Just-in-time Service Composition in Pervasive Environments

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Abstract: Pervasive computing paradigm is characterized by the presence of a diverse variety of computing and communicating devices. The vision of pervasive computing is to create services in order to facilitate user application tasks by utilizing available devices in the environment. It is a challenge to compose basic services that can effectively be combined to provide complex services in environments replete with heterogeneity. A prototype has been developed using our event oriented middleware called Pervasive Information Communities Organization (PICO), and is built on top of a popular P2P framework called JXTA. We model the useful features of devices as services, and by dynamically discovering and utilizing the available services we provide essential support for application task completion. In this demonstration, we show how our model can be exploited to provide emergency response in critical situations, by utilizing sensor nodes, a cell phone, a watch and a PDA.

Introduction

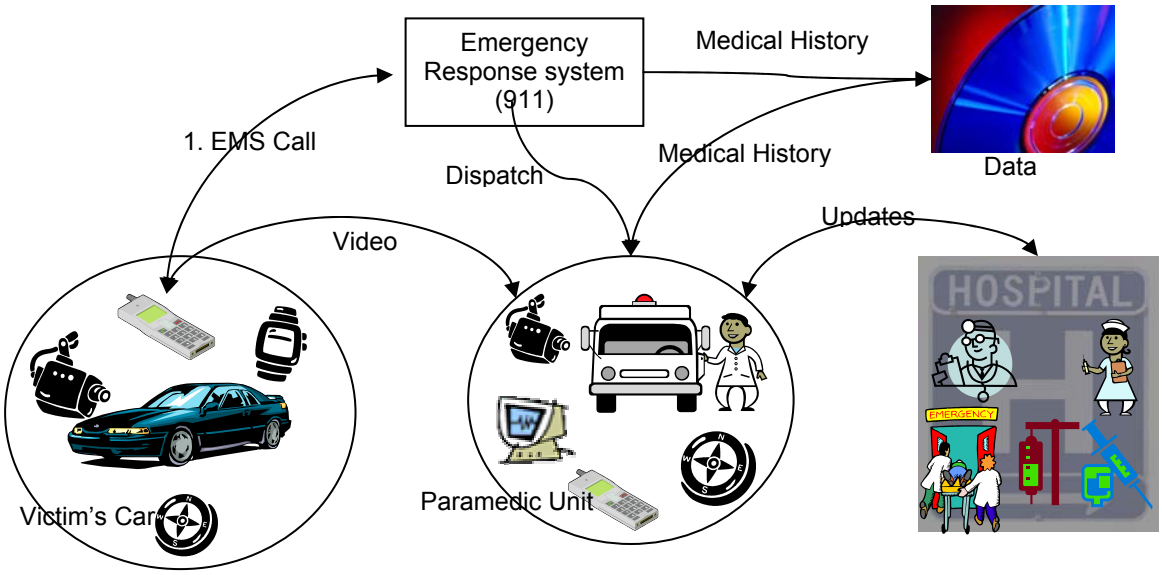
In this demo, we demonstrate a system aimed at assisting an accident victim in a remote area receive emergency response by utilizing the techno-rich devices in the environment. We employ our event oriented middleware architecture called Pervasive Information Community Organization (PICO) [1]. The constructs in PICO architecture enable us to build and operate services around the available devices. By manifesting the features of devices as basic services, we developed a mechanism for seamlessly composing composite services [2]. We demonstrate how services can be composed in dynamic heterogeneous environments in a just-in-time fashion, with a goal to provide a high level service such as, deploying emergency response in the event of an accident. We utilize an open source P2P framework called JXTA [3], as a foundation to build our PICO middleware. The developed prototype model can be extended/modified to provide just-in-time aid in dynamic situations that demand creation and immediate deployment of services, by utilizing available set of devices. Some examples include: monitoring and aiding aged (or disabled) persons in their homes, providing entertainment services etc.

The Scenario

A traveler driving on a highway meets with an accident and is critically injured. The sensors in the car detect the crash and report the emergency. The dispatcher at the emergency response center identifies the location of the car through the location information supplied through the call, and dispatches a paramedic team to the scene. The paramedics, aided by the latest in traffic monitoring systems will take the fastest route to the scene and will assist the victim. The paramedics will be further assisted, if the medical history of the patient is known in advance, or if they can communicate with the victim, when they are on the way to the scene. Access to victim's medical history will assist the paramedics to determine and/or rule our certain causes for the crash such as cardiac arrest, etc. It also helps them in determining the applicable medicine that would be needed to treat the victim. Live communication with the victim will enable them to direct the victim to perform some of the safety operations to avoid further damage. Further, the paramedics, based on the medical history of the victim, and the feedback they obtain from the scene, can identify the most suitable hospital to treat the victim and can contact the hospital and make necessary arrangements fro the victim's treatment. All the above operations will prove invaluable in minimizing the effects of the accident and perhaps saving the victim's life, keeping in mind the critical time window available for response in such emergency situations. In our demonstration,

we show the following actions taken by the various services created in an environment comprising of sensors, watch, PDA and cell phone:

1. Use of the accident detection service that exploits available sensor nodes
2. Interaction between accident detection service and the victim (if possible)
3. Interaction between the accident detection service and the cell phone
4. Creation of a robust composite service to ensure emergency response



The different devices present within the car are modeled as services that manifest functionalities of devices. In the scenario, the sensors within the car first, detect the occurrence of the crash. Then the accident detection service determines whether the driver is responsive by sending a signal to his watch. If in case, the initial query is unanswered by the driver, a call to the emergency service is placed by using the cell phone, along with the information about the current location of the car, the driver details, etc. The emergency service will then dispatch a paramedic unit to the scene. The robust composite service will look for alternative channels (such as an available WiFi access point) to contact with the emergency services if the cell phone is dead.

A web version of this live demonstration is available now at http://www.cse.uta.edu/pico@cse/picodemo.asp. The live demo at the conference will be based on real devices and networks, and will include interaction among the various basic services to create a robust composite service. In addition, ongoing prototype enhancement may include interaction among personnel in the hospital and medical records.

References:

[1] M. Kumar, B. Shirazi, S.K. Das, M. Singhal, B.Y. Sung, and D. Levine, PICO: A Middleware framework for Pervasive Computing, IEEE Pervasive Computing, volume 2, No 3, page 72-79.

[2] S. Kalasapur, M. Kumar, B. Shirazi. "Seamless Service Composition (SeSCo) in pervasive environments," The first international workshop on Multimedia Service composition, ACM Multimedia 2005.

[3] L. Gong, "JXTA: a network programming environment," Internet Computing, IEEE, May-June 2001, Vol 5, Issue 3, page(s) 88-95.