

The COCOON project*

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ABSTRACT

An open challenge in eHealth is to allow health professionals' timely interaction with heterogeneous and distributed healthcare information. COCOON is a 6th Framework EU integrated project aimed at reducing medical errors by delivering an intelligent, electronic health care system that offers the real time support to the General Practitioners in medical diagnosis and treatment decision making [1]. For this reason COCOON is developing a semantics-based health care information infrastructure able to seamlessly integrate medical information and eHealth services.

Categories and Subject Descriptors

J.3 [life and medical sciences]: Health—*Medical information systems*; I.2.1 [Artificial Intelligence]: Applications and Expert Systems—*Medicine and science*

1. INTRODUCTION

COCOON infrastructure, for each patient, will provide the general practitioner with the necessary information from the health records, the appropriate clinical guidelines, the relevant and updated research evidence, the information regarding available medical services, technologies and medications, their efficiency and side effects, possibly even the experience from other similar cases and specialists' advice. From the

*COCOON project will be developed in 42 months (January 2004-June 2007) in the e-health area of the European Community Sixth Framework Programme. It is led by Associazione Impresa Politecnico (Italy) and it is scientifically coordinated by CEFRIEL (both of them are no profit organization of Politecnico di Milano). It is supported by large IT industrial enterprises (Microsoft, Siemens and Telecom Italia), hightech SMEs (as Language and Computing and InferMed), Universities (Israel Institute of Technology and Universidad Politcnica de Madrid) and by medical and international associations such as Italian National Transplant Network and European Medical Association. It total COCOON consortium is made up by 23 partners. Please refer to <http://www.cocoon-health.com> for detailed information.

technological point of view, this means that it builds either on the existing technologies offered by various partners, or on the innovative technologies independently developed by the partners. COCOON seamlessly integrate this variety of technologies into a single architecture.

2. ARCHITECTURE AND COMPONENTS

The architecture (see figure 1) is designed to provide two main functions: Semantic Information Retrieval (SIR), which enables the end-users to query multiple heterogeneous free-text content sources, and Decision Support System (DSS), which supports the decision making process of end-user both in treatment and diagnosis.

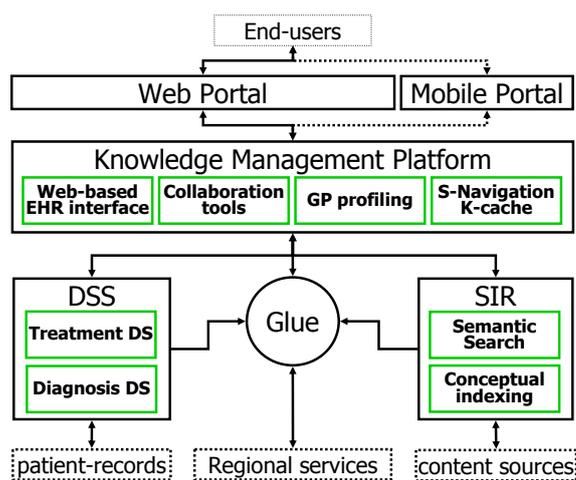


Figure 1: Architecture and Components.

Since this complex information must be provided to a General Practitioner in real time, during his/her interaction with a patient, aside the standard health record interface (possibly used for presenting the DSS results), a web based user interface is provided to the end-users via a portal-based Knowledge Management Platform. In order to make the interaction with the COCOON system available from any location, a Mobile Portal is developed using a Multi-channel Presentation engine.

Last, but not least, in order to enable a seamless integration of so many, complex technologies, the architectural design decision was taken to demand that all the interfaces within various major system components must be exposed as Web

Services. Moreover the regional healthcare systems, where COCOON will be deployed (e.g. Lombardy - Italy), is already populated by thousand of heterogeneous eHealth services, often exposed as Web Services. So, this raised the problem of cataloguing, managing and maintaining these Web Services. To this purpose yet another component is present in COCOON architecture named COCOON Glue.

2.1 Semantic Information Retrieval

The Semantic Information Retrieval module is designed to provide meta search functionality, i.e., the ability to retrieve information from multiple, distributed content sources in parallel. These include both internal content sources (such as personal file systems, intranet based document repositories, corporate document management systems), and external ones (such as Web based search engines, digital libraries, and document databases).

