Software Agents and Java Technology for Cardiology Data Retrieval and Visualization

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Background
The Cardiology division of a hospital resumes inside it the logistic organization of a whole hospital. In fact, many different sections also of other divisions (e.g. nuclear medicine, biochemical and hemodynamic laboratories, etc.) contribute in offering all services needed for the diagnosis and treatment of patients. As well, each of these sections generates patient data that only inside big hospitals converge in a comprehensive information system. In most cases, the results of the medical tests taken in a division are stored inside the data repository of that division and only the relevant parts of them are collected inside the patient record. This is especially true for the imaging tests a patient takes, for which only a resuming image report and a text medical report are provided outside the imaging unit.

In order to implement a comprehensive information system that gives easy access to all personal and clinical patient data, the major challenges to face are the interconnection of different repositories and the integration of the heterogeneous data they contain (i.e. textual reports, signals and images). As a prototype, we started to develop the image managing module of a cardiology information system.

Methods and Results
In order to create a cardiology information system taking care of all patient data, we decided to use technologies for distributed applications, implemented through Java programming language. These technologies enable to interconnect and query the heterogeneous legacy systems and databases containing cardiology patient data. To manage the various types of queries that can be performed on cardiology data, which includes information of heterogeneous type and images of different formats, we implemented a client-server architecture based on software agents. The server side manages secure connections and queries to remote databases and file systems containing the personal and clinical data of the patients and all the images of the imaging tests they took. The client side is constituted by an applet communicating with the server side through Remote Method Invocation (RMI) technology. It provides a medical user interface to perform queries on patient and medical test data, and to properly visualize all query results (e.g. biochemical or hemodynamic test results, echographic, gamma camera or angiographic images, etc.). To accomplish the server and client side tasks, software agents, having some a priori knowledge on the data storage organization and the various image formats used, were designed. They intelligently apply their knowledge to autonomously decide which of the remotely connected databases is to query for each specific type of requested data, and which image format is to use for reading and displaying properly the retrieved images.

Discussion
The platform-independence characteristic of Java technology and its actual wide variety of libraries make it especially suitable to manage secure connections to heterogeneous medical systems and queries to different remote databases, including image repositories. Java also provides the adequate support to perform integration of heterogeneous medical data and images. Nevertheless, when parsed queries to retrieve, integrate and display data and images of different formats need to be performed automatically, a specialized software structure is required. The software agent paradigm of autonomy and knowledge based intelligence we used in our prototype enables to accomplish efficiently these tasks in a transparent interface adequate for medical users.

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References