motes drop to the floor, estimate their position, detect close fires, and finally burn. At the same time, we can place and move a firefighter across the area. This tool has been developed in Adobe Flash 10 (with ActionScript 2.0), accessing to the simulation database through ColdFusion components.

B. *Device Simulator*

The EIDOS device application has been designed to

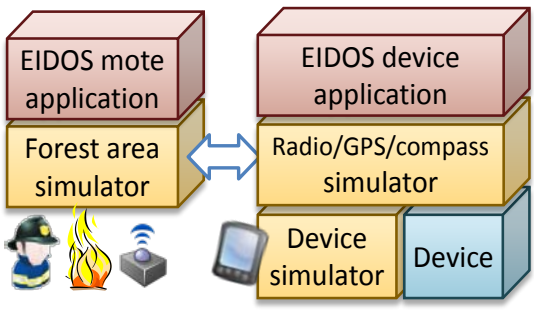

Figure 2. EIDOS demonstration tool.

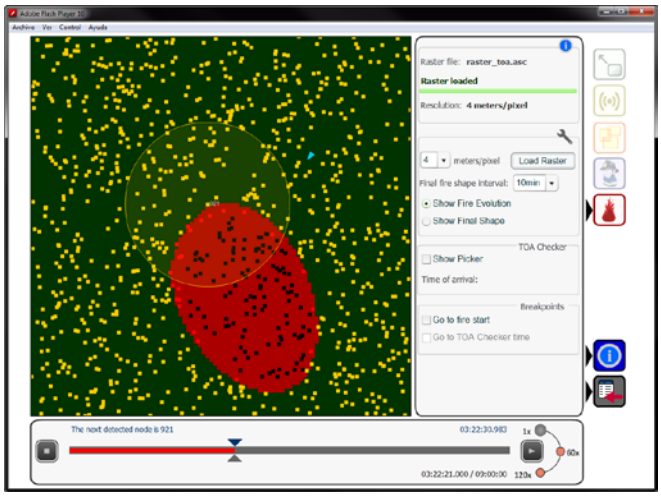

Figure 3. Forest area simulator interface.

wirelessly obtain information from the real WSN motes under coverage. Therefore, to interact with the simulated motes, we have introduced into the application an intermediate layer reproducing the radio communications by means of ColdFusion components.

Also, it is necessary to redirect the device internal GPS and compass to get the position and orientation of the virtual firefighter deployed in the area simulator. To do that, real time information is interchanged between both simulators by means of a Flash Media Server.

IV. Demonstration Details

During the demonstration, we will describe the overall functionality of the EIDOS system. After that, attendants will be able to interact with the system. In more detail, they may spread a fire over the area, move the firefighter arbitrarily, and check the information perceived by the firefighter.

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