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Clinical Protocol Development using Inter/IntraNet Technology: the FENARETE System

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Abstract: In this work we present FENARETE, a software tool to design and distribute clinical protocols in an Inter/IntraNet framework. We consider a medical protocol as a clinical behaviour scheme, formally and clearly defined with sufficient details. Our work allows the knowledge content of any clinical protocol to be fully represented in a symbolic style. A computer based support tool that works as an interface between clinicians and the protocol knowledge base is regarded by the authors as a basic building block developing an integrated environment for medical protocols design and management. The FENARETE application has been developed in Java and it is available for any Internet-linked machine with a Java-compatible browser.

1 Introduction

Nowadays, the development of an Integrated Health Information Environment finds in the Inter/IntraNet technology [3, 13] an adequate answer to most of the internetworking problems. This technology can improve the quality and the cost-effectiveness of hospital activities. Contemporary medicine has to deal with an increase of prices, specialisation levels and information needs. The information technology (IT) is able to give a real support to formalise and to develop a large set of medical guidelines and clinical protocols [7, 8, 2, 9]. This objective fulfils many medical requirements such as: medical knowledge diffusion, medical practice training, health service cost-effectiveness evaluation and clinical activities monitoring. The adoption of standard guidelines for healthcare management improves the quality of patient treatment allowing the circulation of medical protocols independently from any particular hospital infrastructure. The physician who follows a standard clinical protocol, is provided with a support tool able to clarify and improve his action plane. Moreover, the protocol safeguards the clinician from mistakes or from excluding relevant hypothesis. The hospital is recognised as a heterogeneous environment where inter-communication represent a critical activity. However communication can be set up with other hospitals and healthcare centres. This two kinds of communication can be improved using standard technologies as the Inter/IntraNet one. From a technical perspective, the Java development environment [10] is a valid tool to build and to distribute software products that meet the above requirements.
In this work we present FENARETE, a software tool to design and distribute clinical protocols in an Inter/IntraNet framework. The presentation is organised as follows: in section two, we present our general framework for clinical protocol design; in section three, we describe the prototype tool that has been realised to support effective use of clinical protocols in our environment; in section four we discuss related proposal and future evolution of the FENARETE project.

2 Developing clinical protocols

The clinical protocol is a central element for the management of effective patient care processes. It allows to set up, to monitor and evaluate the clinical activities plane. Protocols can be considered real healthcare tools, only when they are adequately represented and when the adopted formalism enables computer based management. We consider medical protocol as *a*

clinical behaviour scheme, formally and clearly defined with sufficient details. Moreover, in a local organisation it has to be considered as a normative statement.
The protocol is a path through different interleaved physiological and pathological states. The clinician, during the decision-making activity, has to choose between different alternatives. The protocol representation has to give more attention to the decision activities then to the therapeutic and diagnostic ones. The opportunity to reuse a protocol, or its parts, in different organisations or moments can be a real improvement for the healthcare service. Moreover, the clear definition of medical protocols allow patient to know what is the care process in which he or she is involved. However healthcare management can quantify necessary resources and improve the service quality. A medical protocol is a symbolic description of a healthcare process. Besides it has to be represented using a finite set of symbols (i.e. graphic symbols) each one used to individuate a different basic activity type. Instead, a healthcare process is a medical knowledge fragment useful for the care of a specific disease. The medical protocol reorganise this knowledge giving it a format that is valid for an effective use. This help physicians to explore the continuos, often messy, information flow proposed by medical knowledge sources. Anyway each application of a medical protocol to a single pa-

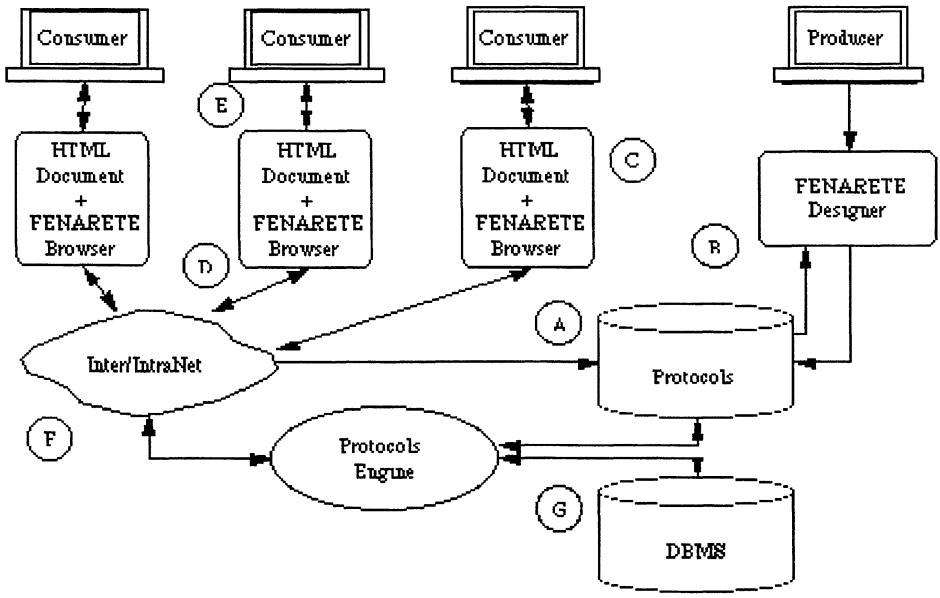

Figure 1: The FENARETE System Architecture

tient is a delicate task under the physician responsibility. The definition of a medical protocol representation formalism is composed by a syntactic and a semantic description. The first one characterise the way how the protocol appears to physicians while the latter define, in a formal and clear style, how it can be used. The formal semantics has the role of an instrument to investigate the expressive power and the algorithmic complexity of the protocol description language. Moreover, only the formal specification of the language semantics allows to compare our proposal with other already formalised.