SIR solution integrates TeSSI¹ (Terminology Supported Semantic Indexing), a natural language processing tool that combines the use of a deep syntactic parser with the ontological representation of a large spectrum medical domain ontology LinKBase², and GRACE³, that is able to integrate the search results originating from various content sources even if they support differing ranking strategies, querying syntaxes, and meta data schemata. As a whole, SIR offers concept indexing of free text documents, in order to provide relevant medical publications from multiple, distributed content sources.

2.2 Decision Support System

The Decision Support System (DSS) combines the power of Arezzo⁴, a software solution provided by Infermed for maintenance and support of clinical guidelines, with a services oriented decision support mechanism that enables the system to be integrated, with potentially any local health record system, from which the relevant personal information required by the clinical guidelines is input into the DSS. In addition, databases containing critical information regarding available medications are also integrated into the system. This, factually guide General Practitioner's decision making during his/her interaction with a specific patient.

2.3 Knowledge Management Platform

The Knowledge Management Platform is based either on Livelink⁵ (a powerful and highly scalable commercial solution) or on MERMIG⁶ (an open-source solution) that allows a General Practitioner to effortlessly interact with the COCOON system, as well as to automatically personalize the presentation of the information. Both of them also allows online collaboration with other end users, including specialists offering their advice. Apart from the collaborative and community working tools, KMP also incorporate four components. A Semantic Navigation component⁷ assists the

¹<http://www.landcglobal.com/pages/tessi.php>

²<http://www.landcglobal.com/pages/linkbase.php>

³<http://www.grace-ist.org/>

⁴<http://www.infermed.com/arezzo/>

⁵<http://www.opentext.com/>

⁶<http://www.mermig.com/>

⁷A demonstrative deployment of Semantic Navigation is available at <http://cocoan.cefriel.it/RD1/>

COCOON users to query SIR and browse results. Each resource retrieved through SIR, in fact, is enriched with metadata described in COCOON ontology; the Semantic navigation component^[4] is able to lever this metadata to present query results to users in a meaningful way, letting them navigate across the result-set following different paths that are related to the "semantics" of the content to be displayed. This innovative component is built on SOIP-F^[3], a framework for the development of Semantic Organization Information Portals. A Profile Engine provides personalization of the user experience while searching and exploring available knowledge items. A Push Engine uses a profiling mechanism to proactively offer COCOON users knowledge that matches their interests. A Knowledge Cache component offers COCOON users the possibility to store semantically annotated information that has been retrieved through the semantic search for later usage.

2.4 Mobile Portal

The Mobile Portal is managed with an adaptation platform (named DeCO), which allows wireless portable devices to access the same contents available on the Cocoon KM web portal. In DeCO the content to be provided to various mobile devices is described one time using an XML based ad-hoc language specifying the "logical" type of contents. This page description can then be adapted to the specific device requesting the service on the basis of XSL terminal style sheet; the appropriate XSL to be used is selected recognizing the mobile terminal characteristics from the information included in the request.

2.5 COCOON glue

COCOON Glue^[2] is a WSMO⁸ compliant Semantic Web Service execution environment that aims at offering an efficient system for the management of the Web Services. It includes facilities for publishing semantic descriptions of the available Web Services, so that a discovery engine, integrated within COCOON Glue, can operate on these descriptions in order to automatically select the most suitable Web Service for a specific task. In future it will also support orchestration and choreography. A demonstrative deployment of COCOON glue is available at <http://cocoan.cefriel.it/RD2/>.

3. REFERENCES

- [1] S. Bettoni, L. Gadda, V. Perdoni, and A. Savoldelli. COCOON - building knowledge driven and dynamically networked communities within european healthcare systems. In *eChallenges*, 2004.
- [2] E. Della Valle, N. Korda, S. Ceri, and D. Dori. Gluing web services through semantics: The COCOON project. In *Proceedings of ICCMSE*, 2004.
- [3] E. Della Valle and M. Brioschi. Toward a framework for Semantic Organizational Information Portal. In *proceedings of first European Semantic Web Symposium, ESWS2004*, 2004.
- [4] I. Celino and E. Della Valle. Multiple vehicles for a semantic navigation across hyper-environments. In *Second European Semantic Web Conference, ESWC2005*, 2005.

⁸<http://www.wsmo.org>