3 Using FENARETE

Our work allows the knowledge content of any clinical protocol to be fully represented in a symbolic style. A protocol describes how to perform some tasks and describes each task with its atomic parts. We adopt a symbolic description where every activity type is represented by an appropriate icon. The main benefit of a symbolic and graphical description of medical protocols is to encapsulate and hide details until they become relevant. A computer based support tool that works as an interface between clinicians and the protocol knowledge base is regarded by the authors as a basic building block developing an integrated environment for

medical protocols design and management. The interface can help doctors in defining and consulting medical protocols and in applying protocols in real cases. Two requirements are to be met by the system:

- the *network centric* paradigm (multimedia management in distributed systems);
- a friendly and intuitive user-system interaction.

Taking into account this requirements - and as the great diffusion of the World Wide Web has well-established a new paradigm that allows to easily create and manage distributed hypermedia - it seemed natural to choose WWW technologies to develop the system.
The FENARETE system[1] has been developed in Java and it's available for any Internet-linked machine with a Java-compatible browser. In this manner we have maximum protocol spread and we offer an instrument that is virtually accessible from everywhere.
Java permits to write programs (applets) that can be sent, by a server and that can be executed on the client. The language is an interpreted object oriented language and it is C++ like. One of the Java main peculiarities is to allow to write machine independent applets. Client safety

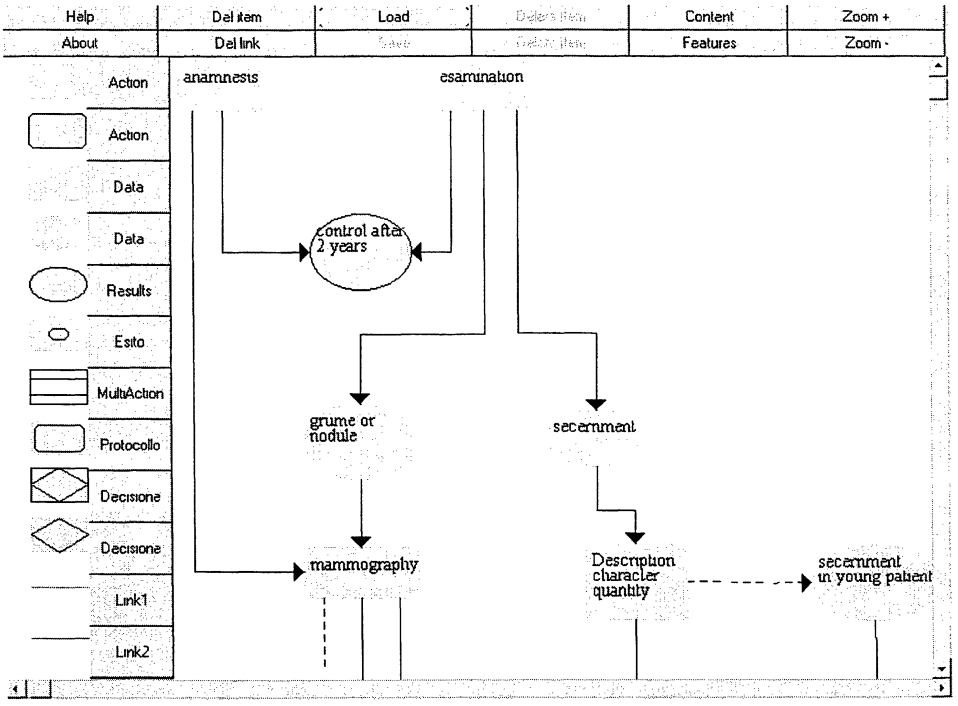

Figure 2: The FENARETE User Interface

is guaranteed from language restrictions, like the impossibility to write on the client itself.
The FENARETE system (fig. 1) is composed by two autonomous software tools: the protocols browser and the protocols designer. The designer tool allows to create new medical protocols, reusing and organising the already developed protocols. The browser tool is a Java-applet able to consult protocol from a remote client.
The FENARETE system offers graphic primitives that represent the above mentioned semantic hierarchies. All clinical activities are supported by a wide medical knowledge concerning general aspects (anatomy, pathology, physiology) and specific aspects joined to the single clinic cases faced by the single medical institutions (ambulatory, hospital, day hospital). The wide medical domain must be subdivided into little manageable fragments, which are derived by different institution and which concern different specialities. This problem has to be compared with that of diffusion and reuse of medical knowledge.

[1] URL:http:// poincare.inf.uniroma3.it/Medinfo/Fenearete

The main request in this specific domain is a representative formalism with an high expressive power that can catch temporal aspects, structural aspects inherent to single information related to a single patient and the related medical concept structure, the control of the single activities to carry on, and finally all the aspects linked to the concurrence of simultaneous activities that use shared resources. The formal definition of an iconographic and textual language that describes protocols, represents the most important goal of the project. This formalism answers, in a practical but scientifically rigorous fashion, to the set of requirements that come from the previous considerations.
The FENARETE user interface (fig. 2) is developed in the same way for both tools. It looks like a graphic editor but it allows to represent and manage all the knowledge useful to describe a clinical protocol. The user interacting with the system can browse inside the behaviour described by the protocol and he/she can record all the information useful to monitor the patient care process.

4 Conclusions and related work

The FENARETE system for medical guideline and protocol management has been presented. The network-centric paradigm allows to share the implicit medical knowledge through the incoming information highways. Java and WWW have been chosen as the reference technologies to develop the running prototype. The system is available at the URL:http:// poincare.inf.uniroma3.it/Medinfo/Fenearete. With respect to related works [8, 9], the authors of this paper tried to exploit those contribution to add sharing capabilities to protocol management systems through the Internet.

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